Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9 – Air and Noise Quality

October 2015

Mountain Valley Pipeline Project
Resource Report 9 – Air and Noise Quality

Resource Report 9 Filing Requirements	
Information	**Location in Resource Report**
Minimum Filing Requirements – 18 CFR § 380.12(k)	
1. Describe the existing air quality, including background levels of nitrogen dioxide and other criteria pollutants that may be emitted above EPA-identified significance levels. (§ 380.12(k)(1))	Section 9.1.1
2. Quantitatively describe existing noise levels at noise-sensitive areas such as schools, hospitals, or residences and include any areas covered by relevant state or local noise ordinances: • Report existing noise levels as the L_{eq} (day), L_{eq} (night), and L_{dn} and include the basis for the data or estimates. • For existing compressor stations, include the results of a sound level survey at the site property line and nearby noise-sensitive areas while the compressors are operated at full load. • For proposed new compressor station sites, measure or estimate the existing ambient sound environment based on current land uses and activities. • Include a plot plan that identifies the locations and duration of noise measurements, the time of day, weather conditions, wind speed and direction, engine load, and other noise sources present during each measurement. (§ 380.12(k)(2)(i-iv))	Section 9.2.3, and Appendices 9-G, 9-H, and 9-I
3. Estimate the impact of the project on air quality, including how existing regulatory standards would be met. • Provide the emission rate of nitrogen oxides from existing and proposed facilities, expressed in pounds per hour and tons per year for maximum operating conditions, include supporting calculations, emission factors, fuel consumption rates, and annual hours of operation. • For major sources of air emissions (as defined by the Environmental Protection Agency), provide copies of applications for permits to construct (and operate, if applicable) or for applicability determinations under regulations for the prevention of significant air quality deterioration and subsequent determinations. (§ 380.12(k)(3)(i-ii))	Section 9.1.4 and 9.1.5 Appendix 9-C
4. Provide a quantitative estimate of the impact of the project on noise levels at noise-sensitive areas, such as schools, hospitals, or residences. • Include step-by-step supporting calculations or identify the computer program used to model the noise levels, the input and raw output data and all assumptions made when running the model, far-field sound level data for maximum facility operation, and the source of the data. • Include sound pressure levels for unmuffled engine inlets and exhausts, engine casings, and cooling equipment; dynamic insertion loss for all mufflers; sound transmission loss for all compressor building components, including walls, roof, doors, windows and ventilation openings; sound attenuation from the station to nearby noise-sensitive areas; the manufacturer's name, the model number, the performance rating; and a description of each noise source and noise control component to be employed at the proposed compressor station. For proposed compressors the initial filing must include at least the proposed horsepower, type of compression, and energy source for the compressor. • Far-field sound level data measured from similar units in service elsewhere, when available, may be substituted for manufacturer's far-field sound level data. • If specific noise control equipment has not been chosen, include a schedule for submitting the data prior to certification. • The estimate must demonstrate that the project will comply with applicable noise regulations and show how the facility will meet the following requirements:	Section 9.2.4 and 9.2.5

Resource Report 9 Filing Requirements	
Information	**Location in Resource Report**
Minimum Filing Requirements – 18 CFR § 380.12(k)	
▪ The noise attributable to any new compressor station, compression added to an existing station, or any modification, upgrade or update of an existing station, must not exceed a day- night sound level (L_{dn}) of 55 dBA at any pre-existing noise-sensitive area (such as schools, hospitals, or residences). ▪ New compressor stations or modifications of existing stations shall not result in a perceptible increase in vibration at any noise-sensitive area. (§ 380.12 (k)(4)(i-v))	
5. Describe measures and manufacturer's specifications for equipment proposed to mitigate impact to air and noise quality, including emission control systems, installation of filters, mufflers, or insulation of piping and buildings, and orientation of equipment away from noise-sensitive areas. (§ 380.12 (k)(5))	Section 9.1.6 and 9.2.5
Minimum Filing Requirements – Appendix A to Part 380 [Note: May overlap with requirements above.]	
1. Describe existing air quality in the vicinity of the project. (§ 380.12(k)(1))	Section 9.1.1
2. Quantify the existing noise levels (daynight sound level (L_{dn}) and other applicable noise parameters) at noise-sensitive areas and at other areas covered by relevant state and local noise ordinances. (§ 380.12(k)(2))	Section 9.2.3, and Appendices 9-G, 9-H, and 9-I
3. Quantify existing and proposed emissions of compressor equipment, plus construction emissions, including nitrogen oxides (NO_x) and carbon monoxide (CO), and the basis for these calculations. Summarize anticipated air quality impacts for the project. (§ 380.12(k)(3))	Section 9.1.4 and 9.1.5 Appendix 9-C
4. Describe the existing compressor units at each station where new, additional, or modified compressor units are proposed, including the manufacturer, model number, and horsepower of the compressor units. For proposed new, additional, or modified compressor units include the horsepower, type, and energy source. (§ 380.12(k)(4)).	There are no existing compressor units; Section 9.1.2.2 for proposed.
5. Identify any nearby noise-sensitive area by distance and direction from the proposed compressor unit building/enclosure. (§ 380.12(k)(4))	Section 9.2.3, Appendices 9-G, 9-H, and 9-I
6. Identify any applicable state or local noise regulations. (§ 380.12(k)(4))	Section 9.2.2
7. Calculate the noise impact at noise-sensitive areas of the proposed compressor unit modifications or additions, specifying how the impact was calculated, including manufacturer's data and proposed noise control equipment. (§ 380.12(k)(4))	Section 9.2.5 Appendices 9-G, 9-H, and 9-I

FERC Environmental Information Request for Resource Report 9 Dated March 13, 2015	
Information	**Location in Resource Report**
1. Include a discussion of impacts resulting from greenhouse gas emissions from the Project. This analysis should include fugitive emissions from all Project components. Further, estimate how much of the natural gas delivered from the Project would be used to supplant other existing fuel sources, such as using new natural gas supplies to replace retiring coal-fired power plants.	Section 9.1.4.5 and 9.1.6

FERC Environmental Information Request for Resource Report 9 Dated August 11, 2015		
	Request	**Location in Resource Report**
Air Quality		
1.	Revise section 9.1.1.1 to include a general description of the climate regions within the states of West Virginia and Virginia.	Section 9.1.1.1
2.	Revise section 9.1.1.2 to include the current State Ambient Air Quality Standards for West Virginia and Virginia.	Section 9.1.1.2
3.	Revise section 9.1.3.1.2, to include an analysis of the applicability of the National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers (NESHAP Subpart JJJJJJ) for the heaters.	Section 9.1.4.4
4.	Revise section 9.1.2 to include: a. a list of all Project-related emission sources and quantified emissions of criteria air pollutants (NOx, CO, PM-10, PM-2.5, SO2, VOC, HAP, GHG) and fugitives in tons per year during each phase of construction and operations. Include supporting calculations, emission factors, fuel consumption rates, vehicle and equipment power ratings, utilization rates, hours of operation, and list all specific control measures assumed in the emission calculations. Identify all mitigation measures that would be implemented to reduce air pollution from Project-related activities; and b. include regional cumulative air emissions data for the Project. Include an inventory of proposed and reasonable foreseeable air emission sources in the counties (or other distance as necessary) where stationary sources are proposed, documenting their location, distance from the proposed Project, estimated or permitted emissions, for each criteria pollutant in tons per year and identify the potential incremental cumulative impacts of the Project. The emissions sources should include, but not be limited to: FERC jurisdictional projects, intrastate pipelines and compression, gathering pipelines, gas processing facilities, gas wells, industrial or commercial facilities, housing developments, etc.	Section 9.1.2.2 and 9.1.5 Appendices 9-A and 9-B Section 9.1.5, Table 9.1-15
5.	Include an air quality screening (AERSCREEN) or refined analysis (AERMOD or EPA-approved alternative) of the proposed Bradshaw, Harris, Stallworth and Swann Compressor Stations demonstrating that the increase in emissions of criteria pollutants do not result in local exceedance of the National Ambient Air Quality Standards (NAAQS); state ambient air quality standards; or cause or contribute to any violations of the NAAQS. This modeling should: a. include all input parameters (emission rate, stack height, stack temperature, exit velocity, etc.) and justify the basis of any assumptions; b. include a narrative describing and justifying the use of meteorological data, terrain data, etc. For any mitigation measures, or air pollution control equipment, include data to justify control efficiency; and c. include output data showing maximum impacts outside the fenceline (the EPA-defined ambient air boundary), and at sensitive receptors in the area (schools, hospitals, nursing homes, etc.).	Appendix 9-D Appendix 9-E Appendix 9-F
6.	Revise section 9.1.4 to include specific details regarding MVP's fugitive dust control plan.	Section 9.1.6
7.	Indicate whether Mountain Valley would install any blowdown facilities, if so, estimate the number of yearly releases and the volume of VOC released per blowdown.	Section 9.1.2.2 Appendix 9-B

FERC Environmental Information Request for Resource Report 9 Dated August 11, 2015		
	Request	**Location in Resource Report**
Noise		
1.	Revise tables 9.2-2, 9.2-3, and 9.2-4, to include the existing ambient noise levels at each nearest sensitive area (NSA) identified. Clarify whether the modeled predicted noise levels at the NSAs include the resulting noise impacts from the Project combined with the NSAs' existing ambient noise level, or only the noise impact from the Project. If the latter, include the resulting combined noise levels from the Project and the existing ambient noise at each NSA combined and explain the calculation methodology used.	Table 9.2-3, Table 9.2-5, Table 9.2-7 Section 9.2.5
2.	Include specific mitigation measures to be employed for each location of noise sources to minimize noise impacts on the NSAs during construction and operation.	Section 9.2.5
3.	Revise section 9.2.1 to include any applicable noise regulations at the state or county level that would apply to HDD construction and/or any other nighttime construction activity.	No HDDs proposed
4.	Revise section 9.2.3 to include: a. a list of all noise generating equipment, including meter stations and MLVs, that would be operated and corresponding noise levels during each of construction and operations; b. for each NSA, the corresponding distances from the noise source, general land use of the affected areas, vegetation type and topography, and existing ambient noise levels at the NSA and noise source locations; and c. resulting noise levels due to Project activities, and the predicted noise levels at the NSA, taking into account the existing ambient noise levels at the Project and the affected NSA locations. Indicate assumptions and the methodologies used in estimating the predicted noise levels.	Sections 9.2.4 – 9.2.7 Section 9.2.5, Appendices 9-G, 9-H, and 9-I Section 9.2.5, Table 9.2-11 Table 9.2-12 Table 9.2-13
5.	Consult with the appropriate agencies and if applicable, consider and assess potential noise impacts on other noise sensitive resources such as the Brush Mountain, Peters Mountain, and Cranberry Wilderness Areas.	Section 9.2.7
6.	Include the same figures and data tables noted above for all NSAs located near HDD sites. Include a discussion of potential noise mitigation measures that could be used at NSAs near HDD sites such as sound walls or tents, as well as the potential to offer alternate temporary accommodations (i.e., hotel) if applicable.	No HDDs proposed
7.	Include a key for color codes and other features depicted in figures 9.2-2, 9.2-3, and 9.2-4.	Appendices 9-G, 9-H, and 9-I
8.	Indicate whether (and if so how) Mountain Valley would perform measurements of actual noise levels during both construction and operation at all applicable locations to confirm modelling results and to confirm that produced sound levels are below the criteria.	Section 9.2.6
9.	Indicate whether Mountain Valley would install any blowdown facilities and indicate whether the blowdown would be installed with a silencer and estimate the noise impact at the nearest NSAs.	Section 9.2.5.2

U.S. Environmental Protection Agency Comments on Resource Report 9		
Page/Section	**Request**	**Location in Resource Report**
General	If this pipeline project intends to have laterals connecting specific end users to the pipeline or make other connections using the compressor stations along the route, then the project may need to be reviewed for source aggregation requirements as they relate to PSD applicability. Not considering source aggregation while determining PSD applicability could lead to sham permitting in contravention to the requirements of 40 CFR 52.21. As such, since the draft report at this time does not provide enough information on this topic, the report has not been reviewed for applicability of source aggregation to one or more of the air pollution sources of this project. EPA does not consider air sources along long distance pipelines to be a single source under the common sense notion of a plant, but these types of determinations are made only on a case-by-case basis, and only after reviewing full project details.	See Appendix 9-C. There are no other facilities located within ¼ mile of the proposed stations.
9-10 and 9-11	This report is still a draft project report. The four compressor stations along the pipeline route envisioned for this project are only conceptual in nature and thus the report does not provide enough details to ascertain the quality of the applicability analysis done with regards to multiple potentially applicable air regulatory requirements. For example, the project notes that the 294.1 mile long, 42-inch diameter (internal) natural gas pipeline will have approximately 210,000 horsepower of compression along its route divided over four compressor stations, the project report does not provide exact amount of horsepower for each location other than providing an estimate; for one compressor station (Swann compressor station), even a list of projected types of associated equipment is not provided. As such, it is not possible to fully review this draft report at this time since it is lacking the most basic information on projected air emissions from its main and ancillary equipment.	See Appendix 9-C materials for complete listing of sources of air emissions, including the division of project-related horsepower.
9-10	The largest compressor station (Bradshaw) is projected to house more than 120,000 hp of compression equipment, in the form of four turbines. Additional equipment at this site is listed to include five microturbines to provide power, two natural gas-fired emergency engines, two natural gas-fired heaters, two storage tanks, and associated equipment. Such an assemblage of turbines and engines could potentially lead to emissions of at least one PSD pollutant at greater than 250 tpy threshold. Additionally, the listed projected layout of this and other compressor stations in this project do not include any equipment for handling gas dehydration, such as triethylene glycol dehydrator or a molecular-sieve, as well as a high pressure or low pressure separator; a dehydrator and separator are usually included at compressor stations as methods of protecting the compression systems from non-compressible hydrates, and such methods also lead to additional air pollution and may be subject to specific federal and state air regulations.	Section 9.1.4, specifically Table 9.1-9, and Appendix 9-C for PSD applicability analysis.
9-11 through 9-16	The segment of the draft report concerning applicability of air regulations to the potentially proposed set of equipment only mentions major air regulations and is not a comprehensive list of potentially applicable regulations. The final report must include not only a full analysis of PSD applicability along with appropriate engineering estimates for expected air emissions from each site associated with this project, but also must include a full review of all state and federal air regulations. For example, aside from major source NESHAPs, there may be area source NESHAPs applicable to certain of the facilities if the HAP emissions from those facilities do not exceed major source thresholds.	Section 9.1.4 and Appendix 9-C

U.S. Environmental Protection Agency Comments on Resource Report 9		
Page/Section	**Request**	**Location in Resource Report**
9-16	It is mentioned that construction and operating emissions and GHG impacts will be presented after the design of the Project is final. Since impacts to air quality can occur from construction and operation of the proposed action, EPA recommends that the next draft of the resource report and/or the proposed draft EIS address what the project will have on the increase of greenhouse gas and what will the indirect effects the project will have on climate change and greenhouse gas. This could include the annual project operation emissions as well as best management practices that will be adopted to reduce methane leakage from the proposed action's operations. Additionally, the draft EIS should also discuss the effects climate change could have on the long-term operation of the project such as increase in flooding and the increase in intense storms. The draft and final EIS should make clear whether commitments have been made to ensure implementation of design or other measures to reduce GHG emissions or to adapt to climate change impacts. Please consider the Council on Environmental Quality's December 2014 Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts. EPA has compiled information on technologies and practices to facilitate methane reductions from natural gas systems that FERC may find useful, see: http://www.epa.gov/gasstar/methaneemissions/onshore_transmission_storage.html	Appendix 9-C includes detailed listing of project-related GHG emissions. Section 9.1.6 includes for additional information relative to GHG mitigation.

RESOURCE REPORT 9
AIR AND NOISE QUALITY

TABLE OF CONTENTS

INTRODUCTION 9-1
ENVIRONMENTAL RESOURCE REPORT ORGANIZATION 9-1
9.1 AIR QUALITY 9-2
9.1.1 Existing Air Quality 9-2
9.1.1.1 Climate 9-2
9.1.1.2 National Ambient Air Quality Standards 9-3
9.1.1.3 Section 107 Attainment Status Designations 9-4
9.1.1.4 Existing Ambient Background Levels 9-4
9.1.1.5 Federal Class I Areas 9-8
9.1.2 Project Emissions 9-9
9.1.2.1 Construction 9-9
9.1.2.2 Operation (including maintenance and malfunctions) 9-9
9.1.2.3 Decommissioning 9-11
9.1.3 Air Permitting Requirements 9-11
9.1.4 Regulatory Review and Applicability 9-11
9.1.4.1 Prevention of Significant Deterioration Source Classification 9-11
9.1.4.2 Title V Operating Permit Program 9-12
9.1.4.3 New Source Performance Standards 9-12
9.1.4.4 National Emission Standards for Hazardous Air Pollutants 9-14
9.1.4.5 Greenhouse Gas Reporting Rule 9-16
9.1.4.6 West Virginia Air Quality Regulations 9-16
9.1.4.7 Virginia Air Quality Regulations 9-18
9.1.5 General Conformity 9-18
9.1.5.1 Construction Emissions 9-18
9.1.6 Air Quality Mitigation Measures 9-28
9.1.7 Energy Efficiency and Waste Heat Recovery 9-33
9.1.8 Impacts on National Forest System Lands 9-34
9.2 NOISE 9-34
9.2.1 Background Information on Sound and Noise 9-34
9.2.2 Applicable Noise Regulations 9-35
9.2.2.1 FERC Requirements 9-36
9.2.2.2 County Limits 9-36
9.2.3 Existing Sound Environment 9-37
9.2.3.1 Compressor Stations 9-37
9.2.3.2 HDD Sites 9-40
9.2.4 Project Construction Noise 9-40
9.2.4.1 Pipeline Construction Noise and Mitigation 9-40
9.2.4.2 Compressor Station Construction Noise and Mitigation 9-41

9.2.5 Project Operation Noise 9-41
9.2.5.1 Compressor Station Operational Noise and Mitigation 9-41
9.2.5.2 Compressor Station Unit Blowdown Noise and Mitigation 9-46
9.2.5.3 Emergency Shutdown Noise and Mitigation 9-46
9.2.6 Post Construction Sound Survey 9-47
9.2.7 Additional Noise Sensitive Areas 9-47
9.2.7.1 Impacts on National Forest System Lands 9-47
9.2.7.2 Cranberry Wildlife Management Area 9-48
9.3 REFERENCES 9-48

LIST OF TABLES

Table 9.1-1 Climate Parameters at the Compressor Station Locations 9-3
Table 9.1-2 National Ambient Air Quality Standards for Criteria Pollutants 9-4
Table 9.1-3 Existing Ambient Background Levels in the Vicinity of the Bradshaw Compressor Station 9-5
Table 9.1-4 Existing Ambient Background Levels in the Vicinity of the Harris Compressor Station 9-6
Table 9.1-5 Existing Ambient Background Levels in the Vicinity of the Stallworth Compressor Station 9-7
Table 9.1-6 Federal Class I Areas Closest to the Bradshaw Compressor Station 9-8
Table 9.1-7 Federal Class I Areas Closest to the Harris Compressor Station 9-8
Table 9.1-8 Federal Class I Areas Closest to the Stallworth Compressor Station 9-9
Table 9.1-9 Emissions from Compressor Stations versus NSR Major Source Thresholds 9-11
Table 9.1-10 Estimated Construction Emissions from the Mountain Valley Project - 2016 9-20
Table 9.1-11 Estimated Construction Emissions from the Mountain Valley Project - 2017 9-22
Table 9.1-12 Estimated Construction Emissions from the Mountain Valley Project - 2018 9-24
Table 9.1-13 Estimated Construction Emissions from the Mountain Valley Project - 2019 9-26
Table 9.1-14 Reasonably Foreseeable Projects Planned in the Vicinity of the MVP Stations 9-30
Table 9.1-15 Summary of Natural Gas Star Program 9-32
Table 9.2-1 Noise Level Limits for Counties with Noise Regulations Crossed by the Project 9-36
Table 9.2-2 Weather Conditions during the Bradshaw Compressor Station Sound Level Survey 9-37
Table 9.2-3 Existing Sound Level Measurement Results – Bradshaw Compressor Station 9-38
Table 9.2-4 Weather Conditions during the Harris Compressor Station Sound Level Survey 9-39
Table 9.2-5 Existing Sound Level Measurement Results – Harris Compressor Station 9-39
Table 9.2-6 Weather Conditions during the Stallworth Compressor Station Sound Level Survey 9-40
Table 9.2-7 Existing Sound Level Measurement Results – Stallworth Compressor Station 9-40
Table 9.2-8 Predicted Temporary Sound Levels Due to Construction 9-41
Table 9.2-9 Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment 9-42
Table 9.2-10 Modeled Noise Control Treatments, Insertion Loss (IL) or Transmission Loss (TL) 9-43
Table 9.2-11 Predicted Sound Levels –Bradshaw Compressor Station 9-44
Table 9.2-12 Predicted Sound Levels– Harris Compressor Station 9-45
Table 9.2-13 Predicted Sound Levels –Stallworth Compressor Station 9-45
Table 9.2-14 Unit Blowdown Sound Level Predictions 9-46
Table 9.2-15 Station ESD Blowdown Sound Level Predictions 9-47

LIST OF FIGURES

Figure 9.2-1. Sound Pressure Levels (Lp) 9-35

LIST OF APPENDICES

Appendix 9-A Construction Emissions Calculations
Appendix 9-B Operating Emissions Calculations
Appendix 9-C West Virginia State Air Permit Applications
Appendix 9-D Bradshaw Compressor Station Air Quality Modeling Report
Appendix 9-E Harris Compressor Station Air Quality Modeling Report
Appendix 9-F Stallworth Compressor Station Air Quality Modeling Report
Appendix 9-G Bradshaw Compressor Station Pre-Construction Noise Study
Appendix 9-H Harris Compressor Station Pre-Construction Noise Study
Appendix 9-I Stallworth Compressor Station Pre-Construction Noise Study

RESOURCE REPORT 9
AIR AND NOISE QUALITY

LIST OF ACRONYMS AND ABBREVIATIONS

CAA	Clean Air Act
CFR	Code of Federal Regulations
CSR	West Virginia Code of State Rules
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
EQT	EQT Corporation
ER	Environmental Report
FERC	Federal Energy Regulatory Commission
GHG	greenhouse gases
HAP	hazardous air pollutant
hp	horsepower
km	kilometer
MACT	Maximum Available Control Technology
MLV	mainline block valve
MMBtu/hr	million British thermal units per hour
MMSCFD	million standard cubic feet per day
MP	milepost
MRR	Greenhouse Gas Mandatory Reporting Rule
MVP	Mountain Valley Pipeline
$\mu g/m^3$	micrograms per cubic meter
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NCDC	National Climatic Data Center
NGA	Natural Gas Act
NNSR	Non-attainment New Source Review
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
NSA	Noise Sensitive Area
NSPS	New Source Performance Standards
NSR	New Source Review
NWS	National Weather Service
PM	particulate matter
$PM_{2.5}$	fine particulate matter with a diameter of 2.5 microns or less
PM_{10}	particulate matter with a diameter of 10 microns or less
ppb	parts per billion
ppm	parts per million
Project	Mountain Valley Pipeline Project

PSD	Prevention of Significant Deterioration
PTE	potential to emit
RACT	Reasonably Available Control Technology
RICE	Stationary Reciprocating Internal Combustion Engines
SAAQS	State Ambient Air Quality Standards
scfh	standard cubic feet per hour
SI	Stationary Spark Engines
SIP	State Implementation Plan
SO_2	sulfur dioxide
Title V	Title V Operating Permit Program
tpy	ton per year
USEPA	U.S. Environmental Protection Agency
VAC	Virginia Administrative Code
VOC	volatile organic compound
VOL	volatile organic liquids
WMA	Wildlife Management Area
WVDEP	West Virginia Department of Environmental Protection

RESOURCE REPORT 9
AIR AND NOISE QUALITY

INTRODUCTION

Mountain Valley Pipeline, LLC (MVP), a joint venture between EQT Midstream Partners, LP and affiliates of NextEra Energy, Inc., WGL Holdings, Inc., Vega Energy Partners, Ltd., and RGC Midstream, LLC, is seeking a Certificate of Public Convenience and Necessity from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act authorizing it to construct and operate the proposed Mountain Valley Pipeline Project (Project) located in 17 counties in West Virginia and Virginia. MVP plans to construct an approximately 301-mile, 42-inch-diameter natural gas pipeline to provide timely, cost-effective access to the growing demand for natural gas for use by local distribution companies, industrial users and power generation in the Mid-Atlantic and southeastern markets, as well as potential markets in the Appalachian region.

The proposed pipeline will extend from the existing Equitrans, L.P. transmission system and other natural gas facilities in Wetzel County, West Virginia to Transcontinental Gas Pipe Line Company, LLC's (Transco) Zone 5 compressor station 165 in Pittsylvania County, Virginia. In addition to the pipeline, the Project will include approximately 171,600 horsepower of compression at three compressor stations along the route, as well as measurement, regulation, and other ancillary facilities required for the safe and reliable operation of the pipeline. The pipeline is designed to transport up to 2.0 million dekatherms per day of natural gas. Resource Report 1 provides a complete summary of the Project facilities and a general location map of the Project facilities (Figure 1.2-1).

ENVIRONMENTAL RESOURCE REPORT ORGANIZATION

Resource Report 9 includes discussion of Air Quality and Noise in the Project area and potential Project impacts. Resource Report 9 is prepared and organized according to the FERC *Guidance Manual for Environmental Report Preparation* issued August 2002. Air quality resources and potential impacts from the Project are discussed in Section 9.1, including a summary of the regional climate and existing air quality in Section 9.1.1, a discussion of Project related emissions in 9.1.2, an overview of the permitting requirements in Section 9.1.3, a discussion of applicable regulatory requirements in Section 9.1.4, an analysis of General Conformity in Section 9.1.5, a summary of air quality mitigation measures in Section 9.1.6, a discussion of energy efficiency in Section 9.1.7, and a discussion of potential air quality impacts on National Forest System Lands in Section 1.8. Noise quality resources and potential impacts from the Project are discussed in Section 9.2. Section 9.2.1 provides background information on noise, Section 9.2.2 provides a description of the applicable regulatory requirements applicable to noise, Section 9.2.3 identifies the existing in-air acoustic conditions and presents noise modeling results, Section 9.2.4 discusses construction noise, Section 9.2.5 discusses Project operation noise, Section 9.2.6 discusses post-construction sound survey, and Section 9.2.7 summarizes impacts on additional noise-sensitive areas including National Forest System lands.

9.1 AIR QUALITY

Both the short-term/temporary, and long-term air quality impacts associated with the Project have been analyzed. Short-term and temporary air quality impacts will result from construction activities necessary to install the pipeline, metering and regulating, and compressor stations. Long-term impacts will result from the operation of the turbines and other equipment. From a regulatory standpoint, the emissions and associated air quality impacts are addressed in two separate ways:

1) Construction Permitting – Construction (and operation) permitting addresses the emissions and associated impacts from the operational equipment and sources at the facilities. Depending on the major/minor status of the Project, and the location of the Project, PSD, Nonattainment NSR (NNSR), and/or associated state permitting programs ensure that the proposed installation of new air emissions sources (i.e., operational equipment) meet required emission levels, install appropriate control technologies, and meet other regulatory requirements, where appropriate. A pollutant that triggers the "major" PSD and/or NNSR programs will be subject to additional reviews and requirements. The regulatory applicability of permitting programs to the Project is discussed in Section 9.1.4 Regulatory Review and Applicability. Please note that while not a regulatory requirement, MVP has modeled the emissions of all criteria pollutants resulting from the Project and has ensured that all National Ambient Air Quality Standards (NAAQS) standards are met after completion of the Project. The modeling approach and results are discussed in detail in Appendices 9-D, 9-E and 9-F (Modeling Reports) and are not reviewed further as part of the regulatory requirements and compliance demonstrations of Sections 9.1.4 through 9.1.6

2) General Conformity – General Conformity addresses the sources of emissions not covered by permitting actions (e.g., construction activities or an increase in traffic to the sites) and ensure that they conform to the applicable State Implementation Plan(s) (SIP). Generally, these include the short-term/temporary emissions from construction activities and new emissions increases from non-permitted emission sources such as mobile sources. General Conformity, discussed in Section 9.1.5, is only applicable in maintenance/non-attainment areas and all counties that are impacted by the Project are in attainment for all criteria pollutants. As such, General Conformity does not apply. However, MVP has included the construction emissions per the FERC's guidance manual.

9.1.1 Existing Air Quality

9.1.1.1 Climate

The Project is located in the states of West Virginia and Virginia. Among the nine climate regions defined in the contiguous United States, defined by the National Centers for Environmental Information, West Virginia falls under the Ohio Valley (Central) climate region and Virginia is in the Southeast climate region. West Virginia has a humid continental climate which is defined by hot summers and cold winters. Moving south along the pipeline, the climate evolves into a warmer and more humid climate, eventually transitioning into the humid subtropical climate, which is typical of the state of Virginia.

Monthly climatological data for the compressor station locations is referenced from the most representative nearby meteorological stations (National Weather Service [NWS] cooperative stations 466202, 462718, 460582, and 447285). There are also closer non-airport meteorological data sources; however, these stations were determined to have the most similar terrain, elevation, surrounding topography, and the most complete meteorological data. Meteorological data for the compressor stations was obtained from the National Climatic Data Center (NCDC) for the period January 1981 to December 2010. The annual average temperatures and average precipitation data for these areas are presented in Table 9.1-1.

Table 9.1-1

Climate Parameters at the Compressor Station Locations

Compressor Station	Monitor	ID	Approximate Distance and Direction from Station	Average Daily Minimum Temperature – January (°F)	Average Daily Maximum Temperature – July (°F)	Annual Precipitation (inches)
Bradshaw	Morgantown Hart Field, WV US	GHCND: USW00013736	33 miles NE	23.7	83.4	41.83
Harris	Elkins-Randolph County Regional Airport, WV US	GHCND: USW00013729	36 miles NE	19.4	81.0	45.93
Stallworth	Raleigh County Memorial Airport, WV US	GHCND: USW00003872	20 miles SW	22.8	79.8	41.19

9.1.1.2 National Ambient Air Quality Standards

Table 9.1-2 summarizes the NAAQS that are currently in effect. Any geographic area that does not meet the NAAQS for the corresponding pollutant is known as a non-attainment area. All counties in which the Project is located are classified as in attainment with all NAAQS. Note that per West Virginia Code of State Regulations, Title 45 section 8 (45 CSR 8) and per Title 9, Section 5, Chapter 30 of the Virginia Administrative Code (9 VAC 5-30), both states have adopted the NAAQS and do not have separate State Ambient Air Quality Standards (SAAQS).[1]

[1] Virginia has not adopted the NAAQS by reference but the ambient air quality standards are the same as the NAAQS.

Table 9.1-2

National Ambient Air Quality Standards for Criteria Pollutants

Pollutant	Primary Standards	Averaging Times	Secondary Standards
Carbon Monoxide (CO)	9 ppm (10,000 µg/m^3)	8-hour	None
	35 ppm (40,000 µg/m^3)	1-hour	None
Lead	0.15 µg/m^3	Rolling 3-month Average	Same as Primary
Nitrogen Dioxide (NO_2)	53 ppb (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary
	100 ppb (188 µg/m^3)	1-hour	None
Particulate Matter (PM_{10})	150 µg/m^3	24-hour	Same as Primary
Particulate Matter ($PM_{2.5}$)	12 µg/m^3	Annual (Arithmetic Mean)	15 µg/m^3
	35 µg/m^3	24-hour	Same as Primary
Ozone	75 ppb	8-hour	Same as Primary
Sulfur Dioxide (SO_2) a/	0.03 ppm (80 µg/m^3)	Annual (Arithmetic Mean)	0.02 ppm
	0.14 ppm (365 µg/m^3)	24-hour	None
	None	3-hour	0.5 ppm (1,300 µg/m^3)
	75 ppb (196 µg/m^3)	1-hour	None

Source: http://epa.gov/air/criteria.html.

a/ The existing annual and 24-hour SO^2 standards will be revoked one year after the effective dates in areas with designated status for the revised SO2 NAAQS.

9.1.1.3 Section 107 Attainment Status Designations

The Project is located in the counties of Wetzel, Harrison, Doddridge, Lewis, Braxton, Webster, Nicholas, Greenbrier, Fayette, Summers, and Monroe, West Virginia, and Giles, Montgomery, Craig, Roanoke, Franklin, and Pittsylvania, Virginia. All counties listed are in attainment for all criteria pollutants.

9.1.1.4 Existing Ambient Background Levels

Existing ambient background concentrations for criteria air pollutants are presented in Tables 9.1-3 through 9.1-5 below. As mentioned above, all counties are in attainment for all criteria pollutants.

Table 9.1-3

Existing Ambient Background Levels in the Vicinity of the Bradshaw Compressor Station

Pollutant	Averaging Period	Monitoring Station	AQS Site ID	County	State	Approx. Distance from Facility (km)	Background Concentration ($\mu g/m^3$)	Primary NAAQS ($\mu g/m^3$)
NO_2	1-hour	Charleroi Waste Treatment Plant	42-125-0005	Washington	PA	87	68.4	188.0
NO_2	Annual	Charleroi Waste Treatment Plant	42-125-0005	Washington	PA	87	16.1	100.0
$PM_{2.5}$	24-hour	Marion Heath Care Hospital	54-049-0006	Marion	WV	35	18.8	35.0
$PM_{2.5}$	Annual	Marion Heath Care Hospital	54-049-0006	Marion	WV	35	9.7	12.0
CO	1-hour	Charleroi Waste Treatment Plant	42-125-0005	Washington	PA	87	2864.0	40000.0
CO	8-hour	Charleroi Waste Treatment Plant	42-125-0005	Washington	PA	87	1718.4	10000.0
PM_{10}	24-hr	Brilliant	39-081-0001	Jefferson	OH	81	47.0	150.0
SO_2	1-hour	Morgantown - Airport US	54-061-0003	Monongalia	WV	54	39.3	196.0
SO_2	3-hour	Morgantown - Airport US	54-061-0003	Monongalia	WV	54	41.9	1300.0
SO_2	24-hour	Morgantown - Airport US	54-061-0003	Monongalia	WV	54	16.8	365.0
SO_2	Annual	Morgantown - Airport US	54-061-0003	Monongalia	WV	54	5.2	80.0

Table 9.1-4

Existing Ambient Background Levels in the Vicinity of the Harris Compressor Station

Pollutant	Averaging Period	Monitoring Station	AQS Site ID	County	State	Approx. Distance from Facility (km)	Background Concentration ($\mu g/m^3$)	Primary NAAQS ($\mu g/m^3$)
NO_2	1-hour	Rockingham VDOT	51-165-0003	Rockingham	VA	149	73.4	188.0
NO_2	Annual	Rockingham VDOT	51-165-0003	Rockingham	VA	149	17.0	100.0
$PM_{2.5}$	24-hour	Washington Irving Junior High School	54-033-0003	Harrison	WV	64	19.0	35.0
$PM_{2.5}$	Annual	Washington Irving Junior High School	54-033-0003	Harrison	WV	64	9.1	12.0
CO	1-hour	Piney Run	24-023-0002	Garrett	MD	167	953.1	40000.0
CO	8-hour	Piney Run	24-023-0002	Garrett	MD	167	508.6	10000.0
PM_{10}	24-hr	Charleston Baptist Temple	54-039-0010	Kanawha	WV	107	30.0	150.0
SO_2	1-hour	Morgantown - Airport US	54-061-0003	Monongalia	WV	114	39.3	196.0
SO_2	3-hour	Morgantown - Airport US	54-061-0003	Monongalia	WV	114	41.9	1300.0
SO_2	24-hour	Morgantown - Airport US	54-061-0003	Monongalia	WV	114	16.8	365.0
SO_2	Annual	Morgantown - Airport US	54-061-0003	Monongalia	WV	114	5.2	80.0

Table 9.1-5

Existing Ambient Background Levels in the Vicinity of the Stallworth Compressor Station

Pollutant	Averaging Period	Monitoring Station	AQS Site ID	County	State	Approx. Distance from Facility (km)	Background Concentration ($\mu g/m^3$)	Primary NAAQS ($\mu g/m^3$)
NO_2	1-hour	East Vinton Elementary School	51-161-1004	Roanoke	VA	101	69.2	188.0
NO_2	Annual	East Vinton Elementary School	51-161-1004	Roanoke	VA	101	12.6	100.0
$PM_{2.5}$	24-hour	Salem High School	51-775-0011	Salem City	VA	87	17.3	35.0
$PM_{2.5}$	Annual	Salem High School	51-775-0011	Salem City	VA	87	8.7	12.0
CO	1-hour	Winston-Salem	37-067-0023	Forsyth	NC	204	2749.5	40000.0
CO	8-hour	Winston-Salem	37-067-0023	Forsyth	NC	204	1947.5	10000.0
PM_{10}	24-hr	Charleston Baptist Temple	54-039-0010	Kanawha	WV	93	30.0	150.0
SO_2	1-hour	Charleston Baptist Temple	54-039-0010	Kanawha	WV	93	110.9	196.0
SO_2	3-hour	Charleston Baptist Temple	54-039-0010	Kanawha	WV	93	120.5	1300.0
SO_2	24-hour	Charleston Baptist Temple	54-039-0010	Kanawha	WV	93	46.9	365.0
SO_2	Annual	Charleston Baptist Temple	54-039-0010	Kanawha	WV	93	10.8	80.0

9.1.1.5 Federal Class I Areas

Federal Class I areas are certain areas established by Congress, such as wilderness areas and national parks, that are afforded special protection under the Clean Air Act. Once designated as a Class I area, an area cannot be re-designated to another (lower) classification. Class I areas are allowed the smallest degree of air quality deterioration through New Source Review (NSR) / Prevention of Significant Deterioration (PSD) permitting, and special considerations must be made in the NSR permitting process when a Class I area is located close to a proposed site. Based on detailed emission calculations, the Project does not require PSD review and Class I modeling will not be required. Regardless, the Class I areas nearest to the proposed locations of the Bradshaw, Harris, and Stallworth Compressor Stations have been identified. The Class I areas are listed in Tables 9.1-6, 9.1-7, and 9.1-8.

Table 9.1-6

Federal Class I Areas Closest to the Bradshaw Compressor Station

Class I Area	Managing Agency	Direction from Bradshaw	Distance to Compressor Station	
			Kilometers	Miles
Otter Creek, WV	U.S. Forest Service	Southeast of Bradshaw	~98	~61
Dolly Sods, WV	U.S. Forest Service	Southeast of Bradshaw	~117	~73
Shenandoah, VA	National Park Service	Southeast of Bradshaw	~211	~131
James River, VA	U.S. Forest Service	Southeast of Bradshaw	~236	~147

Table 9.1-7

Federal Class I Areas Closest to the Harris Compressor Station

Class I Area	Managing Agency	Direction from Harris	Distance to Compressor Station	
			Kilometers	Miles
Otter Creek, WV	U.S. Forest Service	Northeast of Harris	~82	~52
Dolly Sods, WV	U.S. Forest Service	Northeast of Harris	~103	~64
Shenandoah, VA	National Park Service	Southeast of Harris	~166	~103
James River, VA	U.S. Forest Service	Southeast of Harris	~156	~97

Table 9.1-8

Federal Class I Areas Closest to the Stallworth Compressor Station

Class I Area	Managing Agency	Direction from Stallworth	Distance to Compressor Station	
			Kilometers	Miles
Otter Creek, WV	U.S. Forest Service	Northeast of Stallworth	~159	~99
Dolly Sods, WV	U.S. Forest Service	Northeast of Stallworth	~174	~108
Shenandoah, VA	National Park Service	Northeast of Stallworth	~189	~117
James River, VA	U.S. Forest Service	Southeast of Stallworth	~120	~75

9.1.2 Project Emissions

9.1.2.1 Construction

Construction activities will result in temporary increases in emissions of some pollutants due to the use of non-stationary equipment powered by diesel fuel or gasoline engines; the temporary generation of fugitive dust due to disturbance of the ground surface, vegetation clearing, and other dust generating actions; and indirect emissions attributable to workers commuting to and from work sites during construction.

These sources are not considered stationary sources and their impacts will generally be temporary and localized. Therefore, the emissions are not required to be evaluated as part of the Prevention of Significant Deterioration (PSD) or NA-NSR major source determination analysis. Furthermore, the emissions from construction activities are not expected to cause or significantly contribute to an exceedance of the NAAQS.

Three new compressor stations will be constructed in West Virginia as part of the Project. The Bradshaw Compressor Station, in Wetzel County near the northern-most point of the pipeline, will provide suppliers with immediate pipeline access, and two compressor stations located further south in Braxton and Fayette Counties will boost pipeline pressure and allow for the designed capacity. The compressor stations will have pig launcher and receiver sites. Additional meter and mainline block valve (MLV) sites will be located along the pipeline.

Potential emissions from construction of the Project are presented as part of the General Conformity analysis in Section 9.1.5.

9.1.2.2 Operation (including maintenance and malfunctions)

The following four sections list the equipment to be installed at each compressor station. Emission calculations have been performed and presented in Appendix 9-B for these emission sources. MVP has included volatile organic compounds (VOC) and greenhouse gas (GHG) emissions from blowdown events at the compressor stations using the following assumptions:

- While only 8 blowdown events are planned per year, due to system testing and maintenance activities, permitting will reflect 16 for the compressors and one emergency shutdown vent for the Bradshaw Compressor Station in case additional blowdown events become necessary;
- While only 4 blowdown events are planned per year due to system testing and maintenance activities, permitting will reflect 8 for the compressors and one emergency shutdown vent for the Harris Compressor Station in case additional blowdown events become necessary; and,
- While only 4 blowdown events are planned per year due to system testing and maintenance activities, permitting will reflect 8 for the compressors and one emergency shutdown vent for the Stallworth Compressor Station in case additional blowdown events become necessary.

Bradshaw Compressor Station

The proposed Bradshaw Compressor Station will involve the installation of:

- Four (4) turbines for the compression and transmission of natural gas;
- Fourteen (14) microturbines to provide power;
- One (1) produced fluids tank and associated loadout;
- Two (2) fuel gas heaters;
- One (1) office building heater;
- One (1) waste oil tank;
- One (1) produced fluids tank and associated loadout; and
- Associated piping and components.

Harris Compressor Station

The proposed Harris Compressor Station will involve the installation of:

- Two (2) turbines for the compression and transmission of natural gas;
- Nine (9) microturbines to provide power;
- Two (2) fuel gas heaters;
- One (1) office building heater;
- One (1) produced fluids tank and associated loadout;
- One (1) waste oil tank; and
- Associated piping and components.

Stallworth Compressor Station

The proposed Stallworth Compressor Station will involve the installation of:

- Two (2) turbines for the compression and transmission of natural gas;
- Ten (10) microturbines to provide power;
- Two (2) fuel gas heaters;
- One (1) office building heater;
- One (1) produced fluids tank and associated loadout;
- One (1) waste oil tank; and
- Associated piping and components.

9.1.2.3 Decommissioning

Decommissioning is not currently planned. MVP will obtain the necessary state and federal permits for decommissioning at the end of the useful project life.

9.1.3 Air Permitting Requirements

The federal and state regulations that apply to the construction activities and the Project are discussed in the following section. The West Virginia Code of State Rules (CSR) require sources of air contamination to notify the state and receive a permit to construct, modify, relocate and operate the stationary source, unless otherwise exempt. MVP will submit the necessary construction permit applications and other relevant documentation prior to construction. A copy of air permit applications are included in Appendix 9-C.

The CSR contains regulations that fall under two main categories; those regulations that are generally applicable (e.g., permitting requirements), and those that have specific applicability (e.g., sulfur compound emissions from combustion units). The generally applicable requirements are straightforward (e.g., filing of emission statements) and, as such, are not discussed in further detail. The specific requirements associated with the Project are discussed in the following section.

9.1.4 Regulatory Review and Applicability

This section lists applicable air quality regulations at both the federal and state levels.

9.1.4.1 Prevention of Significant Deterioration Source Classification

Federal construction permitting programs regulate new and modified sources of attainment pollutants under PSD and new and modified sources of non-attainment pollutants under NSR. PSD regulations apply when a new source is constructed in which emissions exceed PSD major source thresholds, an existing minor source undergoes a modification in which emission increases exceed PSD major source thresholds, or an existing major source undergoes a modification in which emission increases exceed PSD significant emission rates. The Bradshaw, Harris and Stallworth Compressor Stations will be minor sources with respect to PSD, as shown in Table 9.1-9. As such, PSD permitting is not triggered.

Table 9.1-9

Emissions from Compressor Stations versus NSR Major Source Thresholds

Pollutant	Bradshaw Compressor Station Site-Wide PTE (TPY) a/	Harris Compressor Station Site-Wide PTE (TPY)[1]	Stallworth Compressor Station Site-Wide PTE (TPY) a/	Major Source Threshold (TPY)	NSR Program	Subject to Major NSR?
PM_{10}	47.47	21.39	20.30	250	PSD	No
$PM_{2.5}$	47.36	21.36	20.20	250	PSD	No
SO_2	10.98	4.95	4.74	250	PSD	No
CO	197.78	97.06	91.28	250	PSD	No
NO_X	178.62	86.73	79.84	250	PSD	No
VOC	31.94	13.99	13.46	250	PSD	No

a/ PTE includes emissions from fugitive sources.

NNSR regulations apply only in areas designated as non-attainment. The compressor stations will be located in Wetzel, Braxton and Fayette Counties, which are designated as in attainment/unclassifiable for all criteria pollutants.[2] Therefore, NNSR regulations do not apply to any the compressor stations.

9.1.4.2 Title V Operating Permit Program

Title 40 of the Code of Federal Regulations, Chapter 70 (40 CFR 70) establishes the Federal Title V operating permit program. West Virginia has incorporated the provisions of this federal program in its Title V operating permit program in West Virginia 45 CSR 30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAP and 100 tpy of all other regulated pollutants.[3] The applicability of the Title V operating permit program to each station is outlined below.

Bradshaw Compressor Station

After completion of construction of the proposed Project, potential emissions for NO_X and CO will exceed major source thresholds with respect to the Title V permit program. Therefore, the station will be major source with respect to the Title V Program. In accordance with 40 CFR 70.5(a)(1) and 45 CSR 30 Section 4.1.a.2, MVP will submit a Title V operating permit application within 12 months of start-up of the authorized equipment under this construction permit request.

Stallworth and Harris Compressor Stations

The potential emissions of all regulated pollutants are below the corresponding thresholds for these proposed stations. Therefore, the Stallworth and Harris Compressor Stations are not anticipated to be major sources for Title V purposes.

9.1.4.3 New Source Performance Standards

NSPS, located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the facilities.

NSPS Subpart Dc – Steam Generating Units

Subpart Dc, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, applies to all steam generating units with a heat input greater than or equal to 10 MMBtu/hr and less than 100 MMBtu/hr. No units at the proposed facilities meet the definition of a steam generating unit and have a heat input greater than 10 MMBtu/hr; therefore, the requirements of this subpart will not apply.

NSPS Subpart GG – Stationary Gas Turbines

Subpart GG, Standards of Performance for Stationary Gas Turbines, applies to all gas turbines with a heat input at peak load greater than or equal to 10 MMBtu/hr based on the lower heating value of the fuel

[2] U.S. EPA Greenbook, http://www.epa.gov/airquality/greenbook/anayo_wv.html, as of January 30, 2015.

[3] On June 23, 2014, the U.S Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA* effectively changed the permitting procedures for GHGs under the PSD and Title V programs.

fired. This standard was promulgated in 1979. The applicability of Subpart KKKK, promulgated in 2006, is similar to that of Subpart GG and applies to stationary combustion turbines that commence construction after February 18, 2005. Turbines subject to Subpart KKKK are specifically exempt from the requirements of Subpart GG per 40 CFR § 60.4305(b). As such, this subpart does not apply to the proposed Solar turbines at each compressor station are subject to the requirements of Subpart KKKK as discussed in the below section. The proposed microturbines have a heat input less than 10 MMBtu/hr and are not subject to the requirements of Subpart GG.

NSPS Subparts K, Ka, and Kb – Storage Vessels for Petroleum Liquids/Volatile Organic Liquids

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. Subpart K applies to storage tanks constructed, reconstructed, or modified prior to 1978, and Subpart Ka to those constructed, reconstructed, or modified prior to 1984. All storage tanks located at the compressor stations will be constructed after these dates; therefore, the requirements of Subparts K and Ka do not apply. Subpart Kb applies to volatile organic liquid (VOL) storage tanks constructed, reconstructed, or modified after July 23, 1984 with a capacity equal to or greater than 75 m^3 (~19,813 gallons). All storage tanks at the compressor stations will be constructed after this date, but will not have a capacity greater than 75 m^3. Therefore, Subpart Kb does not apply to the storage tanks at the compressor stations.

NSPS Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines

Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of stationary spark (SI) engines. There will be no SI engines installed at the compressor stations. Therefore, this subpart is not applicable to the MVP compressor stations.

NSPS Subpart KKKK – Stationary Combustion Turbines

Subpart KKKK, Standards of Performance for Stationary Combustion Turbines, applies to stationary combustion units with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the higher heating value of the fuel, commencing construction after February 18, 2005. The microturbines at the compressor stations will each have a heat input less than 10MMBtu/hr. Therefore, they are not subject to this standard.

The proposed Solar turbines for the compressor stations will be subject to the NO_X emissions limitations in §60.4320(a). Turbines with a rated capacity between 50 to 850 MMBtu/hr at peak load are limited to NO_X emissions of 25 ppm at 15% O_2 when firing natural gas. The Solar turbines that will be installed at the stations are equipped with lean pre-mix combustion technology and are guaranteed by the manufacturer to emit a maximum of 15 ppm of NO_X at 15% O_2 under variable turbine load conditions when firing on natural gas. This vendor guarantee is below the NSPS KKKK standard.

MVP will perform annual performance tests in accordance with §60.4340(a) and§ 60.4400 to demonstrate compliance with the NO_X emission limitations, or as an alternative, will continuously monitor the appropriate parameters to determine whether each turbine is operating in low-NO_X mode in accordance with §60.4340(b)(2)(ii) and §60.4355(a). The Solar turbines must also comply with the SO_2 emission limits in §60.4330. MVP will comply with the SO_2 requirements by the exclusive use of natural gas

which contains total potential sulfur emissions less than 0.060 lb SO_2/MMBtu heat input in accordance with §60.4330(a)(2).

NSPS Subpart OOOO – Natural Gas Production, Transmission, and Storage

Subpart OOOO, Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011. This NSPS was published in the Federal Register on August 16, 2012, and was subsequently amended. The list of potentially affected facilities includes:

- Gas wellheads;
- Centrifugal compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Reciprocating compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Continuous bleed natural gas-driven pneumatic controllers with a bleed rate of greater than 6 scfh located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment (excluding natural gas processing plants);
- Continuous bleed natural gas-driven pneumatic controllers located at natural gas processing plants;
- Storage vessels in the production, processing, or transmission and storage segments; and
- Sweetening units located onshore that process natural gas produced from either onshore or offshore wells.

Since the proposed compressor stations will be transmission facilities located after the point of custody transfer, the only potentially applicable requirements for the proposed equipment are those for new storage vessels where construction commenced after August 23, 2011.

The regulatory standards applicable to storage vessels are detailed in 40 CFR §60.5395. The only tanks that falls under the Subpart's definition of a 'storage vessel' are the produced fluid storage tanks, however, these tanks will have potential VOC emissions below 6 tpy each. As such, per 60.5365(e), the tank is not a storage vessel affected facility under the rule.

It is important to note that updates to NSPS Subpart OOOO have been proposed. However, as the changes are not finalized, applicability will be reviewed once the rules have been finalized.

9.1.4.4 National Emission Standards for Hazardous Air Pollutants

Regulatory requirements for facilities subject to NESHAP standards, otherwise known as Maximum Available Control Technology (MACT) Standards for source categories, are contained in 40 CFR Part 63. 40 CFR Part 61 NESHAP standards are defined for specific pollutants while Part 63 NESHAPs are defined for source categories where allowable emission limits are established on the basis of a MACT determination for a particular major source. A major source of HAP is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. Area sources consist of smaller-size facilities that release lesser quantities of toxic pollutants into the air. Area sources are defined as sources that emit less than 10 tpy of a single air toxin, or less than 25 tpy of a combination of air toxins. Part 63 NESHAPs apply to sources in specifically

regulated industrial source categories (CAA Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type.

Potential HAP emissions from each of the proposed compressor stations will be below the major source thresholds (i.e., less than 10 tpy of individual HAP and 25 tpy of total HAP) and therefore the facilities will be area sources of HAP. The potential applicability of specific MACT standards to each compressor station is discussed below.

NESHAP Subpart HH – Natural Gas Production Facilities

This standard applies to sources at natural gas production facilities that are major or area sources of HAP emissions. The proposed stations are transmission facilities; therefore, the facilities will not be subject to Subpart HH.

NESHAP Subpart HHH – Natural Gas Transmission and Storage Facilities

This standard applies to sources at natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and/or treatment in the production sector), but upstream of the distribution sector. The proposed compressor stations are transmission facilities and are area source of HAP emissions. Therefore, the facilities will not be subject to Subpart HHH.

NESHAP Subpart YYYY – Stationary Combustion Turbines.

Stationary combustion turbines located at facilities that are major sources of HAPs are potentially subject to Subpart YYYY, NESHAP for Stationary Combustion Turbines. Subpart YYYY establishes emissions and operating limitations for lean premix gas-fired, lean premix oil-fired, diffusion flame gas-fired and diffusion flame oil-fired stationary combustion turbines. The proposed compressor stations are area sources of HAP and therefore are not subject to the requirements of this subpart.

NESHAP Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines

Stationary reciprocating internal combustion engines (RICE) at both area and major sources of HAP emissions are potentially subject to Subpart ZZZZ – *NESHAP for Stationary Reciprocating Internal Combustion Engines (RICE)*. There are no proposed RICE at the compressor stations. Therefore, the stations are not subject to this subpart.

NESHAP Subpart DDDDD – Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types at major sources of HAP. The proposed facilities are area sources of HAP; therefore, the requirements of this subpart will not apply.

NESHAP Subpart JJJJJJ – Industrial, Commercial, and Institutional Boilers (Area Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types. The proposed fuel heaters are natural gas-fired and are specifically exempt from this subpart. Therefore, the requirements of this subpart will not apply.

9.1.4.5 Greenhouse Gas Reporting Rule

Per 40 CFR 98.2(a)(2), facilities that contain a source category listed in Table A-4 and emit 25,000 metric tons per year of carbon dioxide equivalent (CO_2e) in combined emissions from stationary fuel combustion units, miscellaneous uses of carbonate, and all applicable source categories in Tables A-3 and A-4 are subject to reporting under the Greenhouse Gas Mandatory Reporting Rule (MRR). Table A-4 of 40 CFR 98 Subpart A includes Petroleum and Natural Gas Systems. GHG emissions from each of the compressor stations are over 25,000 metric tons per year on a potential basis. The actual emissions will be calculated annually and compared with the 25,000 metric tons per year of CO_2 to address the applicability of the rule. MVP will meet all requirements of the MRR for these new compressor stations, as applicable. No other subparts under the MRR are applicable to the facilities.

9.1.4.6 West Virginia Air Quality Regulations

The compressor stations are potentially subject to regulations contained in the West Virginia Code of State Regulations, Title 45. The Code of State Regulations fall under two main categories: those regulations that are generally applicable (e.g., permitting requirements) and those that have specific applicability (e.g., PM standards for manufacturing equipment).

45 CSR 2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The proposed fuel heaters and office building heaters at each station are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from this unit shall not exceed 10 percent.

45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

> *No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.*

The stations are generally subject to this requirement. MVP will operate all equipment in a manner as to avoid causing or contributing to an objectionable odor at any location occupied by the public.

45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall be considered incineration." The facilities will not operate any incinerators under this definition and, as such, have no requirements under this rule.

45 CSR 10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides

This rule applies to specific emission sources that are listed by name in the rule, to sulfuric acid manufacturing plants, and to sources that combust any refinery process gas stream or any other process gas stream that contains hydrogen sulfide in a concentration greater than 50 grains per 100 cubic feet. The

compressor stations do not meet any of the categories subject to the rule, and as such are not subject to the rule.

45 CSR 13: Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, Permission to Commence Construction, and Procedures for Evaluation

This rule establishes procedures for permitting and reporting of stationary sources. MVP will comply with the requirements of this rule by complying with the applicable general provisions in the facility's construction and operating permits.

45 CSR 16: Standards of Performance for New Stationary Sources

45 CSR 16-1 incorporates the federal Clean Air Act (CAA) standards of performance for new stationary sources set forth in 40 CPR Part 60 by reference. As noted above, the facilities will comply with all applicable NSPS subparts.

45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

> *No person shall cause, suffer, allow or permit fugitive particulate matter to be discharged beyond the boundary lines of the property lines of the property on which the discharge originates or at any public or residential location, which causes or contributes to statutory air pollution.*

Due to the nature of the activities at these stations, it is unlikely that fugitive particulate matter emissions will be emitted under normal operating conditions.

45 CSR 21: To Prevent and Control Air Pollution from the Emission of Volatile Organic Compounds

45 CSR 21 applies only to sources located in Putnam County, Kanawha County, Cabell County, Wayne County, and Wood County, West Virginia. The compressor stations will be located in Wetzel, Braxton and Fayette Counties. Therefore, the requirements of this section do not apply to the proposed compressor stations.

45 CSR 22: Air Quality Management Fee Program

This regulation establishes a program to collect fees for certificates to operate and for permits to construct, modify or relocate sources of air pollution. MVP will comply with this rule by paying all required permitting fees.

45 CSR 34: Emissions Standards for Hazardous Air Pollutants

45 CSR 34-1 incorporates the federal Clean Air Act (CAA) national emissions standards for hazardous air pollutants (NESHAPs) as set forth in 40 CPR Parts 61 and 63 by reference. As noted above, no NESHAP are applicable to the compressor stations.

Non-Applicability of Other SIP Rules

A thorough examination of the West Virginia SIP rules with respect to applicability at the station reveals many SIP regulations that do not apply or impose additional requirements on operations. Such SIP rules include those specific to a particular type of industrial operation that are categorically not applicable to the compressor stations.

9.1.4.7 Virginia Air Quality Regulations

The only Project emissions occurring in Virginia will be due to construction activities related to installation of the pipeline. These emissions are temporary in nature and limited to the duration of the construction. The Virginia air quality regulations mostly apply to operating sources and not to temporary construction projects. Therefore, a review of the Virginia air quality regulations is not presented here.

9.1.5 General Conformity

Under the Clean Air Act, a General Conformity analysis is required for any project that requires federal action. General Conformity applies to those emission generating activities resulting from the Project that are not already covered by permitting and located in an area that is designated as nonattainment or a maintenance area (40 CFR 93.153(b)). The counties of Wetzel, Harrison, Doddridge, Lewis, Braxton, Webster, Nicholas, Greenbrier, Fayette, Summers, and Monroe, West Virginia, are each in attainment for all criteria pollutants. Similarly, the counties of Giles, Montgomery, Craig, Roanoke, Franklin, and Pittsylvania, Virginia, are each in attainment for all criteria pollutants. Therefore, a General Conformity analysis is not required for the construction at the Bradshaw, Harris, and Stallworth Compressor Stations or for the construction of the pipeline. Construction emissions will be presented per FERC's guidance manual for resource reports, even though the project is not required to undergo a full General Conformity analysis.

9.1.5.1 Construction Emissions

The use of equipment to construct the Project will result in temporary, short-term emissions of air pollutants that will be restricted to the construction period for the compressor stations, pipeline, and interconnects, and will terminate once construction has been completed. Construction for the Project is expected to take place from early 2017 to late 2018. In addition, some pre-construction emissions will occur in 2016 due to activity from pickup trucks and all-terrain vehicles along the pipeline route, and some right-of-way restoration may occur during the first quarter of 2019.

Construction activities can generally be categorized into the following activities:

- Construction Equipment Engines – Emissions from air compressors, backhoes, cranes, and other construction equipment;
- On-Road Vehicle Travel – Emissions from commuter buses, passenger vehicles, and diesel or gasoline trucks;
- Off-Road Vehicle Travel – Emissions from dump trucks, light/medium duty trucks, and water/fuel trucks;
- Earthmoving Fugitives – Emissions resulting from bulldozing, grading, and land disturbance; and
- Wind Erosion – Emissions resulting from soil piles.

Emissions from these source categories were calculated using emission factors and EPA models from the following sources:

- Compilation of Air Pollutant Emission Factors, EPA AP-42;
- EPA NONROAD2008a Model; and
- EPA MOBILE6.2 Vehicle Emission Modeling Software.

Compressor Station Emissions

Emissions from the three compressor stations were estimated based on the type of construction activity occurring and the length of time that type of activity was expected to last at each station. The total emissions are divided based on the year the construction is expected to occur at each station and exhibited in Tables 9.1-10 through 9.1-13.

Pipeline Emissions

Emissions from the construction of the pipeline are calculated based on the length of pipeline being constructed in each county. Emissions were estimated based on the type of construction activity occurring and the length of time that type of activity was expected to last within each county of pipeline construction. Percent of emissions for each county within a pipeline construction spread were calculated based on the length of pipeline in that county. The total emissions are divided based on the year the construction is expected to occur along each pipeline.

Interconnect Emissions

Emissions from the Mobley, Sherwood, Transco, Roanoke, and Columbia interconnects were estimated based on the type of construction activity occurring and the length of time that type of activity was expected to last at each interconnect. The total emissions are divided based on the year the construction is expected to occur at each interconnect. Construction emissions for the Roanoke Gas tap were included within the pipeline construction emissions.

Construction emissions for criteria pollutants and GHGs from the Project were estimated for the construction period. The results of these calculations are summarized in Tables 9.1-10 through 9.1-13. Note that none of the pollutants are subject to General Conformity requirements, as all counties in which construction will take place are in attainment for all criteria pollutants. Therefore, no numerical thresholds apply to the construction emissions (40 CFR 93.153(b)). Back-up calculations are provided in Appendix 9-A.

For Tables 9.1-10 through 9.1-13 that follow, please note the following:

1. Emissions from Wind Erosion were calculated separately from the rest of the construction emissions, but combined in the tables below for ease of viewing the total emissions from the project.
2. The different emissions categories (e.g. On-Road Vehicle Travel) for Total Pipeline emissions have been added together across all spreads.

Table 9.1-10

Estimated Construction Emissions from the Mountain Valley Project - 2016

SOURCE	2016 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Bradshaw Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Bradshaw Total	--	--	--	--	--	--	--
Harris Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Harris Total	--	--	--	--	--	--	--
Stallworth Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Stallworth Total	--	--	--	--	--	--	--
Mobley Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Mobley Total	--	--	--	--	--	--	--
Sherwood Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Sherwood Total	--	--	--	--	--	--	--
Transco Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Transco Total	--	--	--	--	--	--	--

Table 9.1-10

Estimated Construction Emissions from the Mountain Valley Project - 2016

SOURCE	2016 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Roanoke Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Roanoke Total	--	--	--	--	--	--	--
Columbia Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Columbia Total	--	--	--	--	--	--	--
Pipeline:							
Construction Equipment Engines	17.35	171.56	2.02	17.50	2.70	2.70	7,504.16
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	3.97	0.40	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Pipeline Total	**17.35**	**171.56**	**2.02**	**17.50**	**6.67**	**3.10**	**7,504.16**
Pipeline in Wetzel, WV	2.48	24.51	0.29	2.50	1.02	0.45	1,072.02
Pipeline in Harrison, WV	2.48	24.51	0.29	2.50	1.02	0.45	1,072.02
Pipeline in Doddridge, WV	2.48	24.51	0.29	2.50	1.02	0.45	1,072.02
Pipeline in Lewis, WV	2.48	24.51	0.29	2.50	1.02	0.45	1,072.02
Pipeline in Braxton, WV	2.48	24.51	0.29	2.50	0.86	0.43	1,072.02
Pipeline in Webster, WV	2.48	24.51	0.29	2.50	0.86	0.43	1,072.02
Pipeline in Nicholas, WV	2.48	24.51	0.29	2.50	0.86	0.43	1,072.02
Pipeline in Greenbrier, WV	--	--	--	--	--	--	--
Pipeline in Fayette, WV	--	--	--	--	--	--	--
Pipeline in Summers, WV	--	--	--	--	--	--	--
Pipeline in Monroe, WV	--	--	--	--	--	--	--
Pipeline in Giles, VA	--	--	--	--	--	--	--
Pipeline in Craig, VA	--	--	--	--	--	--	--
Pipeline in Montgomery, VA	--	--	--	--	--	--	--
Pipeline in Roanoke, VA	--	--	--	--	--	--	--
Pipeline in Franklin, VA	--	--	--	--	--	--	--
Pipeline in Pittsylvania, VA	--	--	--	--	--	--	--
2016 TOTAL:	**17.35**	**171.56**	**2.02**	**17.50**	**6.67**	**3.10**	**7,504.16**

Table 9.1-11

Estimated Construction Emissions from the Mountain Valley Project - 2017

SOURCE	2017 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Bradshaw Compressor Station:							
Construction Equipment Engines	90.96	107.96	6.62	16.53	12.80	12.80	25,433.39
On-Road Vehicle Travel	0.58	3.13	0.00	0.17	0.02	0.01	395.62
Off-Road Vehicle Travel	--	--	--	--	0.61	0.06	--
Earthmoving Fugitives	--	--	--	--	1.10	0.52	--
Wind Erosion	--	--	--	--	0.00	0.00	--
Bradshaw Total	**91.53**	**111.10**	**6.62**	**16.71**	**14.54**	**13.40**	**25,829.01**
Harris Compressor Station:							
Construction Equipment Engines	80.15	95.24	5.83	14.55	11.25	11.25	22,363.47
On-Road Vehicle Travel	0.58	3.14	0.00	0.18	0.02	0.01	395.62
Off-Road Vehicle Travel	--	--	--	--	0.61	0.06	--
Earthmoving Fugitives	--	--	--	--	1.09	0.52	--
Wind Erosion	--	--	--	--	0.00	0.00	--
Harris Total	**80.72**	**98.38**	**5.83**	**14.73**	**12.98**	**11.85**	**22,759.09**
Stallworth Compressor Station:							
Construction Equipment Engines	80.17	95.19	5.83	14.56	11.25	11.25	22,363.47
On-Road Vehicle Travel	0.58	3.15	0.00	0.17	0.02	0.01	395.62
Off-Road Vehicle Travel	--	--	--	--	0.61	0.06	--
Earthmoving Fugitives	--	--	--	--	1.11	0.52	--
Wind Erosion	--	--	--	--	0.02	0.00	--
Stallworth Total	**80.74**	**98.34**	**5.83**	**14.73**	**13.02**	**11.85**	**22,759.09**
Mobley Interconnect:							
Construction Equipment Engines	19.88	22.81	1.32	3.58	2.49	2.49	5,033.51
On-Road Vehicle Travel	0.34	1.83	0.00	0.10	0.01	0.01	230.78
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.15	0.07	--
Wind Erosion	--	--	--	--	0.00	0.00	--
Mobley Total	**20.21**	**24.64**	**1.32**	**3.68**	**2.90**	**2.59**	**5,264.29**
Sherwood Interconnect:							
Construction Equipment Engines	19.88	22.81	1.32	3.58	2.49	2.49	5,033.51
On-Road Vehicle Travel	0.34	1.83	0.00	0.10	0.01	0.01	230.78
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.16	0.07	--
Wind Erosion	--	--	--	--	0.00	0.00	--
Sherwood Total	**20.21**	**24.64**	**1.32**	**3.68**	**2.90**	**2.59**	**5,264.29**
Transco Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Transco Total	--	--	--	--	--	--	--

Table 9.1-11

Estimated Construction Emissions from the Mountain Valley Project - 2017

SOURCE	2017 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Roanoke Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Roanoke Total	--	--	--	--	--	--	--
Columbia Interconnect:							
Construction Equipment Engines	19.91	22.82	1.32	3.59	2.49	2.49	5,036.31
On-Road Vehicle Travel	0.34	1.83	0.00	0.10	0.01	0.01	230.78
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.15	0.07	--
Wind Erosion	--	--	--	--	0.01	0.00	--
Columbia Total	**20.24**	**24.65**	**1.33**	**3.69**	**2.91**	**2.59**	**5,267.09**
Pipeline:							
Construction Equipment Engines	741.08	1,372.86	65.12	151.81	107.76	107.76	238,062.79
On-Road Vehicle Travel	188.50	102.31	0.69	18.02	5.46	3.53	95,503.42
Off-Road Vehicle Travel	--	--	--	--	1,378.10	137.81	--
Earthmoving Fugitives	--	--	--	--	110.69	53.53	--
Wind Erosion	--	--	--	--	11.70	1.75	--
Pipeline Total	**929.58**	**1,475.17**	**65.81**	**169.83**	**1,613.71**	**304.40**	**333,566.21**
Pipeline in Wetzel, WV	78.95	100.84	4.88	12.27	212.24	31.54	29,438.77
Pipeline in Harrison, WV	160.32	230.26	11.92	26.99	235.09	48.44	55,153.15
Pipeline in Doddridge, WV	51.54	57.23	2.51	7.31	204.54	25.85	20,776.12
Pipeline in Lewis, WV	182.99	266.27	13.88	31.09	242.71	53.66	62,307.44
Pipeline in Braxton, WV	119.06	156.19	7.69	18.85	227.35	40.77	43,575.78
Pipeline in Webster, WV	212.11	304.01	15.74	35.67	259.67	62.62	72,948.96
Pipeline in Nicholas, WV	105.55	134.74	6.52	16.41	222.66	37.60	39,311.93
Pipeline in Greenbrier, WV	2.03	24.11	0.28	2.27	1.05	0.42	1,071.37
Pipeline in Fayette, WV	2.03	24.11	0.28	2.27	1.05	0.42	1,071.37
Pipeline in Summers, WV	2.03	24.11	0.28	2.27	1.05	0.42	1,071.37
Pipeline in Monroe, WV	2.03	24.11	0.28	2.27	1.05	0.42	1,071.37
Pipeline in Giles, VA	1.76	20.90	0.25	1.97	0.94	0.37	928.52
Pipeline in Craig, VA	1.76	20.90	0.25	1.97	0.94	0.37	928.52
Pipeline in Montgomery, VA	1.79	21.19	0.25	1.98	0.94	0.37	955.82
Pipeline in Roanoke, VA	1.76	20.90	0.25	1.97	0.94	0.37	928.52
Pipeline in Franklin, VA	1.79	21.19	0.25	1.98	0.94	0.37	955.82
Pipeline in Pittsylvania, VA	2.03	24.11	0.28	2.27	0.53	0.37	1,071.37
2017 TOTAL:	**1,243.25**	**1,856.91**	**88.06**	**227.05**	**1,662.96**	**349.26**	**420,709.05**

Table 9.1-12

Estimated Construction Emissions from the Mountain Valley Project - 2018

SOURCE	2018 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Bradshaw Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Bradshaw Total	--	--	--	--	--	--	--
Harris Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Harris Total	--	--	--	--	--	--	--
Stallworth Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Stallworth Total	--	--	--	--	--	--	--
Mobley Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Mobley Total	--	--	--	--	--	--	--
Sherwood Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Sherwood Total	--	--	--	--	--	--	--
Transco Interconnect:							
Construction Equipment Engines	17.80	21.19	1.30	3.37	2.37	2.37	5,036.18
On-Road Vehicle Travel	0.29	1.67	0.00	0.10	0.01	0.01	230.76
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.14	0.07	--
Wind Erosion	--	--	--	--	0.02	0.00	--
Transco Total	**18.10**	**22.86**	**1.31**	**3.46**	**2.78**	**2.47**	**5,266.94**

Table 9.1-12

Estimated Construction Emissions from the Mountain Valley Project - 2018

SOURCE	2018 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Roanoke Interconnect:							
Construction Equipment Engines	17.80	21.19	1.30	3.37	2.37	2.37	5,036.18
On-Road Vehicle Travel	0.29	1.67	0.00	0.10	0.01	0.01	230.76
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.14	0.07	--
Wind Erosion	--	--	--	--	0.02	0.00	--
Roanoke Total	**18.10**	**22.86**	**1.31**	**3.46**	**2.78**	**2.47**	**5,266.94**
Columbia Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
ColumbiaTotal	--	--	--	--	--	--	--
Pipeline:							
Construction Equipment Engines	959.19	1,771.38	94.11	198.87	150.99	150.99	349,695.65
On-Road Vehicle Travel	222.40	145.96	0.96	24.76	6.62	4.02	132,266.45
Off-Road Vehicle Travel	--	--	--	--	2,089.02	208.90	--
Earthmoving Fugitives	--	--	--	--	191.31	62.85	--
Wind Erosion	--	--	--	--	51.90	7.79	--
Pipeline Total	**1,181.59**	**1,917.34**	**95.07**	**223.63**	**2,489.85**	**434.54**	**481,962.09**
Pipeline in Wetzel, WV	1.84	26.75	0.28	2.23	6.41	0.95	1,238.47
Pipeline in Harrison, WV	1.84	26.75	0.28	2.23	6.41	0.95	1,238.47
Pipeline in Doddridge, WV	1.84	26.75	0.28	2.23	6.41	0.95	1,238.47
Pipeline in Lewis, WV	1.84	26.75	0.28	2.23	6.41	0.95	1,238.47
Pipeline in Braxton, WV	1.80	26.03	0.28	2.21	4.89	0.79	1,196.55
Pipeline in Webster, WV	1.80	26.03	0.28	2.21	4.89	0.79	1,196.55
Pipeline in Nicholas, WV	55.56	116.66	5.50	12.64	27.52	9.80	20,573.76
Pipeline in Greenbrier, WV	113.06	168.63	9.11	20.21	253.95	37.35	45,427.22
Pipeline in Fayette, WV	21.87	14.88	0.25	2.51	215.56	22.08	12,556.57
Pipeline in Summers, WV	92.17	133.41	7.08	16.16	245.16	33.85	37,896.00
Pipeline in Monroe, WV	116.11	173.77	9.40	20.80	255.23	37.86	46,525.52
Pipeline in Giles, VA	139.82	214.58	11.74	25.45	245.63	51.50	55,204.57
Pipeline in Craig, VA	30.92	29.75	1.14	4.29	201.02	22.81	15,833.54
Pipeline in Montgomery, VA	133.52	203.89	11.13	24.23	243.05	49.84	52,926.90
Pipeline in Roanoke, VA	69.92	95.94	4.93	11.87	216.99	33.08	29,933.35
Pipeline in Franklin, VA	241.38	386.96	21.63	45.20	287.32	78.27	91,925.28
Pipeline in Pittsylvania, VA	156.29	219.80	11.47	26.93	263.01	52.73	65,812.41
2018 TOTAL:	**1,217.78**	**1,963.05**	**97.69**	**230.55**	**2,495.42**	**439.48**	**492,495.97**

Table 9.1-13

Estimated Construction Emissions from the Mountain Valley Project - 2019

SOURCE	2019 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Bradshaw Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Bradshaw Total	--	--	--	--	--	--	--
Harris Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Harris Total	--	--	--	--	--	--	--
Stallworth Compressor Station:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Stallworth Total	--	--	--	--	--	--	--
Mobley Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Mobley Total	--	--	--	--	--	--	--
Sherwood Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Sherwood Total	--	--	--	--	--	--	--
Transco Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Transco Total	--	--	--	--	--	--	--

Table 9.1-13

Estimated Construction Emissions from the Mountain Valley Project - 2019

SOURCE	2019 CONSTRUCTION EMISSIONS (TPY)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Roanoke Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	
On-Road Vehicle Travel	--	--	--	--	--	--	
Off-Road Vehicle Travel	--	--	--	--	--	--	
Earthmoving Fugitives	--	--	--	--	--	--	
Wind Erosion	--	--	--	--	--	--	
Roanoke Total	--	--	--	--	--	--	
Columbia Interconnect:							
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Columbia Total	--	--	--	--	--	--	--
Pipeline:							
Construction Equipment Engines	14.07	220.69	2.61	18.77	3.02	3.02	9,990.11
On-Road Vehicle Travel	1.44	26.18	0.02	1.11	0.08	0.04	1,592.79
Off-Road Vehicle Travel	--	--	--	--	58.49	5.85	--
Earthmoving Fugitives	--	--	--	--	--	--	--
Wind Erosion	--	--	--	--	--	--	--
Pipeline Total	**15.51**	**246.87**	**2.63**	**19.88**	**61.59**	**8.91**	**11,582.90**
Pipeline in Wetzel, WV	--	--	--	--	--	--	--
Pipeline in Harrison, WV	--	--	--	--	--	--	--
Pipeline in Doddridge, WV	--	--	--	--	--	--	--
Pipeline in Lewis, WV	--	--	--	--	--	--	--
Pipeline in Braxton, WV	--	--	--	--	--	--	--
Pipeline in Webster, WV	--	--	--	--	--	--	--
Pipeline in Nicholas, WV	--	--	--	--	--	--	--
Pipeline in Greenbrier, WV	1.66	26.51	0.28	2.13	6.96	0.99	1,238.03
Pipeline in Fayette, WV	1.66	26.51	0.28	2.13	6.96	0.99	1,238.03
Pipeline in Summers, WV	1.66	26.51	0.28	2.13	6.96	0.99	1,238.03
Pipeline in Monroe, WV	1.66	26.51	0.28	2.13	6.96	0.99	1,238.03
Pipeline in Giles, VA	1.46	23.17	0.24	1.86	6.35	0.89	1,095.31
Pipeline in Craig, VA	1.46	23.17	0.24	1.86	6.35	0.89	1,095.31
Pipeline in Montgomery, VA	1.46	23.17	0.24	1.86	6.35	0.89	1,095.31
Pipeline in Roanoke, VA	1.46	23.17	0.24	1.86	6.35	0.89	1,095.31
Pipeline in Franklin, VA	1.46	23.17	0.24	1.86	6.35	0.89	1,095.31
Pipeline in Pittsylvania, VA	1.58	24.98	0.28	2.07	1.98	0.49	1,154.20
2019 TOTAL:	**15.51**	**246.87**	**2.63**	**19.88**	**61.59**	**8.91**	**11,582.90**

9.1.6 Air Quality Mitigation Measures

Construction Emissions

The construction emissions associated with the Project are temporary in nature and are expected to have minimal impact on the air quality in the surrounding area. However, MVP will implement various mitigation measures to minimize construction emissions. These include:

- Unnecessary construction activities leading to increased emissions will be avoided, where possible.
- MVP will follow manufacturer's operating recommendations regarding good combustion practices to ensure that fuel efficiency is maximized and engines are operated such that emissions are minimized.
- MVP will implement the Fugitive Dust Control Plan as described below.
- MVP will avoid idling of the construction equipment to the extent possible.
- MVP will mulch the piles generated during construction to ensure particulate matter emissions are minimized.

The Fugitive Dust Control Plan includes the following specific measures to be taken during construction:

- Fugitive dust emissions from vegetation removal, clearing and grading, cutting and filling, topsoil removal, trenching, backfilling and stockpile storage will be controlled to a great extent by following the construction sequencing and disturbing limited areas at a time.
- Fugitive dust emissions generated by motorized equipment and miscellaneous vehicle traffic will be controlled by wet suppression as necessary.
- Fugitive dust emissions from paved roads will be controlled with a combination of water trucks, power washers, sweeping and/or vacuuming.
- Trackout of loose materials will be controlled using rock construction entrances on access roads that begin at a junction with paved roads.
- When environmental conditions are dry, inspection of dust control measures will be conducted daily.

Operational Emissions

Emissions from operating the equipment at the new Bradshaw, Harris, and Stallworth Compressor Stations are a result of combustion of natural gas of the turbines at the stations. The main emission sources at each compressor station are the natural gas turbines and the microturbines. Emissions of all pollutants have been minimized through the selection of the most efficient turbines. Larger turbines, with greater hp output, are more efficient. More efficient models use less fuel and produce fewer emissions for the same hp output. The new compressor stations will utilize the largest most efficient turbines that meet the pipeline operational requirements. The microturbines that will be installed as part of the Project have very low emissions compared to viable alternatives such as reciprocating internal combustion engines. For example, assuming consistent year-round operations would result in NO_X emissions of 0.35 tpy from each microturbine.

For the natural gas turbine, MVP is planning to purchase and install Solar turbines at the three compressor stations which are equipped with SoLoNOx, Solar's emission reduction technology. SoLoNOx is a lean pre-mixed technology that controls the air to fuel ratio and the temperature of the flame to reduce NO_X emissions without significantly increasing CO. As noted in section 9.1.4.3, the manufacturer's guaranteed NO_X emissions of 15 ppm are below the 25 ppm limit of NSPS Subpart KKKK. Further, MVP will mitigate these emissions through the development and implementation of an Operation and Maintenance Plan that is in line with the manufacturer's recommendations for good combustion practices. Proper operation and preventative maintenance activities will ensure that emissions from the turbines will be minimized and continue to meet the emission standards.

MVP has also performed a complete air dispersion modeling analysis as presented in Appendix 9-D through 9-F to ensure that the concentration levels from the emission sources at the compressor stations will not exceed the NAAQS levels. Per a data request from FERC, MVP has also reviewed recent natural gas-related permit applications submitted to the West Virginia Department of Environmental Protection, Division of Air Quality for the three counties where the stationary sources will be located. Table 9.1-14 presents the list of the projects and the expected level of criteria pollutants from each. Based on this review, the projects proposed in these three counties are all minor in nature. As no major project or major modification has been proposed in the vicinity of the Project, no negative cumulative impact is expected from these other emission sources.

Climate Change and Greenhouse Gases

Construction activities will result in temporary increases in GHG emissions due to the use of non-stationary equipment powered by diesel fuel or gasoline engines and indirect emissions attributable to workers commuting to and from work sites during construction. These sources are not considered stationary sources and their impacts will generally be temporary and localized. MVP will, to the extent practical, employ good management practices to limit these emissions.

With respect to operational emissions, EPA has not published formal white papers for different industries to discuss available GHG control technologies. In permitting guidance, EPA agrees that energy efficiency improvements will satisfy the control requirements for GHGs in most cases. As such, operational GHG emissions would be expected to be limited to the use of energy efficient design and the minimization of GHG releases through good work practices for the natural gas industry. The use of the combustion turbines represents one element of the Project's energy efficient design.

Fugitive GHG (and to a lesser extent, VOC) leaks will be minimized by adhering to good operating and maintenance practices. MVP believes the Project is designed to reduce GHG emissions where technically and economically feasible. In addition, MVP has reviewed EPA's voluntary Natural Gas Star program for potential emission reduction measures, and Table 9.1-15 summarizes the feasibility of various measures for the Project. Total site-wide VOC and GHG emissions from fugitive and blowdown sources are estimated to be low. Therefore, any additional emission reduction will not be cost effective due to the minimal emission reductions achieved.

Through the use of good management practices and energy efficient design, MVP has employed measures to minimize GHG emissions and any resulting impact on climate change.

Table 9.1-14

Reasonably Foreseeable Projects Planned in the Vicinity of the MVP Stations

County	Facility	Owner/Operator	Permit Type	Application Summary	Location (UTM)	Approximate Distance to closest MVP Station (miles)	Emission Increase
Braxton	Burnsville	Equitrans, L.P.	R13	Flare modification	529.40 E, 4,301.40 N	12.90	No increase in emissions
Braxton	Burnsville	Equitrans, L.P.	G60	Emergency Generator Replacement	529.40 E, 4,301.40 N	12.90	No increase in emissions. Permit issued August 2015
Doddridge	Janus Compressor Station	EQT Gathering, LLC	R13	New Compressor Station	516.767 E, 4,345.40 N	9.98	<100 tpy for all pollutants but NOx
Doddridge	Pandora Compressor Station	EQT Gathering, LLC	R13	New Compressor Station	525.316 E, 4357.156 N	13.42	< 100 tpy for all pollutants Permit issued November 2013
Fayette	Armstrong Creek	EQT Gathering, LLC	R13	After-the-fact application	472.84 E, 4,214.26 N	33.38	No increase in emissions. Permit issued May 2015
Fayette	Pocahontas Station	EQT Gathering, LLC	G30	After-the-fact application	480.47 E, 4,217.22 N	30.18	No increase in emissions. Permit issued June 2015
Wetzel	Long 408/409	American Energy – Marcellus, LLC	G70	General permit – modified well pad	527.792 E, 4,381.585 N	8.43	< 50 tpy for all pollutants
Wetzel	Mary Miller	American Energy – Marcellus, LLC	G70	General permit – new well pad	533.057 E, 4,384.756 N	7.08	< 30 tpy for all pollutants
Wetzel	WJ Criswell 405	American Energy – Marcellus, LLC	G70	General permit – new well pad	532.769 E, 4,384.25 N	6.84	< 20 tpy for all pollutants
Wetzel	Smithfield	Columbia Gas Transmission	R13	Turbine Installation	539.68 E, 4,370.03 N	3.70	< 50 tpy for all pollutants
Wetzel	Hastings Compressor Station	Dominion Transmission	R13	Dehydration Unit Replacement	528.64 E, 4,377.66 N	7.57	No increase in emissions
Wetzel	Corona Station	Equitrans, L.P.	R13	New compressor station	542.78 E, 4,377.20 N	1.83	< 50 tpy for all pollutants
Wetzel	BIG-57	EQT Production Company	G70	General permit – modified well pad	540.606 E, 4,378.265 N	1.43	< 50 tpy for all pollutants
Wetzel	BIG-367	EQT Production Company	G70	General permit – new well pad	536.095 E, 4,378.630 N	2.99	< 30 tpy for all pollutants

Table 9.1-14

Reasonably Foreseeable Projects Planned in the Vicinity of the MVP Stations

County	Facility	Owner/Operator	Permit Type	Application Summary	Location (UTM)	Approximate Distance to closest MVP Station (miles)	Emission Increase
Wetzel	PNG-103	EQT Production Company	G70	General permit – modified well pad	532.1 E, 4,380 N	5.47	< 100 tpy for all pollutants
Wetzel	Mobley Gas Plant	MarkWest Liberty Midstream	R13	Gas processing expansions	538.098 E 4,378.315 N	1.90	< 20 tpy for all pollutants
Wetzel	Howell Wellpad	Stone Energy Corporation	R13	Install emergency engine	517.66 E, 4,382.93 N	14.58	< 30 tpy for all pollutants
Wetzel	Lemons	Stone Energy Corporation	R13	After-the-fact application	517.69 E, 4,389.05 N	16.13	No increase in emissions
Wetzel	Maury Wellpad	Stone Energy Corporation	R13	After-the-fact application	518.67 E, 4,385.44 N	14.58	No increase in emissions
Wetzel	Mills Wetzel Pad 3	Stone Energy Corporation	R13	Under Review	528.04 E, 4,375.38 N	7.54	Under Review
Wetzel	Potts Wellpad	Stone Energy Corporation	R13	After-the-fact application	515.88 E, 4,391.86 N	18.00	No increase in emissions
Wetzel	Weekley	Stone Energy Corporation	R13	After-the-fact application	519.04 E, 4,382.45 N	13.72	No increase in emissions
Wetzel	Wilson	Stone Energy Corporation	R13	After-the-fact application	516.46 E, 4,392.19 N	17.86	No increase in emissions
Wetzel	Winters Station	Stone Energy Corporation	R13	Administrative updates	516.14 E, 4,389.06 N	17.04	No increase in emissions
Wetzel	ZMBG Wellpad	Stone Energy Corporation	R13	New wellpad	515.39 E, 4,387.95 N	16.99	< 50 tpy for all pollutants
Wetzel	Ridgetop Land Wellpad	SWN Production Company	G70	General permit – new well pad	528.013 E, 4,390.14 N	11.55	< 100 tpy for all pollutants
Wetzel	WVDNR Pad 6	Triad Hunter LLC	G70	General permit – new well pad	529.45 E, 4,372.90 N	6.89	< 100 tpy for all pollutants
Wetzel	Anderson Dehy Station	Williams Ohio Valley Midstream LLC	R13	New dehydration facility	533.49 E, 4,367.61 N	6.63	< 100 tpy for all pollutants
Wetzel	Yoho Station	Williams Ohio Valley Midstream LLC	R13	Modification to existing dehydration unit	514.86 E, 4,383.33 N	16.42	< 40 tpy for all pollutants

Table 9.1-15 Summary of Natural Gas Star Program	
Energy Star Project[4]	**Feasibility Assessment**
Replace Gas Starters with Air or Nitrogen	Feasible – Gas starters may be replaced with air.
Reduce Natural Gas Venting with Fewer Compressor Engine Startups and Improved Engine Ignition	Feasible – Turbines are intended to operate at all times other than preventative maintenance shutdowns. MVP's preventative maintenance program will reduce starts related to unanticipated shutdown/repairs.
Reducing Methane Emissions from Compressor Rod Packing Systems	Not feasible – This reduction strategy is applicable to older compressors with potentially worn packing. Compressors are equipped with newly installed packing by design. MVP will follow the manufacturer's recommended procedures for proper maintenance and inspection of compressor rod packing systems.
Test and Repair Pressure Safety Valves	Feasible - Completed by MVP on periodic basis.
Eliminate Unnecessary Equipment and/or Systems	MVP will only be installing what is required for this application.
Install Automated Air/Fuel Ratio Controls	Feasible – Turbines will be equipped with state-of-the art AFR (air-to-fuel-ratio) controllers/SoLoNOX technology.
Install Electric Motor Starters	The turbines are intended to operate at all times therefore the number of starts is minimized and the potential methane reductions would be minimal. Nonetheless, current design includes electric motor starts.
Reducing Emissions When Taking Compressors Off-Line	Feasible - Blowdown gas may be injected into the fuel gas recovery system. However, the proposed facility is a gathering facility that is expected to operate at or near 100% capacity year round. Shutdown events are expected to be very infrequent, and the current design of the station does not allow for recycling of turbine blowdowns.
Replace Compressor Cylinder Unloaders	Not Applicable.
Install Electric Compressors	Not Feasible - Electric compressors are cost prohibitive even if electric supply is available. As stated in the NG Star fact sheet "The capital costs and the electricity costs, however, are higher for an electric motor compared to those for a gas driven engine. The savings from maintenance costs relative to the cost of energy will not be justified unless the engine is at the end of its economic life."
Wet Seal Degassing Recovery System for Centrifugal Compressors	Turbine centrifugal compressors will be dry seal.

Loss of Carbon Sequestration Capacity from Forest Clearing

Several public and agency comments on draft Resource Report 9 requested that the impact of clearing forest for the project be assessed with regard to GHG and climate change. It is estimated that approximately 4,772 acres of forest will be cleared along the pipeline right-of-way. The permanent right-of-way area will be kept clear of trees for the lifetime of the Pipeline, and will be planted with grass that will be periodically maintained. Mature forests store organic carbon, which was originally absorbed from the atmosphere as CO_2, in several forms: aboveground and belowground biomass (live trees and their root systems); dead wood; leaf litter on the forest floor; and organic carbon contained in the soil. In addition, forests add to their accumulated stored carbon each year as they continue to absorb CO_2 from the atmosphere.

[4] http://epa.gov/gasstar/tools/recommended.html#compressors

An EPA report, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010" (EPA, 2012), estimates that as of 2011, U.S. forests on average store about 150 metric tons of carbon per hectare (equivalent to about 223 metric tons of CO_2 per acre). This EPA report also estimates that U.S. forests have an average annual increase in total stored carbon of about 0.43 metric tons of carbon per hectare (equivalent to about 0.63 metric tons of CO_2 per acre). In order to estimate the release of sequestered carbon from the 4,772 acres of forest to be cleared for the Project, as well as the loss of future sequestration capacity from the cleared areas, the following conservative assumptions were made:

- Forest clearance would remove all biomass, dead wood, and leaf litter, but would leave the soil organic carbon. The 2012 EPA report estimates the average non-soil carbon content of U.S. forests to be about 88.5 metric tons of carbon per hectare (131.3 metric tons of CO_2 per acre).
- Forest clearance would also result in losing the future carbon sequestration capacity of the trees removed.
- The replacement grasses grown on the right-of-way would not store or accumulate any atmospheric CO_2. In reality, grasses grown on the right-of-way will sequester a moderate amount of carbon each year, as dead leaf litter accumulates.
- Finally, it is conservatively assumed that all of the forest material cleared would release its carbon immediately back into the atmosphere, such as would occur if the wood were burned. In reality, a large portion of the timber removed is expected to be incorporated into durable goods such as lumber used for construction of buildings, where it will remain in a sequestered form for many decades on average.

Given these assumptions, the clearance of 4,772 acres of forest for the Project right-of-way is estimated to result in a one-time release of 626,468 metric tons of CO_2, plus an additional loss of 3,009 metric tons per year of CO_2 sequestration capacity.

9.1.7 Energy Efficiency and Waste Heat Recovery

In light of the FERC interest in integrating alternative environmentally-friendly measures, MVP reviewed the commercial and technical viability of installing and operating waste heat recovery facilities on its system. Waste heat to power is the process of capturing heat discarded by an existing industrial process and using that heat to generate power. MVP has determined that it is not technical or economically feasible at this time to install heat recovery systems to the proposed compressor exhaust stacks and convert the waste heat into electric power without additional environmental impacts. MVP researched the total costs associated with designing, permitting, constructing, and operating and maintaining a waste heat recovery system at each of the proposed compressor stations and compared these costs to the value of the estimated electric power that could be generated and sold back to the local utility. Power is generated through the conversion of water to steam in order to spin a turbine for electric generation. The remote nature of the compressor stations prohibits necessary access to water necessary for the steam generation. Lack of nearby power distribution systems, large or small, prohibits the benefit of generating excess capacity to supplement the electric grid generated power. The comparison resulted in waste heat recovery generating costs substantially greater than the power sales cost estimate. Accordingly, it is not economically feasible to install waste heat recovery systems at any of the proposed compressor stations. However, even though MVP is not proposing the installation of any waste heat facilities at this time, MVP will not preclude the installation of waste heat recovery facilities on its systems as conditions may change over time.

9.1.8 Impacts on National Forest System Lands

MVP will cross approximately 3.4 miles of the Jefferson National Forest (JNF) where it crosses Peters Mountain between MPs 195.3 and 196.9 (1.6 miles), Sinking Creek Mountain between MPs 217.2 and 218.0 (0.8 mile), and Brush Mountain between MPs 218.4 and 219.4 (1.0 mile). No compressor stations are proposed within the JNF, and air quality impacts will be temporary and limited to pipeline construction. Air quality impacts from pipeline construction within JNF will be identical to that described above, except as may be specified for National Forest System lands under the terms and conditions included with a Right-of-Way Grant.

The JNF is managed under the 2004 Revised Land and Resource Management Plan (Forest Plan), which includes specific goals, objectives, and standards related to resources. The Forest Plan includes one standard specific to air quality (FW-11). MVP has prepared a Forest Plan Consistency analysis for the portion of the proposed MVP Project that crosses the JNF. Results of that consistency analysis is included in Appendix 8-F of Resource Report 8.

9.2 Noise

This section provides an overview of the proposed noise generating equipment for the Project, the noise study approach for each compressor station, a discussion of typical noise mitigation methods for this type of equipment, and noise associated with construction. Environmental noise will be generated during construction and operation of the compressor stations associated with the Project. There will also be construction noise associated with the meter stations and the pipeline, although noise during construction is not typically an issue for these sources.

9.2.1 Background Information on Sound and Noise

A sound source is defined by a sound power level (L_W), which is the rate at which acoustical energy is radiated outward and is expressed in units of watts (W). A sound pressure level (L_P) is a measure of this fluctuation at a given receiver location and can be obtained through the use of a microphone or calculated from information about the source sound power level and the surrounding environment. Sound power cannot be measured directly, but rather calculated from measurements of sound intensity or sound pressure at a given distance from the source. The perception of sound as "noise" is influenced by several technical factors such as intensity, sound quality, tonality, duration, and existing background levels. Sound levels are presented on a logarithmic scale to account for the large range of acoustic pressures that the human ear is exposed to and are expressed in units of decibels (dB). Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum is used to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves, and typically the frequency analysis examines 11 octave (or 33 1/3 octave) bands ranging from 16 Hz (low) to 16,000 Hz (high). One-third (1/3) octave bands take these 11 octave bands and split them into three, giving a higher resolution and a more detailed description of the frequency content of the sound. Because the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter.

The A-weighted filter is applied to compensate for the frequency response of the human auditory system and sound exposure in acoustic assessments and is designated in A-weighted decibels (dBA). Environmental noise is commonly described in terms of equivalent sound level (L_{eq}). The L_{eq} value,

conventionally expressed in dBA, is the energy-averaged, A-weighted sound level for the complete time period represented as a steady, continuous sound level. Another common noise descriptor used when assessing environmental noise is the day-night sound level (L_{dn}), which is calculated by averaging the 24-hour hourly L_{eq} levels at a given location and adding 10 dB to noise emitted during the nighttime period (10:00 p.m. to 7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. The L_{max} is the maximum instantaneous sound level as measured during a specified time period. It can also be used to quantify the time-varying maximum instantaneous sound pressure level (as generated by equipment or an activity) or a manufacturer maximum source emission level. Estimates of common noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Figure 9.2-1.

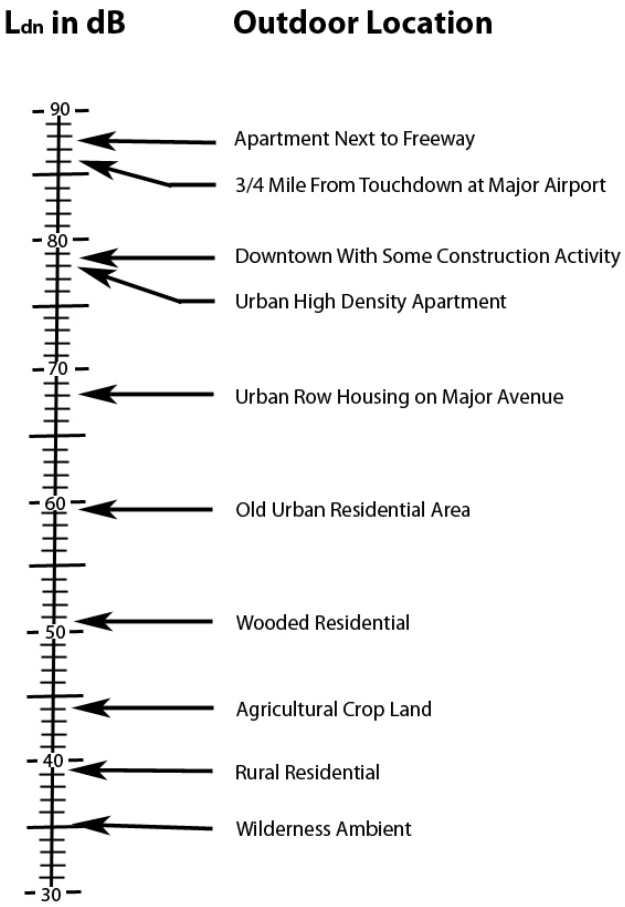

Figure 9.2-1. Sound Pressure Levels (Lp)

9.2.2 Applicable Noise Regulations

The Project is located in West Virginia and Virginia and crosses portions of 17 counties. MVP reviewed noise regulations at the federal, state, county, and local levels to identify possible regulations that are applicable to the Project. There are no state noise standards applicable to the Project; however, there are

some federal requirements and county noise regulations that are applicable to the Project, as described in sections 9.2.2.1 and 9.2.2.2, respectively.

9.2.2.1 FERC Requirements

The FERC's noise regulations, set forth in 18 CFR §380.12(k)(2), require an applicant to identify existing noise sensitive areas (NSAs) (e.g., residences, schools, churches) and quantitatively describe existing sound levels at NSAs and at other areas covered by relevant state and local noise ordinances. The following stipulations are given:

- If new compressor station sites are proposed, measure or estimate the existing ambient sound environment based on current land uses and activities;
- For existing compressor stations (operated at full load), include the results of a sound level survey at the site property line and nearby NSAs;
- Include a plot plan that identifies the locations and duration of noise measurements; and
- All surveys must identify the time of day, weather conditions, wind speed and direction, engine load and other noise sources present during each measurement.

In addition, the FERC's requirement for noise quality, in the absence of any applicable state or local noise regulation, is that the noise attributable to any new compressor station and associated pipeline facilities must not exceed an L_{dn} of 55 dBA at any pre-existing NSA such as schools, hospitals, or residences. This criterion limits the sound level contribution from the Project at any pre-existing NSA to 55 dBA (L_{dn}). An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA L_{eq} for facilities that operate at a constant level of noise.

9.2.2.2 County Limits

Four of the counties that are crossed by the Project prescribe noise level limits that may be applicable to the Project. Table 9.2-1 provides a summary of these limits. These county limits apply at the receiving property line, rather than at the NSA structure, so they cannot be directly compared to FERC's sound level requirements. The Stallworth Compressor Station is located in Fayette County, West Virginia, and the sound levels from that station have been evaluated against both the FERC and the county sound level requirements.

Table 9.2-1

Noise Level Limits for Counties with Noise Regulations Crossed by the Project

County	Daytime	Nighttime
Fayette County, West Virginia	65 dBA L_{eq} (7AM – 6PM)	55 dBA L_{eq} (6PM – 7AM)
Franklin County, Virginia	67 dBA L_{eq} (7AM – 10PM)	62 dBA L_{eq} (10PM – 7AM)
Montgomery County, Virginia	57 dBA L_{eq} (7AM – 10PM)	52 dBA L_{eq} (10PM – 7AM)
Pittsylvania County, Virginia	57 dBA L_{eq} (7AM – 10PM)	52 dBA L_{eq} (10PM – 7AM)

9.2.3 Existing Sound Environment

9.2.3.1 Compressor Stations

The existing sound environment surrounding each proposed compressor station has been quantified during a baseline environmental sound level survey in the vicinity of each proposed station. Sound levels were measured at accessible locations near the NSAs at each proposed station site. Observations of the primary existing environmental sound sources were documented.

Type 1 sound level instrumentation was used, with field calibration before and after each measurement. Windscreens were installed on all microphones. All instrumentation has current laboratory certification. Weather conditions during each survey were recorded, and the measurements were taken during weather periods appropriate for environmental sound level surveys.

Bradshaw Compressor Station

A baseline sound level survey was conducted in the vicinity of the proposed Bradshaw Compressor Station in Wetzel County, West Virginia. The area surrounding the proposed site is primarily comprised of hilly wooded areas with a mix of undeveloped land and residential land uses. Audible sound sources in the area included local traffic, birds, and a nearby stream.

Five NSAs (all residences) were identified near the site. The existing environmental sound levels were monitored at three locations representative of the acoustical environment at the NSAs for about 23 hours, including daytime and nighttime periods. NSAs 1, 2, and 3 are located just off the same local road, and are approximately the same distance from the dominant environmental noise sources in the area.

The baseline measurements show that the existing average ambient sound levels in the area ranged from 42.6 to 45.8 dBA L_{dn}. This is relatively quiet and typical for a rural environment removed from main traffic arteries.

The NSAs and their approximate distances from the proposed compressor building are shown in Appendix 9-G. The sound level measurement locations are also shown on figures in Appendix 9-G.

Equipment used during the sound level survey consisted of the following:

- Larson Davis Model 824 Sound Level Monitor, Serial Numbers A0335, A0424, and A0975
- Larson Davis Model CAL200 Calibrator, Serial Number 7078

Table 9.2-2 shows the weather conditions at the start of the environmental sound level survey.

Table 9.2-2

Weather Conditions during the Bradshaw Compressor Station Sound Level Survey

Dates	May 20 – 21, 2015
Temperature Range	49°F – 58ºF
Relative Humidity Range	55% – 59%
Wind Speed	0 – 5 mph
Wind From	WSW
Precipitation	Intermittent rain at night

Table 9.2-3 shows the measured daytime and nighttime sound levels (L_{eq}, dBA) as well as the equivalent day-night sound levels (L_{dn}, dBA). The measured sound level results at all measurement locations were quite similar, indicating that the sound environment around the proposed station site is uniform.

Table 9.2-3

Existing Sound Level Measurement Results – Bradshaw Compressor Station

Monitoring Location	Measurement Duration[1]	Measured Day Average	Measured Night Average	Measured Day-Night Average
	HH:MM	L_{eq} dBA	L_{eq} dBA	L_{dn} dBA
NSA 1	23:00	43.6	30.2	**42.6**
NSA 2				
NSA 3				
NSA 4	22:15	44.0	34.2	**44.1**
NSA 5	22:45	46.4	34.6	**45.8**

Harris Compressor Station

A baseline sound level survey was conducted in the vicinity of the proposed Harris Compressor Station in Braxton County, West Virginia. The area surrounding the proposed site is rural and sparsely populated, consisting primarily of undeveloped deciduous forests with some residential land uses. Audible sound sources in the area included local traffic, birds, and distant aircraft.

Four NSAs (all residences) were identified near the site. The existing environmental sound levels were monitored at three locations representative of the acoustical environment at the NSAs for about 30 hours, including daytime and nighttime periods. NSAs 2 and 3 are located close together, and are a similar distance from local access roads, so the sound levels at these two NSAs were characterized using a single measurement point.

The baseline measurements show that the existing average ambient sound levels in the area ranged from 47.9 to 55.3 dBA Ldn. This is quiet, and typical for a rural environment close to rural roads with small traffic volumes.

The NSAs and their approximate distances from the proposed compressor building are shown in Appendix 9-H. The sound level measurement locations are also shown on figures in Appendix 9-H.

Equipment used during the sound level survey consisted of the following:

- Larson Davis Model 824 Sound Level Monitor, Serial Numbers A0424, and A0975
- Larson Davis Model CAL200 Calibrator, Serial Number 7078

Table 9.2-4 shows the weather conditions at the start of the environmental sound level survey.

Table 9.2-4 Weather Conditions during the Harris Compressor Station Sound Level Survey	
Dates	May 18 – 23, 2015
Temperature Range	54°F – 78ºF
Relative Humidity Range	46% – 60%
Wind Speed	5 mph
Wind From	West and South
Precipitation	Intermittent rain at night

Table 9.2-5 shows the measured daytime and nighttime sound levels (L_{eq}, dBA) as well as the equivalent day-night sound levels (L_{dn}, dBA). The measured sound level results at all measurement locations were quite similar, indicating that the sound environment around the proposed station site is uniform.

Table 9.2-5

Existing Sound Level Measurement Results – Harris Compressor Station

Monitoring Location	Measurement Duration[1]	Measured Day Average	Measured Night Average	Measured Day-Night Average
	HH:MM	L_{eq} dBA	L_{eq} dBA	L_{dn} dBA
NSA 1	30:30	47.9	38.0	**47.9**
NSA 2	27:45	48.7	38.2	**48.5**
NSA 3				
NSA 4	30:00	53.1	47.4	**55.3**

Stallworth Compressor Station

A baseline sound level survey was conducted in the vicinity of the proposed Stallworth Compressor Station in Fayette County, West Virginia. The area surrounding the proposed site is rural and sparsely populated, consisting primarily of undeveloped deciduous forests with some residential land uses. Audible sound sources in the area included local traffic, distant construction, birds, and distant aircraft.

Six NSAs (all residences) were identified near the site. The existing environmental sound levels were monitored at five locations representative of the acoustical environment at the NSAs for more than 63 hours, including daytime and nighttime periods, at NSAs 1, 3, and 5. Sound levels at NSAs 2 and 4 were characterized using 15 minute or longer handheld sound level measurements. NSAs 5 and 6 are located a similar distance from local access roads, so the sound levels at these two NSAs were characterized using a single measurement point.

The baseline measurements show that existing average ambient sound levels in the area ranged from 35.8 to 54.9 dBA L_{dn}. This is very quiet, and typical for a rural environment removed from main traffic arteries.

The NSAs and their approximate distances from the proposed compressor building are shown in in Appendix 9-I. The sound level measurement locations are also shown on the figures in Appendix 9-I.

Equipment used during the sound level survey consisted of the following:

- Larson Davis Model 824 Sound Level Monitor, Serial Numbers A0335, A0424, and A0975
- Larson Davis Model CAL200 Calibrator, Serial Number 7078

Table 9.2-6 shows the weather conditions at the start of the environmental sound level survey.

Table 9.2-6

Weather Conditions during the Stallworth Compressor Station Sound Level Survey

Dates	April 28 – May 4, 2015
Temperature Range	47 – 61 °F
Relative Humidity Range	45 – 64%
Wind Speed	0 – 5 mph, gusting to 10 mph
Wind From	NE, NW
Precipitation	None

Table 9.2-7 shows the measured daytime and nighttime sound levels (L_{eq}, dBA) as well as the equivalent day-night sound levels (L_{dn}, dBA). The measured sound level results at all measurement locations were quite similar, indicating that the sound environment around the proposed station site is uniform.

Table 9.2-7

Existing Sound Level Measurement Results – Stallworth Compressor Station

Monitoring Location	Measurement Duration[1]	Measured Day Average	Measured Night Average	Measured Day-Night Average
	HH:MM	L_{eq} dBA	L_{eq} dBA	L_{dn} dBA
NSA 1	71:00	54.2	45.9	**54.9**
NSA 2	00:15	37.8	31.6	**39.6**
NSA 3	63:00	42.2	37.3	**44.9**
NSA 4	00:17	34.7	27.8	**35.8**
NSA 5	65:00	51.9	46.3	**54.1**
NSA 6				

9.2.3.2 HDD Sites

MVP is not proposing to install any segments of pipeline using HDD. Therefore, there was no quantification of existing sound environment related to HDD sites, and there will be no construction noise associated with HDD.

9.2.4 Project Construction Noise

9.2.4.1 Pipeline Construction Noise and Mitigation

Potential impacts from pipeline construction could include short-term increases in sound during construction. Construction of the pipeline will generate noise from heavy machinery and equipment as construction moves in phases along the right-of-way (see Resource Report 1 for description of pipeline construction). Sound from pipeline construction will generally be temporary, sporadic, and short-term in

any one location along the pipeline route. Because of the temporary and generally daytime-only nature of pipeline construction activities, no special noise mitigation or noise monitoring program will be implemented during the construction phase.

9.2.4.2 Compressor Station Construction Noise and Mitigation

Potential impacts from the Project could include short-term increases in sound levels during construction of the compressor stations. Only standard construction equipment will be used in the construction of the Project compressor stations, with no dynamic compaction or pile driving expected. Most construction will take place during daytime working hours of 7:00 a.m. until 7:00 p.m. Emergencies or other non-typical circumstances may necessitate limited nighttime work. The highest sound levels during construction are expected during the early earthmoving phase. Equipment that may be operating during this phase would include bulldozers, front end loaders, dump trucks, generators, etc. Based on the equipment usage predictions, a sound level calculation was performed using the Federal Highway Administration's Roadway Construction Noise Model (RCNM) version 1.0. Two bulldozers, two dump trucks, one generator, one front end loader, two excavators, one light plant, and a drill rig were included in the calculation. Based on this collection of equipment, the predicted maximum short-term sound level during construction was calculated for each of the three compressor stations. Table 9.2-8 shows a summary of the predicted short-term sound levels at the worst-case NSAs for each of the three compressor stations. The worst-case NSAs are not necessarily the closest NSAs due to terrain shielding between the stations and NSAs.

Based on the predicted construction sound levels in Table 9.2-8 and the temporary and generally daytime-only nature of the construction activities, no special noise mitigation or noise monitoring program will be implemented during the construction phase.

Table 9.2-8

Predicted Temporary Sound Levels Due to Construction

Compressor Station	Worst Case NSA	Predicted Sound Level (dBA L_{eq})
Bradshaw	NSA 5	50.1
Harris	NSA 3	53.7
Stallworth	NSA 5	42.0

9.2.5 Project Operation Noise

9.2.5.1 Compressor Station Operational Noise and Mitigation

MVP has developed noise models for the Bradshaw, Harris, and Stallworth Compressor Stations using the most current station designs and manufactures' specifications.

The following equipment items were considered significant sound sources in the model:

- Noise from the turbine exhaust, including the exhaust outlet and noise radiated from the exhaust ductwork, expansion joints, and silencer shell;
- Noise from the turbine intake air system, including the inlet opening and noise radiated from the silencer/ductwork shell and any duct joints;
- Turbine/Compressor casing noise that penetrates the building and building ventilation openings;

- Noise from the lube oil/auxiliary cooler and gas aftercooler; and
- Noise radiated by aboveground station piping.

Noise Model Methodology

The noise model for each compressor station was developed using CadnaA, version 4.5.151, a commercial noise modeling package developed by DataKustik GmbH. The software takes into account spreading losses, ground and atmospheric effects, shielding from barriers and buildings, reflections from surfaces and other sound propagation properties. The software is based on published engineering standards. The ISO 9613 standard was used for air absorption and other noise propagation calculations.

To be conservative, no foliage was included in the noise model. The model presents a worst-case prediction without any influence of trees or vegetation.

Noise Model Inputs

Sound power and sound pressure level data for the equipment in the noise model were taken from manufacturer data (if available) or from measurements of similar equipment at other compressor stations. An exhaust system consistent with the planned turbine installations and current vendor proposals for MVP was modeled assuming an exhaust height of 50 feet above grade. The Bradshaw Compressor Station was modeled with four 22,400 horsepower Titan 130E turbines. The Harris and Stallworth Compressor Stations were each modeled with two 20,500 horsepower Titan 130 turbines.

Table 9.2-9 shows the sound pressure levels and sound power levels used to model the Project compressor station equipment along with the source of the information.

Table 9.2-9

Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Solar Titan 130E Exhaust and Ductwork, Sound Pressure Level with Silencer at 50 ft., L_p a/ (Bradshaw Compressor Station)	90	87	70	63	62	54	53	44	46	65
Solar Titan 130 Exhaust and Ductwork, Sound Pressure Level with Silencer at 50 ft., L_p a/ (Harris and Stallworth Compressor Stations)	84	86	72	63	63	54	46	32	21	65
Solar Titan 130 Intake and Ductwork, Sound Pressure Level at 50 ft., L_p a/	82	86	76	68	42	9	8	35	26	65
Solar 90 dBA Lube Oil Cooler, Sound Pressure Level at 50 ft., L_p a/	64	71	68	61	56	53	49	45	39	60
Total Sound Power Level of Gas Aftercooler, L_w b/	103	103	102	99	94	92	86	80	74	97
Sound Level in Compressor Building at Inner Wall Surface, L_p c/(Bradshaw Compressor Station)	84	84	95	99	97	96	98	106	97	109
Sound Level in Compressor Building at Inner Wall Surface, L_p c/ (Harris and Stallworth Compressor Stations)	84	84	95	98	97	96	98	106	97	108
Suction Piping, Total L_w c/ (Bradshaw Compressor Station)	94	96	95	90	91	96	111	100	90	113
Suction Piping, Total L_w c/ (Harris and Stallworth Compressor Stations)	94	96	95	90	91	96	111	100	90	112

Table 9.2-9

Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Discharge Piping, Total L_w c/ (Bradshaw Compressor Station)	96	92	92	98	103	96	108	100	89	110
Discharge Piping, Total L_w c/ (Harris and Stallworth Compressor Stations)	95	91	91	97	102	95	107	99	88	110
42" Building Wall Panel Fan, L_w	97	97	101	97	96	96	93	88	81	100
Throat Ridge Ventilator, Total L_w	111	106	103	98	97	94	93	96	92	102

a/ From Solar.
b/ From Moore Fan Datasheet for MVP, adjusted to a total sound power level of 97 dBA.
c/ Based on measurements of similar installed equipment, adjusted for horsepower increase.

Each compressor building will include wall intakes and a throat ridge ventilator along the roof. The sound levels due to intake ductwork, exhaust system ductwork, and suction and discharge piping were based on sound level measurements of a Mars 100 turbine-driven compressor at an existing compressor station. These levels were scaled up based upon the horsepower of the Titan 130E turbine for Bradshaw Compressor Station and the Titan 130 turbines for Harris Compressor Station and Stallworth Compressor Station.

The gas cooler sound power levels were taken from a manufacturer datasheet and adjusted to a total sound power level of 97 dBA as per the project specification for the gas coolers. The lube oil cooler sound power levels were supplied by Solar and correspond to their 90 dBA lube-oil cooler.

Noise Control Treatments

The noise models include certain noise control treatments as part of each compressor station design. However, there are many different combinations of noise control mitigation measures that would provide similar noise control. As the station designs are finalized, noise mitigation treatments will also be finalized and will be modified as needed to ensure each station operates in compliance with FERC and local sound level requirements. Noise control treatments included in the noise model are shown in Table 9.2-10 and summarized below.

Table 9.2-10

Modeled Noise Control Treatments, Insertion Loss (IL) or Transmission Loss (TL)

Source	Treatment Description	Modeled Treatment Performance								
		31.5	63	125	250	500	1k	2k	4k	8k
Compressor/Valve Building	STC-39 Wall and Roof System, TL	10	16	17	24	44	49	55	55	58
Equipment Door	STC-21 Insulated Roll-up Door, TL	2	7	12	17	18	19	22	30	35
Building Ventilation	Three foot silencers and lined hoods, IL	1	5	10	18	22	26	30	35	25
Comp. Suction and Discharge Piping	Lagging (ISO Type B2), IL	0	0	0	0	6	15	24	33	42

Compressor Building Walls and Roof

The compressor building will include a minimum STC-39 wall and roof system. The compressor buildings will have no windows, skylights, or translucent panels. The building will be well sealed with no cracks or gaps, and that all piping penetrations through the building walls will be acoustically insulated, flashed, and caulked. The interior surfaces of the compressor building walls have been modeled as acoustically absorptive, with an average Noise Reduction Coefficient of 0.8 or better.

Compressor Building Doors and Ventilation

The compressor building will have standard insulated overhead doors and industrial metal doors with good perimeter seals, all meeting defined acoustic transmission loss specifications. All building ventilation openings should include standard acoustical louvers or silencers to meet the project requirements.

Turbine Exhaust Silencers and Breakout

Solar has warranted that the sound pressure level of the entire exhaust system at a distance of 50 feet from the exhaust will not exceed 65 dBA. The breakout noise generated by the exhaust system ductwork was included at this level and is warranted by Solar for both the Titan 130 and the Titan 130E systems.

Turbine Intake Silencers and Breakout

The sound pressure level of the intake system was warranted by Solar to not exceed 65 dBA at 50 feet from the air inlet. This level includes the performance of the entire system, including any filter insertion losses and breakout noise.

Station Piping

Noise from centrifugal compressors can cause significant noise radiation from connected piping. To the extent practical, suction and discharge piping will be run underground. Above ground main gas piping will be acoustically lagged as necessary.

Noise Modeling Results

The predicted sound levels from the acoustic modeling for the Bradshaw, Harris and Stallworth Compressor Stations are shown in figures attached included in Appendices 9-G, 9-H, and 9-I. Predicted noise impacts on the nearest NSAs to each station are presented in Tables 9.2-11 through 9.2-13. Site locations, layouts, and modeled equipment were determined from best available information and incorporated site specific sound mitigation measures for these compressor stations such as acoustical building enclosures, turbine intake and exhaust silencers.

Table 9.2-11

Predicted Sound Levels –Bradshaw Compressor Station

NSA	Distance from Compressor Station to NSA	Direction	Measured Existing Ambient	Estimated Contribution of Station Equipment		Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{eq} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	1,335	NW	42.6	33.8	40.2	44.6	2.0
2	2,135	WNW	42.6	22.8	29.2	42.8	0.2
3	3,105	WSW	42.6	17.9	24.3	42.7	0.1
4	3,030	SE	44.1	37.1	43.5	46.8	2.7
5	2,380	NE	45.8	37.7	44.1	48.0	2.3

Table 9.2-12

Predicted Sound Levels– Harris Compressor Station

NSA	Distance from Compressor Station to NSA	Direction	Measured Existing Ambient	Estimated Contribution of Station Equipment		Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{eq} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	1,445	N	47.9	33.5	39.9	48.5	0.6
2	1,825	SW	48.5	40.5	46.9	50.8	2.3
3	1,965	SSE	48.5	42.1	48.5	51.5	3.0
4	3,340	WSW	55.3	36.6	43.0	55.5	0.2

Table 9.2-13

Predicted Sound Levels –Stallworth Compressor Station

NSA	Distance from Compressor Station to NSA	Direction	Measured Existing Ambient	Estimated Contribution of Station Equipment		Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{eq} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	2,835	WNW	54.9	30.4	36.8	55.0	0.1
2	1,985	West	39.6	34.0	40.4	43.0	3.4
3	2,085	SW	44.9	34.0	40.4	46.2	1.3
4	1,465	SSW	35.8	27.2	33.6	37.8	2.0
5	1,340	SE	54.1	33.0	39.4	54.2	0.1
6	2,755	ESE	54.1	29.7	36.1	54.2	0.1

Results from the modeling show that the predicted sound level contribution of the station equipment at all of the NSAs is within the FERC noise limit of 55 dBA L_{dn}. The FERC sound level limits apply only to the sound level contribution of the compressor station equipment, and do not include the influence of the existing ambient sound levels. For instance, at NSA 4 at the Harris Compressor Station, the combined station equipment and ambient sound levels are greater than 55 dBA L_{dn} due to the 55.3 dBA L_{dn} existing ambient. However, the 43.0 dBA L_{dn} sound level contribution of the Harris Compressor Station equipment at this NSA is well below the FERC sound level limit of 55 dBA L_{dn}.

The Stallworth Compressor Station is also subject to the Fayette County, West Virginia noise ordinance, which limits noise at the receiving residential property lines to 65 dBA between 7 a.m. and 6 p.m. and 55 dBA between 6 p.m. and 7 a.m. The maximum predicted sound level due to the station at the station property line is 50.2 dBA L_{eq}. This is well below Fayette County's nighttime limit of 55 dBA. Therefore, the station is expected to operate in compliance with the county ordinance.

There are no other known state, county, or local regulations that would apply to the proposed compressor stations.

As per FERC requirements, MVP will undertake post-construction sound level testing at all three compressor stations within 60 days of the stations being placed into consistent service. The testing will consist of sound level measurements at the closest NSAs with the station equipment in full-load operation. If full-load operation is not possible, then appropriate adjustments will be applied to the measured levels to estimate the sound levels under full-load conditions. The measured levels, along with the measurement methodology, measurement equipment used, station operating and weather conditions during the testing will be included in a report that will be submitted to FERC. If the station sound level contributions are found to exceed FERC sound level limit, then the reports will include the noise mitigation or equipment modifications that will be implemented to bring the station sound level contributions to below 55 dBA L_{dn}.

9.2.5.2 Compressor Station Unit Blowdown Noise and Mitigation

Under certain circumstances, the pressure in the compressor casing and unit piping must be released in a controlled manner. These events are commonly called "blowdowns" and occur when a unit is shut down for an extended period. During the blowdown, the high pressure gas in the system is released in a controlled fashion through a blowdown silencer. Blowdown events may cause a temporary increase in sound level that usually lasts for about five minutes.

Compressor units will blow down through silencers to limit the noise during blowdown events. Compressor blowdown scenarios were modeled for the Project stations using a blowdown silencer designed to limit the maximum sound level due to a unit blowdown event to less than 75 dBA at 50 feet from each individual silencer. There are two unit blowdown silencers planned for the Bradshaw Compressor Station and one silencer each at the Harris and Stallworth Compressor Stations.

Table 9.2-14 shows a summary of the NSAs at which the compressor blowdown is predicted to be loudest for each of the three compressor stations. The worst-case NSAs are not necessarily the closest NSAs due to terrain shielding between the stations and NSAs. The unit blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term sound level impact at each station. The predicted unit blowdown sound levels are quite low, with the highest predicted sound level of 42.7 dBA at NSA 3 of the Bradshaw Compressor Station.

Table 9.2-14

Unit Blowdown Sound Level Predictions

Compressor Station	Worst Case NSA	Measured Existing Ambient, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-term Sound Level Increase During Blowdown
		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	dB
Bradshaw	NSA 5	34.6	42.7	43.3	8.7
Harris	NSA 3	38.2	42.1	43.6	5.4
Stallworth	NSA 5	46.3	37.0	46.8	0.5

9.2.5.3 Emergency Shutdown Noise and Mitigation

Each compressor station has an emergency shutdown (ESD) system that automatically halts operation of the station in the event of an irregularity. This results in a full station blowdown during which the gas

from all station piping is released in a controlled manner. These events are extremely rare and take place only in the event of an emergency or when the system is tested once every three years. The station ESD system will include a series of silencers that are designed to limit the maximum sound level due to the blowdown to 85 dBA at 50 feet from each individual silencer. There are three ESD silencers planned for the Bradshaw Compressor Station and two silencers each planned at the Harris and Stallworth Compressor Stations. Both the ESD and unit blowdown silencers would be in operation at their rated sound levels during an ESD event.

Table 9.2-15 shows a summary of the NSAs at which the station ESD blowdown is predicted to be loudest for each of the three compressor stations. The worst-case NSAs are not necessarily the closest NSAs due to terrain shielding between the stations and NSAs. The station ESD blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term night time sound level impact at each station. The predicted sound levels are all below 56 dBA, with the highest predicted sound level of 55.3 dBA at NSA 3 of the Harris Compressor Station. This is a reasonable sound level for an event that will only occur in emergency situations or once every three years for testing.

Table 9.2-15

Station ESD Blowdown Sound Level Predictions

Compressor Station	Worst Case NSA	Measured Existing Ambient, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-term Sound Level Increase During Blowdown
		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	dB
Bradshaw	NSA 5	34.6	54.7	54.7	20.1
Harris	NSA 3	38.2	55.3	55.4	17.2
Stallworth	NSA 5	46.3	49.4	51.1	4.8

9.2.6 Post Construction Sound Survey

As per FERC requirements, MVP will undertake post-construction sound level testing at all three compressor stations within 60 days of the stations being placed into constant service. The testing will consist of sound level measurements at the closest NSAs with the station equipment in full-load operation. If full-load operation is not possible, then appropriate adjustments will be applied to the measured levels to estimate the sound levels under full-load conditions. The measured levels, along with the measurement methodology, measurement equipment used, station operating and weather conditions during the testing will be included in a report that will be submitted to the Commission. If the station sound level contributions are found to exceed the Commission's sound level limits, then the reports will include the noise mitigation or equipment modifications that will be implemented to bring the station sound level contributions to below 55 dBA Ldn.

9.2.7 Additional Noise Sensitive Areas

9.2.7.1 Impacts on National Forest System Lands

MVP will cross approximately 3.4 miles of the Jefferson National Forest (JNF) where it crosses Peters Mountain between MPs 195.3 and 196.9 (1.6 miles), Sinking Creek Mountain between MPs 217.2 and

218.0 (0.8 mile), and Brush Mountain between MPs 218.4 and 219.4 (1.0 mile). No compressor stations are proposed within the JNF, and noise impacts will be temporary and limited to pipeline construction. Noise impacts from pipeline construction within JNF will be identical to that described above, except as may be specified for National Forest System lands under the terms and conditions included with the Right-of-Way Grant.

The pipeline will cross the Appalachian National Scenic Trail within the JNF, where the pipeline crosses over Peters Mountain. Noise from pipeline construction activities would be audible to hikers along the trail, however this impact would be temporary, occurring only during the day during active construction. There are no noise impacts anticipated to users of the Appalachian National Scenic Trail during operation of the pipeline.

The JNF is managed under the 2004 Revised Land and Resource Management Plan (Forest Plan), which includes specific goals, objectives, and standards related to resources. There are no standards specific to noise or acoustic impact that would apply to Project construction and operation. MVP has prepared a Forest Plan Consistency analysis for the portion of the proposed MVP Project that crosses the JNF. The results of that consistency analysis are included in Appendix 8-F of Resource Report 8.

9.2.7.2 Cranberry Wildlife Management Area

Cranberry Wildlife Management Area (WMA) is a protected area located in Nicholas, Webster, Pocahontas and Greenbrier Counties, West Virginia as well as Monongahela National Forest. The WMA is 158,147 acres and this area contains the Cranberry Wilderness Area, totaling 35,864 acres. Elevations ranging from 1,900 to 4,600 feet in mountainous terrain covered with mature hardwood forests are present. The WMA is used for hunting and fishing as well as overnight camping at Cranberry, Summit Lake, Bishop Knob, and Big Rock. Fishing is available at Summit Lake, the North and South Forks of Cherry River, Cherry River, Williams River, and Cranberry River. The WMA is managed and owned by the USFS. The pipeline does not cross the WMA property and at its closest point the boundary of the WMA would be approximately 1.9 miles from MP 109.4. Due to the separation distances, as well as the terrain and vegetation, any noise impacts in this area would minor and temporary, occurring only during construction.

9.3 References

EPA (U.S. Environmental Protection Agency). 1978. Protective Noise Levels Condensed Version of EPA Levels Document. Prepared by the U.S. Environmental Protection Agency.

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-A
Construction Emissions Calculations

Summary of Projected Construction Emissions - Criteria Pollutants
Bradshaw Compressor Station

Source	2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	90.96	107.96	6.62	16.53	12.80	12.80	25,433.39
On-Road Vehicle Travel	0.58	3.13	0.00	0.17	0.02	0.01	395.62
Off-Road Vehicle Travel	--	--	--	--	0.61	0.06	--
Earthmoving Fugitives	--	--	--	--	1.10	0.52	--
TOTAL:	**91.53**	**111.10**	**6.62**	**16.71**	**14.54**	**13.40**	**25,829.01**

Summary of Projected Construction Emissions - Selected HAPs
Bradshaw Compressor Station

Source	2017 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	8.76E-01	4.96E-02	3.31E-01	3.31E-02	1.95E+00	3.24E+00
On-Road Vehicle Travel	1.73E-03	2.75E-04	5.67E-03	1.01E-03	4.80E-03	1.35E-02
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**8.78E-01**	**4.99E-02**	**3.36E-01**	**3.41E-02**	**1.96E+00**	**3.25E+00**

Projected Emissions from Construction Equipment Engines
Bradshaw Compressor Station

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	3	60	32	4.04E+00	8.82E-01	2.71E-01	3.65E-01	3.74E-01	3.74E-01	1.04E+03
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	6	60	32	1.47E+00	3.79E+01	1.34E-01	3.27E+00	3.69E-02	3.69E-02	2.95E+02
Asphalt Paver	2270002003	153	1	60	4	7.73E-02	7.60E-02	6.14E-03	7.68E-03	1.48E-02	1.48E-02	2.41E+01
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	4	60	32	2.01E+00	2.49E+01	4.06E-01	7.42E-01	9.06E-02	9.06E-02	8.91E+02
Booster/Pumps	2270006010	370	2	60	32	5.73E+00	1.56E+00	2.30E-01	4.78E-01	4.19E-01	4.19E-01	8.30E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	6	60	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	1.08E-01	9.92E-02	6.70E-03	1.07E-02	1.73E-02	1.73E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	2	60	12	2.19E+00	1.16E+00	8.59E-02	2.34E-01	1.80E-01	1.80E-01	2.80E+02
Compactor, Vibratory	2270002009	100	2	60	12	7.31E-01	3.87E-01	2.86E-02	7.81E-02	5.99E-02	5.99E-02	9.35E+01
Concrete Mixer Truck (main pours)	2270002042	150	5	60	6	1.25E+00	6.55E-01	4.94E-02	1.33E-01	1.32E-01	1.32E-01	1.75E+02
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.49E-01	1.31E-01	9.88E-03	2.66E-02	2.65E-02	2.65E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	24	5.22E-01	3.23E-01	3.65E-02	4.95E-02	7.32E-02	7.32E-02	1.40E+02
Crane, Wheeled (250 ton) A	2270002045	715	1	60	4	4.89E-01	1.26E-01	2.69E-02	3.34E-02	3.61E-02	3.61E-02	1.00E+02
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	4	60	8	1.11E+00	3.64E-01	1.12E-01	1.33E-01	1.81E-01	1.81E-01	4.65E+02
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	1	60	2	4.89E-01	1.69E-01	1.85E-02	3.19E-02	3.15E-02	3.15E-02	6.66E+01
Dump Truck	2270002078	325	10	60	32	3.08E+01	1.78E+01	1.21E+00	4.65E+00	3.97E+00	3.97E+00	4.29E+03
Excavator	2270002036	138	3	60	24	9.34E-01	9.13E-01	9.50E-02	1.05E-01	2.07E-01	2.07E-01	3.91E+02
Fork Lift	2270003020	120	1	60	32	1.85E-01	1.59E-01	3.40E-02	3.47E-02	5.84E-02	5.84E-02	1.51E+02
Front End Loaders	2270002066	196	2	60	32	3.04E+00	1.77E+00	1.44E-01	4.65E-01	4.26E-01	4.26E-01	5.18E+02
Generators	2270006005	430	2	60	32	6.65E+00	1.79E+00	2.67E-01	5.54E-01	4.73E-01	4.73E-01	9.65E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	2	3.59E-02	1.10E-02	1.66E-03	2.77E-03	3.13E-03	3.13E-03	7.09E+00
Jack Hammer	2270003040	405	3	60	24	3.68E+00	8.07E-01	2.64E-01	3.42E-01	3.62E-01	3.62E-01	1.02E+03
Light Tower	2270002081	50	10	60	32	3.82E+00	8.42E-01	1.57E-01	1.97E-01	2.66E-01	2.66E-01	6.30E+02
Man Lift A	2270003010	50	1	60	24	4.17E-01	4.32E-01	1.57E-02	1.11E-01	6.87E-02	6.87E-02	5.49E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Bradshaw Compressor Station

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	40	60	32	1.43E+01	5.05E+00	2.56E+00	2.89E+00	4.24E+00	4.24E+00	1.14E+04
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	8	2.55E-01	2.89E+00	6.75E-02	8.42E-02	1.47E-02	1.47E-02	1.48E+02
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	24	3.85E-01	4.29E-01	1.34E-02	1.04E-01	6.13E-02	6.13E-02	4.39E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.85E-04	8.85E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	4	60	24	1.79E+00	7.77E-01	1.70E-01	2.06E-01	3.32E-01	3.32E-01	6.81E+02
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	1	60	8	1.91E-02	6.91E-03	6.18E-04	1.33E-03	1.28E-03	1.28E-03	2.27E+00
Water / Fuel Truck	2270002051	250	1	60	16	1.78E-01	6.31E-02	3.20E-02	3.61E-02	5.31E-02	5.31E-02	1.42E+02
Welder	2270006025	35	6	60	24	1.78E+00	1.72E+00	7.07E-02	3.75E-01	2.43E-01	2.43E-01	2.31E+02
Welding Machine	2270006025	35	6	60	24	1.78E+00	1.72E+00	7.07E-02	3.75E-01	2.43E-01	2.43E-01	2.31E+02
Welding Rig	2270002051	10	6	60	24	2.58E-01	7.95E-02	1.20E-02	1.99E-02	2.26E-02	2.26E-02	5.11E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Bradshaw Compressor Station

Pollutant	2017 Emissions (tpy)
Acetaldehyde	8.76E-01
Acrolein	4.96E-02
Benzene	3.31E-01
1,3-Butadiene	3.31E-02
Formaldehyde	1.95E+00

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Bradshaw Compressor Station

Pollutant	2017 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.37E-01	3.76E-01	4.58E-01	6.99E+00	3.18E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.79E-01	4.47E-01	2.37E-01	3.48E-01	2.43E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03
1,3-Butadiene	1.85E-03	2.10E-03	2.14E-03	2.23E-03	1.55E-03
Formaldehyde	3.38E-03	3.85E-03	9.17E-03	2.85E-02	1.99E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Bradshaw Compressor Station

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	240	120,000
Light-Duty Gasoline Truck	50	10	240	120,000
Light-Duty Gasoline Vehicle	50	10	240	120,000
Heavy Duty Diesel Vehicle	50	10	240	120,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Bradshaw Compressor Station

Pollutant	2017 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	4.46E-02	4.97E-02	6.06E-02	0.00E+00	4.20E-01
CO	1.49E+00	1.50E+00	6.79E-02	0.00E+00	7.78E-02
SO_2	8.99E-04	1.16E-03	5.42E-04	0.00E+00	1.40E-03
VOC	5.01E-02	5.91E-02	3.13E-02	0.00E+00	3.21E-02
PM_{10}	3.28E-03	3.28E-03	6.14E-03	0.00E+00	1.16E-02
$PM_{2.5}$	1.48E-03	1.49E-03	4.13E-03	0.00E+00	7.53E-03
CO_2	4.87E+01	6.34E+01	7.92E+01	0.00E+00	2.04E+02
Acetaldehyde	1.73E-04	1.97E-04	3.86E-04	0.00E+00	9.70E-04
Acrolein	2.18E-05	2.51E-05	1.10E-04	0.00E+00	1.18E-04
Benzene	2.19E-03	2.50E-03	6.28E-04	0.00E+00	3.54E-04
1,3-Butadiene	2.44E-04	2.78E-04	2.83E-04	0.00E+00	2.05E-04
Formaldehyde	4.47E-04	5.09E-04	1.21E-03	0.00E+00	2.63E-03

Projected Annual Off-Road Vehicle Travel
Bradshaw Compressor Station

Vehicle Type	2017 Round Trip (miles)	2017 Trips per Day	2017 Days/Year	2017 Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	16	240	1,152
Light Duty Trucks	0.8	10	240	1,920
Medium Duty Trucks	0.8	10	240	1,920
School Bus	0	0	0	0
Water / Fuel Truck	0.3	4	240	288

Emissions from Off-Road Vehicle Travel
Bradshaw Compressor Station

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.22	0.02
Light Duty Trucks	2.5	0.60	0.06	75%	0.14	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.20	0.02
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.05	0.01

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Bradshaw Compressor Station

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	$PM_{2.5}$ Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	1920	hr/yr	9.88E-01	5.10E-01
Grading	1.96E+00	2.24E-01	lb/VMT	118.7	VMT/yr	1.16E-01	1.33E-02

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	23.98
Square Miles:	0.037
Miles in 1 Direction:	0.194
Feet in 1 Direction:	1,022
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	204
Miles to Clear 1 Direction:	39.567
Miles with 50% Safety Factor:	59.4
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	118.701

Summary of Projected Construction Emissions - Criteria Pollutants
Harris Compressor Station

Source	2017 Construction Emissions (tpy)						
	NO_X	**CO**	**SO_2**	**VOC**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**
Construction Equipment Engines	80.15	95.24	5.83	14.55	11.25	11.25	22,363.47
On-Road Vehicle Travel	0.58	3.14	0.00	0.18	0.02	0.01	395.62
Off-Road Vehicle Travel	--	--	--	--	0.61	0.06	--
Earthmoving Fugitives	--	--	--	--	1.09	0.52	--
TOTAL:	**80.72**	**98.38**	**5.83**	**14.73**	**12.98**	**11.85**	**22,759.09**

Summary of Projected Construction Emissions - Selected HAPs
Harris Compressor Station

Source	2017 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	7.71E-01	4.37E-02	2.91E-01	2.91E-02	1.72E+00	2.85E+00
On-Road Vehicle Travel	1.73E-03	2.75E-04	5.68E-03	1.01E-03	4.80E-03	1.35E-02
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**7.73E-01**	**4.39E-02**	**2.97E-01**	**3.01E-02**	**1.72E+00**	**2.87E+00**

Projected Emissions from Construction Equipment Engines
Harris Compressor Station

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	3	60	28	3.53E+00	7.72E-01	2.38E-01	3.20E-01	3.27E-01	3.27E-01	9.14E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	6	60	28	1.29E+00	3.32E+01	1.18E-01	2.86E+00	3.23E-02	3.23E-02	2.58E+02
Asphalt Paver	2270002003	153	1	60	4	7.73E-02	7.60E-02	6.14E-03	7.68E-03	1.48E-02	1.48E-02	2.41E+01
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	4	60	28	1.75E+00	2.18E+01	3.56E-01	6.49E-01	7.93E-02	7.93E-02	7.80E+02
Booster/Pumps	2270006010	370	2	60	28	5.02E+00	1.36E+00	2.01E-01	4.18E-01	3.66E-01	3.66E-01	7.26E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	6	60	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	1.08E-01	9.92E-02	6.70E-03	1.07E-02	1.73E-02	1.73E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	2.66E-02	6.77E-03	7.73E-04	1.88E-03	1.45E-03	1.45E-03	2.80E+00
Compactor	2270002009	300	2	60	12	2.19E+00	1.16E+00	8.59E-02	2.34E-01	1.80E-01	1.80E-01	2.80E+02
Compactor, Vibratory	2270002009	100	2	60	12	7.31E-01	3.87E-01	2.86E-02	7.81E-02	5.99E-02	5.99E-02	9.35E+01
Concrete Mixer Truck (main pours)	2270002042	150	5	60	6	1.25E+00	6.55E-01	4.94E-02	1.33E-01	1.32E-01	1.32E-01	1.75E+02
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.49E-01	1.31E-01	9.88E-03	2.66E-02	2.65E-02	2.65E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	24	5.22E-01	3.23E-01	3.65E-02	4.95E-02	7.32E-02	7.32E-02	1.40E+02
Crane, Wheeled (250 ton) A	2270002045	715	1	60	4	4.89E-01	1.26E-01	2.69E-02	3.34E-02	3.61E-02	3.61E-02	1.00E+02
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	4	60	8	1.11E+00	3.64E-01	1.12E-01	1.33E-01	1.81E-01	1.81E-01	4.65E+02
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	1	60	2	4.89E-01	1.69E-01	1.85E-02	3.19E-02	3.15E-02	3.15E-02	6.66E+01
Dump Truck	2270002078	325	10	60	28	2.69E+01	1.55E+01	1.06E+00	4.07E+00	3.47E+00	3.47E+00	3.76E+03
Excavator	2270002036	138	3	60	20	7.79E-01	7.61E-01	7.92E-02	8.74E-02	1.73E-01	1.73E-01	3.26E+02
Fork Lift	2270003020	120	1	60	28	1.62E-01	1.39E-01	2.97E-02	3.03E-02	5.11E-02	5.11E-02	1.32E+02
Front End Loaders	2270002066	196	2	60	28	2.66E+00	1.55E+00	1.26E-01	4.07E-01	3.73E-01	3.73E-01	4.54E+02
Generators	2270006005	430	2	60	28	5.82E+00	1.57E+00	2.34E-01	4.84E-01	4.14E-01	4.14E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	2	3.59E-02	1.10E-02	1.66E-03	2.77E-03	3.13E-03	3.13E-03	7.09E+00
Jack Hammer	2270003040	405	3	60	20	3.06E+00	6.72E-01	2.20E-01	2.85E-01	3.02E-01	3.02E-01	8.53E+02
Light Tower	2270002081	50	10	60	28	3.34E+00	7.37E-01	1.38E-01	1.73E-01	2.33E-01	2.33E-01	5.51E+02
Man Lift A	2270003010	50	1	60	20	3.48E-01	3.60E-01	1.31E-02	9.21E-02	5.72E-02	5.72E-02	4.57E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Harris Compressor Station

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	40	60	28	1.25E+01	4.42E+00	2.24E+00	2.53E+00	3.71E+00	3.71E+00	9.93E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	8	2.55E-01	2.90E+00	6.75E-02	8.41E-02	1.47E-02	1.47E-02	1.48E+02
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.21E-01	3.57E-01	1.12E-02	8.66E-02	5.11E-02	5.11E-02	3.65E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.85E-04	8.85E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	4	60	20	1.49E+00	6.48E-01	1.42E-01	1.72E-01	2.77E-01	2.77E-01	5.68E+02
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	1	60	8	1.91E-02	6.91E-03	6.18E-04	1.33E-03	1.28E-03	1.28E-03	2.27E+00
Water / Fuel Truck	2270002051	250	1	60	16	1.78E-01	6.31E-02	3.20E-02	3.61E-02	5.31E-02	5.31E-02	1.42E+02
Welder	2270006025	35	6	60	20	1.48E+00	1.43E+00	5.89E-02	3.12E-01	2.03E-01	2.03E-01	1.92E+02
Welding Machine	2270006025	35	6	60	20	1.48E+00	1.43E+00	5.89E-02	3.12E-01	2.03E-01	2.03E-01	1.92E+02
Welding Rig	2270002051	10	6	60	20	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines

Harris Compressor Station

Pollutant	2017 Emissions (tpy)
Acetaldehyde	7.71E-01
Acrolein	4.37E-02
Benzene	2.91E-01
1,3-Butadiene	2.91E-02
Formaldehyde	1.72E+00

construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Harris Compressor Station

Pollutant	2017 Emission Factors (grams/mile) LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.38E-01	3.77E-01	4.58E-01	6.99E+00	3.18E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.88E-01	4.59E-01	2.37E-01	3.48E-01	2.43E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03
1,3-Butadiene	1.86E-03	2.11E-03	2.14E-03	2.23E-03	1.55E-03
Formaldehyde	3.39E-03	3.87E-03	9.17E-03	2.85E-02	1.99E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Harris Compressor Station

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	240	120,000
Light-Duty Gasoline Truck	50	10	240	120,000
Light-Duty Gasoline Vehicle	50	10	240	120,000
Heavy Duty Diesel Vehicle	50	10	240	120,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Harris Compressor Station

Pollutant	2017 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	4.47E-02	4.98E-02	6.06E-02	0.00E+00	4.20E-01
CO	1.49E+00	1.50E+00	6.79E-02	0.00E+00	7.78E-02
SO_2	8.99E-04	1.16E-03	5.42E-04	0.00E+00	1.40E-03
VOC	5.13E-02	6.06E-02	3.13E-02	0.00E+00	3.21E-02
PM_{10}	3.28E-03	3.28E-03	6.14E-03	0.00E+00	1.16E-02
$PM_{2.5}$	1.48E-03	1.49E-03	4.13E-03	0.00E+00	7.53E-03
CO_2	4.87E+01	6.34E+01	7.92E+01	0.00E+00	2.04E+02
Acetaldehyde	1.73E-04	1.97E-04	3.86E-04	0.00E+00	9.70E-04
Acrolein	2.18E-05	2.51E-05	1.10E-04	0.00E+00	1.18E-04
Benzene	2.20E-03	2.50E-03	6.28E-04	0.00E+00	3.54E-04
1,3-Butadiene	2.45E-04	2.79E-04	2.83E-04	0.00E+00	2.05E-04
Formaldehyde	4.48E-04	5.11E-04	1.21E-03	0.00E+00	2.63E-03

Projected Annual Off-Road Vehicle Travel
Harris Compressor Station

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	16	240	1,152
Light Duty Trucks	0.8	10	240	1,920
Medium Duty Trucks	0.8	10	240	1,920
School Bus	0	0	0	0
Water / Fuel Truck	0.3	4	240	288

Emissions from Off-Road Vehicle Travel
Harris Compressor Station

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.22	0.02
Light Duty Trucks	2.5	0.60	0.06	75%	0.14	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.20	0.02
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.05	0.01

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Harris Compressor Station

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	$PM_{2.5}$ Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	1920	hr/yr	9.88E-01	5.10E-01
Grading	1.96E+00	2.24E-01	lb/VMT	106.9	VMT/yr	1.05E-01	1.20E-02

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	21.6
Square Miles:	0.034
Miles in 1 Direction:	0.184
Feet in 1 Direction:	970
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	194
Miles to Clear 1 Direction:	35.64
Miles with 50% Safety Factor:	53.5
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	106.92

Summary of Projected Construction Emissions - Criteria Pollutants
Stallworth Compressor Station

Source	2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	80.17	95.19	5.83	14.56	11.25	11.25	22,363.47
On-Road Vehicle Travel	0.58	3.15	0.00	0.17	0.02	0.01	395.62
Off-Road Vehicle Travel	--	--	--	--	0.61	0.06	--
Earthmoving Fugitives	--	--	--	--	1.11	0.52	--
TOTAL:	**80.74**	**98.34**	**5.83**	**14.73**	**13.00**	**11.85**	**22,759.09**

Summary of Projected Construction Emissions - Selected HAPs
Stallworth Compressor Station

Source	2017 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	7.72E-01	4.37E-02	2.91E-01	2.91E-02	1.72E+00	2.85E+00
On-Road Vehicle Travel	1.73E-03	2.76E-04	5.68E-03	1.01E-03	4.81E-03	1.35E-02
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**7.73E-01**	**4.39E-02**	**2.97E-01**	**3.01E-02**	**1.72E+00**	**2.87E+00**

Projected Emissions from Construction Equipment Engines
Stallworth Compressor Station

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	3	60	28	3.53E+00	7.72E-01	2.38E-01	3.20E-01	3.27E-01	3.27E-01	9.14E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	6	60	28	1.29E+00	3.32E+01	1.18E-01	2.86E+00	3.23E-02	3.23E-02	2.58E+02
Asphalt Paver	2270002003	153	1	60	4	7.73E-02	7.60E-02	6.14E-03	7.68E-03	1.48E-02	1.48E-02	2.41E+01
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	4	60	28	1.77E+00	2.18E+01	3.56E-01	6.51E-01	7.93E-02	7.93E-02	7.80E+02
Booster/Pumps	2270006010	370	2	60	28	5.02E+00	1.36E+00	2.01E-01	4.18E-01	3.66E-01	3.66E-01	7.26E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	6	60	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	1.08E-01	9.92E-02	6.70E-03	1.07E-02	1.73E-02	1.73E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	2.66E-02	6.77E-03	7.73E-04	1.88E-03	1.45E-03	1.45E-03	2.80E+00
Compactor	2270002009	300	2	60	12	2.19E+00	1.16E+00	8.59E-02	2.34E-01	1.80E-01	1.80E-01	2.80E+02
Compactor, Vibratory	2270002009	100	2	60	12	7.31E-01	3.87E-01	2.86E-02	7.81E-02	5.99E-02	5.99E-02	9.35E+01
Concrete Mixer Truck (main pours)	2270002042	150	5	60	6	1.25E+00	6.55E-01	4.94E-02	1.33E-01	1.32E-01	1.32E-01	1.75E+02
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.49E-01	1.31E-01	9.88E-03	2.66E-02	2.65E-02	2.65E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	24	5.22E-01	3.23E-01	3.65E-02	4.95E-02	7.32E-02	7.32E-02	1.40E+02
Crane, Wheeled (250 ton) A	2270002045	715	1	60	4	4.89E-01	1.26E-01	2.69E-02	3.34E-02	3.61E-02	3.61E-02	1.00E+02
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	4	60	8	1.11E+00	3.64E-01	1.12E-01	1.33E-01	1.81E-01	1.81E-01	4.65E+02
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	1	60	2	4.89E-01	1.69E-01	1.85E-02	3.19E-02	3.15E-02	3.15E-02	6.66E+01
Dump Truck	2270002078	325	10	60	28	2.69E+01	1.55E+01	1.06E+00	4.07E+00	3.47E+00	3.47E+00	3.76E+03
Excavator	2270002036	138	3	60	20	7.79E-01	7.61E-01	7.92E-02	8.74E-02	1.73E-01	1.73E-01	3.26E+02
Fork Lift	2270003020	120	1	60	28	1.62E-01	1.39E-01	2.97E-02	3.03E-02	5.11E-02	5.11E-02	1.32E+02
Front End Loaders	2270002066	196	2	60	28	2.66E+00	1.55E+00	1.26E-01	4.07E-01	3.73E-01	3.73E-01	4.54E+02
Generators	2270006005	430	2	60	28	5.82E+00	1.57E+00	2.34E-01	4.84E-01	4.14E-01	4.14E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	2	3.59E-02	1.10E-02	1.66E-03	2.77E-03	3.13E-03	3.13E-03	7.09E+00
Jack Hammer	2270003040	405	3	60	20	3.06E+00	6.72E-01	2.20E-01	2.85E-01	3.02E-01	3.02E-01	8.53E+02
Light Tower	2270002081	50	10	60	28	3.34E+00	7.37E-01	1.38E-01	1.73E-01	2.33E-01	2.33E-01	5.51E+02
Man Lift A	2270003010	50	1	60	20	3.48E-01	3.60E-01	1.31E-02	9.21E-02	5.72E-02	5.72E-02	4.57E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Stallworth Compressor Station

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	40	60	28	1.25E+01	4.42E+00	2.24E+00	2.53E+00	3.71E+00	3.71E+00	9.93E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	8	2.58E-01	2.89E+00	6.75E-02	8.44E-02	1.47E-02	1.47E-02	1.48E+02
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.21E-01	3.57E-01	1.12E-02	8.66E-02	5.11E-02	5.11E-02	3.65E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.85E-04	8.85E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	4	60	20	1.49E+00	6.48E-01	1.42E-01	1.72E-01	2.77E-01	2.77E-01	5.68E+02
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	1	60	8	1.91E-02	6.91E-03	6.18E-04	1.33E-03	1.28E-03	1.28E-03	2.27E+00
Water / Fuel Truck	2270002051	250	1	60	16	1.78E-01	6.31E-02	3.20E-02	3.61E-02	5.31E-02	5.31E-02	1.42E+02
Welder	2270006025	35	6	60	20	1.48E+00	1.43E+00	5.89E-02	3.12E-01	2.03E-01	2.03E-01	1.92E+02
Welding Machine	2270006025	35	6	60	20	1.48E+00	1.43E+00	5.89E-02	3.12E-01	2.03E-01	2.03E-01	1.92E+02
Welding Rig	2270002051	10	6	60	20	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Stallworth Compressor Station

Pollutant	2017 Emissions (tpy)
Acetaldehyde	7.72E-01
Acrolein	4.37E-02
Benzene	2.91E-01
1,3-Butadiene	2.91E-02
Formaldehyde	1.72E+00

construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Stallworth Compressor Station

Pollutant	2017 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.36E-01	3.76E-01	4.58E-01	6.99E+00	3.18E+00
CO	1.13E+01	1.14E+01	5.13E-01	1.01E+00	5.88E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.76E-01	4.45E-01	2.37E-01	3.48E-01	2.43E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03
Acrolein	1.65E-04	1.95E-04	8.30E-04	1.28E-03	8.95E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03
1,3-Butadiene	1.85E-03	2.11E-03	2.14E-03	2.23E-03	1.55E-03
Formaldehyde	3.40E-03	3.87E-03	9.17E-03	2.85E-02	1.99E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Stallworth Compressor Station

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	240	120,000
Light-Duty Gasoline Truck	50	10	240	120,000
Light-Duty Gasoline Vehicle	50	10	240	120,000
Heavy Duty Diesel Vehicle	50	10	240	120,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Stallworth Compressor Station

Pollutant	2017 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	4.44E-02	4.97E-02	6.06E-02	0.00E+00	4.20E-01
CO	1.50E+00	1.50E+00	6.79E-02	0.00E+00	7.78E-02
SO_2	8.99E-04	1.16E-03	5.42E-04	0.00E+00	1.40E-03
VOC	4.97E-02	5.89E-02	3.13E-02	0.00E+00	3.21E-02
PM_{10}	3.28E-03	3.28E-03	6.14E-03	0.00E+00	1.16E-02
$PM_{2.5}$	1.48E-03	1.49E-03	4.13E-03	0.00E+00	7.53E-03
CO_2	4.87E+01	6.34E+01	7.92E+01	0.00E+00	2.04E+02
Acetaldehyde	1.73E-04	1.97E-04	3.86E-04	0.00E+00	9.70E-04
Acrolein	2.18E-05	2.58E-05	1.10E-04	0.00E+00	1.18E-04
Benzene	2.20E-03	2.51E-03	6.28E-04	0.00E+00	3.54E-04
1,3-Butadiene	2.45E-04	2.79E-04	2.83E-04	0.00E+00	2.05E-04
Formaldehyde	4.49E-04	5.12E-04	1.21E-03	0.00E+00	2.63E-03

Projected Annual Off-Road Vehicle Travel
Stallworth Compressor Station

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	16	240	1,152
Light Duty Trucks	0.8	10	240	1,920
Medium Duty Trucks	0.8	10	240	1,920
School Bus	0	0	0	0
Water / Fuel Truck	0.3	4	240	288

Emissions from Off-Road Vehicle Travel
Stallworth Compressor Station

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.22	0.02
Light Duty Trucks	2.5	0.60	0.06	75%	0.14	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.20	0.02
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.05	0.01

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Stallworth Compressor Station

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	$PM_{2.5}$ Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	1920	hr/yr	9.88E-01	5.10E-01
Grading	1.96E+00	2.24E-01	lb/VMT	123.1	VMT/yr	1.20E-01	1.38E-02

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	24.86
Square Miles:	0.039
Miles in 1 Direction:	0.197
Feet in 1 Direction:	1,041
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	208
Miles to Clear 1 Direction:	41.019
Miles with 50% Safety Factor:	61.5
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	123.057

Summary of Projected Construction Emissions - Criteria Pollutants
Mobely Interconnect

Source	2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	19.88	22.81	1.32	3.58	2.49	2.49	5,033.51
On-Road Vehicle Travel	0.34	1.83	0.00	0.10	0.01	0.01	230.78
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.15	0.07	--
TOTAL:	**20.21**	**24.64**	**1.32**	**3.68**	**2.90**	**2.59**	**5,264.29**

Summary of Projected Construction Emissions - Selected HAPs
Mobely Interconnect

Source	2017 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	1.90E-01	1.07E-02	7.17E-02	7.17E-03	4.23E-01	7.02E-01
On-Road Vehicle Travel	1.01E-03	1.60E-04	3.31E-03	5.89E-04	2.80E-03	7.86E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.91E-01**	**1.09E-02**	**7.50E-02**	**7.76E-03**	**4.26E-01**	**7.10E-01**

Projected Emissions from Construction Equipment Engines
Mobely Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	1	60	20	8.41E-01	1.84E-01	5.66E-02	7.61E-02	7.80E-02	7.80E-02	2.18E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	2	60	20	3.06E-01	7.91E+00	2.80E-02	6.82E-01	7.68E-03	7.68E-03	6.15E+01
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	1	60	20	3.13E-01	3.90E+00	6.35E-02	1.16E-01	1.42E-02	1.42E-02	1.39E+02
Booster/Pumps	2270006010	370	1	60	20	1.79E+00	4.87E-01	7.19E-02	1.49E-01	1.31E-01	1.31E-01	2.59E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	1	60	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	1.08E-01	9.92E-02	6.70E-03	1.07E-02	1.73E-02	1.73E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.49E-01	1.31E-01	9.88E-03	2.66E-02	2.65E-02	2.65E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	12	2.61E-01	1.62E-01	1.82E-02	2.47E-02	3.66E-02	3.66E-02	7.02E+01
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	1	60	4	1.39E-01	4.56E-02	1.41E-02	1.66E-02	2.26E-02	2.26E-02	5.82E+01
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	1	60	20	1.92E+00	1.11E+00	7.56E-02	2.91E-01	2.48E-01	2.48E-01	2.68E+02
Excavator	2270002036	138	2	60	20	5.19E-01	5.07E-01	5.28E-02	5.83E-02	1.15E-01	1.15E-01	2.17E+02
Fork Lift	2270003020	120	1	60	20	1.16E-01	9.91E-02	2.12E-02	2.17E-02	3.65E-02	3.65E-02	9.46E+01
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	2	60	28	5.82E+00	1.57E+00	2.34E-01	4.84E-01	4.14E-01	4.14E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	1	1.79E-02	5.52E-03	8.31E-04	1.38E-03	1.57E-03	1.57E-03	3.55E+00
Jack Hammer	2270003040	405	2	60	10	1.02E+00	2.24E-01	7.33E-02	9.49E-02	1.01E-01	1.01E-01	2.84E+02
Light Tower	2270002081	50	4	60	20	9.55E-01	2.11E-01	3.93E-02	4.93E-02	6.66E-02	6.66E-02	1.58E+02
Man Lift A	2270003010	50	1	60	20	3.48E-01	3.60E-01	1.31E-02	9.21E-02	5.72E-02	5.72E-02	4.57E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Mobely Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	10	60	20	2.23E+00	7.89E-01	4.00E-01	4.52E-01	6.63E-01	6.63E-01	1.77E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	2	6.38E-02	7.24E-01	1.69E-02	2.10E-02	3.69E-03	3.69E-03	3.70E+01
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.21E-01	3.57E-01	1.12E-02	8.66E-02	5.11E-02	5.11E-02	3.65E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.85E-04	8.85E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	1	60	10	1.87E-01	8.10E-02	1.77E-02	2.15E-02	3.46E-02	3.46E-02	7.09E+01
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	4	60	20	9.86E-01	9.53E-01	3.93E-02	2.08E-01	1.35E-01	1.35E-01	1.28E+02
Welding Machine	2270006025	35	4	60	20	9.86E-01	9.53E-01	3.93E-02	2.08E-01	1.35E-01	1.35E-01	1.28E+02
Welding Rig	2270002051	10	4	60	20	1.43E-01	4.42E-02	6.65E-03	1.11E-02	1.25E-02	1.25E-02	2.84E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Mobely Interconnect

Pollutant	2017 Emissions (tpy)
Acetaldehyde	1.90E-01
Acrolein	1.07E-02
Benzene	7.17E-02
1,3-Butadiene	7.17E-03
Formaldehyde	4.23E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Mobely Interconnect

Pollutant	2017 Emission Factors (grams/mile) LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.37E-01	3.76E-01	4.58E-01	6.99E+00	3.18E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.79E-01	4.47E-01	2.37E-01	3.48E-01	2.43E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03
1,3-Butadiene	1.85E-03	2.10E-03	2.14E-03	2.23E-03	1.55E-03
Formaldehyde	3.38E-03	3.85E-03	9.17E-03	2.85E-02	1.99E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Mobely Interconnect

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	140	70,000
Light-Duty Gasoline Truck	50	10	140	70,000
Light-Duty Gasoline Vehicle	50	10	140	70,000
Heavy Duty Diesel Vehicle	50	10	140	70,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Mobely Interconnect

Pollutant	2017 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	2.60E-02	2.90E-02	3.53E-02	0.00E+00	2.45E-01
CO	8.71E-01	8.72E-01	3.96E-02	0.00E+00	4.54E-02
SO_2	5.25E-04	6.79E-04	3.16E-04	0.00E+00	8.18E-04
VOC	2.92E-02	3.45E-02	1.82E-02	0.00E+00	1.88E-02
PM_{10}	1.91E-03	1.91E-03	3.58E-03	0.00E+00	6.74E-03
$PM_{2.5}$	8.64E-04	8.72E-04	2.41E-03	0.00E+00	4.39E-03
CO_2	2.84E+01	3.70E+01	4.62E+01	0.00E+00	1.19E+02
Acetaldehyde	1.01E-04	1.15E-04	2.25E-04	0.00E+00	5.66E-04
Acrolein	1.27E-05	1.47E-05	6.40E-05	0.00E+00	6.91E-05
Benzene	1.28E-03	1.46E-03	3.66E-04	0.00E+00	2.06E-04
1,3-Butadiene	1.42E-04	1.62E-04	1.65E-04	0.00E+00	1.20E-04
Formaldehyde	2.61E-04	2.97E-04	7.07E-04	0.00E+00	1.54E-03

Projected Annual Off-Road Vehicle Travel
Mobely Interconnect

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	4	140	168
Light Duty Trucks	0.8	10	140	1,120
Medium Duty Trucks	0.8	10	140	1,120
School Bus	0	0	0	0
Water / Fuel Truck	0.3	2	140	84

Emissions from Off-Road Vehicle Travel
Mobely Interconnect

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.03	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.08	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.11	0.01
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.02	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Mobely Interconnect

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	$PM_{2.5}$ Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	240	hr/yr	1.24E-01	6.38E-02
Grading	1.96E+00	2.24E-01	lb/VMT	25.7	VMT/yr	2.52E-02	2.89E-03

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	5.2
Square Miles:	0.008
Miles in 1 Direction:	0.090
Feet in 1 Direction:	476
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	95
Miles to Clear 1 Direction:	8.58
Miles with 50% Safety Factor:	12.9
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	25.74

Summary of Projected Construction Emissions - Criteria Pollutants
Sherwood Interconnect

Source	2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	19.88	22.81	1.32	3.58	2.49	2.49	5,033.51
On-Road Vehicle Travel	0.34	1.83	0.00	0.10	0.01	0.01	230.78
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.16	0.07	--
TOTAL:	**20.21**	**24.64**	**1.32**	**3.68**	**2.90**	**2.59**	**5,264.29**

Summary of Projected Construction Emissions - Selected HAPs
Sherwood Interconnect

Source	2017 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	1.90E-01	1.07E-02	7.17E-02	7.17E-03	4.23E-01	7.02E-01
On-Road Vehicle Travel	1.01E-03	1.60E-04	3.31E-03	5.89E-04	2.80E-03	7.86E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.91E-01**	**1.09E-02**	**7.50E-02**	**7.76E-03**	**4.26E-01**	**7.10E-01**

Projected Emissions from Construction Equipment Engines
Sherwood Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	1	60	20	8.41E-01	1.84E-01	5.66E-02	7.61E-02	7.80E-02	7.80E-02	2.18E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	2	60	20	3.06E-01	7.91E+00	2.80E-02	6.82E-01	7.68E-03	7.68E-03	6.15E+01
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	1	60	20	3.13E-01	3.90E+00	6.35E-02	1.16E-01	1.42E-02	1.42E-02	1.39E+02
Booster/Pumps	2270006010	370	1	60	20	1.79E+00	4.87E-01	7.19E-02	1.49E-01	1.31E-01	1.31E-01	2.59E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	1	60	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	1.08E-01	9.92E-02	6.70E-03	1.07E-02	1.73E-02	1.73E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.49E-01	1.31E-01	9.88E-03	2.66E-02	2.65E-02	2.65E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	12	2.61E-01	1.62E-01	1.82E-02	2.47E-02	3.66E-02	3.66E-02	7.02E+01
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	1	60	4	1.39E-01	4.56E-02	1.41E-02	1.66E-02	2.26E-02	2.26E-02	5.82E+01
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	1	60	20	1.92E+00	1.11E+00	7.56E-02	2.91E-01	2.48E-01	2.48E-01	2.68E+02
Excavator	2270002036	138	2	60	20	5.19E-01	5.07E-01	5.28E-02	5.83E-02	1.15E-01	1.15E-01	2.17E+02
Fork Lift	2270003020	120	1	60	20	1.16E-01	9.91E-02	2.12E-02	2.17E-02	3.65E-02	3.65E-02	9.46E+01
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	2	60	28	5.82E+00	1.57E+00	2.34E-01	4.84E-01	4.14E-01	4.14E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	1	1.79E-02	5.52E-03	8.31E-04	1.38E-03	1.57E-03	1.57E-03	3.55E+00
Jack Hammer	2270003040	405	2	60	10	1.02E+00	2.24E-01	7.33E-02	9.49E-02	1.01E-01	1.01E-01	2.84E+02
Light Tower	2270002081	50	4	60	20	9.55E-01	2.11E-01	3.93E-02	4.93E-02	6.66E-02	6.66E-02	1.58E+02
Man Lift A	2270003010	50	1	60	20	3.48E-01	3.60E-01	1.31E-02	9.21E-02	5.72E-02	5.72E-02	4.57E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Sherwood Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	10	60	20	2.23E+00	7.89E-01	4.00E-01	4.52E-01	6.63E-01	6.63E-01	1.77E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	2	6.38E-02	7.24E-01	1.69E-02	2.10E-02	3.69E-03	3.69E-03	3.70E+01
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.21E-01	3.57E-01	1.12E-02	8.66E-02	5.11E-02	5.11E-02	3.65E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.85E-04	8.85E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	1	60	10	1.87E-01	8.10E-02	1.77E-02	2.15E-02	3.46E-02	3.46E-02	7.09E+01
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	4	60	20	9.86E-01	9.53E-01	3.93E-02	2.08E-01	1.35E-01	1.35E-01	1.28E+02
Welding Machine	2270006025	35	4	60	20	9.86E-01	9.53E-01	3.93E-02	2.08E-01	1.35E-01	1.35E-01	1.28E+02
Welding Rig	2270002051	10	4	60	20	1.43E-01	4.42E-02	6.65E-03	1.11E-02	1.25E-02	1.25E-02	2.84E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment
Sherwood Interconnect

Pollutant	2017 Emissions (tpy)
Acetaldehyde	1.90E-01
Acrolein	1.07E-02
Benzene	7.17E-02
1,3-Butadiene	7.17E-03
Formaldehyde	4.23E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Sherwood Interconnect

Pollutant	2017 Emission Factors (grams/mile) LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.37E-01	3.76E-01	4.58E-01	6.99E+00	3.18E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.79E-01	4.47E-01	2.37E-01	3.48E-01	2.43E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03
1,3-Butadiene	1.85E-03	2.10E-03	2.14E-03	2.23E-03	1.55E-03
Formaldehyde	3.38E-03	3.85E-03	9.17E-03	2.85E-02	1.99E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Sherwood Interconnect

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	140	70,000
Light-Duty Gasoline Truck	50	10	140	70,000
Light-Duty Gasoline Vehicle	50	10	140	70,000
Heavy Duty Diesel Vehicle	50	10	140	70,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Sherwood Interconnect

Pollutant	2017 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	2.60E-02	2.90E-02	3.53E-02	0.00E+00	2.45E-01
CO	8.71E-01	8.72E-01	3.96E-02	0.00E+00	4.54E-02
SO_2	5.25E-04	6.79E-04	3.16E-04	0.00E+00	8.18E-04
VOC	2.92E-02	3.45E-02	1.82E-02	0.00E+00	1.88E-02
PM_{10}	1.91E-03	1.91E-03	3.58E-03	0.00E+00	6.74E-03
$PM_{2.5}$	8.64E-04	8.72E-04	2.41E-03	0.00E+00	4.39E-03
CO_2	2.84E+01	3.70E+01	4.62E+01	0.00E+00	1.19E+02
Acetaldehyde	1.01E-04	1.15E-04	2.25E-04	0.00E+00	5.66E-04
Acrolein	1.27E-05	1.47E-05	6.40E-05	0.00E+00	6.91E-05
Benzene	1.28E-03	1.46E-03	3.66E-04	0.00E+00	2.06E-04
1,3-Butadiene	1.42E-04	1.62E-04	1.65E-04	0.00E+00	1.20E-04
Formaldehyde	2.61E-04	2.97E-04	7.07E-04	0.00E+00	1.54E-03

Projected Annual Off-Road Vehicle Travel
Sherwood Interconnect

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	4	140	168
Light Duty Trucks	0.8	10	140	1,120
Medium Duty Trucks	0.8	10	140	1,120
School Bus	0	0	0	0
Water / Fuel Truck	0.3	2	140	84

Emissions from Off-Road Vehicle Travel
Sherwood Interconnect

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.03	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.08	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.11	0.01
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.02	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Sherwood Interconnect

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	$PM_{2.5}$ Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	240	hr/yr	1.24E-01	6.38E-02
Grading	1.96E+00	2.24E-01	lb/VMT	35.1	VMT/yr	3.44E-02	3.94E-03

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	7.1
Square Miles:	0.011
Miles in 1 Direction:	0.105
Feet in 1 Direction:	556
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	111
Miles to Clear 1 Direction:	11.715
Miles with 50% Safety Factor:	17.6
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	35.145

Summary of Projected Construction Emissions - Criteria Pollutants
Transco Interconnect

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	17.80	21.19	1.30	3.37	2.37	2.37	5,036.18
On-Road Vehicle Travel	0.29	1.67	0.00	0.10	0.01	0.01	230.76
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.14	0.07	--
TOTAL:	**18.10**	**22.86**	**1.31**	**3.46**	**2.76**	**2.47**	**5,266.94**

Summary of Projected Construction Emissions - Selected HAPs
Transco Interconnect

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	1.78E-01	1.01E-02	6.73E-02	6.73E-03	3.97E-01	6.60E-01
On-Road Vehicle Travel	9.54E-04	1.50E-04	3.04E-03	5.46E-04	2.65E-03	7.34E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.79E-01**	**1.02E-02**	**7.04E-02**	**7.28E-03**	**4.00E-01**	**6.67E-01**

Projected Emissions from Construction Equipment Engines
Transco Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	1	60	20	7.32E-01	1.62E-01	5.54E-02	7.16E-02	7.73E-02	7.73E-02	2.18E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	2	60	20	3.00E-01	7.84E+00	2.79E-02	6.31E-01	5.96E-03	5.96E-03	6.13E+01
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	1	60	20	2.63E-01	3.32E+00	6.33E-02	9.59E-02	1.41E-02	1.41E-02	1.39E+02
Booster/Pumps	2270006010	370	1	60	20	1.66E+00	4.42E-01	7.09E-02	1.41E-01	1.26E-01	1.26E-01	2.59E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	1	60	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	9.51E-02	8.90E-02	6.56E-03	9.78E-03	1.63E-02	1.63E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	2.55E-02	6.25E-03	7.63E-04	1.78E-03	1.41E-03	1.41E-03	2.80E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.33E-01	1.23E-01	9.75E-03	2.50E-02	2.54E-02	2.54E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	12	2.20E-01	1.41E-01	1.78E-02	2.24E-02	3.48E-02	3.48E-02	7.02E+01
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	1	60	4	1.12E-01	3.52E-02	1.36E-02	1.59E-02	2.18E-02	2.18E-02	5.82E+01
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	1	60	20	1.79E+00	1.03E+00	7.47E-02	2.71E-01	2.36E-01	2.36E-01	2.68E+02
Excavator	2270002036	138	2	60	20	4.01E-01	3.79E-01	5.10E-02	5.46E-02	1.01E-01	1.01E-01	2.17E+02
Fork Lift	2270003020	120	1	60	20	7.71E-02	8.09E-02	2.10E-02	2.13E-02	3.43E-02	3.43E-02	9.46E+01
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	2	60	28	5.40E+00	1.42E+00	2.31E-01	4.56E-01	4.00E-01	4.00E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	1	1.70E-02	4.66E-03	8.06E-04	1.31E-03	1.54E-03	1.54E-03	3.55E+00
Jack Hammer	2270003040	405	2	60	10	8.79E-01	1.96E-01	7.16E-02	8.93E-02	1.00E-01	1.00E-01	2.84E+02
Light Tower	2270002081	50	4	60	20	9.06E-01	1.65E-01	3.78E-02	4.47E-02	6.33E-02	6.33E-02	1.58E+02
Man Lift A	2270003010	50	1	60	20	3.37E-01	3.32E-01	1.29E-02	8.42E-02	5.40E-02	5.40E-02	4.58E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Transco Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	10	60	20	1.56E+00	6.36E-01	3.95E-01	4.45E-01	6.36E-01	6.36E-01	1.77E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	2	5.94E-02	6.90E-01	1.69E-02	1.98E-02	3.68E-03	3.68E-03	3.70E+01
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.13E-01	3.38E-01	1.12E-02	8.09E-02	4.83E-02	4.83E-02	3.66E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.87E-04	8.87E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	1	60	10	1.53E-01	6.51E-02	1.71E-02	2.04E-02	3.21E-02	3.21E-02	7.09E+01
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	4	60	20	9.57E-01	8.75E-01	3.93E-02	1.87E-01	1.24E-01	1.24E-01	1.28E+02
Welding Machine	2270006025	35	4	60	20	9.57E-01	8.75E-01	3.93E-02	1.87E-01	1.24E-01	1.24E-01	1.28E+02
Welding Rig	2270002051	10	4	60	20	1.36E-01	3.72E-02	6.45E-03	1.05E-02	1.23E-02	1.23E-02	2.84E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.04E-01	5.59E-02	9.68E-03	1.57E-02	1.85E-02	1.85E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Transco Interconnect

Pollutant	2018 Emissions (tpy)
Acetaldehyde	1.78E-01
Acrolein	1.01E-02
Benzene	6.73E-02
1,3-Butadiene	6.73E-03
Formaldehyde	3.97E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Transco Interconnect

Pollutant	2018 Emission Factors (grams/mile) LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.11E-01	3.48E-01	4.06E-01	6.38E+00	2.71E+00
CO	1.04E+01	1.03E+01	4.77E-01	8.85E-01	5.15E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.72E-01	4.41E-01	2.12E-01	3.28E-01	2.38E-01
PM_{10}	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02
$PM_{2.5}$	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.20E-03	1.36E-03	2.62E-03	9.90E-03	7.19E-03
Acrolein	1.55E-04	1.75E-04	7.40E-04	1.21E-03	8.75E-04
Benzene	1.52E-02	1.73E-02	4.26E-03	3.61E-03	2.62E-03
1,3-Butadiene	1.71E-03	1.93E-03	1.92E-03	2.10E-03	1.52E-03
Formaldehyde	3.13E-03	3.53E-03	8.21E-03	2.69E-02	1.95E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Transco Interconnect

Vehicle Type	2018 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	140	70,000
Light-Duty Gasoline Truck	50	10	140	70,000
Light-Duty Gasoline Vehicle	50	10	140	70,000
Heavy Duty Diesel Vehicle	50	10	140	70,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Transco Interconnect

Pollutant	2018 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	2.40E-02	2.69E-02	3.13E-02	0.00E+00	2.09E-01
CO	8.00E-01	7.93E-01	3.68E-02	0.00E+00	3.97E-02
SO_2	5.25E-04	6.79E-04	3.16E-04	0.00E+00	8.18E-04
VOC	2.87E-02	3.40E-02	1.64E-02	0.00E+00	1.84E-02
PM_{10}	1.91E-03	1.91E-03	3.10E-03	0.00E+00	5.88E-03
$PM_{2.5}$	8.64E-04	8.72E-04	1.96E-03	0.00E+00	3.60E-03
CO_2	2.84E+01	3.70E+01	4.62E+01	0.00E+00	1.19E+02
Acetaldehyde	9.26E-05	1.05E-04	2.02E-04	0.00E+00	5.54E-04
Acrolein	1.20E-05	1.35E-05	5.71E-05	0.00E+00	6.75E-05
Benzene	1.18E-03	1.33E-03	3.28E-04	0.00E+00	2.02E-04
1,3-Butadiene	1.32E-04	1.49E-04	1.48E-04	0.00E+00	1.17E-04
Formaldehyde	2.41E-04	2.72E-04	6.33E-04	0.00E+00	1.51E-03

Projected Annual Off-Road Vehicle Travel
Transco Interconnect

Vehicle Type	2018 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	4	140	168
Light Duty Trucks	0.8	10	140	1,120
Medium Duty Trucks	0.8	10	140	1,120
School Bus	0	0	0	0
Water / Fuel Truck	0.3	2	140	84

Emissions from Off-Road Vehicle Travel
Transco Interconnect

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.03	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.08	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.11	0.01
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.02	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Transco Interconnect

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2018	Units of Measure	PM_{10} Emissions (tpy) 2018	$PM_{2.5}$ Emissions (tpy) 2018
Bulldozing	1.03E+00	5.31E-01	lb/hr	240	hr/yr	1.24E-01	6.38E-02
Grading	1.96E+00	2.24E-01	lb/VMT	11.9	VMT/yr	1.16E-02	1.33E-03

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2018
Land Disturbed (acres):	2.4
Square Miles:	0.004
Miles in 1 Direction:	0.061
Feet in 1 Direction:	323
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	65
Miles to Clear 1 Direction:	3.96
Miles with 50% Safety Factor:	5.9
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	11.88

Summary of Projected Construction Emissions - Criteria Pollutants
Roanoke Interconnect

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	17.80	21.19	1.30	3.37	2.37	2.37	5,036.18
On-Road Vehicle Travel	0.29	1.67	0.00	0.10	0.01	0.01	230.76
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.14	0.07	--
TOTAL:	**18.10**	**22.86**	**1.31**	**3.46**	**2.76**	**2.47**	**5,266.94**

Summary of Projected Construction Emissions - Selected HAPs
Roanoke Interconnect

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.78E-01	1.01E-02	6.73E-02	6.73E-03	3.97E-01	6.60E-01
On-Road Vehicle Travel	9.54E-04	1.50E-04	3.04E-03	5.46E-04	2.65E-03	7.34E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.79E-01**	**1.02E-02**	**7.04E-02**	**7.28E-03**	**4.00E-01**	**6.67E-01**

Projected Emissions from Construction Equipment Engines
Roanoke Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	1	60	20	7.32E-01	1.62E-01	5.54E-02	7.16E-02	7.73E-02	7.73E-02	2.18E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	2	60	20	3.00E-01	7.84E+00	2.79E-02	6.31E-01	5.96E-03	5.96E-03	6.13E+01
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	1	60	20	2.63E-01	3.32E+00	6.33E-02	9.59E-02	1.41E-02	1.41E-02	1.39E+02
Booster/Pumps	2270006010	370	1	60	20	1.66E+00	4.42E-01	7.09E-02	1.41E-01	1.26E-01	1.26E-01	2.59E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	1	60	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	9.51E-02	8.90E-02	6.56E-03	9.78E-03	1.63E-02	1.63E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	2.55E-02	6.25E-03	7.63E-04	1.78E-03	1.41E-03	1.41E-03	2.80E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.33E-01	1.23E-01	9.75E-03	2.50E-02	2.54E-02	2.54E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	12	2.20E-01	1.41E-01	1.78E-02	2.24E-02	3.48E-02	3.48E-02	7.02E+01
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	1	60	4	1.12E-01	3.52E-02	1.36E-02	1.59E-02	2.18E-02	2.18E-02	5.82E+01
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	1	60	20	1.79E+00	1.03E+00	7.47E-02	2.71E-01	2.36E-01	2.36E-01	2.68E+02
Excavator	2270002036	138	2	60	20	4.01E-01	3.79E-01	5.10E-02	5.46E-02	1.01E-01	1.01E-01	2.17E+02
Fork Lift	2270003020	120	1	60	20	7.71E-02	8.09E-02	2.10E-02	2.13E-02	3.43E-02	3.43E-02	9.46E+01
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	2	60	28	5.40E+00	1.42E+00	2.31E-01	4.56E-01	4.00E-01	4.00E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	1	1.70E-02	4.66E-03	8.06E-04	1.31E-03	1.54E-03	1.54E-03	3.55E+00
Jack Hammer	2270003040	405	2	60	10	8.79E-01	1.96E-01	7.16E-02	8.93E-02	1.00E-01	1.00E-01	2.84E+02
Light Tower	2270002081	50	4	60	20	9.06E-01	1.65E-01	3.78E-02	4.47E-02	6.33E-02	6.33E-02	1.58E+02
Man Lift A	2270003010	50	1	60	20	3.37E-01	3.32E-01	1.29E-02	8.42E-02	5.40E-02	5.40E-02	4.58E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
Roanoke Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	10	60	20	1.56E+00	6.36E-01	3.95E-01	4.45E-01	6.36E-01	6.36E-01	1.77E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	2	5.94E-02	6.90E-01	1.69E-02	1.98E-02	3.68E-03	3.68E-03	3.70E+01
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.13E-01	3.38E-01	1.12E-02	8.09E-02	4.83E-02	4.83E-02	3.66E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.87E-04	8.87E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	1	60	10	1.53E-01	6.51E-02	1.71E-02	2.04E-02	3.21E-02	3.21E-02	7.09E+01
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	4	60	20	9.57E-01	8.75E-01	3.93E-02	1.87E-01	1.24E-01	1.24E-01	1.28E+02
Welding Machine	2270006025	35	4	60	20	9.57E-01	8.75E-01	3.93E-02	1.87E-01	1.24E-01	1.24E-01	1.28E+02
Welding Rig	2270002051	10	4	60	20	1.36E-01	3.72E-02	6.45E-03	1.05E-02	1.23E-02	1.23E-02	2.84E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.04E-01	5.59E-02	9.68E-03	1.57E-02	1.85E-02	1.85E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Roanoke Interconnect

Pollutant	2018 Emissions (tpy)
Acetaldehyde	1.78E-01
Acrolein	1.01E-02
Benzene	6.73E-02
1,3-Butadiene	6.73E-03
Formaldehyde	3.97E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the c
3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regu*
of Emissions from Nonroad Diesel Engines , EPA420-R-04-007, May 2004

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Roanoke Interconnect

Pollutant	2018 Emission Factors (grams/mile) LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.11E-01	3.48E-01	4.06E-01	6.38E+00	2.71E+00
CO	1.04E+01	1.03E+01	4.77E-01	8.85E-01	5.15E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.72E-01	4.41E-01	2.12E-01	3.28E-01	2.38E-01
PM_{10}	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02
$PM_{2.5}$	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.20E-03	1.36E-03	2.62E-03	9.90E-03	7.19E-03
Acrolein	1.55E-04	1.75E-04	7.40E-04	1.21E-03	8.75E-04
Benzene	1.52E-02	1.73E-02	4.26E-03	3.61E-03	2.62E-03
1,3-Butadiene	1.71E-03	1.93E-03	1.92E-03	2.10E-03	1.52E-03
Formaldehyde	3.13E-03	3.53E-03	8.21E-03	2.69E-02	1.95E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Roanoke Interconnect

Vehicle Type	2018 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	140	70,000
Light-Duty Gasoline Truck	50	10	140	70,000
Light-Duty Gasoline Vehicle	50	10	140	70,000
Heavy Duty Diesel Vehicle	50	10	140	70,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
Roanoke Interconnect

Pollutant	2018 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	2.40E-02	2.69E-02	3.13E-02	0.00E+00	2.09E-01
CO	8.00E-01	7.93E-01	3.68E-02	0.00E+00	3.97E-02
SO_2	5.25E-04	6.79E-04	3.16E-04	0.00E+00	8.18E-04
VOC	2.87E-02	3.40E-02	1.64E-02	0.00E+00	1.84E-02
PM_{10}	1.91E-03	1.91E-03	3.10E-03	0.00E+00	5.88E-03
$PM_{2.5}$	8.64E-04	8.72E-04	1.96E-03	0.00E+00	3.60E-03
CO_2	2.84E+01	3.70E+01	4.62E+01	0.00E+00	1.19E+02
Acetaldehyde	9.26E-05	1.05E-04	2.02E-04	0.00E+00	5.54E-04
Acrolein	1.20E-05	1.35E-05	5.71E-05	0.00E+00	6.75E-05
Benzene	1.18E-03	1.33E-03	3.28E-04	0.00E+00	2.02E-04
1,3-Butadiene	1.32E-04	1.49E-04	1.48E-04	0.00E+00	1.17E-04
Formaldehyde	2.41E-04	2.72E-04	6.33E-04	0.00E+00	1.51E-03

Projected Annual Off-Road Vehicle Travel
Roanoke Interconnect

Vehicle Type	2018 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	4	140	168
Light Duty Trucks	0.8	10	140	1,120
Medium Duty Trucks	0.8	10	140	1,120
School Bus	0	0	0	0
Water / Fuel Truck	0.3	2	140	84

Emissions from Off-Road Vehicle Travel
Roanoke Interconnect

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.03	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.08	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.11	0.01
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.02	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Roanoke Interconnect

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2018	Units of Measure	PM_{10} Emissions (tpy) 2018	$PM_{2.5}$ Emissions (tpy) 2018
Bulldozing	1.03E+00	5.31E-01	lb/hr	240	hr/yr	1.24E-01	6.38E-02
Grading	1.96E+00	2.24E-01	lb/VMT	11.9	VMT/yr	1.16E-02	1.33E-03

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2018
Land Disturbed (acres):	2.4
Square Miles:	0.004
Miles in 1 Direction:	0.061
Feet in 1 Direction:	323
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	65
Miles to Clear 1 Direction:	3.96
Miles with 50% Safety Factor:	5.9
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	11.88

Summary of Projected Construction Emissions - Criteria Pollutants
WB/TCO Interconnect

Source	2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	19.91	22.82	1.32	3.59	2.49	2.49	5,036.31
On-Road Vehicle Travel	0.34	1.83	0.00	0.10	0.01	0.01	230.78
Off-Road Vehicle Travel	--	--	--	--	0.25	0.02	--
Earthmoving Fugitives	--	--	--	--	0.15	0.07	--
TOTAL:	**20.24**	**24.65**	**1.33**	**3.69**	**2.90**	**2.59**	**5,267.09**

Summary of Projected Construction Emissions - Selected HAPs
WB/TCO Interconnect

Source	2017 Construction Emissions (tpy)					
	Acetaldehyde	**Acrolein**	**Benzene**	**1,3-Butadiene**	**Formaldehyde**	**Total HAPs**
Construction Equipment Engines	1.90E-01	1.08E-02	7.17E-02	7.17E-03	4.23E-01	7.03E-01
On-Road Vehicle Travel	1.01E-03	1.60E-04	3.31E-03	5.91E-04	2.80E-03	7.87E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.91E-01**	**1.09E-02**	**7.50E-02**	**7.76E-03**	**4.26E-01**	**7.11E-01**

Projected Emissions from Construction Equipment Engines
WB/TCO Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	1	60	20	8.41E-01	1.84E-01	5.66E-02	7.61E-02	7.80E-02	7.80E-02	2.18E+02
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	2	60	20	3.06E-01	7.91E+00	2.80E-02	6.82E-01	7.68E-03	7.68E-03	6.15E+01
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	1	60	20	3.13E-01	3.90E+00	6.35E-02	1.16E-01	1.42E-02	1.42E-02	1.39E+02
Booster/Pumps	2270006010	370	1	60	20	1.79E+00	4.87E-01	7.19E-02	1.49E-01	1.31E-01	1.31E-01	2.59E+02
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	1	60	2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	1	60	4	1.08E-01	9.92E-02	6.70E-03	1.07E-02	1.73E-02	1.73E-02	2.52E+01
Chipper/Shredder	2270004066	20	1	60	4	2.66E-02	6.77E-03	7.73E-04	1.88E-03	1.45E-03	1.45E-03	2.80E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	1	60	6	2.49E-01	1.31E-01	9.88E-03	2.66E-02	2.65E-02	2.65E-02	3.51E+01
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	1	60	12	2.61E-01	1.62E-01	1.82E-02	2.47E-02	3.66E-02	3.66E-02	7.02E+01
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	1	60	4	1.39E-01	4.56E-02	1.41E-02	1.66E-02	2.26E-02	2.26E-02	5.82E+01
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	1	60	20	1.92E+00	1.11E+00	7.56E-02	2.91E-01	2.48E-01	2.48E-01	2.68E+02
Excavator	2270002036	138	2	60	20	5.19E-01	5.07E-01	5.28E-02	5.83E-02	1.15E-01	1.15E-01	2.17E+02
Fork Lift	2270003020	120	1	60	20	1.16E-01	9.91E-02	2.12E-02	2.17E-02	3.65E-02	3.65E-02	9.46E+01
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	2	60	28	5.82E+00	1.57E+00	2.34E-01	4.84E-01	4.14E-01	4.14E-01	8.44E+02
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	1	60	1	1.79E-02	5.52E-03	8.31E-04	1.38E-03	1.57E-03	1.57E-03	3.55E+00
Jack Hammer	2270003040	405	2	60	10	1.02E+00	2.24E-01	7.33E-02	9.49E-02	1.01E-01	1.01E-01	2.84E+02
Light Tower	2270002081	50	4	60	20	9.55E-01	2.11E-01	3.93E-02	4.93E-02	6.66E-02	6.66E-02	1.58E+02
Man Lift A	2270003010	50	1	60	20	3.48E-01	3.60E-01	1.31E-02	9.21E-02	5.72E-02	5.72E-02	4.57E+01
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Projected Emissions from Construction Equipment Engines
WB/TCO Interconnect

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pickup Trucks	2270002051	250	10	60	20	2.23E+00	7.89E-01	4.00E-01	4.52E-01	6.63E-01	6.63E-01	1.77E+03
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	1	60	2	6.37E-02	7.24E-01	1.69E-02	2.10E-02	3.69E-03	3.69E-03	3.70E+01
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	2	60	20	3.21E-01	3.57E-01	1.12E-02	8.66E-02	5.11E-02	5.11E-02	3.65E+01
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	1	30	6	1.06E-02	5.64E-03	4.30E-04	1.07E-03	8.85E-04	8.85E-04	1.40E+00
Tamper	2260002006	4	2	60	12	7.93E-03	1.84E+00	2.00E-03	3.62E-01	5.89E-02	5.89E-02	4.42E+00
Tandem Truck	2270002069	200	1	60	10	1.87E-01	8.10E-02	1.77E-02	2.15E-02	3.46E-02	3.46E-02	7.09E+01
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	4	60	20	9.86E-01	9.53E-01	3.93E-02	2.08E-01	1.35E-01	1.35E-01	1.28E+02
Welding Machine	2270006025	35	4	60	20	9.86E-01	9.53E-01	3.93E-02	2.08E-01	1.35E-01	1.35E-01	1.28E+02
Welding Rig	2270002051	10	4	60	20	1.43E-01	4.42E-02	6.65E-03	1.11E-02	1.25E-02	1.25E-02	2.84E+01
X-Ray Truck/Machine	2270002051	50	2	60	12	2.15E-01	6.63E-02	9.97E-03	1.66E-02	1.88E-02	1.88E-02	4.26E+01

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment
WB/TCO Interconnect

Pollutant	2017 Emissions (tpy)
Acetaldehyde	1.90E-01
Acrolein	1.08E-02
Benzene	7.17E-02
1,3-Butadiene	7.17E-03
Formaldehyde	4.23E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
WB/TCO Interconnect

Pollutant	2017 Emission Factors (grams/mile) LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.38E-01	3.77E-01	4.58E-01	6.99E+00	3.18E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.88E-01	4.59E-01	2.37E-01	3.48E-01	2.43E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03
1,3-Butadiene	1.86E-03	2.11E-03	2.14E-03	2.23E-03	1.55E-03
Formaldehyde	3.39E-03	3.87E-03	9.17E-03	2.85E-02	1.99E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
WB/TCO Interconnect

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0
Light-Duty Diesel Truck	50	10	140	70,000
Light-Duty Gasoline Truck	50	10	140	70,000
Light-Duty Gasoline Vehicle	50	10	140	70,000
Heavy Duty Diesel Vehicle	50	10	140	70,000
Fuel Delivery	0	0	0	0

Emissions from On-Road Vehicle Travel
WB/TCO Interconnect

Pollutant	2017 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	2.61E-02	2.91E-02	3.53E-02	0.00E+00	2.45E-01
CO	8.72E-01	8.73E-01	3.96E-02	0.00E+00	4.54E-02
SO_2	5.25E-04	6.79E-04	3.16E-04	0.00E+00	8.18E-04
VOC	2.99E-02	3.54E-02	1.82E-02	0.00E+00	1.88E-02
PM_{10}	1.91E-03	1.91E-03	3.58E-03	0.00E+00	6.74E-03
$PM_{2.5}$	8.64E-04	8.72E-04	2.41E-03	0.00E+00	4.39E-03
CO_2	2.84E+01	3.70E+01	4.62E+01	0.00E+00	1.19E+02
Acetaldehyde	1.01E-04	1.15E-04	2.25E-04	0.00E+00	5.66E-04
Acrolein	1.27E-05	1.47E-05	6.40E-05	0.00E+00	6.91E-05
Benzene	1.28E-03	1.46E-03	3.66E-04	0.00E+00	2.06E-04
1,3-Butadiene	1.43E-04	1.63E-04	1.65E-04	0.00E+00	1.20E-04
Formaldehyde	2.62E-04	2.98E-04	7.07E-04	0.00E+00	1.54E-03

Projected Annual Off-Road Vehicle Travel
WB/TCO Interconnect

Vehicle Type	2017 Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	0	0	0	0
Dump Trucks	0.3	4	140	168
Light Duty Trucks	0.8	10	140	1,120
Medium Duty Trucks	0.8	10	140	1,120
School Bus	0	0	0	0
Water / Fuel Truck	0.3	2	140	84

Emissions from Off-Road Vehicle Travel
WB/TCO Interconnect

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	0.00	0.00
Dump Trucks	20	1.52	0.15	75%	0.03	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.08	0.01
Medium Duty Trucks	5	0.82	0.08	75%	0.11	0.01
School Bus	15	1.34	0.13	75%	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.02	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
WB/TCO Interconnect

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	$PM_{2.5}$ Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	240	hr/yr	1.24E-01	6.38E-02
Grading	1.96E+00	2.24E-01	lb/VMT	30.2	VMT/yr	2.96E-02	3.39E-03

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	6.1
Square Miles:	0.010
Miles in 1 Direction:	0.098
Feet in 1 Direction:	515
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	103
Miles to Clear 1 Direction:	10.065
Miles with 50% Safety Factor:	15.1
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	30.195

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Wetzel County

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	55.40	88.12	4.80	10.03	8.02	8.02	17,507.66
On-Road Vehicle Travel	--	--	--	--	--	--	--	23.55	12.71	0.09	2.24	0.68	0.44	11,931.10
Off-Road Vehicle Travel	--	--	--	--	0.64	0.06	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	7.20	3.43	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**1.02**	**0.45**	**1,072.02**	**78.95**	**100.84**	**4.88**	**12.27**	**211.8934**	**31.4922**	**29,438.77**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Harrison County

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	136.77	217.55	11.84	24.75	19.80	19.80	43,222.04
On-Road Vehicle Travel	--	--	--	--	--	--	--	23.55	12.71	0.09	2.24	0.68	0.44	11,931.10
Off-Road Vehicle Travel	--	--	--	--	0.64	0.06	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	17.77	8.48	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**1.02**	**0.45**	**1,072.02**	**160.32**	**230.26**	**11.92**	**26.99**	**234.2412**	**48.3113**	**55,153.15**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Doddridge County

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	27.99	44.52	2.42	5.06	4.05	4.05	8,845.02
On-Road Vehicle Travel	--	--	--	--	--	--	--	23.55	12.71	0.09	2.24	0.68	0.44	11,931.10
Off-Road Vehicle Travel	--	--	--	--	0.64	0.06	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	3.64	1.73	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**1.02**	**0.45**	**1,072.02**	**51.54**	**57.23**	**2.51**	**7.31**	**204.3650**	**25.8262**	**20,776.12**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Lewis County Spread 1

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	140.56	223.58	12.17	25.44	20.34	20.34	44,420.48
On-Road Vehicle Travel	--	--	--	--	--	--	--	23.55	12.71	0.09	2.24	0.68	0.44	11,931.10
Off-Road Vehicle Travel	--	--	--	--	0.64	0.06	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	18.26	8.71	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**1.02**	**0.45**	**1,072.02**	**164.12**	**236.30**	**12.25**	**27.68**	**235.2829**	**49.0953**	**56,351.59**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Wetzel County

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.17	2.91	0.00	0.12	0.01	0.00	167.64
Off-Road Vehicle Travel	--	--	--	--	6.06	0.61	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.84**	**26.75**	**0.28**	**2.23**	**6.4084**	**0.9464**	**1,238.47**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Harrison County

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.17	2.91	0.00	0.12	0.01	0.00	167.64
Off-Road Vehicle Travel	--	--	--	--	6.06	0.61	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.84**	**26.75**	**0.28**	**2.23**	**6.4084**	**0.9464**	**1,238.47**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Doddridge County

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.17	2.91	0.00	0.12	0.01	0.00	167.64
Off-Road Vehicle Travel	--	--	--	--	6.06	0.61	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.84**	**26.75**	**0.28**	**2.23**	**6.4084**	**0.9464**	**1,238.47**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Lewis County Spread 1

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.17	2.91	0.00	0.12	0.01	0.00	167.64
Off-Road Vehicle Travel	--	--	--	--	6.06	0.61	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.84**	**26.75**	**0.28**	**2.23**	**6.4084**	**0.9464**	**1,238.47**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Wetzel County

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	8.14E-02	4.61E-03	3.07E-02	3.07E-03	1.81E-01	3.01E-01	5.31E-01	3.01E-02	2.01E-01	2.01E-02	1.18E+00	1.96E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.62E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**8.14E-02**	**4.61E-03**	**3.07E-02**	**3.07E-03**	**1.81E-01**	**3.01E-01**	**5.87E-01**	**3.73E-02**	**2.37E-01**	**3.43E-02**	**1.34E+00**	**2.23E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Harrison County

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	2.01E-01	1.14E-02	7.58E-02	7.58E-03	4.47E-01	7.43E-01	1.31E+00	7.43E-02	4.95E-01	4.95E-02	2.92E+00	4.85E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.62E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**2.01E-01**	**1.14E-02**	**7.58E-02**	**7.58E-03**	**4.47E-01**	**7.43E-01**	**1.37E+00**	**8.14E-02**	**5.31E-01**	**6.37E-02**	**3.07E+00**	**5.12E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Doddridge County

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	4.11E-02	2.33E-03	1.55E-02	1.55E-03	9.16E-02	1.52E-01	2.68E-01	1.52E-02	1.01E-01	1.01E-02	5.98E-01	9.93E-01
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.62E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**4.11E-02**	**2.33E-03**	**1.55E-02**	**1.55E-03**	**9.16E-02**	**1.52E-01**	**3.25E-01**	**2.24E-02**	**1.38E-01**	**2.44E-02**	**7.51E-01**	**1.26E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Lewis County Spread 1

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	2.07E-01	1.17E-02	7.79E-02	7.79E-03	4.60E-01	7.64E-01	1.35E+00	7.63E-02	5.09E-01	5.09E-02	3.00E+00	4.99E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.62E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**2.07E-01**	**1.17E-02**	**7.79E-02**	**7.79E-03**	**4.60E-01**	**7.64E-01**	**1.40E+00**	**8.35E-02**	**5.45E-01**	**6.51E-02**	**3.15E+00**	**5.25E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Wetzel County

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	6.89E-02	3.90E-03	2.60E-02	2.60E-03	1.53E-01	2.55E-01
On-Road Vehicle Travel	5.66E-04	7.21E-05	4.83E-03	5.72E-04	1.49E-03	7.53E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**6.94E-02**	**3.97E-03**	**3.08E-02**	**3.17E-03**	**1.55E-01**	**2.62E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Harrison County

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.70E-01	9.62E-03	6.41E-02	6.41E-03	3.78E-01	6.29E-01
On-Road Vehicle Travel	5.66E-04	7.21E-05	4.83E-03	5.72E-04	1.49E-03	7.53E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.71E-01**	**9.69E-03**	**6.90E-02**	**6.99E-03**	**3.80E-01**	**6.36E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Doddridge County

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	3.48E-02	1.97E-03	1.31E-02	1.31E-03	7.74E-02	1.29E-01
On-Road Vehicle Travel	5.66E-04	7.21E-05	4.83E-03	5.72E-04	1.49E-03	7.53E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**3.54E-02**	**2.04E-03**	**1.80E-02**	**1.88E-03**	**7.89E-02**	**1.36E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Lewis County Spread 1

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.75E-01	9.89E-03	6.59E-02	6.59E-03	3.89E-01	6.46E-01
On-Road Vehicle Travel	5.66E-04	7.21E-05	4.83E-03	5.72E-04	1.49E-03	7.53E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.75E-01**	**9.96E-03**	**7.08E-02**	**7.16E-03**	**3.90E-01**	**6.54E-01**

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2016 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	48	3.74E+00	9.59E+01	3.37E-01	9.07E+00	1.19E-01	1.19E-01	7.41E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	48	6.17E+00	2.13E+00	8.18E-01	9.29E-01	1.42E+00	1.42E+00	3.55E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2016 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Quantity	Operations (hr/week)	(weeks/yr)	Emissions (tpy)						
						NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	6	60	52	1.31E+01	2.87E+00	8.82E-01	1.19E+00	1.22E+00	1.22E+00	3.39E+03
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	15	60	52	5.97E+00	1.54E+02	5.46E-01	1.33E+01	1.50E-01	1.50E-01	1.20E+03
Asphalt Paver	2270002003	153	1	60	52	1.00E+00	9.87E-01	7.98E-02	9.98E-02	1.93E-01	1.93E-01	3.13E+02
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	3	60	52	2.44E+00	3.04E+01	4.95E-01	9.05E-01	1.10E-01	1.10E-01	1.09E+03
Booster/Pumps	2270006010	370	2	60	52	9.31E+00	2.53E+00	3.74E-01	7.76E-01	6.80E-01	6.80E-01	1.35E+03
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	14	60	52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	2	60	52	2.81E+00	2.58E+00	1.74E-01	2.79E-01	4.49E-01	4.49E-01	6.55E+02
Chipper/Shredder	2270004066	20	2	60	52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	2	60	52	9.50E+00	5.03E+00	3.72E-01	1.01E+00	7.78E-01	7.78E-01	1.22E+03
Compactor, Vibratory	2270002009	100	2	60	52	3.17E+00	1.68E+00	1.24E-01	3.38E-01	2.59E-01	2.59E-01	4.05E+02
Concrete Mixer Truck (main pours)	2270002042	150	1	30	52	1.08E+00	5.67E-01	4.28E-02	1.15E-01	1.15E-01	1.15E-01	1.52E+02
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	1	60	52	2.09E+00	7.03E-01	1.44E-01	1.96E-01	2.38E-01	2.38E-01	5.53E+02
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	37	60	52	6.67E+01	2.19E+01	6.76E+00	8.00E+00	1.09E+01	1.09E+01	2.80E+04
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	20	60	52	1.00E+02	5.78E+01	3.93E+00	1.51E+01	1.29E+01	1.29E+01	1.40E+04
Excavator	2270002036	138	29	60	52	1.96E+01	1.91E+01	1.99E+00	2.20E+00	4.34E+00	4.34E+00	8.20E+03
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	10	20	52	1.80E+01	4.85E+00	7.24E-01	1.50E+00	1.28E+00	1.28E+00	2.61E+03
Grader	2270002048	140	2	60	52	1.58E+00	1.57E+00	1.43E-01	1.65E-01	3.29E-01	3.29E-01	5.74E+02
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	1	10	52	3.26E-01	7.22E-02	2.62E-02	3.23E-02	3.61E-02	3.61E-02	1.03E+02
Hydrotest Truck	2270002051	100	1	40	52	6.22E-01	1.91E-01	2.88E-02	4.79E-02	5.43E-02	5.43E-02	1.23E+02
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	6	12	52	7.45E-01	1.64E-01	3.07E-02	3.85E-02	5.19E-02	5.19E-02	1.23E+02
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	50	60	52	2.90E+01	1.03E+01	5.20E+00	5.87E+00	8.62E+00	8.62E+00	2.31E+04

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Quantity	Operations (hr/week)	(weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	12	60	52	1.99E+01	2.26E+02	5.26E+00	6.56E+00	1.15E+00	1.15E+00	1.15E+04
Portable Pipe Bender	2270003040	75	2	60	52	1.85E+00	8.48E-01	8.23E-02	1.22E-01	1.52E-01	1.52E-01	3.04E+02
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	4	60	52	3.73E+00	1.15E+00	1.73E-01	2.88E-01	3.26E-01	3.26E-01	7.38E+02
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	20	60	52	2.33E+01	1.01E+01	2.21E+00	2.68E+00	4.32E+00	4.32E+00	8.85E+03
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	4	60	52	7.37E-01	3.91E-01	2.98E-02	7.39E-02	6.14E-02	6.14E-02	9.72E+01
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	5	60	52	2.90E+00	1.03E+00	5.20E-01	5.87E-01	8.62E-01	8.62E-01	2.31E+03
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	25	60	52	1.60E+01	1.55E+01	6.38E-01	3.38E+00	2.20E+00	2.20E+00	2.08E+03
Welding Rig	2270002051	10	25	60	52	2.33E+00	7.18E-01	1.08E-01	1.80E-01	2.04E-01	2.04E-01	4.61E+02
X-Ray Truck/Machine	2270002051	50	6	60	52	2.80E+00	8.61E-01	1.30E-01	2.16E-01	2.44E-01	2.44E-01	5.53E+02

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Quantity	Operations (hr/week)	(weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	48	3.60E+00	9.41E+01	3.35E-01	7.57E+00	7.15E-02	7.15E-02	7.36E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	48	3.12E+00	1.27E+00	7.89E-01	8.89E-01	1.27E+00	1.27E+00	3.55E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Quantity	Operations (hr/week)	(weeks/yr)	Emissions (tpy)						
						NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment
Engines
Mountain Valley Pipeline - West Virginia Spread 1

Pollutant	2016 Emissions (tpy)	2017 Emissions (tpy)	2018 Emissions (tpy)
Acetaldehyde	5.30E-01	3.46E+00	4.48E-01
Acrolein	3.00E-02	1.96E-01	2.54E-02
Benzene	2.00E-01	1.31E+00	1.69E-01
1,3-Butadiene	2.00E-02	1.31E-01	1.69E-02
Formaldehyde	1.18E+00	7.70E+00	9.98E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 1

Pollutant	2017 Emission Factors (grams/mile)					2018 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.37E-01	3.76E-01	4.58E-01	6.99E+00	3.18E+00	3.15E-01	3.53E-01	4.06E-01	6.38E+00	2.71E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01	1.11E+01	1.10E+01	4.77E-01	8.85E-01	5.15E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.79E-01	4.47E-01	2.37E-01	3.48E-01	2.43E-01	3.61E-01	4.26E-01	2.12E-01	3.28E-01	2.38E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03	1.25E-03	1.42E-03	2.62E-03	9.90E-03	7.19E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04	1.60E-04	1.85E-04	7.40E-04	1.21E-03	8.75E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03	1.59E-02	1.80E-02	4.26E-03	3.61E-03	2.62E-03
1,3-Butadiene	1.85E-03	2.10E-03	2.14E-03	2.23E-03	1.55E-03	1.77E-03	2.01E-03	1.92E-03	2.10E-03	1.52E-03
Formaldehyde	3.38E-03	3.85E-03	9.17E-03	2.85E-02	1.99E-02	3.25E-03	3.68E-03	8.21E-03	2.69E-02	1.95E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 1

Vehicle Type	2017				2018			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0	0	0	0	0
Light-Duty Diesel Truck	50	200	260	2,600,000	0	0	0	0
Light-Duty Gasoline Truck	50	200	260	2,600,000	50	80	240	960,000
Light-Duty Gasoline Vehicle	0	0	0	0	0	0	0	0
Heavy Duty Diesel Vehicle	100	1000	260	26,000,000	0	0	0	0
Fuel Delivery	100	8	260	208,000	50	8	240	96,000

Emissions from On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 1

Pollutant	2017 Annual Emissions (tpy)					2018 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	0.00E+00	1.08E+00	1.31E+00	0.00E+00	9.18E+01	0.00E+00	3.74E-01	0.00E+00	0.00E+00	2.87E-01
CO	0.00E+00	3.24E+01	1.47E+00	0.00E+00	1.70E+01	0.00E+00	1.16E+01	0.00E+00	0.00E+00	5.44E-02
SO_2	0.00E+00	2.52E-02	1.18E-02	0.00E+00	3.06E-01	0.00E+00	9.31E-03	0.00E+00	0.00E+00	1.12E-03
VOC	0.00E+00	1.28E+00	6.78E-01	0.00E+00	7.02E+00	0.00E+00	4.51E-01	0.00E+00	0.00E+00	2.52E-02
PM_{10}	0.00E+00	7.11E-02	1.33E-01	0.00E+00	2.52E+00	0.00E+00	2.62E-02	0.00E+00	0.00E+00	8.06E-03
$PM_{2.5}$	0.00E+00	3.24E-02	8.94E-02	0.00E+00	1.64E+00	0.00E+00	1.20E-02	0.00E+00	0.00E+00	4.93E-03
CO_2	0.00E+00	1.37E+03	1.72E+03	0.00E+00	4.46E+04	0.00E+00	5.07E+02	0.00E+00	0.00E+00	1.63E+02
Acetaldehyde	0.00E+00	4.27E-03	8.37E-03	0.00E+00	2.12E-01	0.00E+00	1.50E-03	0.00E+00	0.00E+00	7.60E-04
Acrolein	0.00E+00	5.45E-04	2.38E-03	0.00E+00	2.59E-02	0.00E+00	1.96E-04	0.00E+00	0.00E+00	9.26E-05
Benzene	0.00E+00	5.41E-02	1.36E-02	0.00E+00	7.73E-02	0.00E+00	1.91E-02	0.00E+00	0.00E+00	2.77E-04
1,3-Butadiene	0.00E+00	6.02E-03	6.13E-03	0.00E+00	4.48E-02	0.00E+00	2.13E-03	0.00E+00	0.00E+00	1.61E-04
Formaldehyde	0.00E+00	1.10E-02	2.63E-02	0.00E+00	5.75E-01	0.00E+00	3.89E-03	0.00E+00	0.00E+00	2.06E-03

Projected Annual Off-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 1

Vehicle Type	2016				2017				2018			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	2	200	240	96,000	5	200	260	260,000	5	200	240	240,000
Dump Trucks	0	0	0	0	5	400	260	520,000	0	0	0	0
Light Duty Trucks	0	0	0	0	15	1000	260	3,900,000	5	200	240	240,000
Medium Duty Trucks	0	0	0	0	15	300	260	1,170,000	0	0	0	0
School Bus	0	0	0	0	15	32	260	124,800	0	0	0	0
Water / Fuel Truck	0	0	0	0	50	100	260	1,300,000	0	0	0	0

Emissions from Off-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 1

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2016 Annual Emissions PM_{10} (tpy)	2016 Annual Emissions $PM_{2.5}$ (tpy)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	2.54	0.25	6.88	0.69	6.35	0.64
Dump Trucks	20	1.52	0.15	75%	0.00	0.00	98.88	9.89	0.00	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.00	0.00	290.93	29.09	17.90	1.79
Medium Duty Trucks	5	0.82	0.08	75%	0.00	0.00	119.23	11.92	0.00	0.00
School Bus	15	1.34	0.13	75%	0.00	0.00	20.85	2.09	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.00	0.00	247.21	24.72	0.00	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Mountain Valley Pipeline - West Virginia Spread 1

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	PM2.5 Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	82140	hr/yr	4.23E+01	2.18E+01
Grading	1.96E+00	2.24E-01	lb/VMT	4688.0	VMT/yr	4.59E+00	5.26E-01

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	947.07
Square Miles:	1.480
Miles in 1 Direction:	1.216
Feet in 1 Direction:	6,423
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	1285
Miles to Clear 1 Direction:	1562.6655
Miles with 50% Safety Factor:	2344.0
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	4687.9965

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Lewis County Spread 2

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	--	--	--	--	--	--	--	18.87	29.97	1.63	3.41	2.73	2.73	5,955.85
On-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	3.33	1.63	--
TOTAL:	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**18.87**	**29.97**	**1.63**	**3.41**	**6.06**	**4.36**	**5,955.85**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Braxton County

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	87.65	139.23	7.58	15.84	12.67	12.67	27,667.64
On-Road Vehicle Travel	--	--	--	--	--	--	--	31.41	16.96	0.11	3.00	0.91	0.59	15,908.14
Off-Road Vehicle Travel	--	--	--	--	0.48	0.05	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	15.48	7.56	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**0.86**	**0.43**	**1,072.02**	**119.06**	**156.19**	**7.69**	**18.85**	**225.0596**	**40.4238**	**43,575.78**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Webster County

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	180.71	287.05	15.62	32.66	26.13	26.13	57,040.82
On-Road Vehicle Travel	--	--	--	--	--	--	--	31.41	16.96	0.11	3.00	0.91	0.59	15,908.14
Off-Road Vehicle Travel	--	--	--	--	0.48	0.05	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	31.92	15.59	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**0.86**	**0.43**	**1,072.02**	**212.11**	**304.01**	**15.74**	**35.67**	**254.95**	**61.91**	**72,948.96**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Nicholas County Spread 2

Source	2016 Construction Emissions (tpy)							2017 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.48	24.51	0.29	2.50	0.39	0.39	1,072.02	74.14	117.78	6.41	13.40	10.72	10.72	23,403.79
On-Road Vehicle Travel	--	--	--	--	--	--	--	31.41	16.96	0.11	3.00	0.91	0.59	15,908.14
Off-Road Vehicle Travel	--	--	--	--	0.48	0.05	--	--	--	--	--	196.00	19.60	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	13.10	6.40	--
TOTAL:	**2.48**	**24.51**	**0.29**	**2.50**	**0.86**	**0.43**	**1,072.02**	**105.55**	**134.74**	**6.52**	**16.41**	**220.72**	**37.31**	**39,311.93**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Lewis County Spread 2

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**0.00**	**0.00**	**0.00**	**0.00**	**0.0000**	**0.0000**	**0.00**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Braxton County

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.12	2.19	0.00	0.09	0.01	0.00	125.73
Off-Road Vehicle Travel	--	--	--	--	4.55	0.45	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.80**	**26.03**	**0.28**	**2.21**	**4.8902**	**0.7938**	**1,196.55**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Webster County

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.12	2.19	0.00	0.09	0.01	0.00	125.73
Off-Road Vehicle Travel	--	--	--	--	4.55	0.45	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.80**	**26.03**	**0.28**	**2.21**	**4.8902**	**0.7938**	**1,196.55**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Nicholas County Spread 2

Source	2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.68	23.84	0.28	2.11	0.34	0.34	1,070.82
On-Road Vehicle Travel	0.12	2.19	0.00	0.09	0.01	0.00	125.73
Off-Road Vehicle Travel	--	--	--	--	4.55	0.45	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.80**	**26.03**	**0.28**	**2.21**	**4.8902**	**0.7938**	**1,196.55**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Lewis County Spread 2

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	--	--	--	--	--	--	1.81E-01	1.02E-02	6.82E-02	6.82E-03	4.02E-01	6.68E-01
On-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.81E-01**	**1.02E-02**	**6.82E-02**	**6.82E-03**	**4.02E-01**	**6.68E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Braxton County

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.32E-01	7.50E-03	5.00E-02	5.00E-03	2.95E-01	4.90E-01	8.40E-01	4.75E-02	3.17E-01	3.17E-02	1.87E+00	3.11E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.63E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.32E-01**	**7.50E-03**	**5.00E-02**	**5.00E-03**	**2.95E-01**	**4.90E-01**	**8.96E-01**	**5.47E-02**	**3.53E-01**	**4.59E-02**	**2.02E+00**	**3.37E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Webster County

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.32E-01	7.50E-03	5.00E-02	5.00E-03	2.95E-01	4.90E-01	1.73E+00	9.80E-02	6.53E-01	6.53E-02	3.85E+00	6.40E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.63E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.32E-01**	**7.50E-03**	**5.00E-02**	**5.00E-03**	**2.95E-01**	**4.90E-01**	**1.79E+00**	**1.05E-01**	**6.90E-01**	**7.96E-02**	**4.01E+00**	**6.67E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Nicholas County Spread 2

Source	2016 Construction Emissions (tpy)						2017 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.32E-01	7.50E-03	5.00E-02	5.00E-03	2.95E-01	4.90E-01	7.10E-01	4.02E-02	2.68E-01	2.68E-02	1.58E+00	2.63E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.61E-02	7.19E-03	3.63E-02	1.42E-02	1.53E-01	2.67E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.32E-01**	**7.50E-03**	**5.00E-02**	**5.00E-03**	**2.95E-01**	**4.90E-01**	**7.66E-01**	**4.74E-02**	**3.04E-01**	**4.10E-02**	**1.73E+00**	**2.89E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Lewis County Spread 2

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Braxton County

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.12E-01	6.34E-03	4.23E-02	4.23E-03	2.50E-01	4.14E-01
On-Road Vehicle Travel	4.25E-04	5.41E-05	3.64E-03	4.30E-04	1.12E-03	5.66E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.13E-01**	**6.40E-03**	**4.59E-02**	**4.66E-03**	**2.51E-01**	**4.20E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Webster County

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.12E-01	6.34E-03	4.23E-02	4.23E-03	2.50E-01	4.14E-01
On-Road Vehicle Travel	4.25E-04	5.41E-05	3.64E-03	4.30E-04	1.12E-03	5.66E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.13E-01**	**6.40E-03**	**4.59E-02**	**4.66E-03**	**2.51E-01**	**4.20E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Nicholas County Spread 2

Source	2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.12E-01	6.34E-03	4.23E-02	4.23E-03	2.50E-01	4.14E-01
On-Road Vehicle Travel	4.25E-04	5.41E-05	3.64E-03	4.30E-04	1.12E-03	5.66E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.13E-01**	**6.40E-03**	**4.59E-02**	**4.66E-03**	**2.51E-01**	**4.20E-01**

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2016 Construction Year Operations Quantity	Operations (hr/week)	Operations (weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	36	2.81E+00	7.19E+01	2.53E-01	6.80E+00	8.95E-02	8.95E-02	5.55E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	36	4.63E+00	1.60E+00	6.14E-01	6.97E-01	1.07E+00	1.07E+00	2.66E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2016 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year Operations Quantity	Operations (hr/week)	Operations (weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	6	60	52	1.31E+01	2.87E+00	8.82E-01	1.19E+00	1.22E+00	1.22E+00	3.39E+03
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	15	60	52	5.97E+00	1.54E+02	5.46E-01	1.33E+01	1.50E-01	1.50E-01	1.20E+03
Asphalt Paver	2270002003	153	1	60	52	1.00E+00	9.87E-01	7.98E-02	9.98E-02	1.93E-01	1.93E-01	3.13E+02
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	3	60	52	2.44E+00	3.04E+01	4.95E-01	9.04E-01	1.10E-01	1.10E-01	1.09E+03
Booster/Pumps	2270006010	370	2	60	52	9.31E+00	2.53E+00	3.74E-01	7.76E-01	6.80E-01	6.80E-01	1.35E+03
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	14	60	52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	2	60	52	2.81E+00	2.58E+00	1.74E-01	2.79E-01	4.49E-01	4.49E-01	6.55E+02
Chipper/Shredder	2270004066	20	2	60	52	6.91E-01	1.76E-01	2.01E-02	4.88E-02	3.76E-02	3.76E-02	7.29E+01
Compactor	2270002009	300	2	60	52	9.50E+00	5.03E+00	3.72E-01	1.01E+00	7.78E-01	7.78E-01	1.22E+03
Compactor, Vibratory	2270002009	100	2	60	52	3.17E+00	1.68E+00	1.24E-01	3.38E-01	2.59E-01	2.59E-01	4.05E+02
Concrete Mixer Truck (main pours)	2270002042	150	1	30	52	1.08E+00	5.67E-01	4.28E-02	1.15E-01	1.15E-01	1.15E-01	1.52E+02
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	1	60	52	2.09E+00	7.03E-01	1.44E-01	1.96E-01	2.38E-01	2.38E-01	5.53E+02
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	37	60	52	6.67E+01	2.19E+01	6.76E+00	8.00E+00	1.09E+01	1.09E+01	2.80E+04
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	20	60	52	1.00E+02	5.78E+01	3.93E+00	1.51E+01	1.29E+01	1.29E+01	1.40E+04
Excavator	2270002036	138	29	60	52	1.96E+01	1.91E+01	1.99E+00	2.20E+00	4.34E+00	4.34E+00	8.20E+03
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	10	20	52	1.80E+01	4.85E+00	7.24E-01	1.50E+00	1.28E+00	1.28E+00	2.61E+03
Grader	2270002048	140	2	60	52	1.58E+00	1.57E+00	1.43E-01	1.65E-01	3.29E-01	3.29E-01	5.74E+02
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	1	10	52	3.26E-01	7.22E-02	2.62E-02	3.23E-02	3.61E-02	3.61E-02	1.03E+02
Hydrotest Truck	2270002051	100	1	40	52	6.22E-01	1.91E-01	2.88E-02	4.79E-02	5.43E-02	5.43E-02	1.23E+02
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	6	12	52	7.45E-01	1.64E-01	3.07E-02	3.85E-02	5.19E-02	5.19E-02	1.23E+02
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	50	60	52	2.90E+01	1.03E+01	5.20E+00	5.87E+00	8.62E+00	8.62E+00	2.31E+04

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	12	60	52	1.99E+01	2.26E+02	5.26E+00	6.56E+00	1.15E+00	1.15E+00	1.15E+04
Portable Pipe Bender	2270003040	75	2	60	52	1.85E+00	8.48E-01	8.23E-02	1.22E-01	1.52E-01	1.52E-01	3.04E+02
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	4	60	52	3.73E+00	1.15E+00	1.73E-01	2.88E-01	3.26E-01	3.26E-01	7.38E+02
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	20	60	52	2.33E+01	1.01E+01	2.21E+00	2.68E+00	4.32E+00	4.32E+00	8.85E+03
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	4	60	52	7.37E-01	3.91E-01	2.98E-02	7.39E-02	6.14E-02	6.14E-02	9.72E+01
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	5	60	52	2.90E+00	1.03E+00	5.20E-01	5.87E-01	8.62E-01	8.62E-01	2.31E+03
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	25	60	52	1.60E+01	1.55E+01	6.38E-01	3.38E+00	2.20E+00	2.20E+00	2.08E+03
Welding Rig	2270002051	10	25	60	52	2.33E+00	7.18E-01	1.08E-01	1.80E-01	2.04E-01	2.04E-01	4.61E+02
X-Ray Truck/Machine	2270002051	50	6	60	52	2.80E+00	8.61E-01	1.30E-01	2.16E-01	2.44E-01	2.44E-01	5.53E+02

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	36	2.70E+00	7.06E+01	2.51E-01	5.68E+00	5.36E-02	5.36E-02	5.52E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	36	2.34E+00	9.54E-01	5.92E-01	6.67E-01	9.54E-01	9.54E-01	2.66E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 2

Pollutant	2016 Emissions (tpy)	2017 Emissions (tpy)	2018 Emissions (tpy)
Acetaldehyde	3.97E-01	3.46E+00	3.36E-01
Acrolein	2.25E-02	1.96E-01	1.90E-02
Benzene	1.50E-01	1.31E+00	1.27E-01
1,3-Butadiene	1.50E-02	1.31E-01	1.27E-02
Formaldehyde	8.85E-01	7.71E+00	7.49E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC	Fraction of VOC
Acetaldehyde	0.053	0.053
Acrolein	0.003	0.003
Benzene	0.020	0.020
1,3-Butadiene	0.002	0.002
Formaldehyde	0.118	0.118

Emission Factors for On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 2

Pollutant	2017 Emission Factors (grams/mile)					2018 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.38E-01	3.77E-01	4.58E-01	6.99E+00	3.18E+00	3.16E-01	3.54E-01	4.06E-01	6.38E+00	2.71E+00
CO	1.13E+01	1.13E+01	5.13E-01	1.01E+00	5.88E-01	1.11E+01	1.10E+01	4.77E-01	8.85E-01	5.15E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02
VOC	3.88E-01	4.59E-01	2.37E-01	3.48E-01	2.43E-01	3.69E-01	4.37E-01	2.12E-01	3.28E-01	2.38E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.31E-03	1.49E-03	2.92E-03	1.05E-02	7.33E-03	1.26E-03	1.43E-03	2.62E-03	9.90E-03	7.19E-03
Acrolein	1.65E-04	1.90E-04	8.30E-04	1.28E-03	8.95E-04	1.60E-04	1.85E-04	7.40E-04	1.21E-03	8.75E-04
Benzene	1.66E-02	1.89E-02	4.75E-03	3.84E-03	2.68E-03	1.59E-02	1.81E-02	4.26E-03	3.61E-03	2.62E-03
1,3-Butadiene	1.86E-03	2.11E-03	2.14E-03	2.23E-03	1.55E-03	1.78E-03	2.02E-03	1.92E-03	2.10E-03	1.52E-03
Formaldehyde	3.39E-03	3.87E-03	9.17E-03	2.85E-02	1.99E-02	3.25E-03	3.69E-03	8.21E-03	2.69E-02	1.95E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.
2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).
3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 2

Vehicle Type	2017				2018			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0	0	0	0	0
Light-Duty Diesel Truck	50	200	260	2,600,000	0	0	0	0
Light-Duty Gasoline Truck	50	200	260	2,600,000	50	60	180	540,000
Light-Duty Gasoline Vehicle	0	0	0	0	0	0	0	0
Heavy Duty Diesel Vehicle	100	1000	260	26,000,000	0	0	0	0
Fuel Delivery	100	8	260	208,000	50	6	180	54,000

Emissions from On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 2

Pollutant	2017 Annual Emissions (tpy)					2018 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	0.00E+00	1.08E+00	1.31E+00	0.00E+00	9.18E+01	0.00E+00	2.11E-01	0.00E+00	0.00E+00	1.61E-01
CO	0.00E+00	3.24E+01	1.47E+00	0.00E+00	1.70E+01	0.00E+00	6.53E+00	0.00E+00	0.00E+00	3.06E-02
SO_2	0.00E+00	2.52E-02	1.18E-02	0.00E+00	3.06E-01	0.00E+00	5.24E-03	0.00E+00	0.00E+00	6.31E-04
VOC	0.00E+00	1.31E+00	6.78E-01	0.00E+00	7.02E+00	0.00E+00	2.60E-01	0.00E+00	0.00E+00	1.42E-02
PM_{10}	0.00E+00	7.11E-02	1.33E-01	0.00E+00	2.52E+00	0.00E+00	1.48E-02	0.00E+00	0.00E+00	4.54E-03
$PM_{2.5}$	0.00E+00	3.24E-02	8.94E-02	0.00E+00	1.64E+00	0.00E+00	6.73E-03	0.00E+00	0.00E+00	2.77E-03
CO_2	0.00E+00	1.37E+03	1.72E+03	0.00E+00	4.46E+04	0.00E+00	2.85E+02	0.00E+00	0.00E+00	9.20E+01
Acetaldehyde	0.00E+00	4.27E-03	8.37E-03	0.00E+00	2.12E-01	0.00E+00	8.48E-04	0.00E+00	0.00E+00	4.28E-04
Acrolein	0.00E+00	5.45E-04	2.38E-03	0.00E+00	2.59E-02	0.00E+00	1.10E-04	0.00E+00	0.00E+00	5.21E-05
Benzene	0.00E+00	5.43E-02	1.36E-02	0.00E+00	7.73E-02	0.00E+00	1.08E-02	0.00E+00	0.00E+00	1.56E-04
1,3-Butadiene	0.00E+00	6.05E-03	6.13E-03	0.00E+00	4.48E-02	0.00E+00	1.20E-03	0.00E+00	0.00E+00	9.05E-05
Formaldehyde	0.00E+00	1.11E-02	2.63E-02	0.00E+00	5.75E-01	0.00E+00	2.19E-03	0.00E+00	0.00E+00	1.16E-03

Projected Annual Off-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 2

Vehicle Type	2016				2017				2018			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	2	150	180	54,000	5	150	260	195,000	5	150	180	135,000
Dump Trucks	0	0	0	0	5	300	260	390,000	0	0	0	0
Light Duty Trucks	0	0	0	0	15	750	260	2,925,000	5	150	180	135,000
Medium Duty Trucks	0	0	0	0	15	225	260	877,500	0	0	0	0
School Bus	0	0	0	0	15	24	260	93,600	0	0	0	0
Water / Fuel Truck	0	0	0	0	50	75	260	975,000	0	0	0	0

Emissions from Off-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 2

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2016 Annual Emissions PM_{10} (tpy)	2016 Annual Emissions $PM_{2.5}$ (tpy)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	1.43	0.14	5.16	0.52	3.57	0.36
Dump Trucks	20	1.52	0.15	75%	0.00	0.00	74.16	7.42	0.00	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.00	0.00	218.20	21.82	10.07	1.01
Medium Duty Trucks	5	0.82	0.08	75%	0.00	0.00	89.42	8.94	0.00	0.00
School Bus	15	1.34	0.13	75%	0.00	0.00	15.64	1.56	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.00	0.00	185.41	18.54	0.00	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Mountain Valley Pipeline - West Virginia Spread 2

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2017	Units of Measure	PM_{10} Emissions (tpy) 2017	PM2.5 Emissions (tpy) 2017
Bulldozing	1.03E+00	5.31E-01	lb/hr	115440	hr/yr	5.94E+01	3.07E+01
Grading	1.96E+00	2.24E-01	lb/VMT	4514.4	VMT/yr	4.42E+00	5.07E-01

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	912.01
Square Miles:	1.425
Miles in 1 Direction:	1.194
Feet in 1 Direction:	6,303
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	1261
Miles to Clear 1 Direction:	1504.8165
Miles with 50% Safety Factor:	2257.2
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	4514.4495

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Nicholas County Spread 3

Source	2017 Construction Emissions (tpy)							2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	--	--	--	--	--	--	--	53.76	90.64	5.22	10.43	8.42	8.42	19,377.21
On-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	11.00	0.10	--
TOTAL:	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**53.76**	**90.64**	**5.22**	**10.43**	**19.42**	**8.52**	**19,377.21**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Greenbriar County

Source	2017 Construction Emissions (tpy)							2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.03	24.11	0.28	2.27	0.35	0.35	1,071.37	92.93	156.69	9.02	18.04	14.55	14.55	33,498.25
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.13	11.95	0.09	2.17	0.60	0.36	11,928.97
Off-Road Vehicle Travel	--	--	--	--	0.69	0.07	--	--	--	--	--	214.23	21.42	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	19.01	0.18	--
TOTAL:	**2.03**	**24.11**	**0.28**	**2.27**	**1.05**	**0.42**	**1,071.37**	**113.06**	**168.63**	**9.11**	**20.21**	**248.39**	**36.52**	**45,427.22**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Fayette County

Source	2017 Construction Emissions (tpy)							2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.03	24.11	0.28	2.27	0.35	0.35	1,071.37	1.74	2.94	0.17	0.34	0.27	0.27	627.60
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.13	11.95	0.09	2.17	0.60	0.36	11,928.97
Off-Road Vehicle Travel	--	--	--	--	0.69	0.07	--	--	--	--	--	214.23	21.42	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	0.36	0.00	--
TOTAL:	**2.03**	**24.11**	**0.28**	**2.27**	**1.05**	**0.42**	**1,071.37**	**21.87**	**14.88**	**0.25**	**2.51**	**215.45**	**22.06**	**12,556.57**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Summers County

Source	2017 Construction Emissions (tpy)							2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.03	24.11	0.28	2.27	0.35	0.35	1,071.37	72.04	121.46	6.99	13.98	11.28	11.28	25,967.03
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.13	11.95	0.09	2.17	0.60	0.36	11,928.97
Off-Road Vehicle Travel	--	--	--	--	0.69	0.07	--	--	--	--	--	214.23	21.42	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	14.74	0.14	--
TOTAL:	**2.03**	**24.11**	**0.28**	**2.27**	**1.05**	**0.42**	**1,071.37**	**92.17**	**133.41**	**7.08**	**16.16**	**240.84**	**33.20**	**37,896.00**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Monroe County

Source	2017 Construction Emissions (tpy)							2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.03	24.11	0.28	2.27	0.35	0.35	1,071.37	95.98	161.82	9.32	18.63	15.03	15.03	34,596.55
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.13	11.95	0.09	2.17	0.60	0.36	11,928.97
Off-Road Vehicle Travel	--	--	--	--	0.69	0.07	--	--	--	--	--	214.23	21.42	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	19.64	0.19	--
TOTAL:	**2.03**	**24.11**	**0.28**	**2.27**	**1.05**	**0.42**	**1,071.37**	**116.11**	**173.77**	**9.40**	**20.80**	**249.49**	**37.00**	**46,525.52**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Nicholas County Spread 3

Source	2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**0.00**	**0.00**	**0.00**	**0.00**	**0.0000**	**0.0000**	**0.00**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Greenbriar County

Source	2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.51	23.65	0.28	2.01	0.32	0.32	1,070.37
On-Road Vehicle Travel	0.15	2.86	0.00	0.11	0.01	0.00	167.66
Off-Road Vehicle Travel	--	--	--	--	6.63	0.66	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.66**	**26.51**	**0.28**	**2.13**	**6.9600**	**0.9904**	**1,238.03**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Fayette County

Source	2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.51	23.65	0.28	2.01	0.32	0.32	1,070.37
On-Road Vehicle Travel	0.15	2.86	0.00	0.11	0.01	0.00	167.66
Off-Road Vehicle Travel	--	--	--	--	6.63	0.66	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.66**	**26.51**	**0.28**	**2.13**	**6.9600**	**0.9904**	**1,238.03**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Summers County

Source	2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.51	23.65	0.28	2.01	0.32	0.32	1,070.37
On-Road Vehicle Travel	0.15	2.86	0.00	0.11	0.01	0.00	167.66
Off-Road Vehicle Travel	--	--	--	--	6.63	0.66	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.66**	**26.51**	**0.28**	**2.13**	**6.9600**	**0.9904**	**1,238.03**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Monroe County

Source	2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.51	23.65	0.28	2.01	0.32	0.32	1,070.37
On-Road Vehicle Travel	0.15	2.86	0.00	0.11	0.01	0.00	167.66
Off-Road Vehicle Travel	--	--	--	--	6.63	0.66	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL:	**1.66**	**26.51**	**0.28**	**2.13**	**6.9600**	**0.9904**	**1,238.03**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Nicholas County Spread 3

Source	2017 Construction Emissions (tpy)						2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	--	--	--	--	--	--	5.53E-01	3.13E-02	2.09E-01	2.09E-02	1.23E+00	2.04E+00
On-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**5.53E-01**	**3.13E-02**	**2.09E-01**	**2.09E-02**	**1.23E+00**	**2.04E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Greenbriar County

Source	2017 Construction Emissions (tpy)						2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.20E-01	6.82E-03	4.54E-02	4.54E-03	2.68E-01	4.45E-01	9.56E-01	5.41E-02	3.61E-01	3.61E-02	2.13E+00	3.53E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.48E-02	6.98E-03	3.49E-02	1.38E-02	1.49E-01	2.60E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.20E-01**	**6.82E-03**	**4.54E-02**	**4.54E-03**	**2.68E-01**	**4.45E-01**	**1.01E+00**	**6.11E-02**	**3.96E-01**	**4.99E-02**	**2.28E+00**	**3.79E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Fayette County

Source	2017 Construction Emissions (tpy)						2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.20E-01	6.82E-03	4.54E-02	4.54E-03	2.68E-01	4.45E-01	1.79E-02	1.01E-03	6.76E-03	6.76E-04	3.99E-02	6.62E-02
On-Road Vehicle Travel	--	--	--	--	--	--	5.48E-02	6.98E-03	3.49E-02	1.38E-02	1.49E-01	2.60E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.20E-01**	**6.82E-03**	**4.54E-02**	**4.54E-03**	**2.68E-01**	**4.45E-01**	**7.27E-02**	**8.00E-03**	**4.17E-02**	**1.45E-02**	**1.89E-01**	**3.26E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Summers County

Source	2017 Construction Emissions (tpy)						2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.20E-01	6.82E-03	4.54E-02	4.54E-03	2.68E-01	4.45E-01	7.41E-01	4.19E-02	2.80E-01	2.80E-02	1.65E+00	2.74E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.48E-02	6.98E-03	3.49E-02	1.38E-02	1.49E-01	2.60E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.20E-01**	**6.82E-03**	**4.54E-02**	**4.54E-03**	**2.68E-01**	**4.45E-01**	**7.96E-01**	**4.89E-02**	**3.15E-01**	**4.18E-02**	**1.80E+00**	**3.00E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Monroe County

Source	2017 Construction Emissions (tpy)						2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.20E-01	6.82E-03	4.54E-02	4.54E-03	2.68E-01	4.45E-01	9.87E-01	5.59E-02	3.73E-01	3.73E-02	2.20E+00	3.65E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.48E-02	6.98E-03	3.49E-02	1.38E-02	1.49E-01	2.60E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL:	**1.20E-01**	**6.82E-03**	**4.54E-02**	**4.54E-03**	**2.68E-01**	**4.45E-01**	**1.04E+00**	**6.29E-02**	**4.07E-01**	**5.10E-02**	**2.35E+00**	**3.91E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Nicholas County Spread 3

Source	2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Greenbriar County

Source	2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.07E-01	2.85E+04	4.02E-02	4.02E-03	2.37E-01	2.85E+04
On-Road Vehicle Travel	5.53E-04	7.02E-05	4.72E-03	5.59E-04	1.45E-03	7.36E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.07E-01**	**2.85E+04**	**4.49E-02**	**4.58E-03**	**2.39E-01**	**2.85E+04**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Fayette County

Source	2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.07E-01	2.85E+04	4.02E-02	4.02E-03	2.37E-01	2.85E+04
On-Road Vehicle Travel	5.53E-04	7.02E-05	4.72E-03	5.59E-04	1.45E-03	7.36E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.07E-01**	**2.85E+04**	**4.49E-02**	**4.58E-03**	**2.39E-01**	**2.85E+04**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Summers County

Source	2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.07E-01	2.85E+04	4.02E-02	4.02E-03	2.37E-01	2.85E+04
On-Road Vehicle Travel	5.53E-04	7.02E-05	4.72E-03	5.59E-04	1.45E-03	7.36E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.07E-01**	**2.85E+04**	**4.49E-02**	**4.58E-03**	**2.39E-01**	**2.85E+04**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Monroe County

Source	2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.07E-01	2.85E+04	4.02E-02	4.02E-03	2.37E-01	2.85E+04
On-Road Vehicle Travel	5.53E-04	7.02E-05	4.72E-03	5.59E-04	1.45E-03	7.36E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL:	**1.07E-01**	**2.85E+04**	**4.49E-02**	**4.58E-03**	**2.39E-01**	**2.85E+04**

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	48	3.67E+00	9.49E+01	3.36E-01	8.19E+00	9.22E-02	9.22E-02	7.38E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	48	4.46E+00	1.58E+00	8.00E-01	9.03E-01	1.33E+00	1.33E+00	3.55E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	6	60	52	1.14E+01	2.53E+00	8.64E-01	1.12E+00	1.21E+00	1.21E+00	3.39E+03
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	15	60	52	5.85E+00	1.53E+02	5.45E-01	1.23E+01	1.16E-01	1.16E-01	1.20E+03
Asphalt Paver	2270002003	153	1	60	52	8.40E-01	8.32E-01	7.76E-02	9.22E-02	1.77E-01	1.77E-01	3.13E+02
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	3	60	52	2.15E+00	2.57E+01	4.94E-01	7.57E-01	1.10E-01	1.10E-01	1.08E+03
Booster/Pumps	2270006010	370	2	60	52	8.64E+00	2.30E+00	3.69E-01	7.31E-01	6.56E-01	6.56E-01	1.35E+03
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	14	60	52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	2	60	52	2.47E+00	2.31E+00	1.71E-01	2.54E-01	4.24E-01	4.24E-01	6.55E+02
Chipper/Shredder	2270004066	20	2	60	52	6.63E-01	1.63E-01	1.98E-02	4.62E-02	3.66E-02	3.66E-02	7.29E+01
Compactor	2270002009	300	2	60	52	9.42E+00	4.97E+00	3.72E-01	9.87E-01	7.66E-01	7.66E-01	1.22E+03
Compactor, Vibratory	2270002009	100	2	60	52	3.14E+00	1.66E+00	1.24E-01	3.29E-01	2.55E-01	2.55E-01	4.05E+02
Concrete Mixer Truck (main pours)	2270002042	150	1	30	52	1.01E+00	5.33E-01	4.23E-02	1.08E-01	1.10E-01	1.10E-01	1.52E+02
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	1	60	52	1.82E+00	6.19E-01	1.41E-01	1.84E-01	2.32E-01	2.32E-01	5.53E+02
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	37	60	52	5.41E+01	1.69E+01	6.56E+00	7.63E+00	1.05E+01	1.05E+01	2.80E+04
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	20	60	52	9.30E+01	5.33E+01	3.88E+00	1.41E+01	1.23E+01	1.23E+01	1.40E+04
Excavator	2270002036	138	29	60	52	1.51E+01	1.43E+01	1.92E+00	2.06E+00	3.80E+00	3.80E+00	8.20E+03
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	10	20	52	1.67E+01	4.41E+00	7.14E-01	1.41E+00	1.24E+00	1.24E+00	2.61E+03
Grader	2270002048	140	2	60	52	1.27E+00	1.25E+00	1.38E-01	1.53E-01	2.94E-01	2.94E-01	5.74E+02
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	1	10	52	2.79E-01	6.17E-02	2.55E-02	3.09E-02	3.60E-02	3.60E-02	1.03E+02
Hydrotest Truck	2270002051	100	1	40	52	5.89E-01	1.61E-01	2.80E-02	4.55E-02	5.34E-02	5.34E-02	1.23E+02
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	6	12	52	7.07E-01	1.29E-01	2.95E-02	3.49E-02	4.94E-02	4.94E-02	1.23E+02
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	50	60	52	2.03E+01	8.27E+00	5.13E+00	5.78E+00	8.27E+00	8.27E+00	2.31E+04

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	12	60	52	1.94E+01	2.14E+02	5.26E+00	6.25E+00	1.15E+00	1.15E+00	1.15E+04
Portable Pipe Bender	2270003040	75	2	60	52	1.78E+00	7.62E-01	8.03E-02	1.11E-01	1.46E-01	1.46E-01	3.04E+02
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	4	60	52	3.54E+00	9.68E-01	1.68E-01	2.73E-01	3.20E-01	3.20E-01	7.38E+02
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	20	60	52	1.91E+01	8.13E+00	2.14E+00	2.54E+00	4.01E+00	4.01E+00	8.85E+03
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	4	60	52	7.37E-01	3.91E-01	2.98E-02	7.39E-02	6.15E-02	6.15E-02	9.72E+01
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	5	60	52	2.03E+00	8.27E-01	5.13E-01	5.78E-01	8.27E-01	8.27E-01	2.31E+03
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	25	60	52	1.56E+01	1.42E+01	6.39E-01	3.04E+00	2.01E+00	2.01E+00	2.08E+03
Welding Rig	2270002051	10	25	60	52	2.21E+00	6.05E-01	1.05E-01	1.71E-01	2.00E-01	2.00E-01	4.61E+02
X-Ray Truck/Machine	2270002051	50	6	60	52	2.65E+00	7.26E-01	1.26E-01	2.05E-01	2.40E-01	2.40E-01	5.53E+02

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

9.30E+01

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Equipment Type	SCC	Max. Engine Rating (hp)	2019 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	48	3.53E+00	9.35E+01	3.34E-01	7.16E+00	5.60E-02	5.60E-02	7.34E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	48	2.50E+00	1.08E+00	7.83E-01	8.81E-01	1.24E+00	1.24E+00	3.55E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Equipment Type	SCC	Max. Engine Rating (hp)	2019 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Mountain Valley Pipeline - West Virginia Spread 3

Pollutant	2017 Emissions (tpy)	2018 Emissions (tpy)	2019 Emissions (tpy)
Acetaldehyde	4.82E-01	3.25E+00	4.26E-01
Acrolein	2.73E-02	1.84E-01	2.41E-02
Benzene	1.82E-01	1.23E+00	1.61E-01
1,3-Butadiene	1.82E-02	1.23E-01	1.61E-02
Formaldehyde	1.07E+00	7.25E+00	9.49E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 3

Pollutant	2018 Emission Factors (grams/mile)					2019 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.13E-01	3.53E-01	4.06E-01	6.38E+00	2.71E+00	2.95E-01	3.39E-01	3.72E-01	5.89E+00	2.37E+00
CO	1.12E+01	1.10E+01	4.77E-01	8.85E-01	5.15E-01	1.10E+01	1.08E+01	4.61E-01	8.31E-01	4.67E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.13E-02	1.06E-02
VOC	3.58E-01	4.25E-01	2.12E-01	3.28E-01	2.38E-01	3.43E-01	4.10E-01	1.99E-01	3.20E-01	2.34E-01
PM_{10}	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02	2.47E-02	2.48E-02	3.87E-02	3.71E-02	7.24E-02
$PM_{2.5}$	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02	1.12E-02	1.13E-02	2.41E-02	2.06E-02	4.31E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.25E-03	1.43E-03	2.62E-03	9.90E-03	7.19E-03	1.21E-03	1.39E-03	2.45E-03	9.66E-03	7.06E-03
Acrolein	1.60E-04	1.85E-04	7.40E-04	1.21E-03	8.75E-04	1.55E-04	1.80E-04	7.00E-04	1.18E-03	8.55E-04
Benzene	1.59E-02	1.81E-02	4.26E-03	3.61E-03	2.62E-03	1.53E-02	1.76E-02	3.99E-03	3.52E-03	2.57E-03
1,3-Butadiene	1.78E-03	2.02E-03	1.92E-03	2.10E-03	1.52E-03	1.71E-03	1.97E-03	1.80E-03	2.05E-03	1.50E-03
Formaldehyde	3.26E-03	3.69E-03	8.21E-03	2.69E-02	1.95E-02	3.14E-03	3.58E-03	7.70E-03	2.62E-02	1.92E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 3

Vehicle Type	2018				2019			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0	0	0	0	0
Light-Duty Diesel Truck	50	200	260	2,600,000	0	0	0	0
Light-Duty Gasoline Truck	50	200	260	2,600,000	50	80	240	960,000
Light-Duty Gasoline Vehicle	0	0	0	0	0	0	0	0
Heavy Duty Diesel Vehicle	100	1000	260	26,000,000	0	0	0	0
Fuel Delivery	100	8	260	208,000	50	8	240	96,000

Emissions from On-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 3

Pollutant	2018 Annual Emissions (tpy)					2019 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	0.00E+00	1.01E+00	1.16E+00	0.00E+00	7.83E+01	0.00E+00	3.59E-01	0.00E+00	0.00E+00	2.51E-01
CO	0.00E+00	3.16E+01	1.37E+00	0.00E+00	1.49E+01	0.00E+00	1.14E+01	0.00E+00	0.00E+00	4.94E-02
SO_2	0.00E+00	2.52E-02	1.18E-02	0.00E+00	3.06E-01	0.00E+00	9.31E-03	0.00E+00	0.00E+00	1.12E-03
VOC	0.00E+00	1.22E+00	6.08E-01	0.00E+00	6.88E+00	0.00E+00	4.33E-01	0.00E+00	0.00E+00	2.48E-02
PM_{10}	0.00E+00	7.11E-02	1.15E-01	0.00E+00	2.20E+00	0.00E+00	2.62E-02	0.00E+00	0.00E+00	7.66E-03
$PM_{2.5}$	0.00E+00	3.24E-02	7.29E-02	0.00E+00	1.35E+00	0.00E+00	1.20E-02	0.00E+00	0.00E+00	4.56E-03
CO_2	0.00E+00	1.37E+03	1.72E+03	0.00E+00	4.46E+04	0.00E+00	5.07E+02	0.00E+00	0.00E+00	1.63E+02
Acetaldehyde	0.00E+00	4.08E-03	7.49E-03	0.00E+00	2.08E-01	0.00E+00	1.47E-03	0.00E+00	0.00E+00	7.47E-04
Acrolein	0.00E+00	5.30E-04	2.12E-03	0.00E+00	2.53E-02	0.00E+00	1.90E-04	0.00E+00	0.00E+00	9.05E-05
Benzene	0.00E+00	5.18E-02	1.22E-02	0.00E+00	7.57E-02	0.00E+00	1.86E-02	0.00E+00	0.00E+00	2.72E-04
1,3-Butadiene	0.00E+00	5.78E-03	5.49E-03	0.00E+00	4.39E-02	0.00E+00	2.08E-03	0.00E+00	0.00E+00	1.58E-04
Formaldehyde	0.00E+00	1.06E-02	2.35E-02	0.00E+00	5.63E-01	0.00E+00	3.79E-03	0.00E+00	0.00E+00	2.03E-03

Projected Annual Off-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 3

Vehicle Type	2017				2017				2018			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	2	200	240	96,000	5	200	260	260,000	5	200	240	240,000
Dump Trucks	0	0	0	0	5	400	260	520,000	0	0	0	0
Light Duty Trucks	0	0	0	0	15	1000	260	3,900,000	5	200	240	240,000
Medium Duty Trucks	0	0	0	0	15	300	260	1,170,000	0	0	0	0
School Bus	0	0	0	0	15	32	260	124,800	0	0	0	0
Water / Fuel Truck	0	0	0	0	50	100	260	1,300,000	0	0	0	0

Emissions from Off-Road Vehicle Travel
Mountain Valley Pipeline - West Virginia Spread 3

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)	2019 Annual Emissions PM_{10} (tpy)	2019 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.23	0.02	75%	2.78	0.28	7.52	0.75	6.94	0.69
Dump Trucks	20	1.66	0.17	75%	0.00	0.00	108.08	10.81	0.00	0.00
Light Duty Trucks	2.5	0.65	0.07	75%	0.00	0.00	318.00	31.80	19.57	1.96
Medium Duty Trucks	5	0.89	0.09	75%	0.00	0.00	130.32	13.03	0.00	0.00
School Bus	15	1.46	0.15	75%	0.00	0.00	22.79	2.28	0.00	0.00
Water / Fuel Truck	20	1.66	0.17	75%	0.00	0.00	270.20	27.02	0.00	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	130			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Mountain Valley Pipeline - West Virginia Spread 3

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2018	Units of Measure	PM_{10} Emissions (tpy) 2018	PM2.5 Emissions (tpy) 20178
Bulldozing	1.03E+00	5.31E-01	lb/hr	115440	hr/yr	5.94E+01	3.07E+01
Grading	1.96E+00	2.24E-01	lb/VMT	5452.7	VMT/yr	5.34E+00	6.12E-01

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2017
Land Disturbed (acres):	0
Square Miles:	0.000
Miles in 1 Direction:	0.000
Feet in 1 Direction:	0
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	0
Miles to Clear 1 Direction:	0
Miles with 50% Safety Factor:	0.0
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	0

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Giles County

Source	Giles County, VA - 2017 Construction Emissions (tpy)							Giles County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.76	20.90	0.25	1.97	0.31	0.31	928.52	119.69	203.15	11.65	23.27	18.80	18.80	43,275.59
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.12	11.42	0.09	2.19	0.60	0.36	11,928.97
Off-Road Vehicle Travel					0.64	0.06						196.00	19.60	
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	24.00	11.81	--
TOTAL (Giles County):	**1.76**	**20.90**	**0.25**	**1.97**	**0.94**	**0.37**	**928.52**	**139.82**	**214.58**	**11.74**	**25.45**	**239.39**	**50.57**	**55,204.57**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Craig County

Source	Craig County, VA - 2017 Construction Emissions (tpy)							Craig County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.76	20.90	0.25	1.97	0.31	0.31	928.52	10.80	18.33	1.05	2.10	1.70	1.70	3,904.56
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.12	11.42	0.09	2.19	0.60	0.36	11,928.97
Off-Road Vehicle Travel					0.64	0.06						196.00	19.60	
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	2.17	1.07	--
TOTAL (Craig County):	**1.76**	**20.90**	**0.25**	**1.97**	**0.94**	**0.37**	**928.52**	**30.92**	**29.75**	**1.14**	**4.29**	**200.45**	**22.72**	**15,833.54**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Montgomery County

Source	Montgomery County, VA - 2017 Construction Emissions (tpy)							Montgomery County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.76	20.90	0.25	1.97	0.31	0.31	928.52	113.39	192.46	11.04	22.04	17.81	17.81	40,997.93
On-Road Vehicle Travel	0.03	0.29	0.00	0.02	0.00	0.00	27.30	20.12	11.42	0.09	2.19	0.60	0.36	11,928.97
Off-Road Vehicle Travel					0.64	0.06						196.00	19.60	
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	22.74	11.18	--
TOTAL (Montgomery County):	**1.79**	**21.19**	**0.25**	**1.98**	**0.94**	**0.37**	**955.82**	**133.52**	**203.89**	**11.13**	**24.23**	**237.14**	**48.95**	**52,926.90**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Roanoke County

Source	Roanoke County, VA - 2017 Construction Emissions (tpy)							Roanoke County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.76	20.90	0.25	1.97	0.31	0.31	928.52	49.80	84.52	4.85	9.68	7.82	7.82	18,004.38
On-Road Vehicle Travel	--	--	--	--	--	--	--	20.12	11.42	0.09	2.19	0.60	0.36	11,928.97
Off-Road Vehicle Travel					0.64	0.06						196.00	19.60	
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	9.99	4.91	--
TOTAL (Roanoke County):	**1.76**	**20.90**	**0.25**	**1.97**	**0.94**	**0.37**	**928.52**	**69.92**	**95.94**	**4.93**	**11.87**	**214.40**	**32.69**	**29,933.35**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Franklin County Spread 1

Source	Franklin County, VA - 2017 Construction Emissions (tpy)							Franklin County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.76	20.90	0.25	1.97	0.31	0.31	928.52	21.81	37.01	2.12	4.24	3.42	3.42	7,884.15
On-Road Vehicle Travel	0.03	0.29	0.00	0.02	0.00	0.00	27.30	20.12	11.42	0.09	2.19	0.60	0.36	11,928.97
Off-Road Vehicle Travel					0.64	0.06						196.00	19.60	
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	4.37	2.15	--
TOTAL (Franklin County):	**1.79**	**21.19**	**0.25**	**1.98**	**0.94**	**0.37**	**955.82**	**41.93**	**48.43**	**2.21**	**6.43**	**204.39**	**25.54**	**19,813.12**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Giles County

Source	Giles County, VA - 2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.31	20.49	0.24	1.74	0.28	0.28	927.65
On-Road Vehicle Travel	0.15	2.68	0.00	0.12	0.01	0.00	167.66
Off-Road Vehicle Travel					6.06	0.61	
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Giles County):	**1.46**	**23.17**	**0.24**	**1.86**	**6.35**	**0.89**	**1,095.31**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Craig County

Source	Craig County, VA - 2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.31	20.49	0.24	1.74	0.28	0.28	927.65
On-Road Vehicle Travel	0.15	2.68	0.00	0.12	0.01	0.00	167.66
Off-Road Vehicle Travel					6.06	0.61	
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Craig County):	**1.46**	**23.17**	**0.24**	**1.86**	**6.35**	**0.89**	**1,095.31**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Montgomery County

Source	Montgomery County, VA - 2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.31	20.49	0.24	1.74	0.28	0.28	927.65
On-Road Vehicle Travel	0.15	2.68	0.00	0.12	0.01	0.00	167.66
Off-Road Vehicle Travel					6.06	0.61	
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Montgomery County):	**1.46**	**23.17**	**0.24**	**1.86**	**6.35**	**0.89**	**1,095.31**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Roanoke County

Source	Roanoke County, VA - 2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.31	20.49	0.24	1.74	0.28	0.28	927.65
On-Road Vehicle Travel	0.15	2.68	0.00	0.12	0.01	0.00	167.66
Off-Road Vehicle Travel					6.06	0.61	
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Roanoke County):	**1.46**	**23.17**	**0.24**	**1.86**	**6.35**	**0.89**	**1,095.31**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Franklin County Spread 1

Source	Franklin County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.31	20.49	0.24	1.74	0.28	0.28	927.65
On-Road Vehicle Travel	0.15	2.68	0.00	0.12	0.01	0.00	167.66
Off-Road Vehicle Travel					6.06	0.61	
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Franklin County):	**1.46**	**23.17**	**0.24**	**1.86**	**6.35**	**0.89**	**1,095.31**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Giles County

Source	Giles County, VA - 2017 Construction Emissions (tpy)						Giles County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.04E-01	5.91E-03	3.94E-02	3.94E-03	2.32E-01	3.86E-01	1.23E+00	6.98E-02	4.65E-01	4.65E-02	2.75E+00	4.56E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.47E-02	6.98E-03	3.43E-02	1.37E-02	1.49E-01	2.59E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Giles County):	**1.04E-01**	**5.91E-03**	**3.94E-02**	**3.94E-03**	**2.32E-01**	**3.86E-01**	**1.29E+00**	**7.68E-02**	**5.00E-01**	**6.03E-02**	**2.89E+00**	**4.82E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Craig County

Source	Craig County, VA - 2017 Construction Emissions (tpy)						Craig County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.04E-01	5.91E-03	3.94E-02	3.94E-03	2.32E-01	3.86E-01	1.11E-01	6.30E-03	4.20E-02	4.20E-03	2.48E-01	4.11E-01
On-Road Vehicle Travel	--	--	--	--	--	--	5.47E-02	6.98E-03	3.43E-02	1.37E-02	1.49E-01	2.59E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Craig County):	**1.04E-01**	**5.91E-03**	**3.94E-02**	**3.94E-03**	**2.32E-01**	**3.86E-01**	**1.66E-01**	**1.33E-02**	**7.63E-02**	**1.79E-02**	**3.97E-01**	**6.71E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Montgomery County

Source	Montgomery County, VA - 2017 Construction Emissions (tpy)						Montgomery County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.04E-01	5.91E-03	3.94E-02	3.94E-03	2.32E-01	3.86E-01	1.17E+00	6.61E-02	4.41E-01	4.41E-02	2.60E+00	4.32E+00
On-Road Vehicle Travel	1.13E-04	2.02E-05	5.26E-04	8.68E-05	3.18E-04	1.06E-03	5.47E-02	6.98E-03	3.43E-02	1.37E-02	1.49E-01	2.59E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Montgomery County):	**1.04E-01**	**5.93E-03**	**3.99E-02**	**4.03E-03**	**2.33E-01**	**3.87E-01**	**1.22E+00**	**7.31E-02**	**4.75E-01**	**5.78E-02**	**2.75E+00**	**4.58E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Roanoke County

Source	Roanoke County, VA - 2017 Construction Emissions (tpy)						Roanoke County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.04E-01	5.91E-03	3.94E-02	3.94E-03	2.32E-01	3.86E-01	5.13E-01	2.90E-02	1.94E-01	1.94E-02	1.14E+00	1.90E+00
On-Road Vehicle Travel	--	--	--	--	--	--	5.47E-02	6.98E-03	3.43E-02	1.37E-02	1.49E-01	2.59E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Roanoke County):	**1.04E-01**	**5.91E-03**	**3.94E-02**	**3.94E-03**	**2.32E-01**	**3.86E-01**	**5.68E-01**	**3.60E-02**	**2.28E-01**	**3.31E-02**	**1.29E+00**	**2.16E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Franklin County Spread 1

Source	Franklin County, VA - 2017 Construction Emissions (tpy)						Franklin County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.04E-01	5.91E-03	3.94E-02	3.94E-03	2.32E-01	3.86E-01	2.25E-01	1.27E-02	8.48E-02	8.48E-03	5.00E-01	8.31E-01
On-Road Vehicle Travel	1.13E-04	2.02E-05	5.26E-04	8.68E-05	3.18E-04	1.06E-03	5.47E-02	6.98E-03	3.43E-02	1.37E-02	1.49E-01	2.59E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Franklin County):	**1.04E-01**	**5.93E-03**	**3.99E-02**	**4.03E-03**	**2.33E-01**	**3.87E-01**	**2.79E-01**	**1.97E-02**	**1.19E-01**	**2.22E-02**	**6.49E-01**	**1.09E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Giles County

Source	Giles County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	9.24E-02	5.23E-03	3.49E-02	3.49E-03	2.06E-01	3.42E-01
On-Road Vehicle Travel	5.37E-04	6.76E-05	4.51E-03	5.38E-04	1.41E-03	7.07E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Giles County):	**9.29E-02**	**5.30E-03**	**3.94E-02**	**4.02E-03**	**2.07E-01**	**3.49E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Craig County

Source	Craig County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	9.24E-02	5.23E-03	3.49E-02	3.49E-03	2.06E-01	3.42E-01
On-Road Vehicle Travel	5.37E-04	6.76E-05	4.51E-03	5.38E-04	1.41E-03	7.07E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Craig County):	**9.29E-02**	**5.30E-03**	**3.94E-02**	**4.02E-03**	**2.07E-01**	**3.49E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Montgomery County

Source	Montgomery County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	9.24E-02	5.23E-03	3.49E-02	3.49E-03	2.06E-01	3.42E-01
On-Road Vehicle Travel	5.37E-04	6.76E-05	4.51E-03	5.38E-04	1.41E-03	7.07E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Montgomery County):	**9.29E-02**	**5.30E-03**	**3.94E-02**	**4.02E-03**	**2.07E-01**	**3.49E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Roanoke County

Source	Roanoke County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	9.24E-02	5.23E-03	3.49E-02	3.49E-03	2.06E-01	3.42E-01
On-Road Vehicle Travel	5.37E-04	6.76E-05	4.51E-03	5.38E-04	1.41E-03	7.07E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Roanoke County):	**9.29E-02**	**5.30E-03**	**3.94E-02**	**4.02E-03**	**2.07E-01**	**3.49E-01**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Franklin County Spread 1

Source	Franklin County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	9.24E-02	5.23E-03	3.49E-02	3.49E-03	2.06E-01	3.42E-01
On-Road Vehicle Travel	5.37E-04	6.76E-05	4.51E-03	5.38E-04	1.41E-03	7.07E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Franklin County):	**9.29E-02**	**5.30E-03**	**3.94E-02**	**4.02E-03**	**2.07E-01**	**3.49E-01**

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year Operations Quantity	Operations (hr/week)	Operations (weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	52	3.98E+00	1.03E+02	3.64E-01	8.87E+00	9.99E-02	9.99E-02	7.99E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	52	4.83E+00	1.71E+00	8.66E-01	9.79E-01	1.44E+00	1.44E+00	3.84E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	6	60	52	1.14E+01	2.53E+00	8.64E-01	1.12E+00	1.21E+00	1.21E+00	3.39E+03
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	15	60	52	5.85E+00	1.53E+02	5.45E-01	1.23E+01	1.16E-01	1.16E-01	1.20E+03
Asphalt Paver	2270002003	153	1	60	52	8.40E-01	8.32E-01	7.76E-02	9.22E-02	1.77E-01	1.77E-01	3.13E+02
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	3	60	52	2.06E+00	2.59E+01	4.94E-01	7.48E-01	1.10E-01	1.10E-01	1.08E+03
Booster/Pumps	2270006010	370	2	60	52	8.64E+00	2.30E+00	3.69E-01	7.31E-01	6.56E-01	6.56E-01	1.35E+03
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	14	60	52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	2	60	52	2.47E+00	2.31E+00	1.71E-01	2.54E-01	4.24E-01	4.24E-01	6.55E+02
Chipper/Shredder	2270004066	20	2	60	52	6.63E-01	1.63E-01	1.98E-02	4.62E-02	3.66E-02	3.66E-02	7.29E+01
Compactor	2270002009	300	2	60	52	9.42E+00	4.97E+00	3.72E-01	9.87E-01	7.66E-01	7.66E-01	1.22E+03
Compactor, Vibratory	2270002009	100	2	60	52	3.14E+00	1.66E+00	1.24E-01	3.29E-01	2.55E-01	2.55E-01	4.05E+02
Concrete Mixer Truck (main pours)	2270002042	150	1	30	52	1.01E+00	5.33E-01	4.23E-02	1.08E-01	1.10E-01	1.10E-01	1.52E+02
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	1	60	52	1.82E+00	6.19E-01	1.41E-01	1.84E-01	2.32E-01	2.32E-01	5.53E+02
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	37	60	52	5.41E+01	1.69E+01	6.56E+00	7.63E+00	1.05E+01	1.05E+01	2.80E+04
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	20	60	52	9.30E+01	5.33E+01	3.88E+00	1.41E+01	1.23E+01	1.23E+01	1.40E+04
Excavator	2270002036	138	29	60	52	1.51E+01	1.43E+01	1.92E+00	2.06E+00	3.80E+00	3.80E+00	8.20E+03
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	10	20	52	1.67E+01	4.41E+00	7.14E-01	1.41E+00	1.24E+00	1.24E+00	2.61E+03
Grader	2270002048	140	2	60	52	1.27E+00	1.25E+00	1.38E-01	1.53E-01	2.94E-01	2.94E-01	5.74E+02
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	1	10	52	2.79E-01	6.17E-02	2.55E-02	3.09E-02	3.60E-02	3.60E-02	1.03E+02
Hydrotest Truck	2270002051	100	1	40	52	5.89E-01	1.61E-01	2.80E-02	4.55E-02	5.34E-02	5.34E-02	1.23E+02
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	6	12	52	7.07E-01	1.29E-01	2.95E-02	3.49E-02	4.94E-02	4.94E-02	1.23E+02
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	50	60	52	2.03E+01	8.27E+00	5.13E+00	5.78E+00	8.27E+00	8.27E+00	2.31E+04

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	12	60	52	1.85E+01	2.15E+02	5.26E+00	6.17E+00	1.15E+00	1.15E+00	1.15E+04
Portable Pipe Bender	2270003040	75	2	60	52	1.78E+00	7.62E-01	8.03E-02	1.11E-01	1.46E-01	1.46E-01	3.04E+02
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	4	60	52	3.54E+00	9.68E-01	1.68E-01	2.73E-01	3.20E-01	3.20E-01	7.38E+02
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	20	60	52	1.91E+01	8.13E+00	2.14E+00	2.54E+00	4.01E+00	4.01E+00	8.85E+03
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	4	60	52	7.37E-01	3.91E-01	2.98E-02	7.39E-02	6.15E-02	6.15E-02	9.72E+01
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	5	60	52	2.03E+00	8.27E-01	5.13E-01	5.78E-01	8.27E-01	8.27E-01	2.31E+03
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	25	60	52	1.56E+01	1.42E+01	6.39E-01	3.04E+00	2.01E+00	2.01E+00	2.08E+03
Welding Rig	2270002051	10	25	60	52	2.21E+00	6.05E-01	1.05E-01	1.71E-01	2.00E-01	2.00E-01	4.61E+02
X-Ray Truck/Machine	2270002051	50	6	60	52	2.65E+00	7.26E-01	1.26E-01	2.05E-01	2.40E-01	2.40E-01	5.53E+02

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2019 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	52	3.82E+00	1.01E+02	3.62E-01	7.76E+00	6.07E-02	6.07E-02	7.95E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	52	2.71E+00	1.17E+00	8.48E-01	9.54E-01	1.34E+00	1.34E+00	3.84E+03

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Equipment Type	SCC	Max. Engine Rating (hp)	2019 Construction Year									
			Operations			Emissions (tpy)						
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 1

Pollutant	2017 Emissions (tpy)	2018 Emissions (tpy)	2019 Emissions (tpy)
Acetaldehyde	5.22E-01	3.25E+00	4.62E-01
Acrolein	2.95E-02	1.84E-01	2.61E-02
Benzene	1.97E-01	1.23E+00	1.74E-01
1,3-Butadiene	1.97E-02	1.23E-01	1.74E-02
Formaldehyde	1.16E+00	7.24E+00	1.03E+00

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 1

Pollutant	2017 Emission Factors (grams/mile)					2018 Emission Factors (grams/mile)					2019 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.34E-01	3.70E-01	4.58E-01	6.99E+00	3.18E+00	3.11E-01	3.48E-01	4.06E-01	6.38E+00	2.71E+00	2.93E-01	3.36E-01	3.72E-01	5.89E+00	2.37E+00
CO	1.05E+01	1.06E+01	5.13E-01	1.01E+00	5.88E-01	1.04E+01	1.03E+01	4.77E-01	8.85E-01	5.15E-01	1.02E+01	1.01E+01	4.61E-01	8.31E-01	4.67E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.13E-02	1.06E-02
VOC	3.91E-01	4.62E-01	2.37E-01	3.48E-01	2.43E-01	3.72E-01	4.41E-01	2.12E-01	3.28E-01	2.38E-01	3.56E-01	4.25E-01	1.99E-01	3.20E-01	2.34E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02	2.47E-02	2.48E-02	3.87E-02	3.71E-02	7.24E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02	1.12E-02	1.13E-02	2.41E-02	2.06E-02	4.31E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.26E-03	1.43E-03	2.92E-03	1.05E-02	7.33E-03	1.20E-03	1.36E-03	2.62E-03	9.90E-03	7.19E-03	1.16E-03	1.33E-03	2.45E-03	9.66E-03	7.06E-03
Acrolein	1.60E-04	1.80E-04	8.30E-04	1.28E-03	8.95E-04	1.55E-04	1.75E-04	7.40E-04	1.21E-03	8.75E-04	1.50E-04	1.70E-04	7.00E-04	1.18E-03	8.55E-04
Benzene	1.59E-02	1.81E-02	4.75E-03	3.84E-03	2.68E-03	1.52E-02	1.73E-02	4.26E-03	3.61E-03	2.62E-03	1.47E-02	1.68E-02	3.99E-03	3.52E-03	2.57E-03
1,3-Butadiene	1.78E-03	2.02E-03	2.14E-03	2.23E-03	1.55E-03	1.71E-03	1.93E-03	1.92E-03	2.10E-03	1.52E-03	1.64E-03	1.89E-03	1.80E-03	2.05E-03	1.50E-03
Formaldehyde	3.26E-03	3.70E-03	9.17E-03	2.85E-02	1.99E-02	3.13E-03	3.53E-03	8.21E-03	2.69E-02	1.95E-02	3.02E-03	3.43E-03	7.70E-03	2.62E-02	1.92E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 1

Vehicle Type	2017				2018				2019			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0	0	0	0	0	0	0	0	0
Light-Duty Diesel Truck	5	20	240	24,000	50	250	260	3,250,000	0	0	0	0
Light-Duty Gasoline Truck	5	20	240	24,000	50	250	260	3,250,000	50	100	240	1,200,000
Light-Duty Gasoline Vehicle	5	20	240	24,000	0	0	0	0	0	0	0	0
Heavy Duty Diesel Vehicle	0	0	0	0	100	1250	260	32,500,000	0	0	0	0
Fuel Delivery	10	4	240	9,600	100	10	260	260,000	50	10	240	120,000

Emissions from On-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 1

Pollutant	2017 Annual Emissions (tpy)					2018 Annual Emissions (tpy)					2019 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	8.82E-03	9.79E-03	1.21E-02	0.00E+00	3.36E-02	0.00E+00	1.25E+00	1.45E+00	0.00E+00	9.79E+01	0.00E+00	4.44E-01	0.00E+00	0.00E+00	3.14E-01
CO	2.79E-01	2.80E-01	1.36E-02	0.00E+00	6.22E-03	0.00E+00	3.68E+01	1.71E+00	0.00E+00	1.86E+01	0.00E+00	1.33E+01	0.00E+00	0.00E+00	6.17E-02
SO_2	1.80E-04	2.33E-04	1.08E-04	0.00E+00	1.12E-04	0.00E+00	3.15E-02	1.47E-02	0.00E+00	3.83E-01	0.00E+00	1.16E-02	0.00E+00	0.00E+00	1.40E-03
VOC	1.03E-02	1.22E-02	6.26E-03	0.00E+00	2.57E-03	0.00E+00	1.58E+00	7.59E-01	0.00E+00	8.59E+00	0.00E+00	5.62E-01	0.00E+00	0.00E+00	3.10E-02
PM_{10}	6.56E-04	6.56E-04	1.23E-03	0.00E+00	9.24E-04	0.00E+00	8.88E-02	1.44E-01	0.00E+00	2.75E+00	0.00E+00	3.28E-02	0.00E+00	0.00E+00	9.57E-03
$PM_{2.5}$	2.96E-04	2.99E-04	8.25E-04	0.00E+00	6.02E-04	0.00E+00	4.05E-02	9.12E-02	0.00E+00	1.68E+00	0.00E+00	1.49E-02	0.00E+00	0.00E+00	5.70E-03
CO_2	9.74E+00	1.27E+01	1.58E+01	0.00E+00	1.64E+01	0.00E+00	1.72E+03	2.14E+03	0.00E+00	5.58E+04	0.00E+00	6.34E+02	0.00E+00	0.00E+00	2.04E+02
Acetaldehyde	3.32E-05	3.77E-05	7.73E-05	0.00E+00	7.76E-05	0.00E+00	4.87E-03	9.37E-03	0.00E+00	2.59E-01	0.00E+00	1.75E-03	0.00E+00	0.00E+00	9.34E-04
Acrolein	4.23E-06	4.76E-06	2.20E-05	0.00E+00	9.47E-06	0.00E+00	6.27E-04	2.65E-03	0.00E+00	3.16E-02	0.00E+00	2.25E-04	0.00E+00	0.00E+00	1.13E-04
Benzene	4.20E-04	4.78E-04	1.26E-04	0.00E+00	2.83E-05	0.00E+00	6.18E-02	1.52E-02	0.00E+00	9.46E-02	0.00E+00	2.22E-02	0.00E+00	0.00E+00	3.40E-04
1,3-Butadiene	4.71E-05	5.34E-05	5.66E-05	0.00E+00	1.64E-05	0.00E+00	6.91E-03	6.86E-03	0.00E+00	5.49E-02	0.00E+00	2.49E-03	0.00E+00	0.00E+00	1.98E-04
Formaldehyde	8.61E-05	9.78E-05	2.42E-04	0.00E+00	2.11E-04	0.00E+00	1.26E-02	2.94E-02	0.00E+00	7.04E-01	0.00E+00	4.54E-03	0.00E+00	0.00E+00	2.54E-03

Projected Annual Off-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 1

Vehicle Type	2017				2018				2019			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	2	250	240	120,000	5	250	260	325,000	5	250	240	300,000
Dump Trucks	0	0	0	0	5	500	260	650,000	0	0	0	0
Light Duty Trucks	0	0	0	0	15	1250	260	4,875,000	5	250	240	300,000
Medium Duty Trucks	0	0	0	0	15	375	260	1,462,500	0	0	0	0
School Bus	0	0	0	0	15	40	260	156,000	0	0	0	0
Water / Fuel Truck	0	0	0	0	50	125	260	1,625,000	0	0	0	0

Emissions from Off-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 1

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)	2019 Annual Emissions PM_{10} (tpy)	2019 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.21	0.02	75%	3.18	0.32	8.60	0.86	7.94	0.79
Dump Trucks	20	1.52	0.15	75%	0.00	0.00	123.60	12.36	0.00	0.00
Light Duty Trucks	2.5	0.60	0.06	75%	0.00	0.00	363.67	36.37	22.38	2.24
Medium Duty Trucks	5	0.82	0.08	75%	0.00	0.00	149.04	14.90	0.00	0.00
School Bus	15	1.34	0.13	75%	0.00	0.00	26.06	2.61	0.00	0.00
Water / Fuel Truck	20	1.52	0.15	75%	0.00	0.00	309.01	30.90	0.00	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	150			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Mountain Valley Pipeline - Virginia Spread 1

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2018	Units of Measure	PM_{10} 2018	$PM_{2.5}$ 2018
Bulldozing	1.03E+00	5.31E-01	lb/hr	115440	hr/yr	5.94E+01	3.07E+01
Grading	1.96E+00	2.24E-01	lb/VMT	3943.8	VMT/yr	3.86E+00	4.43E-01

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2018
Land Disturbed (acres):	796.73
Square Miles:	1.245
Miles in 1 Direction:	1.116
Feet in 1 Direction:	5,891
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	1178
Miles to Clear 1 Direction:	1314.6045
Miles with 50% Safety Factor:	1971.9
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	3943.8135

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Franklin County

Source	Franklin County, VA - 2017 Construction Emissions (tpy)							Franklin County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	--	--	--	--	--	--	--	199.45	338.53	19.42	38.77	31.32	31.32	72,112.16
On-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	40.02	19.67	--
TOTAL (Franklin County):	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**199.45**	**338.53**	**19.42**	**38.77**	**71.34**	**51.00**	**72,112.16**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Pittsylvania County

Source	Pittsylvania County, VA - 2017 Construction Emissions (tpy)							Pittsylvania County, VA - 2018 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	2.03	24.11	0.28	2.27	0.35	0.35	1,071.37	116.04	196.95	11.30	22.56	18.22	18.22	41,954.47
On-Road Vehicle Travel	--	--	--	--	--	--	--	40.25	22.85	0.17	4.37	1.19	0.73	23,857.94
Off-Road Vehicle Travel	--	--	--	--	0.17	0.02	--	--	--	--	--	214.23	21.42	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	23.28	11.45	--
TOTAL (Pittsylvania County):	**2.03**	**24.11**	**0.28**	**2.27**	**0.53**	**0.37**	**1,071.37**	**156.29**	**219.80**	**11.47**	**26.93**	**256.93**	**51.82**	**65,812.41**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Franklin County

Source	Franklin County, VA - 2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	--	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Franklin County):	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Summary of Projected Construction Emissions - Criteria Pollutants
Mountain Valley Pipeline - Pittsylvania County

Source	Pittsylvania County, VA - 2019 Construction Emissions (tpy)						
	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Construction Equipment Engines	1.51	23.65	0.28	2.01	0.32	0.32	1,070.37
On-Road Vehicle Travel	0.08	1.34	0.00	0.06	0.00	0.00	83.83
Off-Road Vehicle Travel	--	--	--	--	1.66	0.17	--
Earthmoving Fugitives	--	--	--	--	--	--	--
TOTAL (Pittsylvania County):	**1.58**	**24.98**	**0.28**	**2.07**	**1.98**	**0.49**	**1,154.20**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Franklin County

Source	Franklin County, VA - 2017 Construction Emissions (tpy)						Franklin County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	--	--	--	--	--	--	2.05E+00	1.16E-01	7.75E-01	7.75E-02	4.57E+00	7.60E+00
On-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Franklin County):	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**2.05E+00**	**1.16E-01**	**7.75E-01**	**7.75E-02**	**4.57E+00**	**7.60E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Pittsylvania County

Source	Pittsylvania County, VA - 2017 Construction Emissions (tpy)						Pittsylvania County, VA - 2018 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.20E-01	6.82E-03	4.54E-02	4.54E-03	2.68E-01	4.45E-01	1.20E+00	6.77E-02	4.51E-01	4.51E-02	2.66E+00	4.42E+00
On-Road Vehicle Travel	--	--	--	--	--	--	1.09E-01	1.40E-02	6.87E-02	2.75E-02	2.99E-01	5.18E-01
Off-Road Vehicle Travel	--	--	--	--	--	--	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL (Pittsylvania County):	**1.20E-01**	**6.82E-03**	**4.54E-02**	**4.54E-03**	**2.68E-01**	**4.45E-01**	**1.30E+00**	**8.16E-02**	**5.20E-01**	**7.26E-02**	**2.96E+00**	**4.94E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Franklin County

Source	Franklin County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	--	--	--	--	--	--
On-Road Vehicle Travel	--	--	--	--	--	--
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Franklin County):	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Summary of Projected Construction Emissions - Selected HAPs
Mountain Valley Pipeline - Pittsylvania County

Source	Pittsylvania County, VA - 2019 Construction Emissions (tpy)					
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Formaldehyde	Total HAPs
Construction Equipment Engines	1.07E-01	6.03E-03	4.02E-02	4.02E-03	2.37E-01	3.94E-01
On-Road Vehicle Travel	2.69E-04	3.38E-05	2.26E-03	2.69E-04	7.07E-04	3.53E-03
Off-Road Vehicle Travel	--	--	--	--	--	--
Earthmoving Fugitives	--	--	--	--	--	--
TOTAL (Pittsylvania County):	**1.07E-01**	**6.07E-03**	**4.25E-02**	**4.29E-03**	**2.38E-01**	**3.98E-01**

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year Operations Quantity	(hr/week)	(weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	12	9.18E-01	2.37E+01	8.40E-02	2.05E+00	2.31E-02	2.31E-02	1.84E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	12	1.12E+00	3.95E-01	2.00E-01	2.26E-01	3.32E-01	3.32E-01	8.87E+02

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2017 Construction Year Operations Quantity	(hr/week)	(weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year Operations Quantity	(hr/week)	(weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	6	60	52	1.14E+01	2.53E+00	8.64E-01	1.12E+00	1.21E+00	1.21E+00	3.39E+03
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	15	60	52	5.85E+00	1.53E+02	5.45E-01	1.23E+01	1.16E-01	1.16E-01	1.20E+03
Asphalt Paver	2270002003	153	1	60	52	8.40E-01	8.32E-01	7.76E-02	9.22E-02	1.77E-01	1.77E-01	3.13E+02
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	3	60	52	2.06E+00	2.59E+01	4.94E-01	7.48E-01	1.10E-01	1.10E-01	1.08E+03
Booster/Pumps	2270006010	370	2	60	52	8.64E+00	2.30E+00	3.69E-01	7.31E-01	6.56E-01	6.56E-01	1.35E+03
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	14	60	52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	2	60	52	2.47E+00	2.31E+00	1.71E-01	2.54E-01	4.24E-01	4.24E-01	6.55E+02
Chipper/Shredder	2270004066	20	2	60	52	6.63E-01	1.63E-01	1.98E-02	4.62E-02	3.66E-02	3.66E-02	7.29E+01
Compactor	2270002009	300	2	60	52	9.42E+00	4.97E+00	3.72E-01	9.87E-01	7.66E-01	7.66E-01	1.22E+03
Compactor, Vibratory	2270002009	100	2	60	52	3.14E+00	1.66E+00	1.24E-01	3.29E-01	2.55E-01	2.55E-01	4.05E+02
Concrete Mixer Truck (main pours)	2270002042	150	1	30	52	1.01E+00	5.33E-01	4.23E-02	1.08E-01	1.10E-01	1.10E-01	1.52E+02
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	1	60	52	1.82E+00	6.19E-01	1.41E-01	1.84E-01	2.32E-01	2.32E-01	5.53E+02
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	37	60	52	5.41E+01	1.69E+01	6.56E+00	7.63E+00	1.05E+01	1.05E+01	2.80E+04
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	20	60	52	9.30E+01	5.33E+01	3.88E+00	1.41E+01	1.23E+01	1.23E+01	1.40E+04
Excavator	2270002036	138	29	60	52	1.51E+01	1.43E+01	1.92E+00	2.06E+00	3.80E+00	3.80E+00	8.20E+03
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	10	20	52	1.67E+01	4.41E+00	7.14E-01	1.41E+00	1.24E+00	1.24E+00	2.61E+03
Grader	2270002048	140	2	60	52	1.27E+00	1.25E+00	1.38E-01	1.53E-01	2.94E-01	2.94E-01	5.74E+02
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	1	10	52	2.79E-01	6.17E-02	2.55E-02	3.09E-02	3.60E-02	3.60E-02	1.03E+02
Hydrotest Truck	2270002051	100	1	40	52	5.89E-01	1.61E-01	2.80E-02	4.55E-02	5.34E-02	5.34E-02	1.23E+02
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	6	12	52	7.07E-01	1.29E-01	2.95E-02	3.49E-02	4.94E-02	4.94E-02	1.23E+02
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	50	60	52	2.03E+01	8.27E+00	5.13E+00	5.78E+00	8.27E+00	8.27E+00	2.31E+04

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2018 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	12	60	52	1.85E+01	2.15E+02	5.26E+00	6.17E+00	1.15E+00	1.15E+00	1.15E+04
Portable Pipe Bender	2270003040	75	2	60	52	1.78E+00	7.62E-01	8.03E-02	1.11E-01	1.46E-01	1.46E-01	3.04E+02
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	4	60	52	3.54E+00	9.68E-01	1.68E-01	2.73E-01	3.20E-01	3.20E-01	7.38E+02
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	20	60	52	1.91E+01	8.13E+00	2.14E+00	2.54E+00	4.01E+00	4.01E+00	8.85E+03
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	4	60	52	7.37E-01	3.91E-01	2.98E-02	7.39E-02	6.15E-02	6.15E-02	9.72E+01
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	5	60	52	2.03E+00	8.27E-01	5.13E-01	5.78E-01	8.27E-01	8.27E-01	2.31E+03
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	25	60	52	1.56E+01	1.42E+01	6.39E-01	3.04E+00	2.01E+00	2.01E+00	2.08E+03
Welding Rig	2270002051	10	25	60	52	2.21E+00	6.05E-01	1.05E-01	1.71E-01	2.00E-01	2.00E-01	4.61E+02
X-Ray Truck/Machine	2270002051	50	6	60	52	2.65E+00	7.26E-01	1.26E-01	2.05E-01	2.40E-01	2.40E-01	5.53E+02

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2019 Construction Year Operations Quantity	(hr/week)	(weeks/yr)	Emissions (tpy) NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Air Compressor A	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Air Compressor B	2270006015	310	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
All Terrain Vehicle (ATV)[1]	2282005015	18	10	60	12	8.82E-01	2.34E+01	8.36E-02	1.79E+00	1.40E-02	1.40E-02	1.83E+02
Asphalt Paver	2270002003	153	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Backhoe	2265002066	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bobcat[2]	2265003040	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Booster/Pumps	2270006010	370	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bucket Truck	2270002051	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chain Saw	2260004020	1	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cherry Picker	2270002081	160	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chipper/Shredder	2270004066	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	2270002009	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	2270002009	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (main pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Mixer Truck (small pours)	2270002042	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Concrete Pumps	2270006010	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Crawler	2270002069	450	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (20 ton)	2270002045	150	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) A	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Crane, Wheeled (250 ton) B	2270002045	715	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cuttings Cleaner System	2270002081	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Digger Derrick	2270002033	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dozers	2270002069	410	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drill Engine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Drilling Rig	2270002033	950	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2270002078	325	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Excavator	2270002036	138	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	2270003020	120	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Front End Loaders	2270002066	196	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generators	2270006005	430	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Grader	2270002048	140	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HDD Rig	2270002033	600	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heavy Lift Crane	2270002045	340	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hydrotest Truck	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Jack Hammer	2270003040	405	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Light Tower	2270002081	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift A	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Man Lift B	2270003010	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Mudd Unit	2270002081	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pickup Trucks	2270002051	250	10	50	12	6.26E-01	2.71E-01	1.96E-01	2.20E-01	3.09E-01	3.09E-01	8.87E+02

Projected Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Equipment Type	SCC	Max. Engine Rating (hp)	2019 Construction Year										
			Operations			Emissions (tpy)							
			Quantity	(hr/week)	(weeks/yr)	NO_X	CO	SO_2	VOC	PM_{10}	$PM_{2.5}$	CO_2
Pile Driver	2270002081	350	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Beveling Machine	2270002081	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pipe Tractor Trailer	2265002066	400	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Portable Pipe Bender	2270003040	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Rigging Loft	2265003010	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Roller	2270002015	300	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scissor Lift	2270003010	20	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
School Bus	2270002051	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Scrapper	2270002018	488	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SideBoom	2270002069	240	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skid Steer Loader	2270002072	75	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stake Bed	2270002081	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sweeper	2270003030	12	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tamper	2260002006	4	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tandem Truck	2270002069	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trackhoe	2265002066	320	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trenching Machines	2270002030	200	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Trowel	2270002081	8	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Water / Fuel Truck	2270002051	250	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welder	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Machine	2270006025	35	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Welding Rig	2270002051	10	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
X-Ray Truck/Machine	2270002051	50	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[1]NONROAD2008a Model does not contain Emission Factors for All Terrain Vehicles (ATVs). Used Emission Factors for Personal Watercraft as a substitution.

[2]NONROAD2008a Model does not contain Emission Factors for Bobcat vehicle type. Used Emission Factors for Other Industrial Equipment vehicle type as a substitution.

Projected HAP Emissions from Construction Equipment Engines
Mountain Valley Pipeline - Virginia Spread 2

Pollutant	2017 Emissions (tpy)	2018 Emissions (tpy)	2019 Emissions (tpy)
Acetaldehyde	1.20E-01	3.25E+00	1.07E-01
Acrolein	6.82E-03	1.84E-01	6.03E-03
Benzene	4.54E-02	1.23E+00	4.02E-02
1,3-Butadiene	4.54E-03	1.23E-01	4.02E-03
Formaldehyde	2.68E-01	7.24E+00	2.37E-01

1. Emissions of HAPs are estimated based on total VOC emissions for the construction year and Table 3.1-3 Air Toxic Fractions of VOC in EPA's guidance document *Final Regulatory Analysis and Control of Emissions from Nonroad Diesel Engines* , EPA420-R-04-007, May 2004.

Pollutant	Fraction of VOC
Acetaldehyde	0.053
Acrolein	0.003
Benzene	0.020
1,3-Butadiene	0.002
Formaldehyde	0.118

Emission Factors for On-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 2

Pollutant	2017 Emission Factors (grams/mile)					2018 Emission Factors (grams/mile)					2019 Emission Factors (grams/mile)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	3.34E-01	3.70E-01	4.58E-01	6.99E+00	3.18E+00	3.11E-01	3.48E-01	4.06E-01	6.38E+00	2.71E+00	2.93E-01	3.36E-01	3.72E-01	5.89E+00	2.37E+00
CO	1.05E+01	1.06E+01	5.13E-01	1.01E+00	5.88E-01	1.04E+01	1.03E+01	4.77E-01	8.85E-01	5.15E-01	1.02E+01	1.01E+01	4.61E-01	8.31E-01	4.67E-01
SO_2	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.12E-02	1.06E-02	6.80E-03	8.80E-03	4.10E-03	1.13E-02	1.06E-02
VOC	3.91E-01	4.62E-01	2.37E-01	3.48E-01	2.43E-01	3.72E-01	4.41E-01	2.12E-01	3.28E-01	2.38E-01	3.56E-01	4.25E-01	1.99E-01	3.20E-01	2.34E-01
PM_{10}	2.48E-02	2.48E-02	4.65E-02	3.71E-02	8.74E-02	2.47E-02	2.48E-02	4.02E-02	3.71E-02	7.62E-02	2.47E-02	2.48E-02	3.87E-02	3.71E-02	7.24E-02
$PM_{2.5}$	1.12E-02	1.13E-02	3.12E-02	2.06E-02	5.69E-02	1.12E-02	1.13E-02	2.55E-02	2.06E-02	4.66E-02	1.12E-02	1.13E-02	2.41E-02	2.06E-02	4.31E-02
CO_2	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.55E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03	3.68E+02	4.79E+02	5.99E+02	1.65E+03	1.54E+03
Acetaldehyde	1.26E-03	1.43E-03	2.92E-03	1.05E-02	7.33E-03	1.20E-03	1.36E-03	2.62E-03	9.90E-03	7.19E-03	1.16E-03	1.33E-03	2.45E-03	9.66E-03	7.06E-03
Acrolein	1.60E-04	1.80E-04	8.30E-04	1.28E-03	8.95E-04	1.55E-04	1.75E-04	7.40E-04	1.21E-03	8.75E-04	1.50E-04	1.70E-04	7.00E-04	1.18E-03	8.55E-04
Benzene	1.59E-02	1.81E-02	4.75E-03	3.84E-03	2.68E-03	1.52E-02	1.73E-02	4.26E-03	3.61E-03	2.62E-03	1.47E-02	1.68E-02	3.99E-03	3.52E-03	2.57E-03
1,3-Butadiene	1.78E-03	2.02E-03	2.14E-03	2.23E-03	1.55E-03	1.71E-03	1.93E-03	1.92E-03	2.10E-03	1.52E-03	1.64E-03	1.89E-03	1.80E-03	2.05E-03	1.50E-03
Formaldehyde	3.26E-03	3.70E-03	9.17E-03	2.85E-02	1.99E-02	3.13E-03	3.53E-03	8.21E-03	2.69E-02	1.95E-02	3.02E-03	3.43E-03	7.70E-03	2.62E-02	1.92E-02

1. The emission factors were calculated using EPA's Mobile6.2 Vehicle Emission Modeling Software. Emission factors for each calendar year are based on average of Mobile6.2 generated factors for winter and summer of that year.

2. Temperatures for winter were based on average temperatures in January, and the temperatures for summer were based on average temperatures in July. The data was extracted from National Oceanic and Atmospheric Administration (NOAA) website (http://www.ncdc.noaa.gov/cdo-web/datatools/normals) based on data collected from 1981 to 2010 by the Morgantown Hart Field, WV Station (COOP ID 466202).

3. Fuel assumptions included conventional gasoline, with an average RVP limit of 9 psi, and diesel with average sulfur content of 11 ppm.

Projected Annual On-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 2

Vehicle Type	2017				2018				2019			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
Commuter Bus	0	0	0	0	0	0	0	0	0	0	0	0
Light-Duty Diesel Truck	0	0	0	0	50	100	260	1,300,000	0	0	0	0
Light-Duty Gasoline Truck	0	0	0	0	50	100	260	1,300,000	50	40	60	120,000
Light-Duty Gasoline Vehicle	0	0	0	0	0	0	0	0	0	0	0	0
Heavy Duty Diesel Vehicle	0	0	0	0	100	500	260	13,000,000	0	0	0	0
Fuel Delivery	0	0	0	0	100	4	260	104,000	50	4	60	12,000

Emissions from On-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 2

Pollutant	2017 Annual Emissions (tpy)					2018 Annual Emissions (tpy)					2019 Annual Emissions (tpy)				
	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV	LDGV	LDGT	LDDT	COM BUS	HDDV
NO_X	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-01	5.81E-01	0.00E+00	3.92E+01	0.00E+00	4.44E-02	0.00E+00	0.00E+00	3.14E-02
CO	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E+01	6.84E-01	0.00E+00	7.43E+00	0.00E+00	1.33E+00	0.00E+00	0.00E+00	6.17E-03
SO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-02	5.88E-03	0.00E+00	1.53E-01	0.00E+00	1.16E-03	0.00E+00	0.00E+00	1.40E-04
VOC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.31E-01	3.04E-01	0.00E+00	3.44E+00	0.00E+00	5.62E-02	0.00E+00	0.00E+00	3.10E-03
PM_{10}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.55E-02	5.76E-02	0.00E+00	1.10E+00	0.00E+00	3.28E-03	0.00E+00	0.00E+00	9.57E-04
$PM_{2.5}$	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-02	3.65E-02	0.00E+00	6.73E-01	0.00E+00	1.49E-03	0.00E+00	0.00E+00	5.70E-04
CO_2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.87E+02	8.58E+02	0.00E+00	2.23E+04	0.00E+00	6.34E+01	0.00E+00	0.00E+00	2.04E+01
Acetaldehyde	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-03	3.75E-03	0.00E+00	1.04E-01	0.00E+00	1.75E-04	0.00E+00	0.00E+00	9.34E-05
Acrolein	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.51E-04	1.06E-03	0.00E+00	1.26E-02	0.00E+00	2.25E-05	0.00E+00	0.00E+00	1.13E-05
Benzene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-02	6.10E-03	0.00E+00	3.78E-02	0.00E+00	2.22E-03	0.00E+00	0.00E+00	3.40E-05
1,3-Butadiene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E-03	2.74E-03	0.00E+00	2.20E-02	0.00E+00	2.49E-04	0.00E+00	0.00E+00	1.98E-05
Formaldehyde	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.06E-03	1.18E-02	0.00E+00	2.82E-01	0.00E+00	4.54E-04	0.00E+00	0.00E+00	2.54E-04

Projected Annual Off-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 2

Vehicle Type	2017				2018				2019			
	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year	Round Trip (miles)	Trips per Day	Days/Year	Total Miles Per Year
All Terrain Vehicle (ATV)	2	50	60	6,000	5	50	260	65,000	5	50	60	15,000
Dump Trucks	0	0	0	0	5	100	260	130,000	0	0	0	0
Light Duty Trucks	0	0	0	0	15	250	260	975,000	5	50	60	15,000
Medium Duty Trucks	0	0	0	0	15	75	260	292,500	0	0	0	0
School Bus	0	0	0	0	15	8	260	31,200	0	0	0	0
Water / Fuel Truck	0	0	0	0	50	25	260	325,000	0	0	0	0

Emissions from Off-Road Vehicle Travel
Mountain Valley Pipeline - Virginia Spread 2

Vehicle Type	Mean Vehicle Weight (tons)	Emission Factor[1] PM_{10} (lb/VMT)	Emission Factor[1] $PM_{2.5}$ (lb/VMT)	Control Efficiency[2] (%)	2017 Annual Emissions PM_{10} (tpy)	2017 Annual Emissions $PM_{2.5}$ (tpy)	2018 Annual Emissions PM_{10} (tpy)	2018 Annual Emissions $PM_{2.5}$ (tpy)	2019 Annual Emissions PM_{10} (tpy)	2019 Annual Emissions $PM_{2.5}$ (tpy)
All Terrain Vehicle (ATV)	0.25	0.23	0.02	75%	0.17	0.02	1.88	0.19	0.43	0.04
Dump Trucks	20	1.66	0.17	75%	0.00	0.00	27.02	2.70	0.00	0.00
Light Duty Trucks	2.5	0.65	0.07	75%	0.00	0.00	79.50	7.95	1.22	0.12
Medium Duty Trucks	5	0.89	0.09	75%	0.00	0.00	32.58	3.26	0.00	0.00
School Bus	15	1.46	0.15	75%	0.00	0.00	5.70	0.57	0.00	0.00
Water / Fuel Truck	20	1.66	0.17	75%	0.00	0.00	67.55	6.76	0.00	0.00

1. Emission factors calculated in accordance with AP-42 Section 13.2.2:

Unpaved Roads: $E = k(s/12)^a(W/3)^b*[(365-p)/365]$

k Factor (PM_{10}, $PM_{2.5}$) (lb/VMT)	1.5		0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	8.5	%		AP-42 Table 13.2.2-1 (Final, 11/06)
Number of Rain Days, p	130			AP-42 Figure 13.2.2-1 (Final, 11/06)
a (PM_{10}, $PM_{2.5}$)	0.9		0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b (PM_{10}, $PM_{2.5}$)	0.45		0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

2. Assumed average dust control efficiency for road watering from AP-42 Section 13.2.2 and related background documents.

Projected Fugitive Dust Emissions from Earthmoving
Mountain Valley Pipeline - Virginia Spread 2

On-Site Activity	Emission Factors[1] PM_{10}	$PM_{2.5}$	Units of Measure	Operation[2] 2018	Units of Measure	PM_{10} 2018	$PM_{2.5}$ 2018
Bulldozing	1.03E+00	5.31E-01	lb/hr	115440	hr/yr	5.94E+01	3.07E+01
Grading	1.96E+00	2.24E-01	lb/VMT	3972.4	VMT/yr	3.89E+00	4.46E-01

1. Emissions were calculated using emission factor equations from Table 11.9-1, Compilation of Air Pollutant Emission Factors, USEPA AP-42, Fifth Edition, 10/98.

For bulldozing:

PM_{10} emissions factor (lb/hr) = 0.75 * [1.0 (s)^1.5 / (M)^1.4]

$PM_{2.5}$ emission factor (lb/hr) = 0.105 * [5.7(s)^1.2 / (M)^1.3]

For grading:

PM_{10} emission factor (lb/VMT) = 0.60 * [0.051 (S)^2.0]

$PM_{2.5}$ emission factor (lb/VMT) = 0.031 * [0.040 (S)^2.5]

Where:

s (Silt Content) =	8.5
M (Moisture Content) =	7.9
S (Vehicle Speed) =	8

2. Vehicle miles traveled for grading calculate based on amount of land disturbed during construction each year, as follows:

	2018
Land Disturbed (acres):	802.5
Square Miles:	1.254
Miles in 1 Direction:	1.120
Feet in 1 Direction:	5,912
Clearance of Grader (ft):	5
Number of Trips for 1 Grade:	1182
Miles to Clear 1 Direction:	1324.125
Miles with 50% Safety Factor:	1986.2
Number of Times to Go Over Surface:	2
Total Travel (VMT/yr):	3972.375

Material Handling Potential Emissions
Soil Pile Erosion Emissions

Material Storage Pile Wind Erosion Annual Emissions

Material Pile Description	Size (acres)[3]	Emission Control Method	Control Efficiency[4]	Emission Factor[1]			Unit	2017 Emissions (tpy)[5]			2018 Emissions (tpy)[5]		
				PM	PM_{10}	$PM_{2.5}$		PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Bradshaw Compressor Station Stockpiles	0.092	Mulch/seeding	75%	0.27	0.14	0.02	lb/day/acre	0.0045	0.00	0.00	--	--	--
Harris Compressor Station Stockpiles	0.092	Mulch/seeding	75%	1.18	0.59	0.09	lb/day/acre	0.00	0.00	0.00	--	--	--
Stallworth Compressor Station Stockpiles	0.092	Mulch/seeding	75%	1.96	0.98	0.15	lb/day/acre	0.03	0.02	0.00	--	--	--
Compressor Station Total	0.275	Mulch/seeding	75%	--	--	--	--	0.04	0.02	0.00	--	--	--
Wetzel --> Lewis Spread Total	90.9	Mulch/seeding	75%	0.27	0.14	0.02	lb/day/acre	4.50	2.25	0.34	--	--	--
Pipeline Soil Piles in Wetzel, WV	14.0			0.27	0.14	0.02	lb/day/acre	0.69	0.35	0.05	--	--	--
Pipeline Soil Piles in Harrison, WV	34.5			0.27	0.14	0.02	lb/day/acre	1.71	0.85	0.13	--	--	--
Pipeline Soil Piles in Doddridge, WV	7.1			0.27	0.14	0.02	lb/day/acre	0.35	0.17	0.03	--	--	--
Pipeline Soil Piles in Lewis, WV	35.4			0.27	0.14	0.02	lb/day/acre	1.75	0.88	0.13	--	--	--
Lewis --> Nicholas Spread Total	87.5	Mulch/seeding	75%	1.18	0.59	0.09	lb/day/acre	18.89	9.45	1.42	--	--	--
Pipeline Soil Piles in Lewis, WV	4.6			1.18	0.59	0.09	lb/day/acre	0.99	0.49	0.07	--	--	--
Pipeline Soil Piles in Braxton, WV	21.2			1.18	0.59	0.09	lb/day/acre	4.58	2.29	0.34	--	--	--
Pipeline Soil Piles in Webster, WV	43.8			1.18	0.59	0.09	lb/day/acre	9.45	4.72	0.71	--	--	--
Pipeline Soil Piles in Nicholas, WV	18.0			1.18	0.59	0.09	lb/day/acre	3.88	1.94	0.29	--	--	--
Nicholas --> Monroe Spread Total	105.7	Mulch/seeding	75%	1.96	0.98	0.15	lb/day/acre	--	--	--	37.87	18.94	2.84
Pipeline Soil Piles in Nicholas, WV	18.0			1.96	0.98	0.15	lb/day/acre	--	--	--	6.43	3.22	0.48
Pipeline Soil Piles in Greenbrier, WV	31.1			1.96	0.98	0.15	lb/day/acre	--	--	--	11.12	5.56	0.83
Pipeline Soil Piles in Fayette, WV	0.6			1.96	0.98	0.15	lb/day/acre	--	--	--	0.21	0.10	0.02
Pipeline Soil Piles in Summers, WV	24.1			1.96	0.98	0.15	lb/day/acre	--	--	--	8.62	4.31	0.65
Pipeline Soil Piles in Monroe, WV	32.1			1.96	0.98	0.15	lb/day/acre	--	--	--	11.49	5.74	0.86
Giles --> Franklin Spread Total	76.5	Mulch/seeding	75%	2.35	1.18	0.18	lb/day/acre	--	--	--	32.85	16.43	2.46
Pipeline Soil Piles in Giles, VA	29.0			2.35	1.18	0.18	lb/day/acre	--	--	--	12.47	6.23	0.93
Pipeline Soil Piles in Craig, VA	2.6			2.35	1.18	0.18	lb/day/acre	--	--	--	1.12	0.56	0.08
Pipeline Soil Piles in Montgomery, VA	27.5			2.35	1.18	0.18	lb/day/acre	--	--	--	11.81	5.90	0.89
Pipeline Soil Piles in Roanoke, VA	12.1			2.35	1.18	0.18	lb/day/acre	--	--	--	5.19	2.59	0.39
Pipeline Soil Piles in Franklin, VA	5.3			2.35	1.18	0.18	lb/day/acre	--	--	--	2.27	1.13	0.17
Franklin --> Pittsylvania Spread Total	77.0	Mulch/seeding	75%	2.35	1.18	0.18	lb/day/acre	--	--	--	33.08	16.54	2.48
Pipeline Soil Piles in Franklin, VA	48.7			2.35	1.18	0.18	lb/day/acre	--	--	--	20.91	10.46	1.57
Pipeline Soil Piles in Pittsylvania, VA	28.3			2.35	1.18	0.18	lb/day/acre	--	--	--	12.17	6.08	0.91
Pipeline Soil Piles Total	437.70	Mulch/seeding	75%	--	--	--	--	23.39	11.70	1.75	103.81	51.90	7.79
Mobely Interconnect Stockpiles	0.073			0.27	0.14	0.02	lb/day/acre	0.00	0.00	0.00	--	--	--
Sherwood Interconnect Stockpiles	0.073			0.27	0.14	0.02	lb/day/acre	0.00	0.00	0.00	--	--	--
Transco Interconnect Stockpiles	0.073			2.35	1.18	0.18	lb/day/acre	--	--	--	0.03	0.02	0.00
Roanoke Interconnect Stockpiles	0.073			2.35	1.18	0.18	lb/day/acre	--	--	--	0.03	0.02	0.00
WB/TCO Interconnect Stockpiles	0.073			1.18	0.59	0.09	lb/day/acre	0.02	0.01	0.00	--	--	--
Interconnect Total	0.367	Mulch/seeding	75%	--	--	--	--	0.02	0.01	0.00	0.06	0.03	0.00
Total Stockpile Erosion Emissions								**23.45**	**11.73**	**1.76**	**103.87**	**51.93**	**7.79**

[1]USEPA, 1992 (Fugitive Dust Background and Technical Information Document for Best Available Control Measures, Section 2.3.1.3.3, Wind Emissions from Continuously Active Piles). USEPA, 2006 13.2.5 for k factors:

EF (lb/day/acre) = k x 1.7 x (s/1.5) x ((365 - p)/235) x (f/15)*(1-% Control Efficiency)

[2]Total PM assumed to be equal to PM < 30 µm

	Bradshaw	Harris	Stallworth	Swann[6]
Days of precipitation greater than or equal to 0.01 inch (p)	149.8	174.9	157.3	115.9
Time (%) that unobstructed wind speed exceeds 5.4 m/s at mean pile height (f)	1.8	9.1	13.8	13.8

Silt Content (%), (s)	8.5	
Particle Size multiplier (k)	1	(for PM < 30 µm)
	0.5	(for PM < 10 µm)
	0.075	(for PM < 2.5 µm)

[3]Soil Pile Areas:

Compressor Stations Stockpile Area:	2	stockpiles	
	50	ft. wide	
	40	ft. wide	
	0.092	**acres**	
Pipeline Soil Pile Area:	1	pile per spread	
	4	ft. wide (topsoil)	
	8	ft. wide (subsoil)	
	62.51	miles long	Wetzel --> Lewis Spread
	90.9	**acres**	
	60.19	miles long	Lewis --> Nicholas Spread
	87.5	**acres**	
	72.7	miles long	Nicholas --> Monroe Spread
	105.7	**acres**	
	52.58	miles long	Giles --> Franklin Spread
	76.5	**acres**	
	52.94	miles long	Franklin --> Pittsylvania Spread
	77.0	**acres**	
Interconnects Stockpile Area:[7]	2	stockpiles	
	0.073	**acres**	

[4]Engineering estimate for control efficiency from use of mulch/seeding to control erosion.

[5]Emissions are based on the assumption that each station and pipeline county is completed within a calendar year.

[6]Assumed to be the same as Stallworth Station.

[7]Interconnects stockpiles are 20% smaller in size at interconnects than at compressor stations per conversation with Trever Leamon on 9/4/2015

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-B
Operational Emissions Calculations

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 1. Turbine Emissions Calculations

Turbine Information:

Source ID:	S001-S004
Manufacturer:	Solar
Model No.:	Titan 130
Year Installed:	TBD
Fuel Used:	Natural Gas
Fuel Heating Value (Btu/scf):	979
Rated Horsepower (bhp at site-specific conditions):	23536
Maximum Fuel Consumption at 100% Load (scf/hr):	172654
Heat Input (MMBtu/hr)	169.08
Control Device:	SoloNOx Technology
Stack Designation:	TBD

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	1,512.45
Potential Startup/Shutdown Events (per year):	12

Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units	Emission Factor Source
NO_X	9.800	lb/hr	Manufacturer
CO	9.900	lb/hr	Manufacturer
SO_2	3.54E-03	lb/MMBtu	AP-42, Table 3.1-2a
PM_{10}	0.016	lb/MMBtu	Manufacturer, PIL 171
$PM_{2.5}$	0.016	lb/MMBtu	Manufacturer, PIL 171
VOC	1.140	lb/hr	20% of UHC per Manufacturer
Formaldehyde	0.003	lb/MMBtu	Manufacturer, PIL 168
CO_2	122.82	lb/MMBtu	40 CFR 98, Subpart C, Table C-1
CH_4	4.560	lb/hr	80% of UHC per Manufacturer
N_2O	2.3E-04	lb/MMBtu	40 CFR 98, Subpart C, Table C-2

*Emission factors from AP-42 and Subpart C are based on HHV. To calculate a LHV emission factor, emissions are multiplied by (HHV/LHV). For AP-42 HHV is 1020 Btu/scf, for Subpart C HHV is 1028 Btu/scf. PM and HCHO emission factors are provided in HHV in the specifications and were converted to LHV using a HHV value of 1020 Btu/scf.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 1. Turbine Emissions Calculations

Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2]
NO_X	9.80	42.95
CO	9.90	45.67
SO_2	0.60	2.62
PM_{10}	2.64	11.57
$PM_{2.5}$	2.64	11.57
VOC	1.14	5.02
Formaldehyde	0.51	2.22
CO_2	20,766	90,968
CH_4	4.56	24.42
N_2O	0.04	0.17
GHG (CO_2e)	20,891	91,630

*Annual emissions shown above include startup/shutdown events.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 1. Turbine Emissions Calculations

Hazardous Air Pollutant (HAP) Emission Rates:

Pollutant	Emission Factor (lb/MMBtu)[3]	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2,4]
HAPs:			
Acetaldehyde	4.17E-05	7.04E-03	3.09E-02
Acrolein	6.67E-06	1.13E-03	4.94E-03
Benzene	1.25E-05	2.11E-03	9.26E-03
1,3-Butadiene	4.48E-07	7.57E-05	3.32E-04
Propylene Oxide	2.90E-05	4.90E-03	2.15E-02
Ethylbenzene	3.33E-05	5.64E-03	2.47E-02
Toluene	1.35E-04	2.29E-02	1.00E-01
Xylene	6.67E-05	1.13E-02	4.94E-02
Polycyclic Organic Matter:			
Naphthalene	1.35E-06	2.29E-04	1.00E-03
PAH	2.29E-06	3.87E-04	1.70E-03
Total HAP (Including HCHO)		**0.56**	**2.47**

1. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (lb/MMBtu)
2. Emission Rate (tpy) = Emission Rate (lb/hr) × Hours of Operation (hr/yr) / 2000 (tons/lb) + SU/SD emissions, as applicable
3. Emission factors from AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000. Factors are based on HHV. Therefore, they were converted to LHV by multiplying by (HHV/LHV).
4. Emission calculations are based on maxomum operating load of 100%, ambient temperature 0°F and site elevation. The turbine rating can vary with ambient conditions. Each Turbine is ISO rated at 22,400 HP

Startup/Shutdown Combustion Emission Factors:

Pollutant	Startup Emissions[a] (lbs/event)	Shutdown Emissions[a] (lbs/event)	Emission Factor Source
NO_X	1.9	2.4	Manufacturer
CO	176.9	207.6	Manufacturer
VOC	2.0	2.38	20% of UHC per Manufacturer
CO_2	1161	1272	Manufacturer

[a] Each startup and shutdown event is estimated to last approximately 10 minutes, per manufacturer.

Pneumatic Start Venting Emissions		
Natural Gas Purged During Startup	4500	scfm
Duration of Normal Purge	4.0	min
Total Gas Purged (Per Startup)	18000	scf
VOC Purged (Per Startup)	27	lbs/startup
CO_2 Purged (Per Startup)	6	lbs/startup
CH_4 Purged (Per Startup)	742	lbs/startup

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

*Current design includes electric motor starts, but pneumatic starts have been included as a conservative measure.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 2. Microturbine Emissions Calculations

Microturbine Unit Information:

Engine ID:	S005-S018
Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	14

Microturbine Fuel Information:

	Per Unit
Fuel Type:	Natural Gas
Rated Electrical Power Output (kW):	200
Rated Electrical Power Output (MW):	0.2
Rated Horsepower (bhp):	268.2
Heat Input (MMBtu/hr)	2.28
Potential Fuel Consumption (MMBtu/yr):	19,973
Max. Annual Hours of Operation (hr/yr):	8,760

Microturbine Emissions Data:

Pollutant	**Emission Factors**	**Units**	**Maximum Potential Emissions Per Unit**		**Estimation Basis / Emission Factor Source**
			lbs/hr	**tpy**	
NO_X	0.40	lb/MWhe	0.08	0.35	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.02	0.09	Manufacturer's Specifications
CO	1.10	lb/MWhe	0.22	0.96	Manufacturer's Specifications
SO_X	0.0034	lb/MMBtu	0.01	0.03	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.02	0.07	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.02	0.07	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		266	1,166	Manufacturer's Specifications / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHC

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 2. Microturbine Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	1330	lb/MWhe	266	1,165	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**266**	**1,166**	
HAPs:					
1,3-Butadiene	4.3E-07	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.002**	**0.010**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 3. Fuel Gas Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S019-S020
Projected Startup Date:	Upon Approval
Number of Units:	2

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	2.31
Potential Fuel Consumption (MMBtu/yr):	20,215
Max. Fuel Consumption (MMscf/hr):	0.0021
Max. Fuel Consumption (MMscf/yr):	18.7
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.21	0.93	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.01	0.05	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.18	0.78	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.01	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		270	1,184	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.02	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 3. Fuel Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	269.99	1,183	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**270**	**1,184**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.02	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.004**	**0.02**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 4. Storage Tank Emissions Calculations - Produced Fluids Tank

Storage Tank Information:

Source ID:	S021
Tank Capacity (gallons):	10,080
Tank Contents:	Produced Fluids
Annual Throughput (gallons/year):	126,000
Daily Throughput (bbl/day)	8
Percent Condensate	1%
Condensate Throughput (bbl/day)	0.1
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.05	0.21	0.05	0.21	E&P TANK 2.0
HAPs	0.00	0.00	0.00	0.00	E&P TANK 2.0
GHG (CO2e)	0.48	2.10	0.48	2.10	E&P TANK 2.0

E & P Tanks Emissions Data:

Pollutant	Total Emissions (Working + Breathing + Flashing)			Total Emissions		
	lbs/hr	lbs/yr	tpy	lbs/hr	lbs/yr	tpy
VOC	0.05	429.24	0.21	0.05	429.24	0.21
HAPs	0.00	0.00	0.00	0.00	0.00	0.00
GHG (CO_2e)	0.48	4,161.00	2.10	0.48	4,161.00	2.10

Notes:
1. E & P TANKS software estimates working, breathing, and flashing losses and reports as one total. Emissions are based on a conservative estimate of 99% water and 1% condensate

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 5. Storage Tank Emissions Calculations - Used Oil Tank

Storage Tank Information:

Source ID:	S022
Tank Capacity (gallons):	4,200
Tank Contents:	Used Oil
Annual Throughput (gallons/year):	12,600
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
HAPs	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
GHG (CO_2e)	N/A	N/A	N/A	N/A	N/A

Notes:
1. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 21) + N_2O (GWP = 310).

EPA TANKS Emissions Data - Glycol Tank:

Pollutant	Working Losses	Breathing Losses	Flashing Losses	Total Emissions		
	lbs/yr	lbs/yr	lbs/yr	lbs/hr	lbs/yr	tpy
VOC	0.30	0.50	N/A	0.00	0.80	0.00
HAPs	0.00	0.00	N/A	0.00	0.00	0.00

Notes:
1. Working and breathing losses estimated using EPA TANKS 4.0.9d software based on Distillate fuel oil No. 2.
2. This tank does not contain hydrocarbons that would be expected to be flashed off at tank operating conditions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 6. Office Building Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S023
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	0.12
Potential Fuel Consumption (MMBtu/yr):	1,051
Max. Fuel Consumption (MMscf/hr):	0.0001
Max. Fuel Consumption (MMscf/yr):	1.0
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.01	0.05	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.01	0.04	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		14	62	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 6. Office Building Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	14.04	61	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**14**	**62**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.000**	**0.00**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 7. Fugitive Emissions Calculations

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor		Average Gas Leak Rate	Max Gas Leak Rate	Potential VOC Emissions	Potential HAP Emissions
		(lb/hr/component)	Factor Source	(lb/hr)	(tpy)	(tpy)	(tpy)
Connectors	680	0.0004	EPA Protocol, Table 2-4	0.30	1.44	0.04	0.00
Flanges	370	0.001	EPA Protocol, Table 2-4	0.32	1.53	0.05	0.00
Open-Ended Lines	30	0.004	EPA Protocol, Table 2-4	0.13	0.64	0.02	0.00
Pump Seals	0	0.005	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Valves	350	0.010	EPA Protocol, Table 2-4	3.47	16.73	0.51	0.04
Other	0	0.019	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Total				**4.22**	**20.34**	**0.62**	**0.05**

Notes:
1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc
2. The component count is a preliminary estimate based on the proposed design of the station
3. Conservatively assumed that maximum leak rate is 10% greater than measured average leak rate for the purposes of establishing PTE
4. VOC and HAP emissions are based on fractions of these pollutants in the site-specific gas analysis

Dry Seal Emissions

Number of Compressors	Number of seals Per Compressor	Leak Rate (scf/hr/seal)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
4	2	6	420,480	0.32	0.02	0.06	22.05	551.19
Total				**0.32**	**0.02**	**0.06**	**22.05**	**551.19**

1. Leak rate and seal information from EPA Natural Gas Star Program (http://www.epa.gov/gasstar/documents/ll_wetseals.pdf
2. Emission calculations for VOC are calculated assuming a desnity of natural gas of 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)
Sample calculation: Volume vented (scf/yr) x density of natural gas (lb/scf) x wt % VOC / 2000 lb/tor
3. GHG emissions calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98
Sample calculation: Volume vented (scf/yr) x density of GHG (kg/scf) x mol % VOC x 2.2 lb/kg / 2000 lb/tor

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Station ESD Vent	3,200,000	1	3,200,000	2.42	0.18
Compressors	571,000	16	9,136,000	6.91	0.51
Total				**9.33**	**0.69**

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 7. Fugitive Emissions Calculations

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Station ESD Vent	3,200,000	1	3,200,000	61.24	0.48	1531
Compressors	571,000	16	9,136,000	174.84	1.38	4372
Total				**236.1**	**1.87**	**5904**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor		CH_4 Emissions	CO_2 Emissions	CO_2e Emissions
		(scf/hr/component)	Factor Source	(tpy)	(tpy)	(tpy)
Connectors	680	0.003	40 CFR 98, Table W-1A	0.34	0.003	8.55
Flanges	370	0.003	40 CFR 98, Table W-1A	0.19	0.001	4.65
Open-Ended Lines	30	0.061	40 CFR 98, Table W-1A	0.31	0.002	7.67
Pump Seals	0	13.3	40 CFR 98, Table W-1A	0.00	0.000	0.00
Valves	350	0.027	40 CFR 98, Table W-1A	1.58	0.013	39.62
Other	0	0.04	40 CFR 98, Table W-1A	0.00	0.000	0.00
Total				**2.42**	**0.02**	**60.50**

Notes:
1. The component count is a preliminary estimate based on the proposed design of the station
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis
3. Emissions are calculated in accordance with Equations W-32a, W-35 and W-36 in Subpart W of 40 CFR 98
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	2.34	10.26	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.17	0.75	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	1,488	6,516	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 8. Liquid Loading Emissions Calculations

Liquid Loading Information:

Parameter	Value	Description
S	1.45	saturation factor for splash loading (AP-42 Table 5.2-1)
Collection Efficiency	0.0%	
Control Efficiency	0%	
P	0.21	true vapor pressure of liquid loaded (psia) - assume octane
M	114.23	molecular weight of vapors (lb/lb-mol) - assume octane
T	516.4	temperature of liquids loaded (deg R) - TANKS Data

Description	Loading Losses	Maximum Throughput[2]	VOC Emissions	
	($lb/10^3$ gal)[1]	(gal)	(lb/hr)	(tpy)
Liquids Hauling	0.8	126,000	0.01	0.05

Notes:

1. Uncontrolled Loading Losses: L_L ($lb/10^3$ gal) = 12.46 (SPM)/T
2. Produced fluids throughput.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 9. Haul Road Emission Calculations

Unpaved Road Information:

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM		PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9		1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8	%			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150				AP-42 Figure 13.2.1-2
a	0.7		0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45		0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Service Truck	4	4	4	0.75	365	274	0	0.24	0.06	0.01
Liquids Hauling - Vendor Fluid	12	20	16	0.75	4	3	0	0.00	0.00	0.00
Liquids Hauling - Produced Fluid	20	32	26	0.75	32	24	0	0.05	0.01	0.00
Employee Vehicles	2	2	2	0.75	365	274	0	0.17	0.04	0.00
Total Potential Emissions								**0.46**	**0.12**	**0.01**

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 10. Potential Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																	
	VOC		NO_x		CO		PM_{10}		$PM_{2.5}$		SO_x		HCHO		Total HAPs		GHG (CO_2e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Turbine 1 (S001)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Turbine 2 (S002)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Turbine 3 (S003)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Turbine 4 (S004)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Microturbine 1 (S005)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 2 (S006)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 3 (S007)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 4 (S008)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 5 (S009)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 6 (S010)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 7 (S011)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 8 (S012)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 9 (S013)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 10 (S014)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 11 (S015)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 12 (S016)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 13 (S017)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 14 (S018)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Fuel Gas Heater (S019)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Fuel Gas Heater (S020)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Produced Fluids Tank (S021)	0.05	0.21	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0	2
Used Oil Tank (S022)	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	--	--
Office Building Heater (S023)	0.00	0.00	0.01	0.05	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	62
Fugitive Leaks (S024)	2.34	10.26	--	--	--	--	0.03	0.12	0.00	0.01	--	--	--	--	0.17	0.75	1,488	6,516
Liquid Loading (S025)	0.01	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.
2. VOC emissions for the engines are conservatively estimated as: VOC=NMNEHC+HCHO (Formaldehyde)
3. Fugitive emissions include haul road emissions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 11. Total Potential Emissions from All Sources at the Facility

Pollutants	Estimated Site-Wide Emissions	
	lb/hr	tpy
VOC	7.27	31.94
NO_X	40.76	178.62
CO	43.05	197.78
SO_X	2.51	10.98
PM_{10}	10.84	47.47
$PM_{2.5}$	10.81	47.36
Formaldehyde (HCHO)	2.05	8.99
Total HAPs	2.46	10.79
GHG (CO_2e)	89,336	391,794

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: Operational Emissions

TABLE 12. Site-Specific Gas Analysis

Sample Location: Multiple Locations
HHV (Btu/scf): 1,083

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)
N2	0.4949	0.788
METHANE	90.4241	82.411
CO2	0.2608	0.652
ETHANE	7.6812	13.124
PROPANE	0.6778	1.698
I-BUTANE	0.0754	0.249
N-BUTANE	0.1355	0.447
I-PENTANE	0.054	0.223
N-PENTANE	0.045	0.186
I-H EXAN ES	0.000	0.000
N-HEXANE	0.045	0.222
BENZENE	0.000	0.000
CYCLOHEXANE	0.000	0.000
HEPTANES	0.000	0.000
TOLUENE	0.000	0.000
2,2,4 Trimethylpentane	0.000	0.000
N-OCTANE	0.000	0.000
*E-BENZENE	0.000	0.000
*m,o,&p-XYLENE	0.000	0.000
I-NONANES	0.000	0.000
N-NONANE	0.000	0.000
I-DECANES	0.000	0.000
N-DECANE	0.000	0.000
I-UNDECANES +	0.000	0.000
Totals	99.895	100

*Gas Analysis showed no detectable compounds above hexane +, conservatively assumed all hexane + was n-he

TOC (Total)	99.14	98.56
VOC (Total)	1.03	3.03
HAP (Total)	0.05	0.22

Company Name: **Mountain Valley Pipeline, LLC**
Facility Name: **Harris Compressor Station**
Project Description: **Operational Emissions**

TABLE 1. Internal Combustion Turbine Emissions Calculations

Turbine Information:

Source ID:	S001-S002
Manufacturer:	Solar
Model No.:	Titan 130
Year Installed:	TBD
Fuel Used:	Natural Gas
Fuel Heating Value (Btu/scf):	979
Rated Horsepower (bhp at site conditions):	20455
Maximum Fuel Consumption at 100% Load (scf/hr):	151731
Heat Input (MMBtu/hr)	148.59
Control Device:	None

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	1,329.16
Potential Startup/Shutdown Events (per year):	12

Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units	Emission Factor Source
NO_X	8.900	lb/hr	Manufacturer
CO	9.030	lb/hr	Manufacturer
SO_2	3.54E-03	lb/MMBtu	Manufacturer
PM_{10}	0.016	lb/MMBtu	Manufacturer, PIL 171
$PM_{2.5}$	0.016	lb/MMBtu	Manufacturer, PIL 171
VOC	1.034	lb/hr	20% of UHC per Manufacturer
Formaldehyde	0.003	lb/MMBtu	Manufacturer, PIL 168
CO_2	122.82	lb/MMBtu	40 CFR 98, Subpart C, Table C-1
CH_4	4.136	lb/hr	80% of UHC per Manufacturer
N_2O	2.3E-04	lb/MMBtu	40 CFR 98, Subpart C, Table C-2

*Emission factors from AP-42 and Subpart C are based on HHV. To calculate a LHV emission factor, emissions are multiplied by (HHV/LHV). For AP-42 HHV is 1020 Btu/scf, for Subpart C HHV is 1028 Btu/scf. PM and HCHO emission factors are provided in HHV in the specifications and were converted to LHV using a HHV value of 1020 Btu/scf.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 1. Internal Combustion Turbine Emissions Calculations

Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2]
NO_X	8.90	39.01
CO	9.03	41.86
SO_2	0.53	2.30
PM_{10}	2.32	10.17
$PM_{2.5}$	2.32	10.17
VOC	1.03	4.56
Formaldehyde	0.45	1.95
CO_2	18,249	79,946
CH_4	4.14	22.57
N_2O	0.03	0.15
GHG (CO2e)	18,363	80,555

*Annual emissions shown above include startup/shutdown events.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 1. Internal Combustion Turbine Emissions Calculations

Hazardous Air Pollutant (HAP) Emission Rates:

Pollutant	Emission Factor (lb/MMBtu)[3]	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2,4]
HAPs:			
Acetaldehyde	4.17E-05	6.19E-03	2.71E-02
Acrolein	6.67E-06	9.90E-04	4.34E-03
Benzene	1.25E-05	1.86E-03	8.13E-03
1,3-Butadiene	4.48E-07	6.65E-05	2.91E-04
Propylene Oxide	2.90E-05	4.31E-03	1.89E-02
Ethylbenzene	3.33E-05	4.95E-03	2.17E-02
Toluene	1.35E-04	2.01E-02	8.81E-02
Xylene	6.67E-05	9.90E-03	4.34E-02
Polycyclic Organic Matter:			
Naphthalene	1.35E-06	2.01E-04	8.81E-04
PAH	2.29E-06	3.40E-04	1.49E-03
Total HAP (Including HCHO)		**0.49**	**2.17**

1. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (lb/MMBtu)
2. Emission Rate (tpy) = Emission Rate (lb/hr) × Hours of Operation (hr/yr) / 2000 (tons/lb) + SU/SD emissions, as applicable
3. Emission factors from AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000. Factors are based on HHV. Therefore, they were converted to LHV by multiplying by (HHV/LHV).
4. Emission calculations are based on maximum operating load of 100% load, ambient temperature 0°F and site elevation. The turbine ratings can vary with ambient conditions. Each Turbine is ISO rated at 20,500 HP

Startup/Shutdown Combustion Emission Factors:

Pollutant	Startup Emissions[1] (lbs/event)	Shutdown Emissions[1] (lbs/event)	Emission Factor Source
NO_X	1.9	2.4	Manufacturer
CO	176.9	207.6	Manufacturer
VOC	2.0	2.38	20% of UHC per Manufacturer
CO_2	1161	1272	Manufacturer

1. Each startup and shutdown event is estimated to last approximately 10 minutes, per manufacturer.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 1. Internal Combustion Turbine Emissions Calculations

Pneumatic Start Venting Emissions		
Natural Gas Purged During Startup	4500	scfm
Duration of Normal Purge	4.0	min
Total Gas Purged (Per Startup)	18000	scf
VOC Purged (Per Startup)	27	lbs/startup
CO_2 Purged (Per Startup)	6	lbs/startup
CH_4 Purged (Per Startup)	742	lbs/startup
Density of natural gas:	0.05	lb/ft^3 @ STP (www.engineeringtoolbox.com)

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 2. Microturbine Emissions Calculations

Microturbine Unit Information:

Engine ID:	S003-S011
Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	9

Microturbine Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Rated Electrical Power Output (kW):	200	1,800
Rated Electrical Power Output (MW):	0.2	1.8
Rated Horsepower (bhp):	268.2	2,414
Heat Input (MMBtu/hr)	2.28	20.52
Potential Fuel Consumption (MMBtu/yr):	19,973	179,755
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Microturbine Emissions Data:

Pollutant	Emission Factors	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO_X	0.40	lb/MWhe	0.08	0.35	0.72	3.15	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.02	0.09	0.18	0.79	Manufacturer's Specifications
CO	1.10	lb/MWhe	0.22	0.96	1.98	8.67	Manufacturer's Specifications
SO_X	0.0034	lb/MMBtu	0.01	0.03	0.07	0.31	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.02	0.07	0.14	0.59	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.02	0.07	0.14	0.59	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		266	1,166	2,396	10,497	Manufacturer's Specifications / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.00	0.01	0.02	0.09	AP-42, Table 3.1-3 (Apr-2000)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHC

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 2. Microturbine Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO_2	1330	lb/MWhe	266	1,165	2,394	10,486	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.01	0.02	0.05	0.20	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	0.00	0.02	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**266**	**1,166**	**2,396**	**10,497**	
HAPs:							
1,3-Butadiene	4.3E-07	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	0.00	0.01	0.01	0.06	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.002**	**0.010**	**0.021**	**0.09**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 3. Fuel Gas Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S012-S013
Projected Startup Date:	Upon Approval
Number of Units:	2

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	2.31
Potential Fuel Consumption (MMBtu/yr):	20,215
Max. Fuel Consumption (MMscf/hr):	0.0021
Max. Fuel Consumption (MMscf/yr):	18.7
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.21	0.93	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.01	0.05	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.18	0.78	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.01	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		270	1,184	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.02	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 3. Fuel Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	269.99	1,183	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**270**	**1,184**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.02	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.004**	**0.02**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 4. Office Building Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S014
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	0.12
Potential Fuel Consumption (MMBtu/yr):	1,051
Max. Fuel Consumption (MMscf/hr):	0.0001
Max. Fuel Consumption (MMscf/yr):	1.0
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.01	0.05	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.01	0.04	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		14	62	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 4. Office Building Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	14.04	61	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**14**	**62**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.000**	**0.00**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 5. WB Interconnect Line Heater (off station)

Fuel Gas Heater Information:

Source ID:	S015
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	9.00
Potential Fuel Consumption (MMBtu/yr):	78,840
Max. Fuel Consumption (MMscf/hr):	0.0083
Max. Fuel Consumption (MMscf/yr):	72.8
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.83	3.64	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.05	0.20	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.70	3.06	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.02	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.06	0.28	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.06	0.28	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		1,054	4,617	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.02	0.07	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 5. WB Interconnect Line Heater (off station)

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	1052.98	4,612	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.02	0.09	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**1,054**	**4,617**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.01	0.07	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.015**	**0.07**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 6. Storage Tank Emissions Calculations - Produced Fluids Tank

Storage Tank Information:

Source ID:	S016
Tank Capacity (gallons):	10,080
Tank Contents:	Produced Water
Annual Throughput (gallons/year):	126,000
Daily Throughput (bbl/day)	8
Percent Condensate	1%
Condensate Throughput (bbl/day)	0.1
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.05	0.21	0.05	0.21	E&P TANK 2.0
HAPs	0.00	0.00	0.00	0.00	E&P TANK 2.0
GHG (CO2e)	0.48	2.10	0.48	2.10	E&P TANK 2.0

E & P Tanks Emissions Data:

Pollutant	Total Emissions (Working + Breathing + Flashing)			Total Emissions		
	lbs/hr	lbs/yr	tpy	lbs/hr	lbs/yr	tpy
VOC	0.05	429.24	0.21	0.05	429.24	0.21
HAPs	0.00	0.00	0.00	0.00	0.00	0.00
GHG (CO_2e)	0.48	4,161.00	2.10	0.48	4,161.00	2.10

Notes:

1. E & P TANKS software estimates working, breathing, and flashing losses and reports as one total. Emissions are based on a conservative estimate of 99 % water and 1% condensate
2. This tank does contain hydrocarbons that could be flashed off at tank operating conditions

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 7. Storage Tank Emissions Calculations - Used Oil Tank

Storage Tank Information:

Source ID:	S017
Tank Capacity (gallons):	4,200
Tank Contents:	Used Oil
Annual Throughput (gallons/year):	3,150
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
HAPs	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
GHG (CO_2e)	N/A	N/A	N/A	N/A	N/A

Notes:
1. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

EPA TANKS Emissions Data - Glycol Tank:

Pollutant	Working Losses	Breathing Losses	Flashing Losses	Total Emissions		
	lbs/yr	lbs/yr	lbs/yr	lbs/hr	lbs/yr	tpy
VOC	0.05	0.08	N/A	0.00	0.13	0.00
HAPs	0.05	0.08	N/A	0.00	0.13	0.00

Notes:
1. Working and breathing losses estimated using EPA TANKS 4.0.9d software based on Distillate fuel oil No. 2.
2. This tank does not contain hydrocarbons that would be expected to be flashed off at tank operating conditions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 8. Fugitive Emissions Calculations

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor		Average Gas Leak Rate	Max Gas Leak Rate	Potential VOC Emissions	Potential HAP Emissions
		(lb/hr/component)	Factor Source	(lb/hr)	(tpy)	(tpy)	(tpy)
Connectors	355	0.0004	EPA Protocol, Table 2-4	0.16	0.75	0.02	0.00
Flanges	220	0.001	EPA Protocol, Table 2-4	0.19	0.91	0.03	0.00
Open-Ended Lines	20	0.004	EPA Protocol, Table 2-4	0.09	0.42	0.01	0.00
Pump Seals	0	0.005	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Valves	210	0.010	EPA Protocol, Table 2-4	2.08	10.04	0.30	0.02
Other	0	0.019	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Total				**2.52**	**12.13**	**0.37**	**0.03**

Notes:
1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
2. The component count is a preliminary estimate based on the proposed design of the station.
3. Conservatively assumed that maximum leak rate is 10% greater than measured average leak rate for the purposes of establishing PTE.
4. VOC and HAP emissions are based on fractions of these pollutants in the site-specific gas analysis.

Dry Seal Emissions

Number of Compressors	Number of seals Per Compressor	Leak Rate (scf/hr/seal)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
2	2	6	210,240	0.16	0.01	0.03	11.02	275.60
Total				**0.16**	**0.01**	**0.03**	**11.02**	**275.60**

1. Leak rate and seal information from EPA Natural Gas Star Program (http://www.epa.gov/gasstar/documents/ll_wetseals.pdf)
2. Emission calculations for VOC are calculated assuming a desnity of natural gas of 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)
Sample calculation: Volume vented (scf/yr) x density of natural gas (lb/scf) x wt % VOC / 2000 lb/ton
3. GHG emissions calculated in accordance with EquationsW-35 and W-36 in Subpart W of 40 CFR 98.
Sample calculation: Volume vented (scf/yr) x density of GHG (kg/scf) x mol % VOC x 2.2 lb/kg / 2000 lb/ton

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 8. Fugitive Emissions Calculations

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	1.06	0.08
Compressors	320,000	8	2,560,000	1.94	0.14
Total				**3.00**	**0.22**

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	26.79	0.21	670
Compressors	320,000	8	2,560,000	48.99	0.39	1225
Total				**75.8**	**0.60**	**1895**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor		CH_4 Emissions	CO_2 Emissions	CO_2e Emissions
		(scf/hr/component)	Factor Source	(tpy)	(tpy)	(tpy)
Connectors	355	0.003	40 CFR 98, Table W-1A	0.18	0.001	4.46
Flanges	220	0.003	40 CFR 98, Table W-1A	0.11	0.001	2.77
Open-Ended Lines	20	0.061	40 CFR 98, Table W-1A	0.20	0.002	5.11
Pump Seals	0	13.3	40 CFR 98, Table W-1A	0.00	0.000	0.00
Valves	210	0.03	40 CFR 98, Table W-1A	0.95	0.008	23.77
Other	0	0.04	40 CFR 98, Table W-1A	0.00	0.000	0.00
Total				**1.44**	**0.01**	**36.12**

Notes:
1. The component count is a preliminary estimate based on the proposed design of the station.
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis.
3. Emissions are calculated in accordance with Equations W-32a, W-35 and W-36 in Subpart W of 40 CFR 98.
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	0.80	3.52	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.06	0.26	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	504	2,207	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 9. Liquid Loading Emissions Calculations

Liquid Loading Information:

Parameter	Value	Description
S	1.45	saturation factor for splash loading (AP-42 Table 5.2-1)
Collection Efficiency	0.0%	
Control Efficiency	0%	
P	0.21	true vapor pressure of liquid loaded (psia) - assume octane
M	114.23	molecular weight of vapors (lb/lb-mol) - assume octane
T	516.4	temperature of liquids loaded (deg R) - TANKS Data

Description	Loading Losses	Maximum Throughput[2]	VOC Emissions	
	(lb/10^3 gal)[1]	(gal)	(lb/hr)	(tpy)
Liquids Hauling	0.8	126,000	0.01	0.05

Notes:

1. Uncontrolled Loading Losses: L_L (lb/10^3 gal) = 12.46 (SPM)/T
2. Produced fluids throughput.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 10. Haul Road Emission Calculations

Unpaved Road Information:

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM	PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9	1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8 %			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150			AP-42 Figure 13.2.1-2
a	0.7	0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45	0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Service Truck	4	4	4	0.25	365	91	0	0.08	0.02	0.00
Liquids Hauling - Vendor Fluid	12	20	16	0.25	2	1	0	0.00	0.00	0.00
Liquids Hauling - Produced Fluid	20	32	26	0.25	32	8	0	0.02	0.00	0.00
Employee Vehicles	2	2	2	0.25	365	91	0	0.06	0.01	0.00
Total Potential Emissions								**0.15**	**0.04**	**0.00**

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 11. Potential Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																	
	VOC		NO_X		CO		PM_{10}		$PM_{2.5}$		SO_X		HCHO		Total HAPs		GHG (CO_2e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Turbine 1 (S001)	1.03	4.56	8.90	39.01	9.03	41.86	2.32	10.17	2.32	10.17	0.53	2.30	0.45	1.95	0.49	2.17	18,363	80,555
Turbine 2 (S002)	1.03	4.56	8.90	39.01	9.03	41.86	2.32	10.17	2.32	10.17	0.53	2.30	0.45	1.95	0.49	2.17	18,363	80,555
Microturbine 1 (S003)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 2 (S004)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 3 (S005)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 4 (S006)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 5 (S007)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 6 (S008)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 7 (S009)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 8 (S010)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 9 (S011)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Fuel Gas Heater (S012)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Fuel Gas Heater (S013)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Office Building Heater (S014)	0.00	0.00	0.01	0.05	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	62
WB Pipeline Heater (S015)	0.05	0.20	0.83	3.64	0.70	3.06	0.06	0.28	0.06	0.28	0.00	0.02	0.00	0.00	0.02	0.07	1,054	4,617
Produced Fluids Tank (S016)	0.05	0.21	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0	2
Used Oil Tank (S017)	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	--	--
Fugitive Leaks (S018)	0.80	3.52	--	--	--	--	0.01	0.04	0.00	0.00	--	--	--	--	0.06	0.26	504	2,207
Liquid Loading (S019)	0.01	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.
2. VOC emissions for the engines are conservatively estimated as: VOC=NMNEHC+HCHO (Formaldehyde)
3. Fugitive emissions include haul road emissions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: Operational Emissions

TABLE 11. Total Potential Emissions from All Sources at the Facility

Pollutants	Estimated Site-Wide Emissions	
	lb/hr	tpy
VOC	3.18	13.99
NO_X	19.79	86.73
CO	21.11	97.06
SO_X	1.13	4.95
PM_{10}	4.88	21.39
$PM_{2.5}$	4.88	21.36
Formaldehyde (HCHO)	0.91	3.97
Total HAPs	1.09	4.79
GHG (CO_2e)	41,235	180,861

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.

Company Name: **Mountain Valley Pipeline, LLC**
Facility Name: **Harris Compressor Station**
Project Description: **Operational Emissions**

TABLE 12. Site-Specific Gas Analysis

Sample Location: Multiple Locations
HHV (Btu/scf): 1,083

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)
N2	0.4949	0.788
METHANE	90.4241	82.411
CO2	0.2608	0.652
ETHANE	7.6812	13.124
PROPANE	0.6778	1.698
I-BUTANE	0.0754	0.249
N-BUTANE	0.1355	0.447
I-PENTANE	0.054	0.223
N-PENTANE	0.045	0.186
I-H EXAN ES	0.000	0.000
N-HEXANE	0.045	0.222
BENZENE	0.000	0.000
CYCLOHEXANE	0.000	0.000
HEPTANES	0.000	0.000
TOLUENE	0.000	0.000
2,2,4 Trimethylpentane	0.000	0.000
N-OCTANE	0.000	0.000
*E-BENZENE	0.000	0.000
*m,o,&p-XYLENE	0.000	0.000
I-NONANES	0.000	0.000
N-NONANE	0.000	0.000
I-DECANES	0.000	0.000
N-DECANE	0.000	0.000
I-UNDECANES +	0.000	0.000
Totals	99.895	100

*Gas Analysis showed no detectable compounds above hexane +, conservatively assumed all hexane + was n-he

TOC (Total)	99.14	98.56
VOC (Total)	1.03	3.03
HAP (Total)	0.05	0.22

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 1. Internal Combustion Turbine Emissions Calculations

Turbine Information:

Source ID:	S001-S002
Manufacturer:	Solar
Model No.:	Titan 130
Year Installed:	TBD
Fuel Used:	Natural Gas
Fuel Heating Value (Btu/scf):	979
Rated Horsepower (bhp at site conditions):	19483
Maximum Fuel Consumption at 100% Load (scf/hr):	144613
Heat Input (MMBtu/hr)	141.62
Control Device:	None
Stack Designation:	TBD

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	1,266.81
Potential Startup/Shutdown Events (per year):	12

Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units	Emission Factor Source
NO_X	8.490	lb/hr	Manufacturer
CO	8.610	lb/hr	Manufacturer
SO_2	3.54E-03	lb/MMBtu	Manufacturer
PM_{10}	0.016	lb/MMBtu	Manufacturer, PIL 171
$PM_{2.5}$	0.016	lb/MMBtu	Manufacturer, PIL 171
VOC	0.986	lb/hr	20% of UHC per Manufacturer
Formaldehyde	0.003	lb/MMBtu	Manufacturer, PIL 168
CO_2	122.82	lb/MMBtu	40 CFR 98, Subpart C, Table C-1
CH_4	3.944	lb/hr	80% of UHC per Manufacturer
N_2O	2.3E-04	lb/MMBtu	40 CFR 98, Subpart C, Table C-2

*Emission factors from AP-42 and Subpart C are based on HHV. To calculate a LHV emission factor, emissions are multiplied by (HHV/LHV). For AP-42 HHV is 1020 Btu/scf, for Subpart C HHV is 1028 Btu/scf. PM and HCHO emission factors are provided in HHV in the specifications and were converted to LHV using a HHV value of 1020 Btu/scf.

Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[1]	(tpy)[2]
NO_X	8.49	37.21
CO	8.61	40.02
SO_2	0.50	2.20
PM_{10}	2.21	9.69
$PM_{2.5}$	2.21	9.69
VOC	0.99	4.35
Formaldehyde	0.42	1.86
CO_2	17,393	76,197
CH_4	3.94	21.72
N_2O	0.03	0.14
GHG (CO2e)	17502	76782

*Annual emissions shown above include startup/shutdown events.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 1. Internal Combustion Turbine Emissions Calculations

Hazardous Air Pollutant (HAP) Emission Rates:

Pollutant	Emission Factor (lb/MMBtu)[3]	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2,4]
HAPs:			
Acetaldehyde	4.17E-05	5.90E-03	2.58E-02
Acrolein	6.67E-06	9.44E-04	4.13E-03
Benzene	1.25E-05	1.77E-03	7.75E-03
1,3-Butadiene	4.48E-07	6.34E-05	2.78E-04
Propylene Oxide	2.90E-05	4.11E-03	1.80E-02
Ethylbenzene	3.33E-05	4.72E-03	2.07E-02
Toluene	1.35E-04	1.92E-02	8.40E-02
Xylene	6.67E-05	9.44E-03	4.13E-02
Polycyclic Organic Matter:			
Naphthalene	1.35E-06	1.92E-04	8.40E-04
PAH	2.29E-06	3.25E-04	1.42E-03
Total HAP (Including HCHO)		**0.47**	**2.06**

1. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (lb/MMBtu)
2. Emission Rate (tpy) = Emission Rate (lb/hr) × Hours of Operation (hr/yr) / 2000 (tons/lb) + SU/SD emissions, as applicable
3. Emission factors from AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000. Factors are based on HHV. Therefore, they were converted to LHV by multiplying by (HHV/LHV).
4. Emission calculations are based on maximum operating load of 100% load, ambient temperature 0°F and site elevation. The turbine ratings can vary with ambient conditions. Each Turbine is ISO rated at 20,500 HP

Startup/Shutdown Combustion Emission Factors:

Pollutant	Startup Emissions[1] (lbs/event)	Shutdown Emissions[1] (lbs/event)	Emission Factor Source
NO_X	1.9	2.4	Manufacturer
CO	176.9	207.6	Manufacturer
VOC	2.0	2.38	20% of UHC per Manufacturer
CO_2	1161	1272	Manufacturer

1. Each startup and shutdown event is estimated to last approximately 10 minutes, per manufacturer.

Pneumatic Start Venting Emissions		
Natural Gas Purged During Startup	4500	scfm
Duration of Normal Purge	4.0	min
Total Gas Purged (Per Startup)	18000	scf
VOC Purged (Per Startup)	27	lbs/startup
CO_2 Purged (Per Startup)	6	lbs/startup
CH_4 Purged (Per Startup)	742	lbs/startup

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 2. Microturbine Emissions Calculations

Microturbine Unit Information:

Engine ID:	S003-S012
Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	10

Microturbine Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Rated Electrical Power Output (kW):	200	2,000
Rated Electrical Power Output (MW):	0.2	2
Rated Horsepower (bhp):	268.2	2,682
Heat Input (MMBtu/hr)	2.28	22.8
Potential Fuel Consumption (MMBtu/yr)	19,973	199,728
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Microturbine Emissions Data:

Pollutant	Emission Factors	Units	Maximum Potential Emissions		Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO_X	0.40	lb/MWhe	0.08	0.35	0.80	3.50	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.02	0.09	0.20	0.88	Manufacturer's Specifications
CO	1.10	lb/MWhe	0.22	0.96	2.20	9.64	Manufacturer's Specifications
SO_X	0.0034	lb/MMBtu	0.01	0.03	0.08	0.34	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.02	0.07	0.15	0.66	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.02	0.07	0.15	0.66	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		266	1,166	2,663	11,663	Manufacturer's Specifications / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.00	0.01	0.02	0.10	AP-42, Table 3.1-3 (Apr-2000)

Notes:
1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHO.

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO_2	1330	lb/MWhe	266	1,165	2,660	11,651	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.01	0.02	0.05	0.22	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	0.01	0.02	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**266**	**1,166**	**2,663**	**11,663**	
HAPs:							
1,3-Butadiene	4.3E-07	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	0.00	0.01	0.02	0.07	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.002**	**0.010**	**0.023**	**0.10**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 3. Fuel Gas Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S013-S014
Projected Startup Date:	Upon Approval
Number of Units:	2

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	2.31
Potential Fuel Consumption (MMBtu/yr):	20,215
Max. Fuel Consumption (MMscf/hr):	0.0021
Max. Fuel Consumption (MMscf/yr):	18.7
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.21	0.93	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.01	0.05	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.18	0.78	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.01	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		270	1,184	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.02	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:
1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable)
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 3. Fuel Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	269.99	1,183	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**270**	**1,184**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.02	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.004**	**0.02**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 4. Storage Tank Emissions Calculations - Produced Fluids Tank

Storage Tank Information:

Source ID:	S015
Tank Capacity (gallons):	10,080
Tank Contents:	Produced Water
Annual Throughput (gallons/year):	126,000
Daily Throughput (bbl/day)	8
Percent Condensate	1%
Condensate Throughput (bbl/day)	0.1
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.05	0.21	0.05	0.21	E&P TANK 2.0
HAPs	0.00	0.00	0.00	0.00	E&P TANK 2.0
GHG (CO2e)	0.48	2.10	0.48	2.10	E&P TANK 2.0

E & P Tanks Emissions Data:

Pollutant	Total Emissions (Working + Breathing + Flashing)			Total Emissions		
	lbs/hr	lbs/yr	tpy	lbs/hr	lbs/yr	tpy
VOC	0.05	429.24	0.21	0.05	429.24	0.21
HAPs	0.00	0.00	0.00	0.00	0.00	0.00
GHG (CO_2e)	0.48	4,161.00	2.10	0.48	4,161.00	2.10

Notes:
1. E & P TANKS software estimates working, breathing, and flashing losses and reports as one total. Emissions are based on a conservative estimate of 99% water and 1% condensate
2. This tank does contain hydrocarbons that could be flashed off at tank operating conditions

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 5. Storage Tank Emissions Calculations - Used Oil Tank

Storage Tank Information:

Source ID:	S016
Tank Capacity (gallons):	4,200
Tank Contents:	Used Oil
Annual Throughput (gallons/year):	3,150
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
HAPs	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
GHG (CO_2e)	N/A	N/A	N/A	N/A	N/A

Notes:
1. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

EPA TANKS Emissions Data - Glycol Tank:

Pollutant	Working Losses	Breathing Losses	Flashing Losses	Total Emissions		
	lbs/yr	lbs/yr	lbs/yr	lbs/hr	lbs/yr	tpy
VOC	0.06	1.28	N/A	0.00	1.34	0.00
HAPs	0.06	1.28	N/A	0.00	1.34	0.00

Notes:
1. Working and breathing losses estimated using EPA TANKS 4.0.9d software based on Distillate fuel oil No. 2.
2. This tank does not contain hydrocarbons that would be expected to be flashed off at tank operating conditions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 6. Office Building Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S017
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	0.12
Potential Fuel Consumption (MMBtu/yr):	1,051
Max. Fuel Consumption (MMscf/hr):	0.0001
Max. Fuel Consumption (MMscf/yr):	1.0
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.01	0.05	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.01	0.04	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		14	62	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:
1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable)
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 6. Office Building Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	14.04	61	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**14**	**62**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.000**	**0.00**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 7. Fugitive Emissions Calculations

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor		Average Gas Leak Rate	Max Gas Leak Rate	Potential VOC Emissions	Potential HAP Emissions
		(lb/hr/component)	Factor Source	(lb/hr)	(tpy)	(tpy)	(tpy)
Connectors	355	0.0004	EPA Protocol, Table 2-4	0.16	0.75	0.02	0.00
Flanges	220	0.001	EPA Protocol, Table 2-4	0.19	0.91	0.03	0.00
Open-Ended Lines	20	0.004	EPA Protocol, Table 2-4	0.09	0.42	0.01	0.00
Pump Seals	0	0.005	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Valves	210	0.010	EPA Protocol, Table 2-4	2.08	10.04	0.30	0.02
Other	0	0.019	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Total				**2.52**	**12.13**	**0.37**	**0.03**

Notes:
1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
2. The component count is a preliminary estimate based on the proposed design of the station.
3. Conservatively assumed that maximum leak rate is 10% greater than measured average leak rate for the purposes of establishing PTE.
4. VOC and HAP emissions are based on fractions of these pollutants in the site-specific gas analysis.

Dry Seal Emissions

Number of Compressors	Number of seals Per Compressor	Leak Rate (scf/hr/seal)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
2	2	6	210,240	0.16	0.01	0.03	11.02	275.60
Total				**0.16**	**0.01**	**0.03**	**11.02**	**275.60**

1. Leak rate and seal information from EPA Natural Gas Star Program (http://www.epa.gov/gasstar/documents/ll_wetseals.pdf)
2. Emission calculations for VOC are calculated assuming a desnity of natural gas of 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)
Sample calculation: Volume vented (scf/yr) x density of natural gas (lb/scf) x wt % VOC / 2000 lb/ton
3. GHG emissions calculated in accordance with EquationsW-35 and W-36 in Subpart W of 40 CFR 98.
Sample calculation: Volume vented (scf/yr) x density of GHG (kg/scf) x mol % VOC x 2.2 lb/kg / 2000 lb/ton

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	1.06	0.08
Compressors	320,000	8	2,560,000	1.94	0.14
Total				**3.00**	**0.22**

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	26.79	0.21	670
Compressors	320,000	8	2,560,000	48.99	0.39	1225
Total				**75.8**	**0.60**	**1895**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor		CH_4 Emissions	CO_2 Emissions	CO_2e Emissions
		(scf/hr/component)	Factor Source	(tpy)	(tpy)	(tpy)
Connectors	355	0.003	40 CFR 98, Table W-1A	0.18	0.001	4.46
Flanges	220	0.003	40 CFR 98, Table W-1A	0.11	0.001	2.77
Open-Ended Lines	20	0.061	40 CFR 98, Table W-1A	0.20	0.002	5.11
Pump Seals	0	13.3	40 CFR 98, Table W-1A	0.00	0.000	0.00
Valves	210	0.03	40 CFR 98, Table W-1A	0.95	0.008	23.77
Other	0	0.04	40 CFR 98, Table W-1A	0.00	0.000	0.00
Total				**1.44**	**0.01**	**36.12**

Notes:
1. The component count is a preliminary estimate based on the proposed design of the station.
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis.
3. Emissions are calculated in accordance with Equations W-32a, W-35 and W-36 in Subpart W of 40 CFR 98.
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	0.80	3.52	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.06	0.26	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	504	2,207	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 8. Liquid Loading Emissions Calculations

Liquid Loading Information:

Parameter	Value	Description
S	1.45	saturation factor for splash loading (AP-42 Table 5.2-1)
Collection Efficiency	0.0%	No Control
Control Efficiency	0%	No Control
P	0.21	true vapor pressure of liquid loaded (psia) - assume octane
M	114.23	molecular weight of vapors (lb/lb-mol) - assume octane
T	516.4	temperature of liquids loaded (deg R) - TANKS Data

Description	Loading Losses	Maximum Throughput[2]	VOC Emissions	
	(lb/10^3 gal)[1]	(gal)	(lb/hr)	(tpy)
Liquids Hauling	0.8	126,000	0.01	0.05

Notes:

1. Uncontrolled Loading Losses: L_L (lb/10^3 gal) = 12.46 (SPM)/T
2. Engineering Estimates of Produced fluids throughput at the Facility. Produced Water will not compose of HAP

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 9. Haul Road Emission Calculations

Unpaved Road Information:

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM		PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9		1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8	%			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150				AP-42 Figure 13.2.1-2
a	0.7		0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45		0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Service Truck	4	4	4	0.75	365	274	0	0.24	0.06	0.01
Liquids Hauling - Vendor Fluid	12	20	16	0.75	2	2	0	0.00	0.00	0.00
Liquids Hauling - Produced Fluid	20	32	26	0.75	32	24	0	0.05	0.01	0.00
Employee Vehicles	2	2	2	0.75	365	274	0	0.17	0.04	0.00
Total Potential Emissions								**0.46**	**0.12**	**0.01**

Company Name: **Mountain Valley Pipeline, LLC**
Facility Name: **Stallworth Compressor Station**
Project Description: **Operational Emissions**

TABLE 10. Site-Specific Gas Analysis

Sample Location: Multiple Locations
HHV (Btu/scf): 1,083

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)
N2	0.4949	0.788
METHANE	90.4241	82.411
CO2	0.2608	0.652
ETHANE	7.6812	13.124
PROPANE	0.6778	1.698
I-BUTANE	0.0754	0.249
N-BUTANE	0.1355	0.447
I-PENTANE	0.054	0.223
N-PENTANE	0.045	0.186
I-H EXAN ES	0.000	0.000
N-HEXANE	0.045	0.222
BENZENE	0.000	0.000
CYCLOHEXANE	0.000	0.000
HEPTANES	0.000	0.000
TOLUENE	0.000	0.000
2,2,4 Trimethylpentane	0.000	0.000
N-OCTANE	0.000	0.000
*E-BENZENE	0.000	0.000
*m,o,&p-XYLENE	0.000	0.000
I-NONANES	0.000	0.000
N-NONANE	0.000	0.000
I-DECANES	0.000	0.000
N-DECANE	0.000	0.000
I-UNDECANES +	0.000	0.000
Totals	99.895	100

*Gas Analysis showed no detectable compounds above hexane +, conservatively assumed all hexane + was n-hexan

TOC (Total)	99.14	98.56
VOC (Total)	1.03	3.03
HAP (Total)	0.05	0.22

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: Operational Emissions

TABLE 11. Potential Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																	
	VOC		NO_X		CO		PM_{10}		$PM_{2.5}$		SO_X		HCHO		Total HAPs		GHG (CO_2e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Turbine 1 (S001)	0.99	4.35	8.49	37.21	8.61	40.02	2.21	9.69	2.21	9.69	0.50	2.20	0.42	1.86	0.47	2.06	17,502	76,782
Turbine 2 (S002)	0.99	4.35	8.49	37.21	8.61	40.02	2.21	9.69	2.21	9.69	0.50	2.20	0.42	1.86	0.47	2.06	17,502	76,782
Microturbine 1 (S003)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 2 (S004)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 3 (S005)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 4 (S006)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 5 (S007)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 6 (S008)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 7 (S009)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 8 (S010)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 9 (S011)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 10 (S012)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Fuel Gas Heater (S013)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Fuel Gas Heater (S014)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Produced Fluids Tank (S015)	0.05	0.21	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0	2
Used Oil Tank (S016)	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	--	--
Office Building Heater (S017)	0.00	0.00	0.01	0.05	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	62
Fugitives (S018)	0.80	3.52	--	--	--	--	0.03	0.12	0.00	0.01	--	--	--	--	0.06	0.26	504	2,207
Liquid Loading (S019)	0.01	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.
2. VOC emissions for the engines are conservatively estimated as: VOC=NMNEHC+HCHO (Formaldehyde)
3. Fugitives emissions include haul road emissions.

Company Name: **Mountain Valley Pipeline, LLC**
Facility Name: **Stallworth Compressor Station**
Project Description: **Operational Emissions**

TABLE 12. Total Potential Emissions from All Sources at the Facility

Pollutants	Estimated Site-Wide Emissions	
	lb/hr	tpy
VOC	3.06	13.46
NO_X	18.22	79.84
CO	19.79	91.28
SO_X	1.08	4.74
PM_{10}	4.64	20.30
$PM_{2.5}$	4.61	20.20
Formaldehyde (HCHO)	0.87	3.79
Total HAPs	1.03	4.53
GHG (CO_2e)	38,725	169,866

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-C
West Virginia State Air Permit Applications

Bradshaw Compressor Station

Mountain Valley PIPELINE

October 21, 2015

Via Certified Mail
Return Receipt Requested
No. 7015 0640 0000 9694 1204

Mr. William Durham
WVDEP – Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Re: R13 Permit Application
Mountain Valley Pipeline, LLC – Bradshaw Compressor Station
Wetzel County, WV

Dear Mr. Durham:

Mountain Valley Pipeline, LLC (MVP) is submitting this request to the West Virginia Department of Environmental Protection (WVDEP) for the construction of a new natural gas transmission compressor station located in Wetzel County, West Virginia (Bradshaw Compressor Station). MVP is submitting this application to install the following equipment:

- Four (4) Solar Titan 130 natural gas-fired turbines each rated at 23,536 horsepower (hp) at site-specific conditions (ISO rating at 22,400 hp each);
- Fourteen (14) Capstone C200 natural gas-fired microturbines each rated at 200 kW;
- Two (2) natural gas-fired, fuel gas heaters each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input);
- One (1) natural gas-fired, office building heater rated at 0.12 MMBtu/hr, heat input; and
- Two (2) miscellaneous storage tanks with capacities less than 15, 000 gallons

The construction of the facility will not trigger prevention of significant deterioration, but the facility will be a major source with respect to the Title V permit program. MVP will submit a Title V operating permit application within one year of start-up of the facility.

Enclosed are two electronic copies and one original hard copy of the R13 application. The legal advertisement is scheduled to be published in the next few days. The affidavit of publication will be forwarded to WVDEP as soon as it is received from the newspaper. The fees will be paid by credit card once the application is received by your office.

625 Liberty Ave., Suite 1700, Pittsburgh PA 15222
Tel 304.848.0061 | Fax 412.395.3166 www.mountainvalleypipeline.info

MVP appreciates your review of this application. If you have any questions or comments about the attached information or have additional information requirements, please, feel free to contact me at (412) 553-7848.

Sincerely,

Regina Henry
Supervisor, Environmental

Attachments

R13 PERMIT APPLICATION

Mountain Valley Pipeline, LLC
Bradshaw Compressor Station

Mountain Valley PIPELINE LLC

Wetzel County, West Virginia

Prepared By:

TRINITY CONSULTANTS
4500 Brooktree Rd.
Suite 103
Wexford, PA 15090
(724) 935-2611

October 2015

Trinity Consultants

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

1. INTRODUCTION 3

1.1. Facility and Project Description 3

1.1.1. Turbines 3

1.1.2. Storage Tanks 3

1.1.3. Fuel Gas and Office Heaters 3

1.1.4. Microturbine Generators 3

1.2. R-13 APPLICATION ORGANIZATION 4

2. SAMPLE EMISSION SOURCE CALCULATIONS 5

2.1. Turbines 5

2.2. Fuel Gas and Office Heaters 5

2.3. Microturbine Generator 5

2.4. Storage Tanks 6

2.5. Fugitive Emissions 6

3. R13 APPLICATION FORM 7

ATTACHMENT A: CURRENT BUSINESS CERTIFICATE

ATTACHMENT B: MAP

ATTACHMENT C: INSTALLATION AND START UP SCHEDULE

ATTACHMENT D: REGULATORY DISCUSSION

ATTACHMENT E: PLOT PLAN

ATTACHMENT F: DETAILED PROCESS FLOW DIAGRAM

ATTACHMENT G: PROCESS DESCRIPTION

ATTACHMENT I: EMISSION UNITS TABLE

ATTACHMENT J: EMISSION POINTS DATA SUMMARY SHEET

ATTACHMENT K: FUGITIVE EMISSIONS DATA SUMMARY SHEET

ATTACHMENT L: EMISSIONS UNIT DATA SHEETS

ATTACHMENT N: SUPPORTING EMISSION CALCULATIONS

ATTACHMENT O: MONITORING/RECORDKEEPING/REPORTING/TESTING PLANS

ATTACHMENT P: PUBLIC NOTICE

Mountain Valley Pipeline, LLC (MVP), a subsidiary of EQT Corporation (EQT), is submitting this application to the West Virginia Department of Environmental Protection (WVDEP) for the construction of a new natural gas transmission compressor station located in Wetzel County, West Virginia (Bradshaw Compressor Station).

1.1. FACILITY AND PROJECT DESCRIPTION

The Bradshaw Compressor Station is a natural gas transmission facility that will compress natural gas along the Mountain Valley Pipeline. The station has the potential to operate 24 hours per day, 7 days per week. The Bradshaw Compressor Station will consist of the following equipment

- Four (4) Solar Titan 130 natural gas-fired turbines each rated at 23,536 horsepower (hp) at site-specific conditions (ISO rating at 22,400 hp each);
- Fourteen (14) Capstone C200 natural gas-fired microturbines each rated at 200 kW;
- Two (2) natural gas-fired, fuel gas heaters each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input);
- One (1) natural gas-fired, office building heater rated at 0.12 MMBtu/hr, heat input; and
- Two (2) miscellaneous storage tanks with capacities less than 15, 000 gallons

A description of each source category is included below. A process flow diagram is included as Attachment F. There are no faciltiies within ¼ mile from the proposed Bradshaw Compressor Station.

1.1.1. Turbines

MVP is proposing to install four (4) natural gas-fired turbines for the compression and transmission of natural gas. The turbines are each rated at 23,536 hp at site-specific conditions and equipped with SoLoNO$_x$ combustion technology.

The function of these turbines is to raise the discharge pressure of the gas to overcome the effect of frictional losses in the pipeline upstream of the station

1.1.2. Storage Tanks

The Bradshaw Compressor Station will operate one (1) produced fluids storage tank, and one (1) used oil storage tank. Once the tanks are filled, the contents are loaded into trucks for transport.

1.1.3. Fuel Gas and Office Heaters

MVP is proposing to add two (2) natural gas-fired heaters rated at 2.31 MMBtu/hr of heat input and an office heater rated at 0.12 MMBtu/hr at the Bradshaw Compressor Station. The fuel heaters will operate continuously (i.e., 8760 hours per year) and preheat natural gas to maintain temperature above dewpoint prior to combustion. The office heater will provide comfort heating for the building and will operate as needed

1.1.4. Microturbine Generators

There will be fourteen (14) microturbine generators at the Bradshaw Compressor Station. The microturbine generators are two (2) Model C1000 low-NO$_x$ generators (5 identical units of 200 kW each) and four additional, identical microturbines of 200 kW each manufactured by Capstone. Two units will provide main electrical power, while the additional 200 kW units will provide backup power to the station.

1.2. R-13 APPLICATION ORGANIZATION

This R-13 permit application is organized as follows:

- Section 2: Sample Emission Source Calculations;
- Section 3: R-13 Application Forms;
- Attachment A: Business Certificate;
- Attachment B: Map;
- Attachment C: Installation and Start Up Schedule;
- Attachment D: Regulatory Discussion;
- Attachment E: Plot Plan;
- Attachment F: Detailed Process Flow Diagram;
- Attachment G: Process Description;
- Attachment I: Emission Units Table;
- Attachment J: Emission Points Data Summary Sheet;
- Attachment K: Fugitive Emissions Data Summary Sheet;
- Attachment L: Emissions Unit Data Sheets;
- Attachment M: Air Pollution Control Device Sheet;
- Attachment N: Supporting Emission Calculations;
- Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans;
- Attachment P: Public Notice; and
- Application Fee

2. SAMPLE EMISSION SOURCE CALCULATIONS

The characteristics of air emissions from the Bradshaw Compressor Station, along with the methodology used for calculating emissions from the proposed new sources, are described in narrative form below. Detailed supporting calculations are also provided in Attachment N.

Emissions from the Bradshaw Compressor Station will result from natural gas combustion in the turbines, fuel gas heaters, microturbine generators, and flashing, working, and breathing losses from the storage tanks. In addition, fugitive emissions from component leaks will result from the operation of the station. The methodologies employed in calculating emissions from these sources have been summarized below, with specific citations included in Attachment N.

2.1. TURBINES

Potential emissions of nitrogen oxides (NO_X), CO, VOC, and CH_4 are calculated using factors provided by the turbine manufacturer. Potential emissions of sulfur dioxide (SO_2), particulate matter ($PM/PM_{10}/PM_{2.5}$), and formaldehyde are calculated using factors from Product Information Letters published by the turbine manufacturer. All hazardous air pollutants (HAPs), with the exception of formaldehyde, are calculated using U.S. EPA's AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines". Potential emissions of greenhouse gas pollutants (GHGs) are calculated using manufacturer's data as available (CH_4 in this case) and U.S. EPA's emission factors from 40 CFR Part 98, Subpart C for all others.

Emissions from the turbine may vary due to operational load and ambient temperature. The vendor guarantees emissions of the $SoLoNO_x$ system at and above 0°F. The vendor has also provided estimated emissions from subzero temperatures, which are expected to occur infrequently. To calculate potential emissions, the vendor guaranteed emission rates at 0°F and maximum operating load (on a lb/hr basis) were assumed continuously (i.e., 8,760 hour per year). This calculation resulted in a more conservative (i.e., higher) annual emission rate compared to assuming nominal operation below 0°F and the remainder of the year at annual average temperature.

Annual emissions also include emissions from startup and shutdown, which are calculated by multiplying emissions per startup by the number of estimated startups per year.

2.2. FUEL GAS AND OFFICE HEATERS

Potential emissions of all criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas combustion equipment. These calculations assume a site-specific heat content. Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C. Although the operation of these sources may be intermittent, potential emissions are calculated assuming continuous operation (i.e., 8,760 hours per year).

2.3. MICROTURBINE GENERATOR

Potential emissions of NO_X, CO, VOC, methane, and CO_2 are calculated using manufacturer's emission data. Emissions of all other criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas internal combustion engines. These calculations use a site specific heat content. Although one unit will provide backup power, potential emissions of all units are calculated assuming continuous operation (i.e., 8,760 hours per year).

2.4. STORAGE TANKS

Working, standing, and flash loss emissions of VOC and HAPs from the produced fluids storage tank are calculated using E&P Tank v2.0. Liquid loading emissions are calculated using EPA AP-42 emission factors.

2.5. FUGITIVE EMISSIONS

Emissions from fugitive equipment leaks are calculated using published EPA emission factors and 40 CFR Part 98, Subpart W emission factors. Emissions from blowdown events are calculated using engineering estimates of the amount of gas vented during each event. Site specific gas analyses were used to speciate VOC, HAP, and GHG emissions.

3. R13 APPLICATION FORM

The WVDEP permit application forms contained in this application include all applicable R13 application forms including the required attachments.

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT AND TITLE V PERMIT REVISION (OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):

☒ **CONSTRUCTION** ☐ **MODIFICATION** ☐ **RELOCATION**
☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**
☐ **CLASS II ADMINISTRATIVE UPDATE** ☐ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30 (TITLE V)** REVISION (IF ANY):

☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**
☐ **SIGNIFICANT MODIFICATION**

IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant *(as registered with the WV Secretary of State's Office)*:
Mountain Valley Pipeline, LLC

2. Federal Employer ID No. ***(FEIN):***
61-1744744

3. Name of facility *(if different from above)*:
Bradshaw Compressor Station

4. The applicant is the:
☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**

5A. Applicant's mailing address:
625 Liberty Avenue, Suite 1700
Pittsburgh, PA 15222

5B. Facility's present physical address:
Bear Run Rd, Mannington, WV 26582

6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☒ **YES** ☐ **NO**
- If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
- If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**

7. If applicant is a subsidiary corporation, please provide the name of parent corporation: EQT Corporation

8. Does the applicant own, lease, have an option to buy or otherwise have control of the *proposed site?* ☒ **YES** ☐ **NO**
- If **YES,** please explain: Applicant owns the site
- If **NO,** you are not eligible for a permit for this source.

9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): Natural Gas Compressor Station

10. North American Industry Classification System **(NAICS)** code for the facility:
486210

11A. DAQ Plant ID No. (for existing facilities only):

11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only):

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

12A.

- For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the *present location* of the facility from the nearest state road;
- For **Construction** or **Relocation permits,** please provide directions to the *proposed new site location* from the nearest state road. Include a **MAP** as **Attachment B**.

From Charleston, WV take I-79 N for approximately 121 miles. Take exit 119 for US-50 toward Clarksburg/Bridgeport. Continue on US-50 W for 7 miles. Then, Turn right onto Bean Run/Gregory Run and continue for 5.8 miles. Next, turn left onto WV-20 N/State Hwy 20 and continue for 16 miles. Then, Turn right onto Mannington Rd and drive 1.2 miles. Finally, Turn left onto Bear Run Rd and continue 2.2 miles to the site.

12.B. New site address (if applicable):	12C. Nearest city or town: Mannington, WV 26582	12D. County: Wetzel
12.E. UTM Northing (KM): 4,376.00	12F. UTM Easting (KM): 540.05	12G. UTM Zone: 17

13. Briefly describe the proposed change(s) at the facility:

Mountain Valley Pipeline, LLC is constructing a new natural gas transmission compressor station as part of the Mountain Valley Pipeline (MVP).

14A. Provide the date of anticipated installation or change: October 2014 – If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen:	14B. Date of anticipated Start-Up if a permit is granted: 12/2017

14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).

15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day 24 Days Per Week 7 Weeks Per Year 52

16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**

17. **Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.

18. **Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process *(if known)*. A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance *(if known)*. Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

20. Include a **Table of Contents** as the first page of your application package.

21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to ***Plot Plan Guidance***) .
– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).

22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**

23. Provide a **Process Description** as **Attachment G.**
– Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**

– For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

☒ Bulk Liquid Transfer Operations	☒ Haul Road Emissions	☐ Quarry
☒ Chemical Processes	☐ Hot Mix Asphalt Plant	☐ Solid Materials Sizing, Handling and Storage Facilities
☐ Concrete Batch Plant	☐ Incinerator	☒ Storage Tanks
☐ Grey Iron and Steel Foundry	☐ Indirect Heat Exchanger	

☒ General Emission Unit, specify Microturbines, Fuel Gas Heater, Office Building Heater, and Turbines

Fill out and provide the **Emissions Unit Data Sheet(s)** as **Attachment L.**

29. Check all applicable **Air Pollution Control Device Sheets** listed below:

☐ Absorption Systems	☐ Baghouse	☐ Flare
☐ Adsorption Systems	☐ Condenser	☐ Mechanical Collector
☐ Afterburner	☐ Electrostatic Precipitator	☐ Wet Collecting System

☐ Other Collectors, specify

Fill out and provide the **Air Pollution Control Device Sheet(s)** as **Attachment M.**

30. Provide all **Supporting Emissions Calculations** as **Attachment N,** or attach the calculations directly to the forms listed in Items 28 through 31.

31. **Monitoring, Recordkeeping, Reporting and Testing Plans.** Attach proposed monitoring, recordkeeping, reporting and testing plans in order to demonstrate compliance with the proposed emissions limits and operating parameters in this permit application. Provide this information as **Attachment O.**

➢ Please be aware that all permits must be practically enforceable whether or not the applicant chooses to propose such measures. Additionally, the DAQ may not be able to accept all measures proposed by the applicant. If none of these plans are proposed by the applicant, DAQ will develop such plans and include them in the permit.

32. **Public Notice.** At the time that the application is submitted, place a **Class I Legal Advertisement** in a newspaper of general circulation in the area where the source is or will be located (See 45CSR§13-8.3 through 45CSR§13-8.5 and ***Example Legal Advertisement*** for details). Please submit the **Affidavit of Publication** as **Attachment P** immediately upon receipt.

33. **Business Confidentiality Claims.** Does this application include confidential information (per 45CSR31)?

☐ **YES** ☒ **NO**

➢ If **YES,** identify each segment of information on each page that is submitted as confidential and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's ***"Precautionary Notice – Claims of Confidentiality"*** guidance found in the ***General Instructions*** as **Attachment Q.**

Section III. Certification of Information

34. **Authority/Delegation of Authority.** Only required when someone other than the responsible official signs the application. Check applicable **Authority Form** below:

☐ Authority of Corporation or Other Business Entity	☐ Authority of Partnership
☐ Authority of Governmental Agency	☐ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

35A. **Certification of Information.** To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☒ **Responsible Official** / ☐ **Authorized Representative,** hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE _____ DATE: 10-20-15

(Please use blue ink) *(Please use blue ink)*

35B. Printed name of signee: Shawn Posey		35C. Title: Sr. Vice President – Engineering and Construction
35D. E-mail: sposey@eqt.com	36E. Phone:	36F. FAX:
36A. Printed name of contact person (if different from above): Regina Henry		36B. Title: Supervisor - Environmental
36C. E-mail: rhenry@eqt.com	36D. Phone: 412-553-7848	36E. FAX:

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

- ☒ **Attachment A: Business Certificate**
- ☒ **Attachment B: Map(s)**
- ☒ **Attachment C: Installation and Start Up Schedule**
- ☒ **Attachment D: Regulatory Discussion**
- ☒ **Attachment E: Plot Plan**
- ☒ **Attachment F: Detailed Process Flow Diagram(s)**
- ☒ **Attachment G: Process Description**
- ☐ **Attachment H: Material Safety Data Sheets (MSDS)**
- ☒ **Attachment I: Emission Units Table**
- ☒ **Attachment J: Emission Points Data Summary Sheet**
- ☒ **Attachment K: Fugitive Emissions Data Summary Sheet**
- ☒ **Attachment L: Emissions Unit Data Sheet(s)**
- ☐ **Attachment M: Air Pollution Control Device Sheet(s)**
- ☒ **Attachment N: Supporting Emissions Calculations**
- ☒ **Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans**
- ☒ **Attachment P: Public Notice**
- ☐ **Attachment Q: Business Confidential Claims**
- ☐ **Attachment R: Authority Forms**
- ☐ **Attachment S: Title V Permit Revision Information**
- ☒ **Application Fee**

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

- ☐ ***Forward 1 copy of the application to the Title V Permitting Group and:***
- ☐ ***For Title V Administrative Amendments:***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit,***
- ☐ ***For Title V Minor Modifications:***
  - ☐ ***Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt,***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit.***
- ☐ ***For Title V Significant Modifications processed in parallel with NSR Permit revision:***
  - ☐ ***NSR permit writer should notify a Title V permit writer of draft permit,***
  - ☐ ***Public notice should reference both 45CSR13 and Title V permits,***
  - ☐ ***EPA has 45 day review period of a draft permit.***

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

ATTACHMENT A

Current Business Certificate

WEST VIRGINIA
STATE TAX DEPARTMENT

BUSINESS REGISTRATION CERTIFICATE

ISSUED TO:
MOUNTAIN VALLEY PIPELINE, LLC
625 LIBERTY AVE, SUITE 1700
PITTSBURGH, PA 15222-0000

BUSINESS REGISTRATION ACCOUNT NUMBER: **2305-4787**

This certificate is issued on: **04/8/2015**

This certificate is issued by
the West Virginia State Tax Commissioner
in accordance with Chapter 11, Article 12, of the West Virginia Code

The person or organization identified on this certificate is registered to conduct business in the State of West Virginia at the location above.

This certificate is not transferrable and must be displayed at the location for which issued

This certificate shall be permanent until cessation of the business for which the certificate of registration was granted or until it is suspended, revoked or cancelled by the Tax Commissioner.

Change in name or change of location shall be considered a cessation of the business and a new certificate shall be required.

TRAVELING/STREET VENDORS: Must carry a copy of this certificate in every vehicle operated by them. CONTRACTORS, DRILLING OPERATORS, TIMBER/LOGGING OPERATIONS: Must have a copy of this certificate displayed at every job site within West Virginia.

atL006 v.4
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ATTACHMENT B

Map

ATTACHMENT B - AREA MAP



Figure 1 - Map of Bradshaw Station

UTM Northing (KM):	4,376.018
UTM Easting (KM):	540.135
Elevation:	~1,515 ft

ATTACHMENT C

Startup and Installation Schedule

ATTACHMENT C

Schedule of Planned Installation and Start-Up

Unit	Installation Schedule	Startup Schedule
Four (4) Solar Titan 130 Turbines – Each rated 23,536 HP at site-specific conditions (22,400 HP ISO)	2017	4Q 2017
Fourteen (14) 200 KW Capstone Microturbines	2017	4Q 2017
Two (2) Fuel Gas Heaters – Each rated 2.31 MMBtu/hr	2017	4Q 2017
One (1) 10,080 gallon Produced Fluids Tank	2017	4Q 2017
One (1) 4,200 gallon Used Oil Tank	2017	4Q 2017
Office Building Heater – Rated 0.12 MMBtu/hr	2017	4Q 2017

ATTACHMENT D

Regulatory Discussion

ATTACHMENT D - REGULATORY APPLICABILITY

This section documents the applicability determinations made for Federal and State air quality regulations. The monitoring, recordkeeping, reporting, and testing plan is presented in Attachment O. In this section, applicability or non-applicability of the following regulatory programs is addressed:

- Prevention of Significant Deterioration (PSD) permitting;
- Non-Attainment New Source Review (NNSR) permitting;
- Title V of the 1990 Clean Air Act Amendments;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP); and
- West Virginia State Implementation Plan (SIP) regulations.

This review is presented to supplement and/or add clarification to the information provided in the WVDEP R13 permit application forms, which fulfill the requirement to include citations and descriptions of applicable statutory and administrative code requirements.

In addition to providing a summary of applicable requirements, this section of the application also provides non-applicability determinations for certain regulations, allowing the WVDEP to confirm that identified regulations are not applicable to the station. Note that explanations of non-applicability are limited to those regulations for which there may be some question of applicability specific to the operations at the station. Regulations that are categorically non-applicable are not discussed (e.g., NSPS Subpart J, Standards of Performance for Petroleum Refineries).

Prevention of Significant Deterioration Source Classification

Federal construction permitting programs regulate new and modified sources of attainment pollutants under PSD and new and modified sources of non-attainment pollutants under NNSR. PSD regulations apply when a new source is constructed in which emissions exceed PSD major source thresholds, an existing minor source undergoes a modification in which emission increases exceed PSD major source thresholds, or an existing major source undergoes a modification in which emission increases exceed PSD significant emission rates. The Bradshaw Station will be a minor source with respect to PSD, as shown in Attachment N. As such, PSD permitting is not triggered.

NNSR regulations apply only in areas designated as non-attainment. The Bradshaw Station will be located in Wetzel County, which is designated as attainment/unclassifiable for all criteria pollutants.[1] Therefore, NNSR regulations do not apply to the Bradshaw Station.

Title V Operating Permit Program

Title 40 of the Code of Federal Regulations, Chapter 70 (40 CFR 70) establishes the Federal Title V operating permit program. West Virginia has incorporated the provisions of this Federal program in its Title V operating permit program in West Virginia 45CSR30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAP and 100 tpy of all other regulated pollutants.[2] After completion of construction of the proposed project,

[1] U.S. EPA Greenbook, http://www.epa.gov/airquality/greenbook/anayo_wv.html, as of January 30, 2015.
[2] On June 23, 2014, the U.S Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA* effectively changed the permitting procedures for GHGs under the PSD and Title V programs.

potential emissions for NO_X and CO will exceed major source thresholds with respect to the Title V permit program. Therefore, the station will be major source with respect to the Title V Program. In accordance with 40 CFR 70.5(a)(1) and 45CSR30 Section 4.1.a.2, Mountain Valley Pipeline (MVP) will submit a Title V operating permit application within 12 months of start-up of the authorized equipment under this construction permit request.

New Source Performance Standards

NSPS, located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the facility.

NSPS Subpart Dc - Steam Generating Units

Subpart Dc, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, applies to all steam generating units with a heat input greater than or equal to 10 MMBtu/hr and less than 100 MMBtu/hr. No units at the proposed facility meet the definition of a steam generating unit and have a heat input greater than 10 MMBtu/hr; therefore, the requirements of this subpart will not apply.

NSPS Subpart GG - Stationary Gas Turbines

Subpart GG, Standards of Performance for Stationary Gas Turbines, applies to all gas turbines with a heat input at peak load greater than or equal to 10 MMBtu/hr based on the lower heating value of the fuel fired. This standard was promulgated in 1979. The applicability of Subpart KKKK, promulgated in 2006, is similar to that of Subpart GG and applies to stationary combustion turbines that commence construction after February 18, 2005. Turbines subject to Subpart KKKK are specifically exempt from the requirements of Subpart GG per 40 CFR § 60.4305(b). As such, this subpart does not apply to the proposed Solar turbines at the Bradshaw Compressor station as they are subject to the requirements of Subpart KKKK as discussed in the following section. The proposed microturbines have a heat input below 10 MMBtu/hr and are not subject to the requirements of Subpart GG.

NSPS Subparts K, Ka, and Kb - Storage Vessels for Petroleum Liquids/Volatile Organic Liquids

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. Subpart K applies to storage tanks constructed, reconstructed, or modified prior to 1978, and Subpart Ka to those constructed, reconstructed, or modified prior to 1984. All storage tanks located at the Bradshaw Compressor Station will be constructed after these dates; therefore, the requirements of Subparts K and Ka do not apply. Subpart Kb applies to volatile organic liquid (VOL) storage tanks constructed, reconstructed, or modified after July 23, 1984 with a capacity equal to or greater than 75 m^3 (~19,813 gallons). All storage tanks at the Bradshaw Compressor Station will be constructed after this date, but will not have a capacity greater than 75 m^3. Therefore, Subpart Kb does not apply to the storage tanks at the Bradshaw Compressor Station.

NSPS Subpart IIII - Stationary Spark Ignition Internal Combustion Engines

Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of compression ignition (CI) engines. There will be no CI engines installed at the Bradshaw Compressor Station. Therefore, this subpart is not applicable to the station.

NSPS Subpart JJJJ - Stationary Spark Ignition Internal Combustion Engines

Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of stationary spark (SI) engines. There will be no SI engines installed at the Bradshaw Compressor Station. Therefore, this subpart is not applicable to the station.

NSPS Subpart KKKK - Stationary Combustion Turbines

Subpart KKKK, Standards of Performance for Stationary Combustion Turbines, applies to stationary combustion units with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the higher heating value of the fuel, commencing construction after February 18, 2005. The microturbines at the Bradshaw Compressor station will each have a heat input less than 10 MMbtu/hr. Therefore, they are not subject to this standard.

The proposed Solar turbines for the Bradshaw Compressor Station will be subject to the NO_X emissions limitations in §60.4320(a). Turbines with a rated capacity of 50 < MMBtu/hr ≤ 850 MMBtu/hr at peak load are limited to NO_X emissions of 25 ppm at 15% O_2 when firing natural gas. The Solar turbines that will be installed at the station are equipped with lean pre-mix combustion technology and are guaranteed by the manufacturer to emit a maximum of 15 ppm of NO_X at 15% O_2 under variable turbine load conditions when firing natural gas. This vendor guarantee is well below the NSPS KKKK standard.

MVP will perform annual performance tests in accordance with §60.4340(a) and§ 60.4400 to demonstrate compliance with the NO_X emission limitations, or as an alternative, will continuously monitor the appropriate parameters to determine whether the turbine is operating in low-NO_X mode in accordance with §60.4340(b)(2)(ii) and §60.4355(a). The Solar turbines must also comply with the SO_2 emission limits in 40 §60.4330. MVP will comply with the SO_2 requirements by the exclusive use of natural gas which contains total potential sulfur emissions less than 0.060 lb SO_2/MMBtu heat input in accordance with 40 CFR 60.4330(a)(2).

NSPS Subpart OOOO - Natural Gas Production, Transmission, and Storage

Subpart OOOO, Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011. This NSPS was published in the Federal Register on August 16, 2012, and subsequently amended. The list of potentially affected facilities includes:

- Gas wellheads ;
- Centrifugal compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Reciprocating compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Continuous bleed natural gas-driven pneumatic controllers with a bleed rate of > 6 scfh located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment (excluding natural gas processing plants);
- Continuous bleed natural gas-driven pneumatic controllers located at natural gas processing plants;
- Storage vessels in the production, processing, or transmission and storage segments; and
- Sweetening units located onshore that process natural gas produced from either onshore or offshore wells.

Since the proposed Bradshaw Compressor Station will be a transmission facility located after the point of custody transfer, the only potentially applicable requirements for the proposed equipment are those for new storage vessels where construction commenced after August 23, 2011.

The standards applicable to storage vessels are detailed in 40 CFR §60.5395. The only tank that falls under the Subpart's definition of a 'storage vessel' is the produced fluid storage tank, however, this tank will have potential VOC emissions below 6 tpy. As such, per 60.5365(e), the tank is not a storage vessel affected facility under the rule.

It is important to note that updates to NSPS OOOO have been proposed. However, as the changes are not finalized, applicability will be reviewed once the rules have been finalized.

National Emission Standards for Hazardous Air Pollutants

Regulatory requirements for facilities subject to NESHAP standards, otherwise known as Maximum Available Control Technology (MACT) Standards for source categories, are contained in 40 CFR Part 63. 40 CFR Part 61 NESHAP standards are defined for specific pollutants while Part 63 NESHAPs are defined for source categories where allowable emission limits are established on the basis of a MACT determination for a particular major source. A major source of HAP is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. Part 63 NESHAPs apply to sources in specifically regulated industrial source categories (CAA Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type.

Potential HAP emissions from the proposed Bradshaw Compressor Station will be below the major source thresholds (i.e., less than 10 tpy of individual HAP and 25 tpy of total HAP) and therefore the facility will be an area source of HAP. The potential applicability of specific MACT standards to the Bradshaw Compressor Station is discussed below.

NESHAP Subpart HH - Natural Gas Production Facilities

This standard applies to sources at natural gas production facilities that are major or area sources of HAP emissions. The proposed Bradshaw Station is a transmission facility; therefore, this facility will not be subject to Subpart HH.

NESHAP Subpart HHH - Natural Gas Transmission and Storage Facilities

This standard applies to sources at natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and/or treatment in the production sector), but upstream of the distribution sector. The proposed Bradshaw Compressor Station is a transmission facility and is an area source of HAP emissions. Therefore, this facility will not be subject to Subpart HHH.

NESHAP Subpart YYYY - Stationary Combustion Turbines.

Stationary combustion turbines located at facilities that are major sources of HAPs are potentially subject to Subpart YYYY, NESHAP for Stationary Combustion Turbines. Subpart YYYY establishes emissions and operating limitations for lean premix gas-fired, lean premix oil-fired, diffusion flame gas-fired and diffusion flame oil-fired stationary combustion turbines. The proposed Bradshaw Station is an area source of HAP and therefore is not subject to the requirements of this subpart.

NESHAP Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines

Stationary reciprocating internal combustion engines (RICE) at both area and major sources of HAP emissions are potentially subject to Subpart ZZZZ – *NESHAP for Stationary Reciprocating Internal Combustion Engines*

(RICE). There are no proposed RICE at the Bradshaw Compressor Station. Therefore, the station is not subject to this subpart.

NESHAP Subpart DDDDD - Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types at major sources of HAP. The proposed facility is an area source of HAP; therefore, the requirements of this subpart will not apply.

NESHAP Subpart JJJJJJ - Industrial, Commercial, and Institutional Boilers (Area Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types. The proposed fuel heaters are natural gas-fired and are specifically exempt from this subpart. Therefore, the requirements of this subpart will not apply.

West Virginia SIP Regulations

The station is potentially subject to regulations contained in the West Virginia Code of State Regulations, Title 45. The Code of State Regulations fall under two main categories: those regulations that are generally applicable (e.g., permitting requirements), and those that have specific applicability (e.g., PM standards for manufacturing equipment).

45 CSR 2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The proposed fuel heaters and office building heater are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from this unit shall not exceed 10 percent.

45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

The station is generally subject to this requirement. MVP will operate all equipment in a manner as to avoid causing or contributing to an objectionable odor at any location occupied by the public.

45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall be considered incineration." The facility will not operate any incinerators under this definition and, as such, has no requirements under this rule.

45 CSR 10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides

This rule applies to specific emission sources that are listed by name in the rule, to sulfuric acid manufacturing plants, and to sources that combust any refinery process gas stream or any other process gas stream that contains hydrogen sulfide in a concentration greater than 50 grains per 100 cubic feet. The Bradshaw Station does not meet any of the categories subject to the rule, and as such is not subject to comply.

45 CSR 13: Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, Permission to Commence Construction, and Procedures for Evaluation

This rule establishes procedures for permitting and reporting of stationary sources. MVP will comply with the requirements of this rule by complying with the applicable general provisions in the facility's construction and operating permits.

45 CSR 16: Standards of Performance for New Stationary Sources

45 CSR 16-1 incorporates the federal Clean Air Act (CAA) standards of performance for new stationary sources set forth in 40 CPR Part 60 by reference. As noted above, the facility will comply with all applicable NSPS subparts.

45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

No person shall cause, suffer, allow or permit fugitive particulate matter to be discharged beyond the boundary lines of the property lines of the property on which the discharge originates or at any public or residential location, which causes or contributes to statutory air pollution.

Due to the nature of the activities at the station, it is unlikely that fugitive particulate matter emissions will be emitted under normal operating conditions. However, MVP will take measures to ensure any fugitive particulate matter emissions will not cross the property boundary should any such emissions occur.

45 CSR 21: To Prevent and Control Air Pollution from the Emission of Volatile Organic Compounds

45 CSR 21 applies only to sources located in Putnam County, Kanawha County, Cabell County, Wayne County, and Wood County, West Virginia. The Bradshaw Station will be located in Wetzel County. Therefore, the requirements of this section to not apply to the station.

45 CSR 22: Air Quality Management Fee Program

This regulation establishes a program to collect fees for certificates to operate and for permits to construct, modify or relocate sources of air pollution. Mountain Valley Pipeline will comply with this rule by paying all required permitting fees.

45 CSR 34: Emissions Standards for Hazardous Air Pollutants

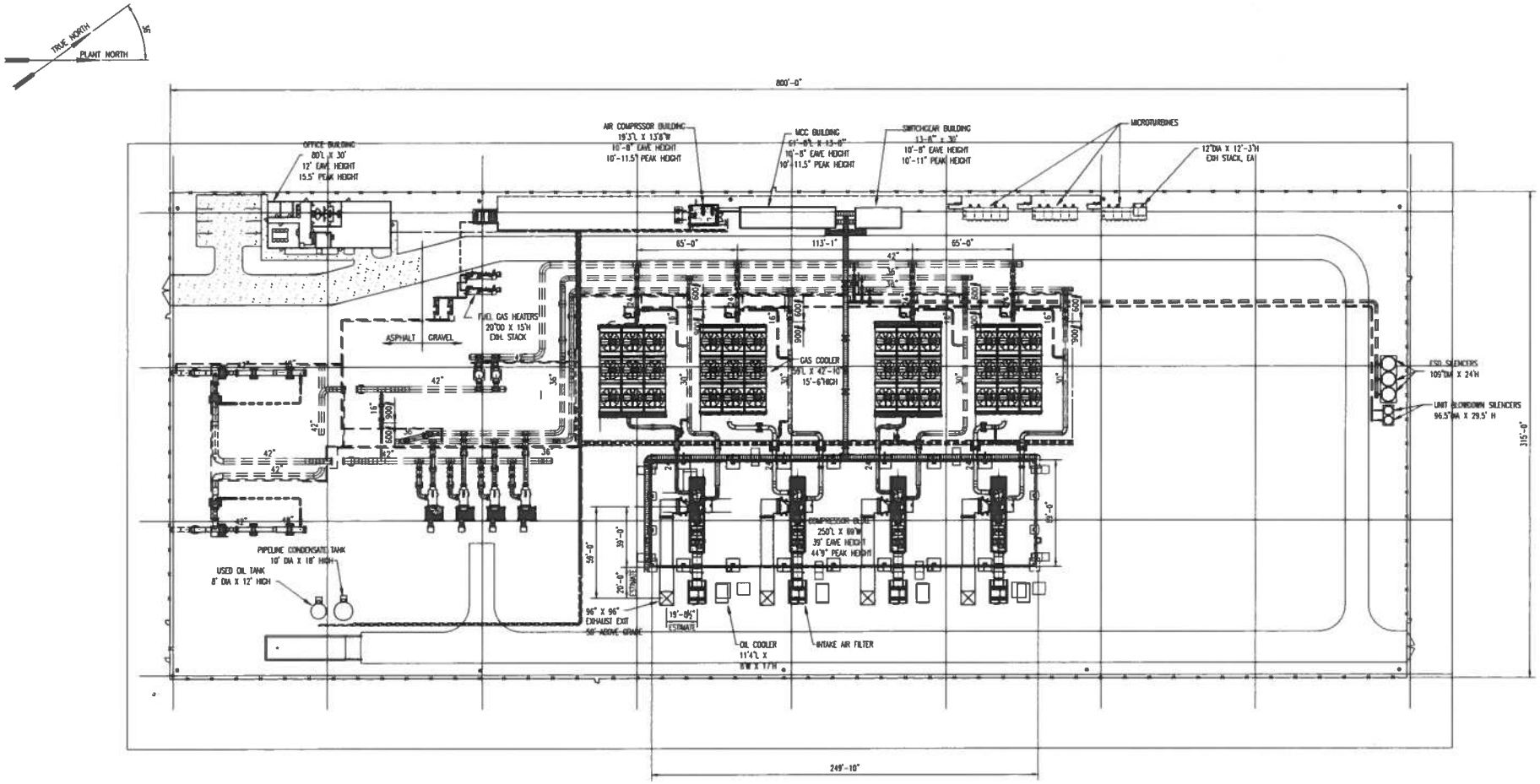
45 CSR 34-1 incorporates the federal Clean Air Act (CAA) national emissions standards for hazardous air pollutants (NESHAPs) as set forth in 40 CPR Parts 61 and 63 by reference. As noted above, no NESHAP are applicable to the station.

Non-Applicability of Other SIP Rules

A thorough examination of the West Virginia SIP rules with respect to applicability at the station reveals many SIP regulations that do not apply or impose additional requirements on operations. Such SIP rules include those specific to a particular type of industrial operation that is categorically not applicable to the station.

ATTACHMENT E

Plot Plan



REFERENCE DRAWINGS		NO	DATE	REVISION	BY	CHK	APPD	NO	DATE	REVISION	BY	CHK	APPD
DRAWING NUMBER	DRAWING TITLE	P	06/18/2015	ISSUED FOR BUDGETARY RFI	CET	WJJ	RLM	-					
-		-						-					
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-		-						-					

TO THE BEST OF MY KNOWLEDGE, ALL COMPONENTS OF THIS DRAWING ARE DESIGNED IN ACCORDANCE WITH APPLICABLE GUIDELINES AND SPECIFICATIONS

BYRON MOORE — MECHANICAL DESIGN ENGINEER — DATE

JOE HAUGHT — ELECTRICAL DESIGN ENGINEER — DATE

NOTE: ANY CHANGES TO THE DESIGN SHOWN ON THIS DRAWING MUST BE APPROVED BY THE DESIGN ENGINEER.

Mountain Valley PIPELINE

PROJECT ID

DRAWING SCALE: 1"=30'

DRAWING TITLE:
MOUNTAIN VALLEY PIPELINE
BRADSHAW COMPRESSOR STATION
PIPING
PLOT PLAN

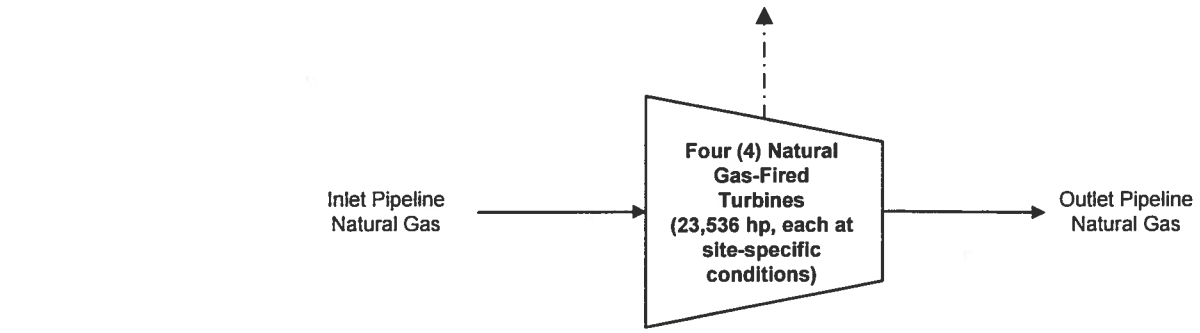
FACILITY	STATE	IDENTIFICATION	SERIES	SHEET	REVISION
C	W	BRD01	1100	01	P

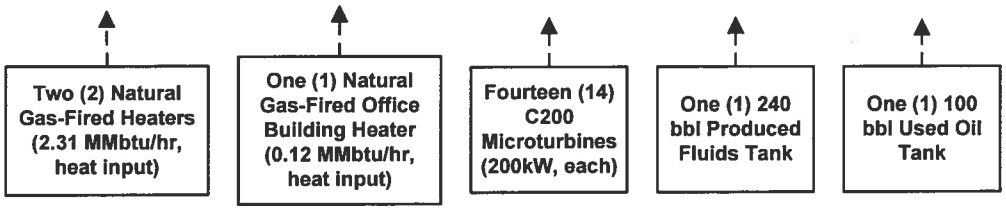
Plotted by: Thompson, Carmen, July 13, 2015 - 2:19 PM

File Path: C:\Vault Workspaces\3D\MVP\Bradshaw Compressor Station\Drawing Files\Design Files\Mechanical\2Dmodel\C-W-BRD01-1100-01.dwg

ATTACHMENT F

Detailed Process Flow Diagram





Flow Legend

Gas/Water/Condensate Flow

Stack Emissions

Mountain Valley

Mountain Valley Pipeline, LLC

Process Flow Diagram
Bradshaw Station

Trinity Consultants

October 2015

ATTACHMENT G

Process Description

ATTACHMENT G - PROCESS DESCRIPTION

Mountain Valley Pipeline, LLC (MVP) is submitting this application for the construction of a new natural gas transmission compressor station located in Wetzel County, West Virginia (Bradshaw Station).

Natural gas enters the station via the transmission pipeline system and is compressed using one of the four (4) natural gas-fired turbines (each rated at 23,536 hp at site-specific conditions, and ISO rated at 22,400 hp each). The compressed natural gas flows into the pipeline to be transported further along the transmission system. The station is also equipped with two (2) fuel gas heaters, one (1) office building heater, one (1) produced fluids storage tank, one (1) used oil storage tank, and fourteen (14) natural gas-fired microturbine generators (each rated at 200 kW) providing electricity to the station. Once the tanks are filled, the contents are loaded into trucks for transport.

A process flow diagram is included as Attachment F.

ATTACHMENT I

Emission Units Table

Attachment I

Emission Units Table

(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device[4]
S001	E001	Solar Turbine #1	2017	23,536 HP (site-specific conditions)	New	N/A
S002	E002	Solar Turbine #2	2017	23,536 HP (site-specific conditions)	New	N/A
S003	E003	Solar Turbine #3	2017	23,536 HP (site-specific conditions)	New	N/A
S004	E004	Solar Turbine #4	2017	23,536 HP (site-specific conditions)	New	N/A
S005	E005	Microturbine Generator #1	2017	200 KW	New	N/A
S006	E006	Microturbine Generator #2	2017	200 KW	New	N/A
S007	E007	Microturbine Generator #3	2017	200 KW	New	N/A
S008	E008	Microturbine Generator #4	2017	200 KW	New	N/A
S009	E009	Microturbine Generator #5	2017	200 KW	New	N/A
S010	E010	Microturbine Generator #6	2017	200 KW	New	N/A
S011	E011	Microturbine Generator #7	2017	200 KW	New	N/A
S012	E012	Microturbine Generator #8	2017	200 KW	New	N/A
S013	E013	Microturbine Generator #9	2017	200 KW	New	N/A
S014	E014	Microturbine Generator #10	2017	200 KW	New	N/A
S015	E015	Microturbine Generator #11	2017	200 KW	New	N/A
S016	E016	Microturbine Generator #12	2017	200 KW	New	N/A
S017	E017	Microturbine Generator #13	2017	200 KW	New	N/A
S018	E018	Microturbine Generator #14	2017	200 KW	New	N/A
S019	E019	Fuel Gas Heater	2017	2.31 MMBtu/hr	New	N/A
S020	E020	Fuel Gas Heater	2017	2.31 MMBtu/hr	New	N/A
S021	E021	Produced Fluids Tank	2017	10,080 gallons	New	N/A
S022	E022	Used Oil Tank	2017	4,200 gallons	New	N/A
S023	E023	Office Building Heater	2017	0.12 MMBtu/hr	New	N/A
S024	E024	Fugitives	2017	N/A	New	N/A
S025	E025	Liquid Loading	2017	126,000 gal/yr	New	N/A

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

ATTACHMENT J

Emission Points Data Summary Sheet

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 1: Emissions Data

Emission Point ID No. *(Must match Emission Units Table & Plot Plan)*	Emission Point Type[1]	Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)*		Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)*		Vent Time for Emission Unit *(chemical processes only)*		All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions[4]		Maximum Potential Controlled Emissions[5]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used[6]	Emission Concentration[7] (ppmv or mg/m^4)
		ID No.	Source	ID No.	Device Type	Short Term[2]	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
S001	Upward Vertical stack	E001	Solar Turbine	NA	NA	NA	NA	NOx	9.80	42.95	9.80	42.95	Gas/Vapor	O^A	
								CO	9.90	45.67	9.90	45.67		O^A	
								VOC	1.14	5.02	1.14	5.02		O^A	
								SO2	0.60	2.62	0.60	2.62		O^A	
								PM/PM10/PM2.5	2.64	11.57	2.64	11.57		O^A	
								HAPs	0.56	2.47	0.56	2.47		$O^{A,B}$	
								CO2e	20,891	91,630	20,891	91,630		$O^{A,C}$	
S002	Upward Vertical stack	E002	Solar Turbine	NA	NA	NA	NA	NOx	9.80	42.95	9.80	42.95	Gas/Vapor	O^A	
								CO	9.90	45.67	9.90	45.67		O^A	
								VOC	1.14	5.02	1.14	5.02		O^A	
								SO2	0.60	2.62	0.60	2.62		O^A	
								PM/PM10/PM2.5	2.64	11.57	2.64	11.57		O^A	
								HAPs	0.56	2.47	0.56	2.47		$O^{A,B}$	
								CO2e	20,891	91,630	20,891	91,630		$O^{A,C}$	
S003	Upward Vertical stack	E003	Solar Turbine	NA	NA	NA	NA	NOx	9.80	42.95	9.80	42.95	Gas/Vapor	O^A	
								CO	9.90	45.67	9.90	45.67		O^A	
								VOC	1.14	5.02	1.14	5.02		O^A	
								SO2	0.60	2.62	0.60	2.62		O^A	
								PM/PM10/PM2.5	2.64	11.57	2.64	11.57		O^A	
								HAPs	0.56	2.47	0.56	2.47		$O^{A,B}$	
								CO2e	20,891	91,630	20,891	91,630		$O^{A,C}$	
S004	Upward Vertical stack	E004	Solar Turbine	NA	NA	NA	NA	NOx	9.80	42.95	9.80	42.95	Gas/Vapor	O^A	
								CO	9.90	45.67	9.90	45.67		O^A	
								VOC	1.14	5.02	1.14	5.02		O^A	
								SO2	0.60	2.62	0.60	2.62		O^A	
								PM/PM10/PM2.5	2.64	11.57	2.64	11.57		O^A	
								HAPs	0.56	2.47	0.56	2.47		$O^{A,B}$	
								CO2e	20,891	91,630	20,891	91,630		$O^{A,C}$	
S005	Upward Vertical Stack	E005	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O^A	
								CO	0.22	0.96	0.22	0.96		O^A	
								VOC	0.02	0.09	0.02	0.09		O^A	
								SO2	0.01	0.03	0.01	0.03		O^D	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O^D	
								HAPs	0.002	0.01	0.002	0.01		O^D	
								CO2e	266	1,166	266	1,166		$O^{A,C}$	

S006	Upward Vertical Stack	E006	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S007	Upward Vertical Stack	E007	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S008	Upward Vertical Stack	E008	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S009	Upward Vertical Stack	E009	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S010	Upward Vertical Stack	E010	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S011	Upward Vertical Stack	E011	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S012	Upward Vertical Stack	E012	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S013	Upward Vertical Stack	E013	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	

S014	Upward Vertical Stack	E014	Microturbine	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 HAPs CO2e	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	Gas/Vapor	O[A] O[A] O[A] O[D] O[D] O[D] O[A,C]	
S015	Upward Vertical Stack	E015	Microturbine	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 HAPs CO2e	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	Gas/Vapor	O[A] O[A] O[A] O[D] O[D] O[D] O[A,C]	
S016	Upward Vertical Stack	E016	Microturbine	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 HAPs CO2e	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	Gas/Vapor	O[A] O[A] O[A] O[D] O[D] O[D] O[A,C]	
S017	Upward Vertical Stack	E017	Microturbine	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 HAPs CO2e	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	Gas/Vapor	O[A] O[A] O[A] O[D] O[D] O[D] O[A,C]	
S018	Upward Vertical Stack	E018	Microturbine	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 HAPs CO2e	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	0.08 0.22 0.02 0.01 0.02 0.002 266	0.35 0.96 0.09 0.03 0.07 0.01 1,166	Gas/Vapor	O[A] O[A] O[A] O[D] O[D] O[D] O[A,C]	
S019	Upward Vertical stack	E019	Fuel Gas Heaters	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.21 0.18 0.01 <0.01 0.02 270	0.93 0.78 0.05 0.01 0.07 1,184	0.21 0.18 0.01 <0.01 0.02 270	0.93 0.78 0.05 0.01 0.07 1,184	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S020	Upward Vertical stack	E020	Fuel Gas Heaters	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.21 0.18 0.01 <0.01 0.02 270	0.93 0.78 0.05 0.01 0.07 1,184	0.21 0.18 0.01 <0.01 0.02 270	0.93 0.78 0.05 0.01 0.07 1,184	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S021	Upward Vertical Stack	E021	Produced Fluids Storage Tank	NA	NA	NA	NA	VOC HAP	0.05 0.00	0.21 0.00	0.05 0.00	0.21 0.00	Gas/Vapor	O[E]	

S022	Upward Vertical Stack	E022	Used Oil Storage Tank	NA	NA	NA	NA	VOC HAP	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	Gas/Vapor	O[E]	
S023	Upward Vertical stack	E023	Office Building Heater	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.01 0.01 <0.01 <0.01 <0.01 14	0.05 0.04 <0.01 <0.01 <0.01 62	0.01 0.01 <0.01 <0.01 <0.01 14	0.05 0.04 <0.01 <0.01 <0.01 62	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S024	Fugitives	E024	Fugitives including Haul Roads	NA	NA	NA	NA	VOC PM/PM10/PM2.5 HAP CO2e	2.34 0.03 0.17 1,488	10.26 0.12 0.75 6,516	2.34 0.03 0.17 1,488	10.26 0.12 0.75 6,516	Gas/Vapor	O[G] O[H] O[G] O[C]	
S025	Liquid Loading	E025	Liquid Loading	NA	NA	NA	NA	VOC	NA	0.05	NA	0.05	Gas/Vapor	O[I]	

A- Manufacturer's specific pollutant emission factor
B- AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000, except for Formaldehyde which is manufacturer's spec.
C- 40 CFR 98, Subpart C for natural gas fired combustion.
D- AP-42 Section 3.1 Table 3.1-2a
E- API E&P Tanks/EPA TANKS 9.0d
F- AP-42 Section 1.4 Tables 1.4-1, 1.4-2 and 1.4-3, July 1998.
G- EPA Leak Protocol, Table 2-4, 40 CFR 98 Subpart W, & Site-Specific Gas Analysis
H- AP-42 Table 13.2.2-2 (Final, 11/06)
I- AP-42 Section 5.2 Table 5.2-1

The EMISSION POINTS DATA SUMMARY SHEET provides a summation of emissions by emission unit. Note that uncaptured process emission unit emissions are not typically considered to be fugitive and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET. Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions). Please complete the FUGITIVE EMISSIONS DATA SUMMARY SHEET for fugitive emission activities.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] Indicate by "C" if venting is continuous. Otherwise, specify the average short-term venting rate with units, for intermittent venting (ie., 15 min/hr). Indicate as many rates as needed to clarify frequency of venting (e.g., 5 min/day, 2 days/wk).

[3] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases.

[4] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[6] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

[7] Provide for all pollutant emissions. Typically, the units of parts per million by volume (ppmv) are used. If the emission is a mineral acid (sulfuric, nitric, hydrochloric or phosphoric) use units of milligram per dry cubic meter (mg/m^3) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO_2, use units of ppmv (See 45CSR10).

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 2: Release Parameter Data								
Emission Point ID No. *(Must match Emission Units Table)*	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (^{o}F)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2] *(Release height of emissions above ground level)*	Northing	Easting

[1] Give at operating conditions. Include inerts.
[2] Release height of emissions above ground level.

ATTACHMENT K

Fugitive Emissions Data Summary Sheet

Attachment K

FUGITIVE EMISSIONS DATA SUMMARY SHEET

The FUGITIVE EMISSIONS SUMMARY SHEET provides a summation of fugitive emissions. Fugitive emissions are those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Note that uncaptured process emissions are not typically considered to be fugitive, and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET.

Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions).

APPLICATION FORMS CHECKLIST - FUGITIVE EMISSIONS
1.) Will there be haul road activities? ☒ Yes ☐ No ☐ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☒ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☒ Yes ☐ No ☐ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☒ Yes ☐ No ☐ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered "NO" to all of the items above, it is not necessary to complete the following table, "Fugitive Emissions Summary."

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads	NA	--	--	--	--	--
Unpaved Haul Roads	PM PM_{10} $PM_{2.5}$	0.11 0.03 <0.01	0.46 0.12 0.01	0.11 0.03 <0.01	0.46 0.12 0.01	O[C]
Storage Pile Emissions	NA	---	---	---	---	---
Loading/Unloading Operations	VOC	N/A	0.05	N/A	0.05	O[B]
Wastewater Treatment Evaporation & Operations	NA	---	---	---	---	---
Equipment Leaks (includes blowdowns and maintenance)	VOC HAP	N/A	10.26 0.75	N/A	10.26 0.75	O[A]
General Clean-up VOC Emissions	NA	---	---	---	---	---
Other	NA	---	---	---	---	---

A – Oil *and Gas Production Operations Average Emission Factors*, Protocol for Equipment Leak Emission Estimates, EPA 453/R-95-017, Table 2-4, November 1995, 40 CFR 98 Subpart W, and mass balance.

B- AP 42 Section 5.2.1

C – AP 42 Section 13.2.2.

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. DO NOT LIST H_2, H_2O, N_2, O_2, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

ATTACHMENT L

Emission Unit Data Sheet

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S001 to S004

1. Name or type and model of proposed affected source:

   Four (4) Natural Gas-Fired Solar Titan 130 Turbines - Each rated 23,536 HP at site-specific conditions. ISO rating is 22,400 HP (each)

2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.

3. Name(s) and maximum amount of proposed process material(s) charged per hour:

   NA

4. Name(s) and maximum amount of proposed material(s) produced per hour:

   Does not produce any materials. The turbines compress natural gas.

5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:

   External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 172,654 scf/hr (each)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Four (4) 169.08 MMBtu/hr stationary gas turbines

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 169.08 (each) × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
Monitor sulfur content of the fuel per 60.4360	Maintain records of fuel consumption
REPORTING	TESTING
Submit report of initial compliance testing in accordance with 40 CFR 60.4375(b) days of the performance test	Annual performance testing in accordance with 40 CFR 60.4340(a) to demonstrate compliance with NOx emission limitations

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S005 to S018

1. Name or type and model of proposed affected source: Natural Gas-fired combustion Capstone Microturbines (each rated at 200kW) – Consist of fourteen (14) identical units
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Electrical generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 2,106 scf/hr (each)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Fourteen (14) 2.28 MMBtu/hr stationary gas turbines

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.28 (each) × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N.**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S019 to S020

1. Name or type and model of proposed affected source: Natural gas-fired fuel gas heaters (2.31 MMBtu/hr, heat input each)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Thermal generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 2,100 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Two (2) 2.31 MMBtu/hr, natural gas fired external combustion heaters

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.31 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT www.epa.gov/tnn/tanks.html), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (http://www.epa.gov/tnn/chief/).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Bradshaw Compressor Station	2. Tank Name Produced Fluids Storage Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) S021	4. Emission Point Identification No. (as assigned on *Equipment List Form*) E021
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. S021: 10,000 gal (~240 bbl)	
9A. Tank Internal Diameter (ft) ~10	9B. Tank Internal Height (or Length) (ft) ~17
10A. Maximum Liquid Height (ft) ~17	10B. Average Liquid Height (ft) ~ 10
11A. Maximum Vapor Space Height (ft) ~17	11B. Average Vapor Space Height (ft) ~5
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 240 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
126,000	345

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 12.5

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):
- ☒ Fixed Roof _x_ vertical __ horizontal ___ flat roof _x_ cone roof ___ dome roof
  ___ other (describe)
- ☐ External Floating Roof ___ pontoon roof ___ double deck roof
- ☐ Domed External (or Covered) Floating Roof
- ☐ Internal Floating Roof ___ vertical column support ___ self-supporting
- ☐ Variable Vapor Space ___ lifter roof ___ diaphragm
- ☐ Pressurized ___ spherical ___ cylindrical
- ☐ Underground
- ☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color Gray	20B. Roof Color Gray	20C. Year Last Painted

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): -0.30 to 0.70 psig

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft) 0.0625

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one)
☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal
☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:		
ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:
LADDER WELL		
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:	
GAUGE-HATCH/SAMPLE PORT		
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:	
ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)
VACUUM BREAKER		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
RIM VENT		
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
DECK DRAIN (3-INCH DIAMETER)		
OPEN:	90% CLOSED:	
STUB DRAIN		
1-INCH DIAMETER:		
OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)		

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F) 54.98	
29. Annual Average Maximum Temperature (°F) 65.75	
30. Annual Average Minimum Temperature (°F) 44.22	
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,251
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: 56.74			
34A. Minimum (°F)		34B. Maximum (°F) 61.79	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F) 56.74		37B. Corresponding Vapor Pressure (psia)	
38A. Maximum Liquid Surface Temperature (°F) 61.79		38B. Corresponding Vapor Pressure (psia)	
39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Produced Fluids		
39B. CAS Number	TBD		
39C. Liquid Density (lb/gal)	TBD		
39D. Liquid Molecular Weight (lb/lb-mole)	TBD		
39E. Vapor Molecular Weight (lb/lb-mole)	36.25		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	TBD TBD		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☒ Conservation Vent (psig) – TBD
  - Vacuum Setting 0.30 Pressure Setting 0.70
- ☒ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☐ Other[1] (describe):

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
See attached emission calculations					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT www.epa.gov/tnn/tanks.html), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (http://www.epa.gov/tnn/chief/).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Bradshaw Compressor Station	2. Tank Name Used Oil Storage Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) S022	4. Emission Point Identification No. (as assigned on *Equipment List Form*) E022
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. S022: 100 bbl	
9A. Tank Internal Diameter (ft) ~8	9B. Tank Internal Height (or Length) (ft) ~11
10A. Maximum Liquid Height (ft) ~11	10B. Average Liquid Height (ft) ~ 6
11A. Maximum Vapor Space Height (ft) ~11	11B. Average Vapor Space Height (ft) ~6
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 100 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
3,150	8.6

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume)
<1

15. Maximum tank fill rate (gal/min) TBD

16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):
☒ Fixed Roof _x_ vertical __ horizontal ___ flat roof _x_ cone roof ___ dome roof
___ other (describe)
☐ External Floating Roof ___ pontoon roof ___ double deck roof
☐ Domed External (or Covered) Floating Roof
☐ Internal Floating Roof ___ vertical column support ___ self-supporting
☐ Variable Vapor Space ___ lifter roof ___ diaphragm
☐ Pressurized ___ spherical ___ cylindrical
☐ Underground
☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color Gray	20B. Roof Color Gray	20C. Year Last Painted

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): -0.30 to 0.25 psig

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft) 0.0625

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:		
ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:
LADDER WELL		
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:	
GAUGE-HATCH/SAMPLE PORT		
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:	
ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)
VACUUM BREAKER		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
RIM VENT		
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
DECK DRAIN (3-INCH DIAMETER)		
OPEN:	90% CLOSED:	
STUB DRAIN		
1-INCH DIAMETER:		
OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)		

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply		
26A. Deck Type: ☐ Bolted ☐ Welded		
26B. For Bolted decks, provide deck construction:		
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)		
26D. Deck seam length (ft)	26E. Area of deck (ft^2)	
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:	

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F) 54.98	
29. Annual Average Maximum Temperature (°F) 65.75	
30. Annual Average Minimum Temperature (°F) 44.22	
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,251
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: **See TANKS Summary Sheets**			
34A. Minimum (°F)		34B. Maximum (°F)	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F)		37B. Corresponding Vapor Pressure (psia)	
38A. Maximum Liquid Surface Temperature (°F)		38B. Corresponding Vapor Pressure (psia)	
39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Used Oil		
39B. CAS Number			
39C. Liquid Density (lb/gal)	TBD		
39D. Liquid Molecular Weight (lb/lb-mole)	TBD		
39E. Vapor Molecular Weight (lb/lb-mole)	TBD		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	<1.5 psia		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☒ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting — Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☐ Other[1] (describe):

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
See attached emission calculations					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S023

1. Name or type and model of proposed affected source: Natural gas-fired office building heater (0.12 MMBtu/hr, heat input)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Thermal generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 110 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

One (1) 0.12 MMBtu/hr, natural gas fired external combustion heater

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 0.12 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
FUGITIVE EMISSIONS FROM UNPAVED HAULROADS

UNPAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

		PM	PM-10
k =	Particle size multiplier	0.80	0.36
s =	Silt content of road surface material (%)	4.8	
p =	Number of days per year with precipitation >0.01 in.	150	150

Item Number	Description	Number of Wheels	Mean Vehicle Weight (tons)	Mean Vehicle Speed (mph)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	Service Truck		4	15	0.75	TBD	365	N/A	0
2	Liquid Hauling – Vendor Fluids		16	15	0.75	TBD	4	N/A	0
3	Liquid Hauling – Produced Fluids		26	15	0.75	TBD	32	N/A	0
4	Employee Vehicles		2	15	0.75	TBD	365	N/A	0
5									
6									
7									
8									

Source: *AP-42 Fifth Edition – 13.2.2 Unpaved Roads*

$E = k \times 5.9 \times (s \div 12) \times (S \div 30) \times (W \div 3)^{0.7} \times (w \div 4)^{0.5} \times ((365 - p) \div 365) =$ lb/Vehicle Mile Traveled (VMT)

Where:

		PM	PM-10
k =	Particle size multiplier	4.9	1.5
s =	Silt content of road surface material (%)	4.8	
S =	Mean vehicle speed (mph)		
W =	Mean vehicle weight (tons)		
w =	Mean number of wheels per vehicle		
p =	Number of days per year with precipitation >0.01 in.	150	150

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF UNPAVED HAULROAD EMISSIONS

Item No.	PM				PM-10			
	Uncontrolled		Controlled		Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
1	0.05	024			0.01	0.06		
2	<0.01	<0.01			<0.01	<0.01		
3	0.01	0.05			0.00	0.01		
4	0.04	0.17			0.01	0.04		
5								
6								
7								
8								
TOTALS	0.11	0.46			0.03	0.12		

FUGITIVE EMISSIONS FROM PAVED HAULROADS

INDUSTRIAL PAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

I =	Industrial augmentation factor (dimensionless)	N/A
n =	Number of traffic lanes	
s =	Surface material silt content (%)	
L =	Surface dust loading (lb/mile)	

Item Number	Description	Mean Vehicle Weight (tons)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	N/A						
2							
3							
4							
5							
6							
7							
8							

Source: *AP-42 Fifth Edition – 11.2.6 Industrial Paved Roads*

$E = 0.077 \times I \times (4 \div n) \times (s \div 10) \times (L \div 1000) \times (W \div 3)^{0.7}$ = lb/Vehicle Mile Traveled (VMT)

Where:

I =	Industrial augmentation factor (dimensionless)	N/A
n =	Number of traffic lanes	
s =	Surface meterial silt content (%)	
L =	Surface dust loading (lb/mile)	
W =	Average vehicle weight (tons)	

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF PAVED HAULROAD EMISSIONS

Item No.	Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY
1	N/A		N/A	
2				
3				
4				
5				
6				
7				
8				
TOTALS				

Attachment L
EMISSIONS UNIT DATA SHEET
BULK LIQUID TRANSFER OPERATIONS

Furnish the following information for each new or modified bulk liquid transfer area or loading rack, as shown on the *Equipment List Form* and other parts of this application. This form is to be used for bulk liquid transfer operations such as to and from drums, marine vessels, rail tank cars, and tank trucks.

Identification Number (as assigned on *Equipment List Form*): S025

1. Loading Area Name: Liquid Loading

2. Type of cargo vessels accommodated at this rack or transfer point (check as many as apply):

☐Drums ☐ Marine Vessels ☐Rail Tank Cars ☒Tank Trucks

3. Loading Rack or Transfer Point Data:

Number of pumps	1
Number of liquids loaded	1
Maximum number of marine vessels, tank trucks, tank cars, and/or drums loading at one time	1

4. Does ballasting of marine vessels occur at this loading area?

☐ Yes ☐ No ☒ Does not apply

5. Describe cleaning location, compounds and procedure for cargo vessels using this transfer point:

6. Are cargo vessels pressure tested for leaks at this or any other location?

☐ Yes ☒ No

If YES, describe:

7. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.

hours/day	24	24	24	24
days/week	7	7	7	7
weeks/quarter	13	13	13	13

8. Bulk Liquid Data *(add pages as necessary):*							
Pump ID No.		NA					
Liquid Name		Produced Fluids					
Max. daily throughput (1000 gal/day)							
Max. annual throughput (1000 gal/yr)		126					
Loading Method [1]		Splash Fill					
Max. Fill Rate (gal/min)		TBD					
Average Fill Time (min/loading)		TBD					
Max. Bulk Liquid Temperature (°F)		~70					
True Vapor Pressure [2]		0.21 psia					
Cargo Vessel Condition [3]		Unknown					
Control Equipment or Method [4]		NA					
Minimum control efficiency (%)		0					
Maximum Emission Rate	Loading (lb/hr)	0.01					
	Annual (lb/yr)	106					
Estimation Method [5]		AP-42					

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets*):CA = Carbon Adsorption LOA = Lean Oil AdsorptionCO = Condensation SC = Scrubber (Absorption)CRA = Compressor-Refrigeration-Absorption TO = Thermal Oxidation or Incineration

CRC = Compression-Refrigeration-Condensation VB = Dedicated Vapor Balance (closed system) O = other (descibe)
[5] EPA = EPA Emission Factor as stated in AP-42 MB = Material Balance TM = Test Measurement based upon test data submittal O = other (describe)

9. **Proposed Monitoring, Recordkeeping, Reporting, and Testing** Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.	
MONITORING Liquid throughput (gal/yr)	RECORDKEEPING None
REPORTING None	TESTING None
MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS	
RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.	

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.
TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.
10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

Attachment L
EMISSIONS UNIT DATA SHEET
CHEMICAL PROCESS

For chemical processes please fill out this sheet and all supplementary forms (see below) that apply. Please check all supplementary forms that have been completed.

- ☐ *Emergency Vent Summary Sheet*
- ☒ *Leak Sources Data Sheet*
- ☐ *Toxicology Data Sheet*
- ☐ *Reactor Data Sheet*
- ☐ *Distillation Column Data Sheet*

1. Chemical process area name and equipment ID number (as shown in *Equipment List Form*)
   Fugitives

2. Standard Industrial Classification Codes (SICs) for process(es)
   4922

3. List raw materials and ☐ attach MSDSs
   NA

4. List Products and Maximum Production and ☐ attach MSDSs

Description and CAS Number	Maximum Hourly (lb/hr)	Maximum Annual (ton/year)
NA		

5. Complete the *Emergency Vent Summary Sheet* for all emergency relief devices.

6. Complete the *Leak Source Data Sheet* and describe below or attach to application the leak detection or maintenance program to minimize fugitive emissions. Include detection instruments, calibration gases or methods, planned inspection frequency, and record-keeping, and similar pertinent information. If subject to a rule requirement (e.g. 40CFR60, Subpart VV), please list those here.
   LDAR program in accordance with 40 CFR 98 Subpart W

7. Clearly describe below or attach to application Accident Procedures to be followed in the event of an accidental spill or release.
   NA

8A. Complete the *Toxicology Data Sheet* or attach to application a toxicology report (an up-to-date material safety data sheets (MSDS) may be used) outlining the currently known acute and chronic health effects of each compound or chemical entity emitted to the air. If these compounds have already been listed in Item 3, then a duplicate MSDS sheet is not required. Include data such as the OSHA time weighted average (TWA) or mutagenicity, teratogenicity, irritation, and other known or suspected effects should be addressed. Indicate where these are unknown, and provide references.

8B. Describe any health effects testing or epidemiological studies on these compounds that are being or may be conducted by the company or required under TSCA, RCRA or other federal regulations. Discuss the persistence in the environment of any emission (e.g. pesticides, etc.).

9. **Waste Products** - Waste products status: (If source is subject to RCRA or 45CSR25, please contact the Hazardous Waste Section of WVDEP, OAQ at (304) 926-3647.) NA

9A. Types and amounts of wastes to be disposed:

9B. Method of disposal and location of waste disposal facilities:

Carrier: Phone:

9C. Check here if approved USEPA/State Hazardous Waste Landfill will be used ☐

10. Maximum and Projected Typical Operating Schedule for process or project as a whole (circle appropriate units).

circle units:	(hrs/day) (hr/batch)	(days), (batches/day), (batches/week)	(days/yr), (weeks/year)
10A. Maximum			
10B. Typical			

11. Complete a *Reactor Data Sheet* for each reactor in this chemical process.

12. Complete a *Distillation Column Data Sheet* for each distillation column in this chemical process.

13. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING
None

RECORDKEEPING
None

REPORTING
None

TESTING
None

MONITORING. Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment operation or air pollution control device.

RECORDKEEPING. Please describe the proposed recordkeeping that will accompany the monitoring.

REPORTING. Please describe the proposed frequency of reporting of the recordkeeping.

TESTING. Please describe any proposed emissions testing for this process equipment or air pollution control device.

14. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
NA

LEAK SOURCE DATA SHEET

Source Category	Pollutant	Number of Source Components[1]	Number of Components Monitored by Frequency[2]	Average Time to Repair (days)[3]	Estimated Annual Emission Rate (lb/yr)[4]
Pumps[5]	light liquid VOC[6,7]				
	heavy liquid VOC[8]				
	Non-VOC[9]				
Valves[10]	Gas VOC	350	TBD	TBD	1,012
	Light Liquid VOC				
	Heavy Liquid VOC				
	Non-VOC				
Safety Relief Valves[11]	Gas VOC				
	Non VOC				
Open-ended Lines[12]	VOC	30	TBD	TBD	39
	Non-VOC				
Sampling Connections[13]	VOC				
	Non-VOC				
Compressors	VOC				
	Non-VOC				
Flanges	VOC	1,050	TBD	TBD	180
	Non-VOC				
Other	VOC				
	Non-VOC				

[1 - 13] See notes on the following page.

Notes for Leak Source Data Sheet

1. For VOC sources include components on streams and equipment that contain greater than 10% w/w VOC, including feed streams, reaction/separation facilities, and product/by-product delivery lines. Do not include certain leakless equipment as defined below by category.

2. By monitoring frequency, give the number of sources routinely monitored for leaks, using a portable detection device that measures concentration in ppm. Do not include monitoring by visual or soap-bubble leak detection methods. "M/Q(M)/Q/SA/A/O" means the time period between inspections as follows:

   Monthly/Quarterly, with Monthly follow-up of repaired leakers/Quarterly/Semi-annual/Annually/Other (specify time period)

   If source category is not monitored, a single zero in the space will suffice. For example, if 50 gas-service valves are monitored quarterly, with monthly follow-up of those repaired, 75 are monitored semi-annually, and 50 are checked bimonthly (alternate months), with non checked at any other frequency, you would put in the category "valves, gas service:" 0/50/0/75/0/50 (bimonthly).

3. Give the average number of days, after a leak is discovered, that an attempt will be made to repair the leak.

4. Note the method used: MB - material balance; EE - engineering estimate; EPA - emission factors established by EPA (cite document used); O - other method, such as in-house emission factor (specify).

5. Do not include in the equipment count sealless pumps (canned motor or diaphragm) or those with enclosed venting to a control device. (Emissions from vented equipment should be included in the estimates given in the Emission Points Data Sheet.)

6. Volatile organic compounds (VOC) means the term as defined in 40 CFR □51.100 (s).

7. A light liquid is defined as a fluid with vapor pressure equal to or greater than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if 20% w/w or more of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a light liquid.

8. A heavy liquid is defined as a fluid with a vapor pressure less than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if less than 20% w/w of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a heavy liquid.

9. LIST CO, H_2S, mineral acids, NO, NO_2, SO_3, etc. DO NOT LIST CO_2, H_2, H_2O, N_2, O_2, and Noble Gases.

10. Include all process valves whether in-line or on an open-ended line such as sample, drain and purge valves. Do not include safety-relief valves, or leakless valves such as check, diaphragm, and bellows seal valves.

11. Do not include a safety-relief valve if there is a rupture disk in place upstream of the valve, or if the valve vents to a control device.

12 Open-ended lines include purge, drain and vent lines. Do not include sampling connections, or lines sealed by plugs, caps, blinds or second valves.

13. Do not include closed-purge sampling connections.

ATTACHMENT N

Supporting Emission Calculations

Company Name: **Mountain Valley Pipeline, LLC**
Facility Name: **Bradshaw Compressor Station**
Project Description: **R13 Permit Application**

TABLE 1. Turbine Emissions Calculations

Turbine Information:

Source ID:	S001-S004
Manufacturer:	Solar
Model No.:	Titan 130
Year Installed:	TBD
Fuel Used:	Natural Gas
Fuel Heating Value (Btu/scf):	979
Rated Horsepower (bhp at site-specific conditions):	23536
Maximum Fuel Consumption at 100% Load (scf/hr):	172654
Heat Input (MMBtu/hr)	169.08
Control Device:	SoloNOx Technology
Stack Designation:	TBD

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	1,512.45
Potential Startup/Shutdown Events (per year):	12

Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units	Emission Factor Source
NO_X	9.800	lb/hr	Manufacturer
CO	9.900	lb/hr	Manufacturer
SO_2	3.54E-03	lb/MMBtu	AP-42, Table 3.1-2a
PM_{10}	0.016	lb/MMBtu	Manufacturer, PIL 171
$PM_{2.5}$	0.016	lb/MMBtu	Manufacturer, PIL 171
VOC	1.140	lb/hr	20% of UHC per Manufacturer
Formaldehyde	0.003	lb/MMBtu	Manufacturer, PIL 168
CO_2	122.82	lb/MMBtu	40 CFR 98, Subpart C, Table C-1
CH_4	4.560	lb/hr	80% of UHC per Manufacturer
N_2O	2.3E-04	lb/MMBtu	40 CFR 98, Subpart C, Table C-2

*Emission factors from AP-42 and Subpart C are based on HHV. To calculate a LHV emission factor, emissions are multiplied by (HHV/LHV). For AP-42 HHV is 1020 Btu/scf, for Subpart C HHV is 1028 Btu/scf. PM and HCHO emission factors are provided in HHV in the specifications and were converted to LHV using a HHV value of 1020 Btu/scf.

Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[1]	(tpy)[2]
NO_X	9.80	42.95
CO	9.90	45.67
SO_2	0.60	2.62
PM_{10}	2.64	11.57
$PM_{2.5}$	2.64	11.57
VOC	1.14	5.02
Formaldehyde	0.51	2.22
CO_2	20,766	90,968
CH_4	4.56	24.42
N_2O	0.04	0.17
GHG (CO_2e)	20,891	91,630

*Annual emissions shown above include startup/shutdown events.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 1. Turbine Emissions Calculations

Hazardous Air Pollutant (HAP) Emission Rates:

Pollutant	Emission Factor (lb/MMBtu)[3]	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2,4]
HAPs:			
Acetaldehyde	4.17E-05	7.04E-03	3.09E-02
Acrolein	6.67E-06	1.13E-03	4.94E-03
Benzene	1.25E-05	2.11E-03	9.26E-03
1,3-Butadiene	4.48E-07	7.57E-05	3.32E-04
Propylene Oxide	2.90E-05	4.90E-03	2.15E-02
Ethylbenzene	3.33E-05	5.64E-03	2.47E-02
Toluene	1.35E-04	2.29E-02	1.00E-01
Xylene	6.67E-05	1.13E-02	4.94E-02
Polycyclic Organic Matter:			
Naphthalene	1.35E-06	2.29E-04	1.00E-03
PAH	2.29E-06	3.87E-04	1.70E-03
Total HAP (Including HCHO)		**0.56**	**2.47**

1. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (lb/MMBtu)
2. Emission Rate (tpy) = Emission Rate (lb/hr) × Hours of Operation (hr/yr) / 2000 (tons/lb) + SU/SD emissions, as applicable
3. Emission factors from AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000. Factors are based on HHV. Therefore, they were converted to LHV by multiplying by (HHV/LHV).
4. Emission calculations are based on maxomum operating load of 100%, ambient temperature 0°F and site elevation. The turbine rating can vary with ambient conditions. Each Turbine is ISO rated at 22,400 HP

Startup/Shutdown Combustion Emission Factors:

Pollutant	Startup Emissions[a] (lbs/event)	Shutdown Emissions[a] (lbs/event)	Emission Factor Source
NO_X	1.9	2.4	Manufacturer
CO	176.9	207.6	Manufacturer
VOC	2.0	2.38	20% of UHC per Manufacturer
CO_2	1161	1272	Manufacturer

[a] Each startup and shutdown event is estimated to last approximately 10 minutes, per manufacturer.

Pneumatic Start Venting Emissions		
Natural Gas Purged During Startup	4500	scfm
Duration of Normal Purge	4.0	min
Total Gas Purged (Per Startup)	18000	scf
VOC Purged (Per Startup)	27	lbs/startup
CO_2 Purged (Per Startup)	6	lbs/startup
CH_4 Purged (Per Startup)	742	lbs/startup

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

*Current design includes electric motor starts, but pneumatic starts have been included as a conservative measure.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 2. Microturbine Emissions Calculations

Microturbine Unit Information:

Engine ID:	S005-S018
Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	14

Microturbine Fuel Information:

	Per Unit
Fuel Type:	Natural Gas
Rated Electrical Power Output (kW):	200
Rated Electrical Power Output (MW):	0.2
Rated Horsepower (bhp):	268.2
Heat Input (MMBtu/hr)	2.28
Potential Fuel Consumption (MMBtu/yr):	19,973
Max. Annual Hours of Operation (hr/yr):	8,760

Microturbine Emissions Data:

Pollutant	Emission Factors	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_x	0.40	lb/MWhe	0.08	0.35	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.02	0.09	Manufacturer's Specifications
CO	1.10	lb/MWhe	0.22	0.96	Manufacturer's Specifications
SO_x	0.0034	lb/MMBtu	0.01	0.03	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.02	0.07	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.02	0.07	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		266	1,166	Manufacturer's Specifications / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)

Notes:
1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHO.

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	1330	lb/MWhe	266	1,165	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**266**	**1,166**	
HAPs:					
1,3-Butadiene	4.3E-07	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.002**	**0.010**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 3. Fuel Gas Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S019-S020
Projected Startup Date:	Upon Approval
Number of Units:	2

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	2.31
Potential Fuel Consumption (MMBtu/yr):	20,215
Max. Fuel Consumption (MMscf/hr):	0.0021
Max. Fuel Consumption (MMscf/yr):	18.7
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.21	0.93	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.01	0.05	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.18	0.78	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.01	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		270	1,184	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.02	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 3. Fuel Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	269.99	1,183	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**270**	**1,184**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.02	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.004**	**0.02**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 4. Storage Tank Emissions Calculations - Produced Fluids Tank

Storage Tank Information:

Source ID:	S021
Tank Capacity (gallons):	10,080
Tank Contents:	Produced Fluids
Annual Throughput (gallons/year):	126,000
Daily Throughput (bbl/day)	8
Percent Condensate	1%
Condensate Throughput (bbl/day)	0.1
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.05	0.21	0.05	0.21	E&P TANK 2.0
HAPs	0.00	0.00	0.00	0.00	E&P TANK 2.0
GHG (CO2e)	0.48	2.10	0.48	2.10	E&P TANK 2.0

E & P Tanks Emissions Data:

Pollutant	Total Emissions (Working + Breathing + Flashing)			Total Emissions		
	lbs/hr	lbs/yr	tpy	lbs/hr	lbs/yr	tpy
VOC	0.05	429.24	0.21	0.05	429.24	0.21
HAPs	0.00	0.00	0.00	0.00	0.00	0.00
GHG (CO_2e)	0.48	4,161.00	2.10	0.48	4,161.00	2.10

Notes:
1. E & P TANKS software estimates working, breathing, and flashing losses and reports as one total. Emissions are based on a conservative estimate of 9% water and 1% condensate

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 5. Storage Tank Emissions Calculations - Used Oil Tank

Storage Tank Information:

Source ID:	5022
Tank Capacity (gallons):	4,200
Tank Contents:	Used Oil
Annual Throughput (gallons/year):	12,600
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
HAPs	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
GHG (CO_2e)	N/A	N/A	N/A	N/A	N/A

Notes:
1. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 21) + N_2O (GWP = 310).

EPA TANKS Emissions Data - Glycol Tank:

Pollutant	Working Losses	Breathing Losses	Flashing Losses	Total Emissions		
	lbs/yr	lbs/yr	lbs/yr	lbs/hr	lbs/yr	tpy
VOC	0.30	0.50	N/A	0.00	0.80	0.00
HAPs	0.00	0.00	N/A	0.00	0.00	0.00

Notes:
1. Working and breathing losses estimated using EPA TANKS 4.0.9d software based on Distillate fuel oil No. 2.
2. This tank does not contain hydrocarbons that would be expected to be flashed off at tank operating conditions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 6. Office Building Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S023
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	0.12
Potential Fuel Consumption (MMBtu/yr):	1,051
Max. Fuel Consumption (MMscf/hr):	0.0001
Max. Fuel Consumption (MMscf/yr):	1.0
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.01	0.05	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.01	0.04	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		14	62	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 6. Office Building Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	14.04	61	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**14**	**62**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.000**	**0.00**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 7. Fugitive Emissions Calculations

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor		Average Gas Leak Rate	Max Gas Leak Rate	Potential VOC Emissions	Potential HAP Emissions
		(lb/hr/component)	Factor Source	(lb/hr)	(tpy)	(tpy)	(tpy)
Connectors	680	0.0004	EPA Protocol, Table 2-4	0.30	1.44	0.04	0.00
Flanges	370	0.001	EPA Protocol, Table 2-4	0.32	1.53	0.05	0.00
Open-Ended Lines	30	0.004	EPA Protocol, Table 2-4	0.13	0.64	0.02	0.00
Pump Seals	0	0.005	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Valves	350	0.010	EPA Protocol, Table 2-4	3.47	16.73	0.51	0.04
Other	0	0.019	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Total				**4.22**	**20.34**	**0.62**	**0.05**

Notes:
1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc
2. The component count is a preliminary estimate based on the proposed design of the station
3. Conservatively assumed that maximum leak rate is 10% greater than measured average leak rate for the purposes of establishing PTE
4. VOC and HAP emissions are based on fractions of these pollutants in the site-specific gas analysis

Dry Seal Emissions

Number of Compressors	Number of seals Per Compressor	Leak Rate (scf/hr/seal)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
4	2	6	420,480	0.32	0.02	0.06	22.05	551.19
Total				**0.32**	**0.02**	**0.06**	**22.05**	**551.19**

1. Leak rate and seal information from EPA Natural Gas Star Program (http://www.epa.gov/gasstar/documents/ll_wetseals.pdf
2. Emission calculations for VOC are calculated assuming a desnity of natural gas of 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)
Sample calculation: Volume vented (scf/yr) x density of natural gas (lb/scf) x wt % VOC / 2000 lb/ton
3. GHG emissions calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98
Sample calculation: Volume vented (scf/yr) x density of GHG (kg/scf) x mol % VOC x 2.2 lb/kg / 2000 lb/ton

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Station ESD Vent	3,200,000	1	3,200,000	2.42	0.18
Compressors	571,000	16	9,136,000	6.91	0.51
Total				**9.33**	**0.69**

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Station ESD Vent	3,200,000	1	3,200,000	61.24	0.48	1531
Compressors	571,000	16	9,136,000	174.84	1.38	4372
Total				**236.1**	**1.87**	**5904**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor		CH_4 Emissions	CO_2 Emissions	CO_2e Emissions
		(scf/hr/component)	Factor Source	(tpy)	(tpy)	(tpy)
Connectors	680	0.003	40 CFR 98, Table W-1A	0.34	0.003	8.55
Flanges	370	0.003	40 CFR 98, Table W-1A	0.19	0.001	4.65
Open-Ended Lines	30	0.061	40 CFR 98, Table W-1A	0.31	0.002	7.67
Pump Seals	0	13.3	40 CFR 98, Table W-1A	0.00	0.000	0.00
Valves	350	0.027	40 CFR 98, Table W-1A	1.58	0.013	39.62
Other	0	0.04	40 CFR 98, Table W-1A	0.00	0.000	0.00
Total				**2.42**	**0.02**	**60.50**

Notes:
1. The component count is a preliminary estimate based on the proposed design of the station
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis
3. Emissions are calculated in accordance with Equations W-32a, W-35 and W-36 in Subpart W of 40 CFR 98
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	2.34	10.26	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.17	0.75	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	1,488	6,516	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 8. Liquid Loading Emissions Calculations

Liquid Loading Information:

Parameter	Value	Description
S	1.45	saturation factor for splash loading (AP-42 Table 5.2-1)
Collection Efficiency	0.0%	
Control Efficiency	0%	
P	0.21	true vapor pressure of liquid loaded (psia) - assume octane
M	114.23	molecular weight of vapors (lb/lb-mol) - assume octane
T	516.4	temperature of liquids loaded (deg R) - TANKS Data

Description	Loading Losses	Maximum Throughput[2]	VOC Emissions	
	(lb/10^3 gal)[1]	(gal)	(lb/hr)	(tpy)
Liquids Hauling	0.8	126,000	0.01	0.05

Notes:

1. Uncontrolled Loading Losses: L_L (lb/10^3 gal) = 12.46 (SPM)/T
2. Produced fluids throughput.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 9. Haul Road Emission Calculations

Unpaved Road Information:

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM		PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9		1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8	%			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150				AP-42 Figure 13.2.1-2
a	0.7		0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45		0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Service Truck	4	4	4	0.75	365	274	0	0.24	0.06	0.01
Liquids Hauling - Vendor Fluid	12	20	16	0.75	4	3	0	0.00	0.00	0.00
Liquids Hauling - Produced Fluid	20	32	26	0.75	32	24	0	0.05	0.01	0.00
Employee Vehicles	2	2	2	0.75	365	274	0	0.17	0.04	0.00
Total Potential Emissions								**0.46**	**0.12**	**0.01**

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 9. Potential Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																	
	VOC		NO_X		CO		PM_{10}		$PM_{2.5}$		SO_X		HCHO		Total HAPs		GHG (CO_2e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Turbine 1 (S001)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Turbine 2 (S002)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Turbine 3 (S003)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Turbine 4 (S004)	1.14	5.02	9.80	42.95	9.90	45.67	2.64	11.57	2.64	11.57	0.60	2.62	0.51	2.22	0.56	2.47	20,891	91,630
Microturbine 1 (S005)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 2 (S006)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 3 (S007)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 4 (S008)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 5 (S009)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 6 (S010)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 7 (S011)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 8 (S012)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 9 (S013)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 10 (S014)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 11 (S015)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 12 (S016)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 13 (S017)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 14 (S018)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Fuel Gas Heater (S019)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Fuel Gas Heater (S020)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Produced Fluids Tank (S021)	0.05	0.21	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0	2
Used Oil Tank (S022)	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	--	--
Office Building Heater (S023)	0.00	0.00	0.01	0.05	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	62
Fugitive Leaks (S024)	2.34	10.26	--	--	--	--	0.03	0.12	0.00	0.01	--	--	--	--	0.17	0.75	1,488	6,516
Liquid Loading (S025)	0.01	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.
2. VOC emissions for the engines are conservatively estimated as: VOC=NMNEHC+HCHO (Formaldehyde)
3. Fugitive emissions include haul road emissions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 10. Total Potential Emissions from All Sources at the Facility

Pollutants	Estimated Site-Wide Emissions	
	lb/hr	tpy
VOC	7.27	31.94
NO_X	40.76	178.62
CO	43.05	197.78
SO_X	2.51	10.98
PM_{10}	10.84	47.47
$PM_{2.5}$	10.81	47.36
Formaldehyde (HCHO)	2.05	8.99
Total HAPs	2.46	10.79
GHG (CO_2e)	89,336	391,794

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Bradshaw Compressor Station
Project Description: R13 Permit Application

TABLE 11. Site-Specific Gas Analysis

Sample Location: Multiple Locations
HHV (Btu/scf): 1,083

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)
N2	0.4949	0.788
METHANE	90.4241	82.411
CO2	0.2608	0.652
ETHANE	7.6812	13.124
PROPANE	0.6778	1.698
I-BUTANE	0.0754	0.249
N-BUTANE	0.1355	0.447
I-PENTANE	0.054	0.223
N-PENTANE	0.045	0.186
I-H EXAN ES	0.000	0.000
N-HEXANE	0.045	0.222
BENZENE	0.000	0.000
CYCLOHEXANE	0.000	0.000
HEPTANES	0.000	0.000
TOLUENE	0.000	0.000
2,2,4 Trimethylpentane	0.000	0.000
N-OCTANE	0.000	0.000
*E-BENZENE	0.000	0.000
*m,o,&p-XYLENE	0.000	0.000
I-NONANES	0.000	0.000
N-NONANE	0.000	0.000
I-DECANES	0.000	0.000
N-DECANE	0.000	0.000
I-UNDECANES +	0.000	0.000
Totals	99.895	100

*Gas Analysis showed no detectable compounds above hexane +, conservatively assumed all hexane + was n-hexane

TOC (Total)	99.14	98.56
VOC (Total)	1.03	3.03
HAP (Total)	0.05	0.22

****
* Project Setup Information *
****

Project File : \\Pit-dc1\p\Client\EQT Corporation\Corporate\02 Projects\143901.0087 Mountain Valley Project\04 Draft\2015-0311 Bradshaw R13\2015-0312 Bradshaw PF Tank v1.0.ept
Flowsheet Selection : Oil Tank with Separator
Calculation Method : RVP Distillation
Control Efficiency : 0.0%
Known Separator Stream : Low Pressure Oil
Entering Air Composition : No

Filed Name : Bradshaw Produced Fluid Tanks
Well Name : PTE
Date : 2015.03.12

****
* Data Input *
****

Separator Pressure : 414.00[psig]
Separator Temperature : 60.00[F]
Ambient Pressure : 14.70[psia]
Ambient Temperature : 55.00[F]
C10+ SG : 0.8024
C10+ MW : 163.342

-- Low Pressure Oil ----------

No.	Component	mol %
1	H2S	0.0000
2	O2	0.0000
3	CO2	0.0840
4	N2	0.0000
5	C1	9.9570
6	C2	8.1140
7	C3	6.8240
8	i-C4	1.8640
9	n-C4	4.8700
10	i-C5	2.9440
11	n-C5	3.3610
12	C6	2.2410
13	C7	9.7080
14	C8	11.4500
15	C9	8.4380
16	C10+	25.3730
17	Benzene	0.0910
18	Toluene	0.7580
19	E-Benzene	0.1130
20	Xylenes	1.3570
21	n-C6	2.4330
22	224Trimethylp	0.0200

-- Sales Oil ----------
Production Rate : 0.1[bbl/day]
Days of Annual Operation : 365 [days/year]
API Gravity : 59.11
Reid Vapor Pressure : 10.60[psia]

****
* Calculation Results *
****

-- Emission Summary ----------

Item	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
Total HAPs	0.000	0.000	0.000	0.000
Page 1---------- E&P TANK				
Total HC	0.423	0.097	0.423	0.097
VOCs, C2+	0.339	0.077	0.339	0.077
VOCs, C3+	0.213	0.049	0.213	0.049

Uncontrolled Recovery Info.
Vapor 28.1600 x1E-3 [MSCFD]
HC Vapor 28.0700 x1E-3 [MSCFD]
GOR 281.60 [SCF/bbl]

-- Emission Composition ----------

No	Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
1	H2S	0.000	0.000	0.000	0.000
2	O2	0.000	0.000	0.000	0.000
3	CO2	0.002	0.000	0.002	0.000
4	N2	0.000	0.000	0.000	0.000
5	C1	0.084	0.019	0.084	0.019
6	C2	0.125	0.029	0.125	0.029
7	C3	0.109	0.025	0.109	0.025
8	i-C4	0.023	0.005	0.023	0.005
9	n-C4	0.045	0.010	0.045	0.010
10	i-C5	0.014	0.003	0.014	0.003
11	n-C5	0.012	0.003	0.012	0.003
12	C6	0.003	0.001	0.003	0.001
13	C7	0.004	0.001	0.004	0.001
14	C8	0.001	0.000	0.001	0.000
15	C9	0.000	0.000	0.000	0.000
16	C10+	0.000	0.000	0.000	0.000
17	Benzene	0.000	0.000	0.000	0.000
18	Toluene	0.000	0.000	0.000	0.000
19	E-Benzene	0.000	0.000	0.000	0.000
20	Xylenes	0.000	0.000	0.000	0.000
21	n-C6	0.002	0.000	0.002	0.000
22	224Trimethylp	0.000	0.000	0.000	0.000
	Total	0.424	0.097	0.424	0.097

-- Stream Data ----------

No.	Component	MW	LP Oil	Flash Oil	Sale Oil	Flash Gas	W&S Gas	Total Emissions

			mol %	mol %	mol %	mol %	mol %	mol %
1	H2S	34.80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	O2	32.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	CO2	44.01	0.0840	0.0069	0.0001	0.3251	0.3289	0.3254
4	N2	28.01	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	C1	16.04	9.9570	0.2491	0.0001	40.3145	12.0792	38.6045
6	C2	30.07	8.1140	1.3061	0.2375	29.4027	52.0759	30.7759
7	C3	44.10	6.8240	3.2946	2.8877	17.8607	22.6275	18.1494
8	i-C4	58.12	1.8640	1.5368	1.5034	2.8873	3.1206	2.9014
9	n-C4	58.12	4.8700	4.6049	4.5743	5.6989	6.0623	5.7209
10	i-C5	72.15	2.9440	3.4237	3.4639	1.4439	1.5163	1.4483
11	n-C5	72.15	3.3610	4.0550	4.1140	1.1907	1.2521	1.1944
12	C6	86.16	2.2410	2.8819	2.9372	0.2370	0.2510	0.2378
13	C7	100.20	9.7080	12.7165	12.9774	0.3002	0.3211	0.3015
14	C8	114.23	11.4500	15.0807	15.3960	0.0965	0.1043	0.0969
15	C9	128.28	8.4380	11.1296	11.3633	0.0212	0.0250	0.0215
16	C10+	163.34	25.3730	33.4860	34.1908	0.0030	0.0034	0.0030
17	Benzene	78.11	0.0910	0.1181	0.1204	0.0064	0.0068	0.0064
18	Toluene	92.13	0.7580	0.9963	1.0170	0.0128	0.0138	0.0128
19	E-Benzene	106.17	0.1130	0.1490	0.1521	0.0005	0.0006	0.0005
20	Xylenes	106.17	1.3570	1.7892	1.8267	0.0056	0.0061	0.0056
21	n-C6	86.18	2.4330	3.1494	3.2114	0.1926	0.2046	0.1933
22	224Trimethylp	114.24	0.0200	0.0262	0.0268	0.0005	0.0005	0.0005

MW	95.74	116.43	118.13	31.04	35.93	31.33
Stream Mole Ratio	1.0000	0.7577	0.7421	0.2423	0.0156	0.2579
Heating Value [BTU/SCF]				1808.07	2072.28	1824.07
Gas Gravity [Gas/Air]				1.07	1.24	1.08
Bubble Pt. @ 100F [psia]	406.75	28.61	13.23			
RVP @ 100F [psia]	101.88	15.92	10.81			

Spec. Gravity @ 100F	0.685	0.715	0.717

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

Identification

User Identification:	S022 - Used Oil Tank
City:	Charleston
State:	West Virginia
Company:	Mountain Vallley Pipeline
Type of Tank:	Vertical Fixed Roof Tank
Description:	4,200 Gallon Used Oil Tank

Tank Dimensions

Shell Height (ft):	11.00
Diameter (ft):	8.00
Liquid Height (ft) :	11.00
Avg. Liquid Height (ft):	5.50
Volume (gallons):	4,200.00
Turnovers:	3.00
Net Throughput(gal/yr):	12,600.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition	Good
Roof Color/Shade:	Gray/Light
Roof Condition:	Good

Roof Characteristics

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

Breather Vent Settings

Vacuum Settings (psig):	-0.30
Pressure Settings (psig)	0.25

Meterological Data used in Emissions Calculations: Charleston, West Virginia (Avg Atmospheric Pressure = 14.25 psia)

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

S022 - Used Oil Tank - Vertical Fixed Roof Tank
Charleston, West Virginia

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Distillate fuel oil no. 2	All	61.57	52.97	70.18	57.22	0.0077	0.0054	0.0091	130.0000			188.00	Option 1: VP60 = .0074 VP70 = .009

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

S022 - Used Oil Tank - Vertical Fixed Roof Tank
Charleston, West Virginia

Annual Emission Calcaulations	
Standing Losses (lb):	0.5030
Vapor Space Volume (cu ft):	280.6489
Vapor Density (lb/cu ft):	0.0002
Vapor Space Expansion Factor:	0.0277
Vented Vapor Saturation Factor:	0.9977
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	280.6489
Tank Diameter (ft):	8.0000
Vapor Space Outage (ft):	5.5833
Tank Shell Height (ft):	11.0000
Average Liquid Height (ft):	5.5000

Roof Outage (ft):	0.0833
Roof Outage (Cone Roof)	
Roof Outage (ft):	0.0833
Roof Height (ft):	0.0000
Roof Slope (ft/ft):	0.0625
Shell Radius (ft):	4.0000
Vapor Density	
Vapor Density (lb/cu ft):	0.0002
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0077
Daily Avg. Liquid Surface Temp. (deg. R):	521.2427
Daily Average Ambient Temp. (deg. F):	54.9833
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	516.8933
Tank Paint Solar Absorptance (Shell):	0.5400
Tank Paint Solar Absorptance (Roof):	0.5400
Daily Total Solar Insulation Factor (Btu/sqft day):	1,250.5726
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0277
Daily Vapor Temperature Range (deg. R):	34.4127
Daily Vapor Pressure Range (psia):	0.0037
Breather Vent Press. Setting Range(psia):	0.5500
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0077
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0054
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0091
Daily Avg. Liquid Surface Temp. (deg R):	521.2427
Daily Min. Liquid Surface Temp. (deg R):	512.6395
Daily Max. Liquid Surface Temp. (deg R):	529.8458
Daily Ambient Temp. Range (deg. R):	21.5333
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9977
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	0.0077
Vapor Space Outage (ft):	5.5833
Working Losses (lb):	0.2984
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0077
Annual Net Throughput (gal/yr.):	12,600.0000
Annual Turnovers:	3.0000
Turnover Factor:	1.0000
Maximum Liquid Volume (gal):	4,200.0000
Maximum Liquid Height (ft):	11.0000
Tank Diameter (ft):	8.0000
Working Loss Product Factor:	1.0000
Total Losses (lb):	0.8014

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

Emissions Report for: Annual

S022 - Used Oil Tank - Vertical Fixed Roof Tank
Charleston, West Virginia

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	0.30	0.50	0.80

LAFAYETTE AREA LABORATORY
4790 N.E. EVANGELINE THRUWAY
CARENCRO, LA 70520
PHONE (337) 896-3055
FAX (337) 896-3077

Certificate of Analysis : 13050161-002A

Company:	Gas Analytical Services	**For:**	Gas Analytical Services
Well:	OXF 131 Pad		Alan Ball
Field:	EQT Production		PO Box 1028
Sample of:	Condensate-Spot		
Conditions:	414 @ N.G.		Bridgeport, WV, 26330
Sampled by:	GR-GAS		
Sample date:	5/14/2013	**Report Date:**	5/29/2013
Remarks:	Cylinder No.: GAS		
Remarks:			

Analysis: (*GPA 2186M*)	**Mol. %**	**MW**	**Wt. %**	**Sp. Gravity**	**L.V. %**
Nitrogen	0.000	28.013	0.000	0.8094	0.000
Methane	9.957	16.043	1.664	0.3000	3.884
Carbon Dioxide	0.084	44.010	0.039	0.8180	0.033
Ethane	8.114	30.070	2.542	0.3562	4.991
Propane	6.824	44.097	3.135	0.5070	4.324
Iso-butane	1.864	58.123	1.129	0.5629	1.403
N-butane	4.870	58.123	2.948	0.5840	3.533
Iso-pentane	2.944	72.150	2.213	0.6244	2.479
N-pentane	3.361	72.150	2.526	0.6311	2.801
i-Hexanes	2.241	86.177	1.990	0.6795	2.104
n-Hexane	2.433	85.734	2.184	0.6640	2.288
2,2,4 trimethylpentane	0.020	114.231	0.024	0.6967	0.024
Benzene	0.091	78.114	0.065	0.8846	0.059
Heptanes	9.708	98.181	9.953	0.7010	9.943
Toluene	0.758	92.141	0.641	0.8719	0.588
Octanes	11.450	107.956	13.087	0.7510	12.206
E-benzene	0.113	106.167	0.053	0.8718	0.102
M-,O-,P-xylene	1.357	106.167	1.501	0.8731	1.214
Nonanes	8.438	122.962	11.137	0.7603	10.366
Decanes Plus	25.373	163.342	43.169	0.8024	37.658
	100.000		100.000		100.000

Calculated Values	**Total Sample**	**Decanes Plus**
Specific Gravity at 60 °F	0.6999	0.8024
Api Gravity at 60 °F	70.675	44.841
Molecular Weight	96.001	163.342
Pounds per Gallon (in Vacuum)	5.835	6.690
Pounds per Gallon (in Air)	5.829	6.683
Cu. Ft. Vapor per Gallon @ 14.73 psia	23.120	15.507

Brian Gaspard

Southern Petroleum Laboratories, Inc.

LAFAYETTE AREA LABORATORY
4790 N.E. EVANGELINE THRUWAY
CARENCRO, LA 70520
PHONE (337) 896-3055
FAX (337) 896-3077

Certificate of Analysis : 13050161-002A

Company:	Gas Analytical Services	**For:**	Gas Analytical Services
Well:	OXF 131 Pad		Alan Ball
Field:	EQT Production		PO Box 1028
Sample of:	Condensate-Spot		
Conditions:	414 @ N.G.		Bridgeport, WV, 26330
Sampled by:	GR-GAS		
Sample date:	5/14/2013	**Report Date:**	5/29/2013
Remarks:	Cylinder No.: GAS		
Remarks:			

Analysis: (*GPA 2103*)	**Mol. %**	**MW**	**Wt. %**	**Sp. Gravity**	**L.V. %**
Nitrogen	0.000	28.013	0.000	0.8094	0.000
Methane	9.957	16.043	1.664	0.3000	3.884
Carbon Dioxide	0.084	44.010	0.039	0.8180	0.033
Ethane	8.114	30.070	2.542	0.3562	4.991
Propane	6.824	44.097	3.135	0.5070	4.324
Iso-butane	1.864	58.123	1.129	0.5629	1.403
N-butane	4.870	58.123	2.948	0.5840	3.533
Iso-pentane	2.944	72.150	2.213	0.6244	2.479
N-pentane	3.361	72.150	2.526	0.6311	2.801
Hexanes	4.674	85.734	4.174	0.6652	4.392
Heptanes Plus	57.308	98.181	79.630	0.7010	72.160
	100.000		100.000		100.000

Calculated Values	**Total Sample**	**Heptanes Plus**
Specific Gravity at 60 °F	0.6999	0.7741
Api Gravity at 60 °F	70.675	51.303
Molecular Weight	96.001	133.398
Pounds per Gallon (in Vacuum)	5.835	6.454
Pounds per Gallon (in Air)	5.829	6.447
Cu. Ft. Vapor per Gallon @ 14.73 psia	23.120	18.402
Standing-Katz Density (lb. / ft^3)		

Brian Lovpard

Southern Petroleum Laboratories, Inc.

Certificate of Analysis

Number: 2030-13050161-002A

Carencro Laboratory
4790 NE Evangeline Thruway
Carencro, LA 70520

Alan Ball
Gas Analytical Services
PO Box 1028
Bridgeport, WV 26330

May 22, 2013

Station Name: OXF 131 Pad
Station Number: 512441
Station Location: EQT Production
Sample Point: Wellhead

Sampled By: GR-GAS
Sample Of: Condensate Spot
Sample Date: 05/14/2013 13:00
Sample Conditions: 414 psig
Cylinder No: GAS

Analytical Data

Test	Method	Result	Units	Detection Limit	Lab Tech.	Analysis Date
Color-Visual	Proprietary	L STRAW			AR	05/22/2013
API Gravity @ 60° F	ASTM D-5002	61.22	°		AR	05/22/2013
Specific Gravity @ 60/60° F	ASTM D-5002	0.7342			AR	05/22/2013
Density @ 60° F	ASTM D-5002	0.7335	g/ml		AR	05/22/2013
Shrinkage Factor	Proprietary	0.9043			AR	05/22/2013
Flash Factor	Proprietary	256.6792	Cu. Ft./S.T. Bbl		AR	05/22/2013

Patti L. Perro

Hydrocarbon Laboratory Manager

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated.

MVP Turbine/Compressor Package Performance Evaluation Sheet

Constants		
Elevation (fasl)	1485	
Relative Humidity	80%	
Fuel HHV (BTU/SCF)	1085	
Fuel LHV (BTU/SCF)	979.3	
Emissions Load Range	50-100%	Guaranteed
Turbine ISO Rating (HP)	22400	Uprated T130
Number of Units	4	Station 1

Ambient Temp			50% Load	75% Load	100% Load
-20°F	Turbine Performance	Output Shaft Speed (RPM)	6808	7792	8543
		Output Shaft Power (HP)	11760	17636	23238
		HP Utilization (%)	50%	75%	99%
		Heat Rate (BTU/HP-hr)	9653	8235	7363
		Unit Fuel Consumption (MMSCF/D)	**2.8341**	**3.6258**	**4.2718**
		Engine Thermal Efficiency (%)	26.4%	30.9%	34.6%
		Exhaust Temp (°F)	905	872	888
		Exhaust Flow (lb/s)	88.5	109.7	127.6
		Unit NO_x (PPMvd)	42	42	42
		Unit NO_x (lb/hr)	13.8	21.9	27.6
		Unit CO (PPMvd)	100	100	100
		Unit CO (lb/hr)	20	32	40
		Unit UHC (PPMvd)	50	50	50
		Unit UHC (lb/hr)	6	9	11

Ambient Temp			50% Load	75% Load	100% Load
0°F	Turbine Performance	Output Shaft Speed (RPM)	6809	7795	8579
		Output Shaft Power (HP)	11768	17652	23536
		HP Utilization (%)	50%	75%	100%
		Heat Rate (BTU/HP-hr)	9369	8041	7184
		Unit Fuel Consumption (MMSCF/D)	**2.7524**	**3.5438**	**4.2214**
		Engine Thermal Efficiency (%)	27.2%	31.6%	35.4%
		Exhaust Temp (°F)	911	876	895
		Exhaust Flow (lb/s)	88.2	109.5	128.0
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.1	7.8	9.8
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.2	7.9	9.9
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.0	4.5	5.7

Ambient Temp			50% Load	75% Load	100% Load
20°F	Turbine Performance	Output Shaft Speed (RPM)	6706	7676	8449
		Output Shaft Power (HP)	11239	16859	22478
		HP Utilization (%)	50%	75%	100%
		Heat Rate (BTU/HP-hr)	9302	8043	7199
		Unit Fuel Consumption (MMSCF/D)	**2.6103**	**3.3854**	**4.0401**
		Engine Thermal Efficiency (%)	27.4%	31.6%	35.3%
		Exhaust Temp (°F)	923	887	904
		Exhaust Flow (lb/s)	85.8	106.3	123.9
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	6.4	7.6	9.5
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	6.5	7.7	9.6
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.7	4.4	5.5

MVP Turbine/Compressor Package Performance Evaluation Sheet

Ambient Temp			50% Load	75% Load	100% Load
40°F	Turbine Performance	Output Shaft Speed (RPM)	6596	7550	8310
		Output Shaft Power (HP)	10695	16042	21390
		HP Utilization (%)	50%	75%	100%
		Heat Rate (BTU/HP-hr)	9271	7981	7227
		Unit Fuel Consumption (MMSCF/D)	**2.4753**	**3.1965**	**3.8595**
		Engine Thermal Efficiency (%)	27.4%	31.9%	35.2%
		Exhaust Temp (°F)	935	900	913
		Exhaust Flow (lb/s)	83.3	102.9	119.6
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	6.2	7.3	9.2
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	6.3	7.4	9.3
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.6	4.3	5.3

Ambient Temp			50% Load	75% Load	100% Load
60°F	Turbine Performance	Output Shaft Speed (RPM)	6484	7422	8169
		Output Shaft Power (HP)	10161	15242	20323
		HP Utilization (%)	50%	75%	100%
		Heat Rate (BTU/HP-hr)	9319	7972	7264
		Unit Fuel Consumption (MMSCF/D)	**2.3641**	**3.0337**	**3.6856**
		Engine Thermal Efficiency (%)	27.3%	31.9%	35.0%
		Exhaust Temp (°F)	949	913	924
		Exhaust Flow (lb/s)	80.7	99.4	115.2
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.9	7.0	8.9
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	6	7.1	9
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.5	4.0	5.2

Ambient Temp			50% Load	75% Load	100% Load
80°F	Turbine Performance	Output Shaft Speed (RPM)	6322	7237	7966
		Output Shaft Power (HP)	9420	14130	18840
		HP Utilization (%)	50%	75%	100%
		Heat Rate (BTU/HP-hr)	9654	8102	7392
		Unit Fuel Consumption (MMSCF/D)	**2.2704**	**2.8582**	**3.4769**
		Engine Thermal Efficiency (%)	26.4%	31.4%	34.4%
		Exhaust Temp (°F)	979	931	939
		Exhaust Flow (lb/s)	76.7	94.7	109.0
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.7	6.6	8.4
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.8	6.7	8.6
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.3	3.8	4.9

MVP Turbine/Compressor Package Performance Evaluation Sheet

Ambient Temp			50% Load	75% Load	100% Load
100°F	Turbine Performance	Output Shaft Speed (RPM)	6113	6997	7702
		Output Shaft Power (HP)	8514	12771	17028
		HP Utilization (%)	50%	75%	100%
		Heat Rate (BTU/HP-hr)	10197	8473	7679
		Unit Fuel Consumption (MMSCF/D)	**2.1675**	**2.7016**	**3.2647**
		Engine Thermal Efficiency (%)	25.0%	30.0%	33.1%
		Exhaust Temp (°F)	1010	962	963
		Exhaust Flow (lb/s)	72.1	88.3	101.5
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.7	6.6	7.7
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.7	6.7	7.8
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.3	3.8	4.5

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PIL 167
Product Information Letter

SoLoNOx Products: Emissions in Non-SoLoNOx Modes

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

Solar's gas turbine dry low NOx emissions combustion systems, known as *SoLoNOx*™, have been developed to provide the lowest emissions possible during normal operating conditions. In order to optimize the performance of the turbine, the combustion and fuel systems are designed to reduce NOx, CO and unburned hydrocarbons (UHC) without penalizing stability or transient capabilities. At very low load and cold temperature extremes, the *SoLoNOx* system must be controlled differently in order to assure stable operation. The required adjustments to the turbine controls at these conditions cause emissions to increase.

The purpose of this Product Information Letter is to provide emissions estimates, and in some cases warrantable emissions for NOx, CO and UHC, at off-design conditions.

Historically, regulatory agencies have not required a specific emissions level to be met at low load or cold ambient operating conditions, but have asked what emissions levels are expected. The expected values are necessary to appropriately estimate emissions for annual emissions inventory purposes and for New Source Review applicability determinations and permitting.

COLD AMBIENT EMISSIONS ESTIMATES

Solar's standard temperature range warranty for gas turbines with *SoLoNOx* combustion is ≥ 0°F (–20°C). The *Titan*™ 250 is an exception, with a lower standard warranty at ≥ –20°F (–29°C). At ambient temperatures below 0°F, many of Solar's turbine engine models are controlled to increase pilot fuel to improve flame stability and emissions are higher. Without the increase in pilot fuel at temperatures below 0°F the engines may exhibit combustor rumble, as operation may be near the lean stability limit.

If a cold ambient emissions warranty is requested, a new production turbine configured with the latest combustion hardware is required. For most models this refers to the inclusion of Cold Ambient Fuel Control Logic.

Emissions warranties are not offered for ambient temperatures below –20°F (–29°C). In addition, cold ambient emissions warranties cannot be offered for the *Centaur*® 40 turbine.

Table 1 provides expected and warrantable (upon Solar's documented approval) emissions levels for Solar's *SoLoNOx* combustion turbines. All emissions levels are in ppm at 15% O_2. Refer to Product Information Letter 205 for *Mercury*™ 50 turbine emissions estimates.

For information on the availability and approvals for cold ambient temperature emissions warranties, please contact Solar's sales representatives.

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Table 2 summarizes "expected" emissions levels for ambient temperatures below 0°F (–20°C) for Solar's *SoLoNOx* turbines that do not have current production hardware or for new production hardware that is not equipped with the cold ambient fuel control logic. The emissions levels are extrapolated from San Diego factory tests and may vary at extreme temperatures and as a result of variations in other parameters, such as fuel composition, fuel quality, etc.

For more conservative NOx emissions estimate for new equipment, customers can refer to the New Source Performance Standard (NSPS) 40CFR60, subpart KKKK, where the allowable NOx emissions level for ambient temperatures < 0°F (–20°F) is 150 ppm NOx at 15% O_2. For pre-February 18, 2005, *SoLoNOx* combustion turbines subject to 40CFR60 subpart GG, a conservative estimate is the appropriate subpart GG emissions level. Subpart GG levels range from 150 to 214 ppm NOx at 15% O_2 depending on the turbine model.

Table 3 summarizes emissions levels for ambient temperatures below –20°F (–29°C) for the *Titan* 250.

Table 1. Warrantable Emissions Between 0°F and –20°F (–20° to –29°C) for New Production

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 50	Gas Only	Gas	50 to 100% load	42	100	50
	Dual Fuel	Gas	50 to 100% load	72	100	50
Taurus™ 60	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Taurus 65	Gas Only	Gas	50 to 100% load	42	100	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Mars® 90	Gas Only	Gas	50 to 100% load	42	100	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 250	Gas Only	Gas	40 to 100% load	25	50	25
	Gas Only	Gas	40 to 100% load	15	25	25
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

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EMISSIONS ESTIMATES IN NON-SOLONOX MODE (LOW LOAD)

At operating loads < 50% (<40% load for the *Titan* 250) on natural gas fuel and < 65% (< 80% load for *Centaur* 40) on liquid fuels, *SoLoNOx* engines are controlled to increase stability and transient response capability. The control steps that are required affect emissions in two ways: 1) pilot fuel flow is increased, increasing NOx emissions, and 2) airflow through the combustor is increased, increasing CO emissions. Note that the load levels are approximate. Engine controls are triggered either by power output for single-shaft engines or gas producer speed for two-shaft engines.

A conservative method for estimating emissions of NOx at low loads is to use the applicable NSPS: 40CFR60 subpart GG or KKKK. For projects that commence construction after February 18, 2005, subpart KKKK is the applicable NSPS and contains a NOx level of 150 ppm @ 15% O_2 for operating loads less than 75%.

Table 4 provides estimates of NOx, CO, and UHC emissions when operating in non-SoLoNOx mode for natural gas or liquid fuel. The estimated emissions can be assumed to vary linearly as load is decreased from just below 50% load for natural gas (or 65% load for liquid fuel) to idle.

The estimates in Table 4 apply for any product for gas only or dual fuel systems using pipeline quality natural gas. Refer to Product Information Letter 205 for *Mercury* 50 emissions estimates.

Table 4. Estimated Emissions in non-SoLoNOx Mode

Ambient	Fuel System	Engine Load	NOx, ppm	CO, ppm	UHC, ppm
***Centaur* 40/50, *Taurus* 60/65/70, *Mars* 90/100, *Titan* 130**					
≥ –20°F (–29°C)	Natural Gas	Less than 50%	70	8,000	800
		Idle	50	10,000	1,000
< –20°F (–29°C)	Natural Gas	Less than 50%	120	8,000	800
		Idle	120	10,000	1,000
***Titan* 250**					
≥ –20°F (–29°C)	Natural Gas	Less than 40%	50	25	20
		Idle	50	2,000	200
< –20°F (–29°C)	Natural Gas	Less than 40%	70	150	50
		Idle	70	2,000	200
***Centaur* 50, *Taurus* 60/70, *Mars* 100, *Titan* 130**					
≥ –20°F (–29°C)	Liquid	Less than 65%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 65%	120	1,000	150
		Idle	120	10,000	3,000
***Centaur* 40**					
≥ –20°F (–29°C)	Liquid	Less than 80%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 80%	120	1,000	150
		Idle	120	10,000	3,000

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Table 2. Expected Emissions below 0°F (–20°C) for SoLoNOx Combustion Turbines

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 40	Gas Only or Dual Fuel	Gas	80 to 100% load	120	150	50
Centaur 50	Gas Only	Gas	50 to 100% load	120	150	50
	Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 60	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 65	Gas Only	Gas	50 to 100% load	120	150	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Mars 90	Gas Only	Gas	80 to 100% load	120	150	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Centaur 40	Dual Fuel	Liquid	80 to 100% load	120	150	75
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

Table 3. Expected Emissions below –20°F (–29°C) for the Titan 250 SoLoNOx Combustion Turbine

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Titan 250	Gas Only	Gas	40 to 100% load	70	150	50

COLD AMBIENT PERMITTING STRATEGY

There are several permitting options to consider when permitting in cold ambient climates. Customers can use a tiered permitting approach or choose to permit a single emission rate over all temperatures. Historically, most construction and operating permits were silent on the ambient temperature boundaries for *SoLoNOx* operation.

Some customers have used a tiered permitting strategy. For purposes of compliance and annual emissions inventories, a digital thermometer is installed to record ambient temperature. The amount of time is recorded that the ambient temperature falls below 0°F. The amount of time below 0°F is then used with the emissions estimates shown in Tables 1 and 2 to estimate "actual" emissions during sub-zero operation.

A conservative alternative to using the NOx values in Tables 1, 2 and 3 is to reference 40CFR60 subpart KKKK, which allows 150 ppm NOx at 15% O_2 for sub-zero operation.

For customers who wish to permit at a single emission rate over all ambient temperatures, inlet air heating can be used to raise the engine inlet air temperature (T_1) above 0°F. With inlet air heating to keep T_1 above 0°F, standard emission warranty levels may be offered.

Inlet air heating technology options include an electric resistance heater, an inlet air to exhaust heat exchanger and a glycol heat exchanger.

If an emissions warranty is desired and ambient temperatures are commonly below –20°F (–29°C), inlet air heating can be used to raise the turbine inlet temperature (T_1) to at least –20°F. In such cases, the values shown in Table 1 can be warranted for new production.

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PIL 168
Product Information Letter

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

Leslie Witherspoon
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PURPOSE

This Product Information Letter summarizes methods that are available to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO_2), and formaldehyde from gas turbines. Emissions estimates of these pollutants are often necessary during the air permitting process.

INTRODUCTION

In absence of site-specific or representative source test data, Solar refers customers to a United States Environmental Protection Agency (EPA) document titled "AP-42" or other appropriate EPA reference documents. AP-42 is a collection of emission factors for different emission sources. The emission factors found in AP-42 provide a generally accepted way of estimating emissions when more representative data are not available. The most recent version of AP-42 (dated April 2000) can be found at:

http://www.epa.gov/ttn/chief/ap42/ch03/index.html

Solar does not typically warranty the emission rates for VOC, SO_2 or formaldehyde.

Volatile Organic Compounds

Many permitting agencies require gas turbine users to estimate emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are some of the many ways of referring to the non-methane (and non-ethane) portion of an "unburned hydrocarbon" emission estimate.

For natural gas fuel, Solar's customers use 10-20% of the UHC emission rate to represent VOC emissions. The estimate of 10-20% is based on a ratio of total non-methane hydrocarbons to total organic compounds. The use of 10-20% provides a conservative estimate of VOC emissions. The balance of the UHC is assumed to be primarily methane.

For liquid fuel, it is appropriate to estimate that 100% of the UHC emission estimate is VOC.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of sulfur in the fuel to SO_2. Since Solar does not control the amount of sulfur in the fuel, we are unable to predict SO_2 emissions without a site fuel composition analysis. Customers generally estimate SO_2 emissions with a mass balance calculation by assuming that any sulfur in the fuel will convert to SO_2. For reference, the typical mass balance equation is shown below.

Variables: wt % of sulfur in fuel
Btu/lb fuel (LHV*)
MMBtu/hr fuel flow (LHV)

$$\frac{\text{lb } SO_2}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100}\right)\left(\frac{\text{lb fuel}}{\text{Btu}}\right)\left(\frac{10^6 \text{ Btu}}{\text{MMBtu}}\right)\left(\frac{\text{MMBtu fuel}}{\text{hr}}\right)\left(\frac{\text{MW } SO_2}{\text{MW Sulfur}}\right)$$

As an alternative to the mass balance calculation, EPA's AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.0034 lb/MMBtu for gas fuel (HHV*) and 0.033 lb/MMBtu for liquid fuel (HHV).

*LHV = Lower Heating Value; HHV = Higher Heating Value

Formaldehyde

In gas turbines, formaldehyde emissions are a result of incomplete combustion. Formaldehyde

in the exhaust stream is unstable and very difficult to measure. In addition to turbine characteristics including combustor design, size, maintenance history, and load profile, the formaldehyde emission level is also affected by:

- Ambient temperature
- Humidity
- Atmospheric pressure
- Fuel quality
- Formaldehyde concentration in the ambient air
- Test method measurement variability
- Operational factors

The emission factor data in Table 1 is an excerpt from an EPA memo: "Revised HAP Emission Factors for Stationary Combustion Turbines, 8/22/03." The memo presents hazardous air pollutant (HAP) emission factor data in several categories including: mean, median, maximum, and minimum. The emission factors in the memo are a compilation of the HAP data EPA collected during the Maximum Achievable Control Technology (MACT) standard development process. The emission factor documentation shows there is a high degree of variability in formaldehyde emissions from gas turbines, depending on the manufacturer, rating size of equipment, combustor design, and testing events. To estimate formaldehyde emissions from gas turbines, users should use the emission factor(s) that best represent the gas turbines actual / planned operating profile. Refer to the memo for alternative emission factors.

Table 1. EPA's Total HAP and Formaldehyde Emission Factors for <50 MW Lean-Premix Gas Turbines burning Natural Gas

(Source: Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09, 8/22/03)

Pollutant	Engine Load	95% Upper Confidence of Mean, lb/MMBtu HHV	95% Upper Confidence of Data, lb/MMBtu HHV	Memo Reference
Total HAP	> 90%	0.00144	0.00258	Table 19
Total HAP	All	0.00160	0.00305	Table 16
Formaldehyde	> 90%	0.00127	0.00241	Table 19
Formaldehyde	All	0.00143	0.00288	Table 16

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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-

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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% load[1] 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).

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[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).

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Table 1. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
10 Minute Start-up and 10 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S				Taurus 65 8401S			
	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)	0.6	58.1	3.3	359	0.8	75.0	4.3	454	0.8	78.5	4.5	482	0.9	85.8	4.9	523
Total Emissions per Shutdown (lbs)	0.3	25.5	1.5	160	0.4	31.1	1.8	194	0.4	34.7	2.0	217	0.4	38.2	2.2	237

	Taurus 70 10801S				Mars 90 13002S GSC				Mars 100 16002S GSC				Titan 130 20501S				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)	1.1	103.9	5.9	634	1.4	129.0	7.4	868	1.6	151.2	8.6	952	2.1	195.6	11.2	1,194	2.5	22.7	1.5	1,925
Total Emissions per Shutdown (lbs)	1.3	110.7	6.3	689	1.7	147.9	8.4	912	1.9	166.8	9.5	1,026	2.4	210.0	12.0	1,303	3.0	19.9	1.5	1,993

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.

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Table 2. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
60 Minute Start-up and 30 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S				Taurus 65 8401S			
	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)	4.1	219.4	13.0	3,420	5.0	272.4	16.1	4,219	5.7	299.8	17.8	4,780	6.1	326.5	19.3	5,074
Total Emissions per Shutdown (lbs)	1.8	121.1	7.1	1,442	2.3	163.3	9.5	1,834	2.5	163.5	9.6	1,994	2.6	177.2	10.4	2,119

	Taurus 70 10801S				Mars 90 13002S				Mars 100 16002S				Titan 130 20501S				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)	7.6	410.3	24.2	6,164	10.5	570.8	33.7	8,641	11.3	583.5	34.6	9,691	13.8	740.4	43.8	11,495	14.6	75.5	7.3	16,253
Total Emissions per Shutdown (lbs)	3.3	223.0	13.0	2,588	4.3	277.0	16.2	3,685	4.8	308.1	18.0	4,056	6.0	405.3	23.7	4,826	6.2	52.6	4.1	7,222

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.

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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.

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Table 4. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
10 Minute Start-up and 10 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S			
	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)	1.3	44.5	7.4	473	1.7	59.0	9.8	601	1.7	59.8	9.9	636
Total Emissions per Shutdown (lbs)	0.6	17.3	2.8	211	0.7	21.2	3.4	256	0.8	23.5	3.8	286

	Taurus 70 10801S				Mars 100 16002S GSC				Titan 130 20501S			
	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)	2.3	78.5	13.0	823	3.4	114.1	18.8	1,239	4.3	147.5	24.4	1,547
Total Emissions per Shutdown (lbs)	2.5	73.6	12.0	889	3.8	111.4	18.1	1,331	4.7	139.1	22.6	1,677

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

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

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Table 5. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
60 Minute Start-up and 30 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S			
	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)	11.7	194.7	30.9	4,255	15.2	271.9	43.3	5,302	14.7	282.6	45.0	5,962
Total Emissions per Shutdown (lbs)	4.4	84.7	13.6	1,816	6.7	164.3	27.0	2,334	6.3	159.0	26.0	2,515

	Taurus 70 10801S				Mars 100 16002S				Titan 130 20501S			
	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)	18.4	360.3	57.4	7,375	29.1	552.0	87.7	11,685	34.4	677.0	108.0	13,731
Total Emissions per Shutdown (lbs)	8.0	207.8	34.1	3,156	12.3	302.6	49.4	4,970	15.0	388.5	63.7	5,876

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

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

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Particulate Matter Emission Estimates

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

This document summarizes Solar's recommended $PM_{10/2.5}$ emission levels for our combustion turbines. The recommended levels are based on an analysis of emissions tests collected from customer sites.

Particulate Matter Definition

National Ambient Air Quality Standards (NAAQS) for particulate matter were first set in 1971. Total suspended particulate (TSP) was the first indicator used to represent suspended particles in the ambient air. Since July 1, 1987, the Environmental Protection Agency (EPA) has used the indicator PM_{10}, which includes only the particles with aerodynamic diameter smaller than 10 micrometers. PM_{10} (coarse particles) come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads by vehicle traffic.

The EPA added a $PM_{2.5}$ ambient air standard in 1997. $PM_{2.5}$ includes particles with an aerodynamic diameter less than 2.5 micrometers. $PM_{2.5}$ (fine particles) are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds, emitted by combustion activities, are transformed by chemical reactions.

Nearly all particulate matter from gas turbine exhaust is less than one micrometer (micron) in diameter. Thus the emission rates of TSP, PM_{10}, and $PM_{2.5}$ from gas turbines are theoretically equivalent although source testing will show variation due to test method detection levels and processes.

TESTING FOR PARTICULATE MATTER

The turbine combustion process has little effect on the particulate matter generated and measured. The largest contributor to particulate matter emissions for gas and liquid fired combustion turbines is measurement technique and error. Other, minor contributing, sources of particulate matter emissions include carbon, ash, fuel-bound sulfur, artifact sulfate formation, compressor/lubricating oils, and inlet air.

Historical customer particulate matter source test data show that there is significant variability from test to test. The source test results support the common industry argument that particulate matter from natural gas fired combustion sources is difficult to measure accurately. The reference test methods for particulate matter were developed primarily for measuring emissions from coal-fired power plants and other major emitters of particulates. Particulate concentrations from gas turbine can be 100 to 10,000 times lower than the "traditional" particulate sources. The test methods were not developed or verified for low emission levels. There are interferences, insignificant at higher exhaust particulate matter concentrations that result in emissions greater than the actual emissions from gas turbines. New methods are being developed to address this problem.

Due to measurement and procedural errors, the measured results, in most cases, may not be representative of actual particulate matter emitted. There are many potential error sources in measuring particulate matter. Most of these have to do with contamination of the samples, material from the sampling apparatus getting into the samples, and general human error in samples and analysis.

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Recommended Particulate Matter Emission Factors

When necessary to support the air permitting process Solar recommends the following $PM_{10/2.5}$ emission factors:

- Natural Gas: 0.015 lb/MMBtu fuel input (HHV)
- Landfill Gas: 0.03 lb/MMBtu fuel input (HHV)
- Liquid Fuel: 0.06 lb/MMBtu fuel input (HHV). The liquid fuel emission factor assumes fuel sulfur content is <500 ppm and ash content is <0.005% by wt.

The emission levels cited above are only for engine operation with the fuels listed. Other fuels may not yield similar results.

Recent customer source testing has shown that AP-42 (EPA AP-42 "Compilation of Air Pollutant Emission Factors.") emission factors for natural gas are achievable in the field, when the test method recommendations shown below are followed. Historically, Solar did not recommend using AP-42 because while some source test firms have measured below AP-42 levels, others have measured higher. Because particulate matter emissions levels are highly dependent on the test firm and have very little to do with the turbine, Solar does not warrant AP-42 levels but does recognize they are achievable in the field. Customers generally choose a particulate matter emissions factor at or above the AP-42 level that works for their site permitting recognizing that the lower the emissions factor the higher the risk for source testing. Any Solar warranty on particulate matter would be at the recommended levels above, e.g. 0.015 lb/MMBtu (HHV) for natural gas.

Test Method Recommendation

Solar recommends that EPA Methods 201/201A[1] be used to measure the "front half". "Front half" represents filterable particulate matter.

EPA Method 202[2] (with nitrogen purge and field blanks) should be used to measure the "back half". "Back half" measurements represent the condensable portion of particulate matter.

EPA Method 5[3], which measures the front and back halves may be substituted (e.g. where exhaust temperatures do not allow the use of Method 202).

Testing should include three test runs of 4 hours each.

Solar recommends using the aforementioned test methods until more representative test methods are developed and made commercially available.

References

[1] EPA Method 201, Determination of PM10 Emissions, Exhaust Gas Recycle Procedure. EPA Method 201A, Determination of PM10 Emissions, Constant Sampling Rate Procedure, 40 CFR 60, Part 60, Appendix A.

[2] EPA Method 202, Determination of Condensible Particulate Emissions from Stationary Sources, 40 CFR 60, Part 60, Appendix A.

[3] EPA Method 5, Determination of Particulate Emissions from Stationary Sources, 40 CFR 60, Part 60, Appendix

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Emissions from Centrifugal Compressor Gas Seal Systems

Anthony Pocengal
Solar Turbines Incorporated

PURPOSE

The U.S. Environmental Protection Agency ("EPA") has recently established regulations related to monitoring, reporting and control of Greenhouse Gas (GHG) emissions from industrial sources. Methane, the main constituent of natural gas, is a GHG which may escape from various points along the gas turbine package and the driven equipment. One source of 'fugitive' emissions under regulatory scrutiny includes the gas seal systems installed in centrifugal gas compressors. As natural gas is used as seal gas there will be some emission of methane through the seal vents. The purpose of this PIL is to provide information pertaining to expected emissions leakage from Solar compressor dry gas seals. Regulatory requirements for wet seal systems are also briefly summarized.

DRY GAS SEAL LEAKAGE DATA

The figures in the Appendix may be used to estimate dry gas seal leakage through the primary and secondary (combined) vents based on the compressor suction pressure (P1). The charts show the expected leakage rate per each compressor. Leakage rates are not be guaranteed.

For further technical information on Dry Gas Seal systems refer to PIL 140 Dry Gas Face Seals for Solar Gas Compressors.

Note on PIL 140: The maximum dynamic leakage from Tables 3 and 4 are the maximum possible dynamic leakage rates at maximum allowable speed and pressure and should not be utilized for emission inventories or expected emissions from Solar compressors.

REGULATIONS CONCERNING CENTRIFUGAL COMPRESSOR GAS SEAL EMISSIONS

There are two EPA regulations in Title 40 of the Code of Federal Regulations (CFR) which concern emissions from centrifugal compressor gas seal systems: Part 98, Subpart W (40 CFR §§ 98.230 – 98.238) and Part 60, Subpart OOOO (40 CFR §§ 60.5360 – 60.5423). The final rule that promulgated Subpart W was published in in November 2010 and requires reporting of GHG emissions for oil and gas operations beginning in September 2012. Subpart OOOO, New Source Performance Standards for Crude Oil and Natural Gas Production, Transmission and Distribution, requires the reduction of volatile organic compounds (VOCs) from oil and gas operations and became effective October 15, 2012.

Neither regulation requires actual measurement of emissions from compressor dry gas seal systems.

Although measurement of dry gas seal emissions is not required by EPA, several US state environmental agencies are requiring customers to estimate dry gas seal vent emissions as part of the air permitting process. Dry gas seal vent emissions estimates are provided in the Appendix. A brief summary of the regulations follows.

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Subpart W - Mandatory Reporting of Greenhouse Gases: Petroleum and Natural Gas Systems

Subpart W is included in the EPA's Mandatory Reporting of Greenhouse Gases regulation. While there is no requirement for measurement of dry gas seal emissions, emissions from wet gas seal de-gas systems are required to be measured by operators in the gas processing, transmission, storage and LNG segments of the industry. Or, as applicable, estimates from Best Available Monitoring Methods (BAMM) may be used. BAMM may be very common in the initial years (e.g., 2011 and 2012 GHG inventories) but EPA does not anticipate long term BAMM, so measurements in future years will be required. Production operators use an emission factor rather than measurement and the distribution segment does not report wet seal system emissions. See 40 CFR §§ 98.236 for details on reporting. Subpart W also requires reporting of emissions from blowdown vents and leakage from unit isolation valves (note that these emission sources are not directly emitted from the compressor). See 40 CFR §§ 98.233(o) and 98.234 for further details.

Subpart OOOO - Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution

40 CFR Part 60, Subpart OOOO impacts centrifugal compressors with wet gas seal systems that are new, modified, or reconstructed after August 23, 2011, that are used in natural gas gathering and processing. Compressors located at well-heads or in the transmission, distribution or storage segments are not affected by Subpart OOOO.

Compliance with Subpart OOOO requires a dry seal system, or a wet seal system that reduces VOC emissions by 95% (through routing of seal de-gas emissions through a closed vent system to a control device or recirculation to the compressor suction). Note that although Subpart OOOO mentions flaring, flares may present a safety hazard and should not be used with wet seal applications.

Subpart OOOO applicability to Solar equipment would be limited to new, modified, or reconstructed (since August 23, 2011) centrifugal compressors with wet seal systems in use at gathering facilities or gas processing plants.

Under Subpart OOOO if a control device (such as an adsorbent chiller) is used, monitoring and performance testing to verify 95% VOC reduction is required. See 40 CFR § 60.5413 for further details. Inspections of closed vent systems are required per 40 CFR § 60.5416.

At this time EPA has not provided an interpretation of what constitutes a 'modified' or 'reconstructed' centrifugal compressor, and guidance is not likely until an operator requests an applicability determination from EPA. According to the NSPS definitions, a compressor restage would be considered a modification if there is an increase in emissions; or reconstruction would apply in cases where the restage costs are greater than 50% of a comparable new compressor.

SUMMARY

Per Subpart W, wet seal de-gas emissions from centrifugal compressors must be measured (or estimated with BAMM) for all sources except those in the offshore production or distribution segments. Onshore production uses emission factors rather than direct measurement. Emissions estimates from blowdown vents and isolation valves, although not emitted directly from the compressor, are also required.

Per Subpart OOOO, new, modified, or reconstructed centrifugal compressors as of August 23, 2011 at gas gathering or production sites must use dry seals or reduce VOC emissions from wet seal systems by 95%.

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No specific requirements apply to emissions from dry gas seal systems although state environmental agencies may require estimates of these emissions for air permitting purposes. Emissions estimates are included in the Appendix.

Table of Figures

Centrifugal Compressor Dry Gas Seal Leakage Estimates

Figure 1 C16,.... 4
Figure 2 C160K, C166K.... 4
Figure 3 C160R, C160, C166S, C166V, C168V, C169V.... 5
Figure 4 C28.... 5
Figure 5 C304, C306, C33, C33i, C33E, C33EL, C337i, C401.... 6
Figure 6 C33EH, C404A, C404B, 406A, 406B.... 6
Figure 7 C41.... 7
Figure 8 C45.... 7
Figure 9 C505J.... 8
Figure 10 C505U.... 8
Figure 11 C51.... 9
Figure 12 C61.... 9
Figure 13 C65.... 10
Figure 14 C85.... 10

APPENDIX

The charts shown below are the total seal / process gas that leaks across the two primary dry gas seals and is vented through the primary and secondary vents on a Solar Gas Compressor. The dry gas seal leakage flow is a function of the compressor suction pressure. The charts show seal gas vented flow (scfm) vs. compressor suction pressure (psig)

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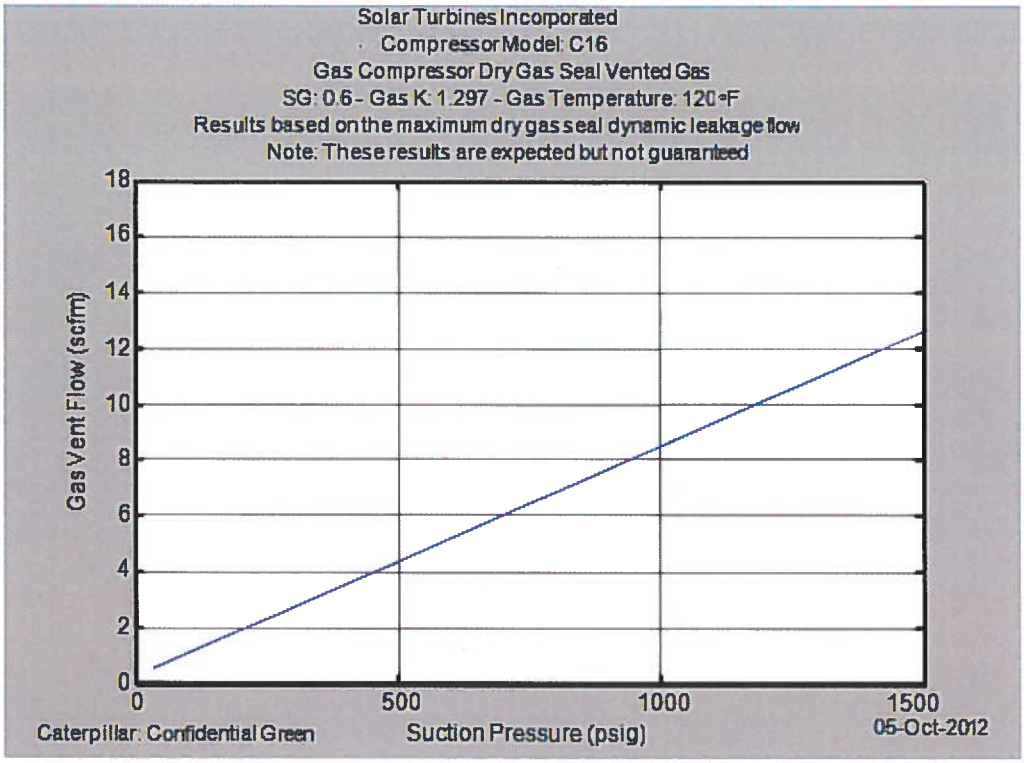

Figure 1 C16

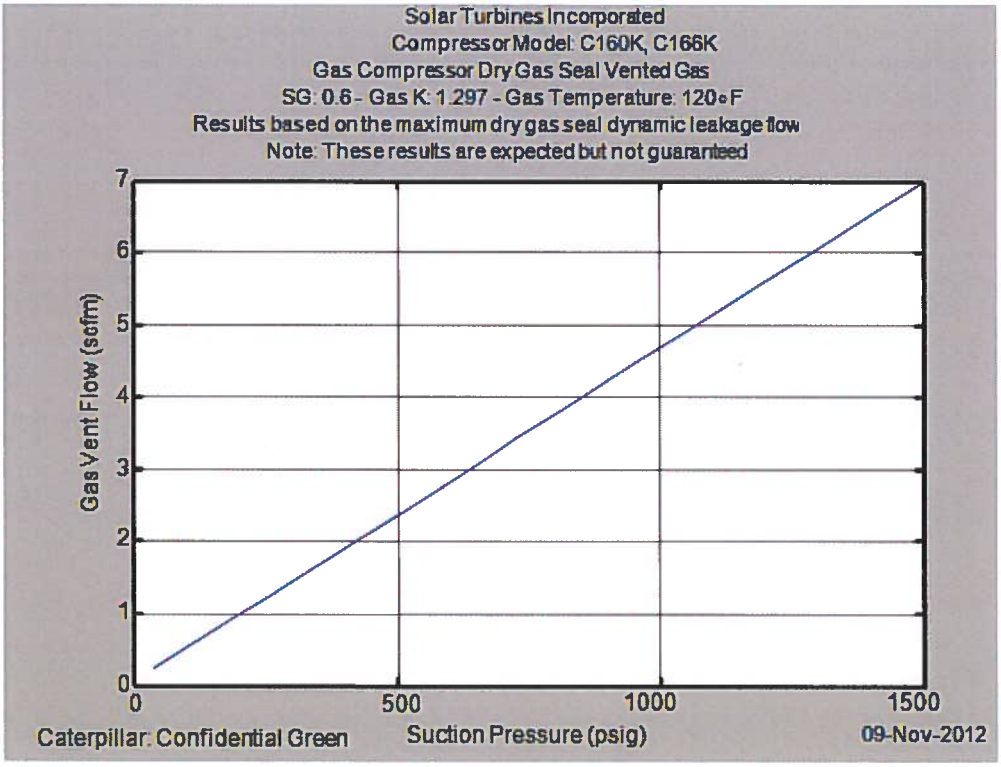

Figure 2 C160K, C166K

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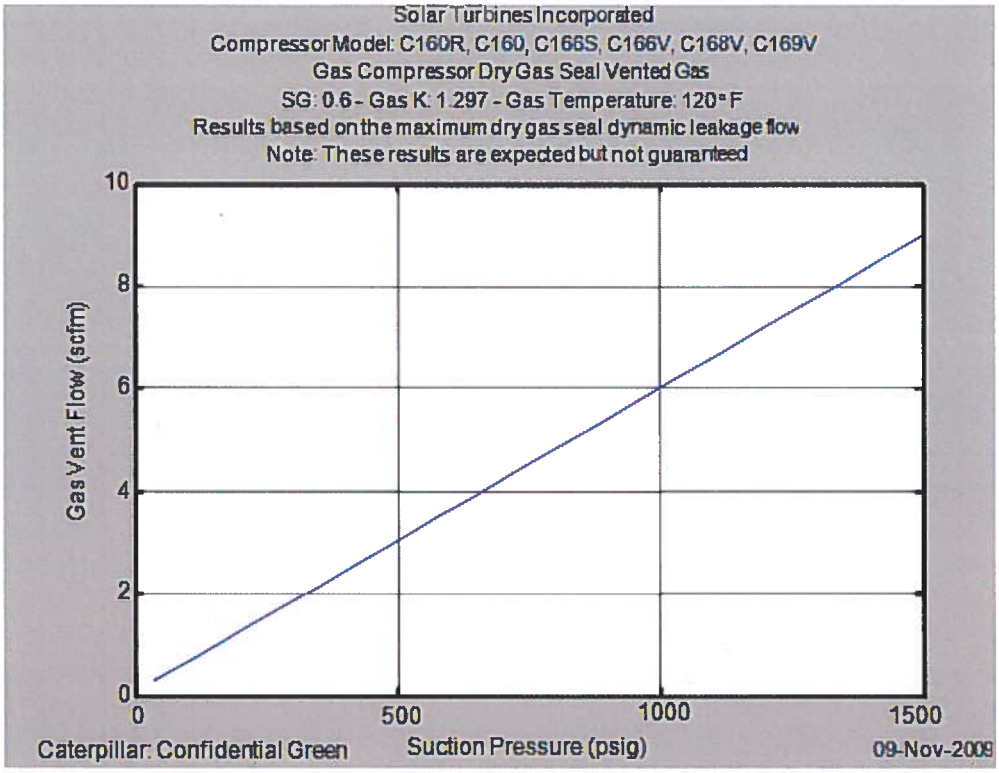

Figure 3 C160R, C160, C166S, C166V, C168V, C169V

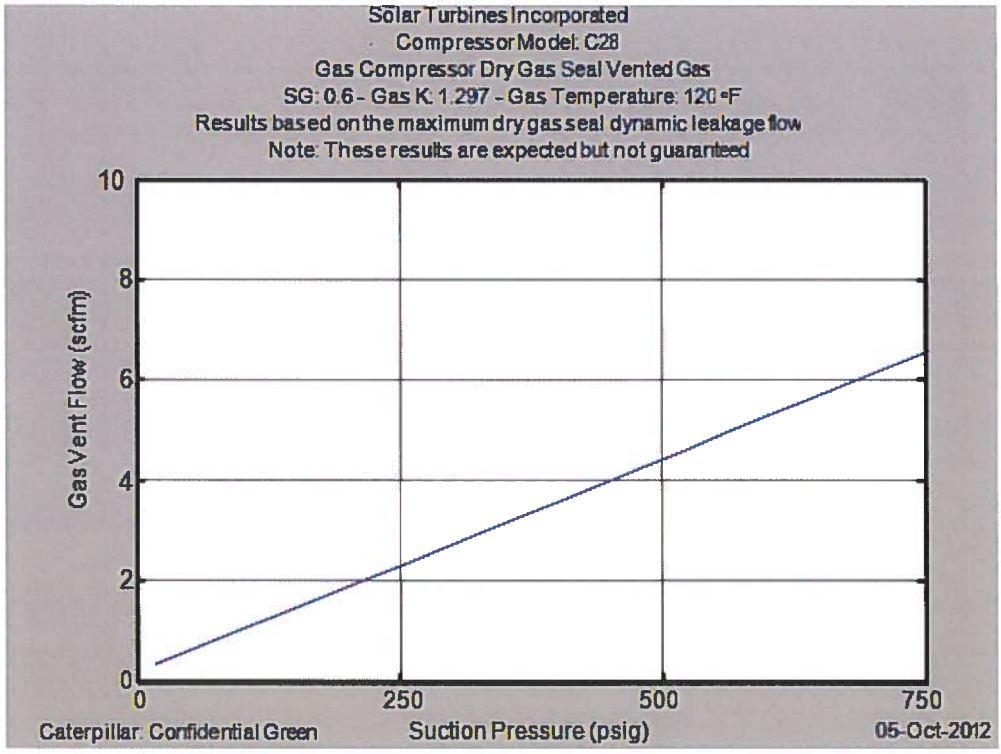

Figure 4 C28

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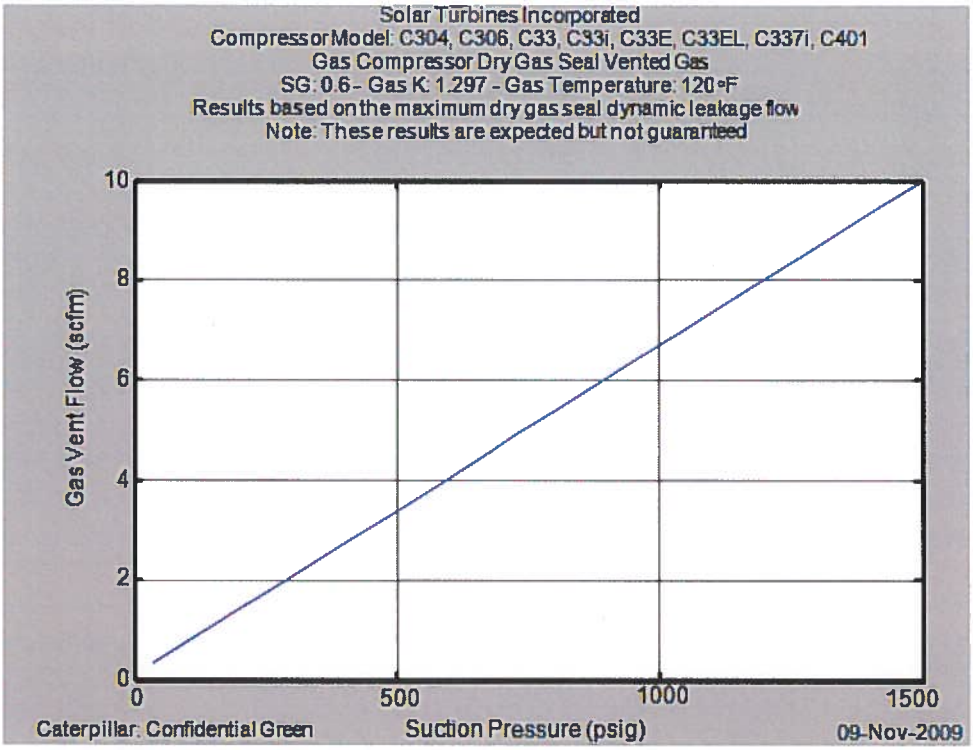

Figure 5 C304, C306, C33, C33i, C33E, C33EL, C337i, C401

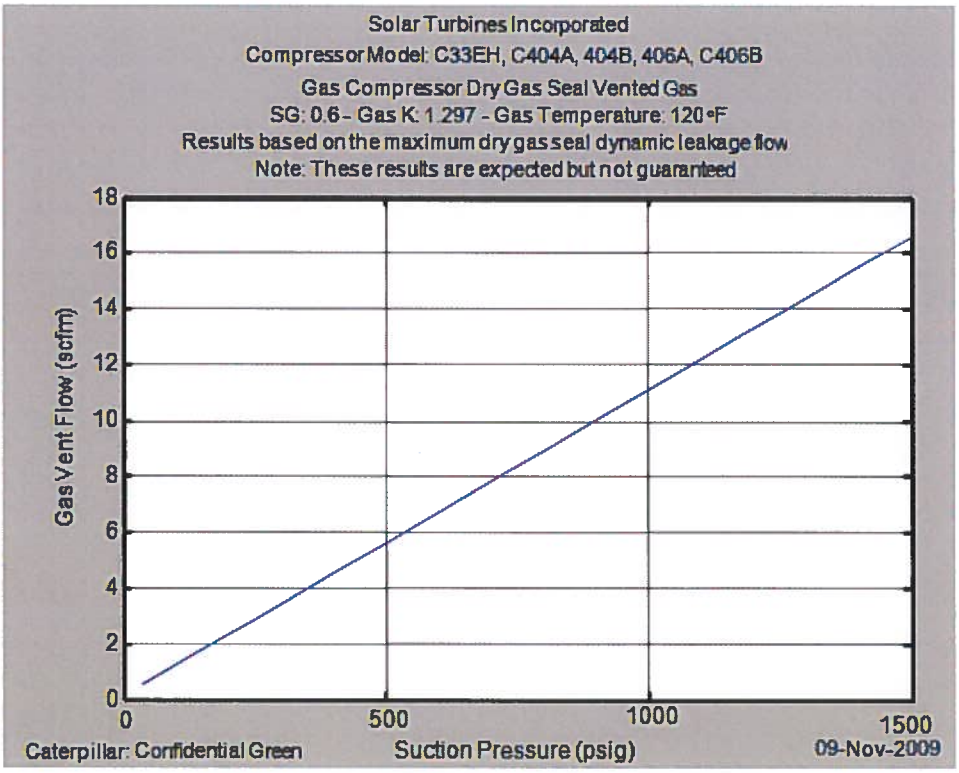

Figure 6 C33EH, C404A, C404B, 406A, 406B

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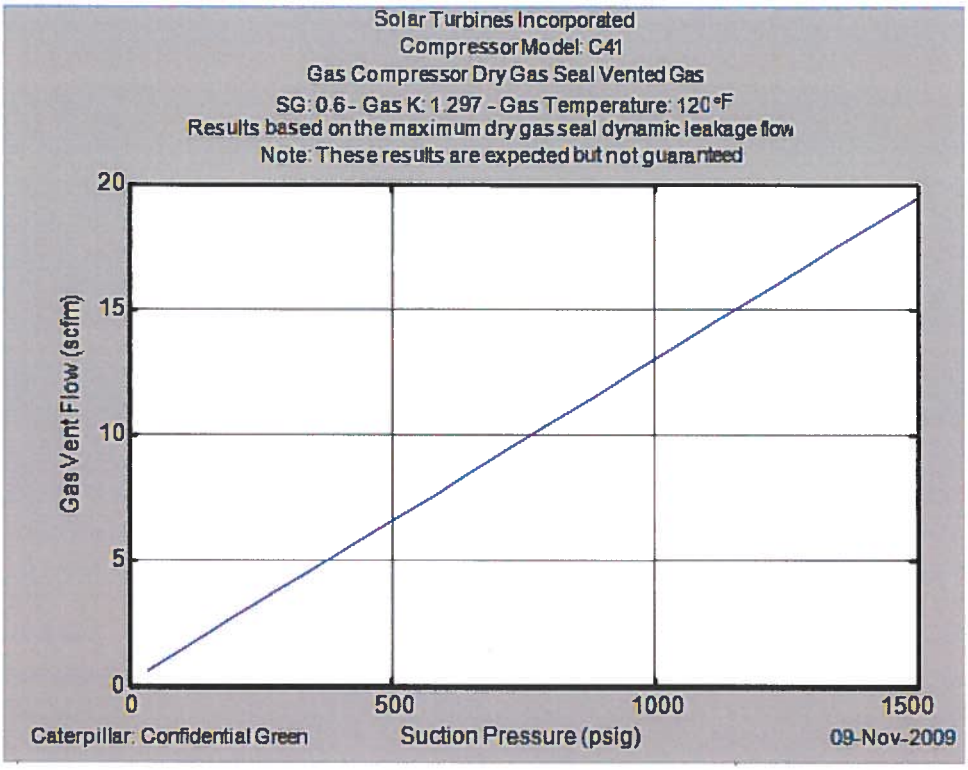

Figure 7 C41

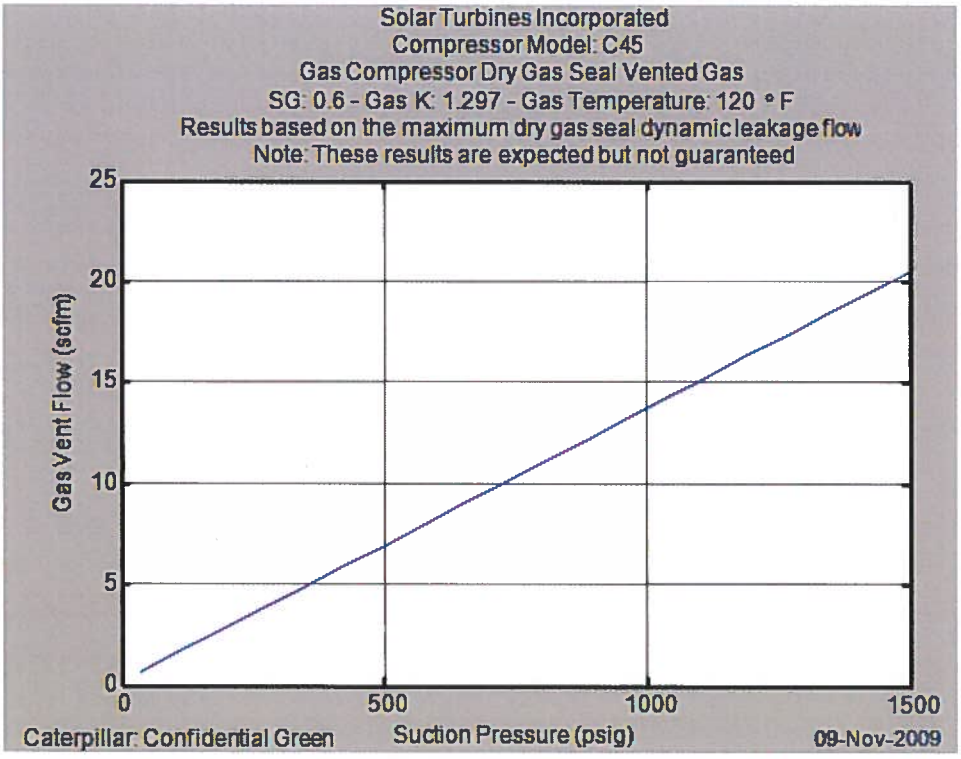

Figure 8 C45

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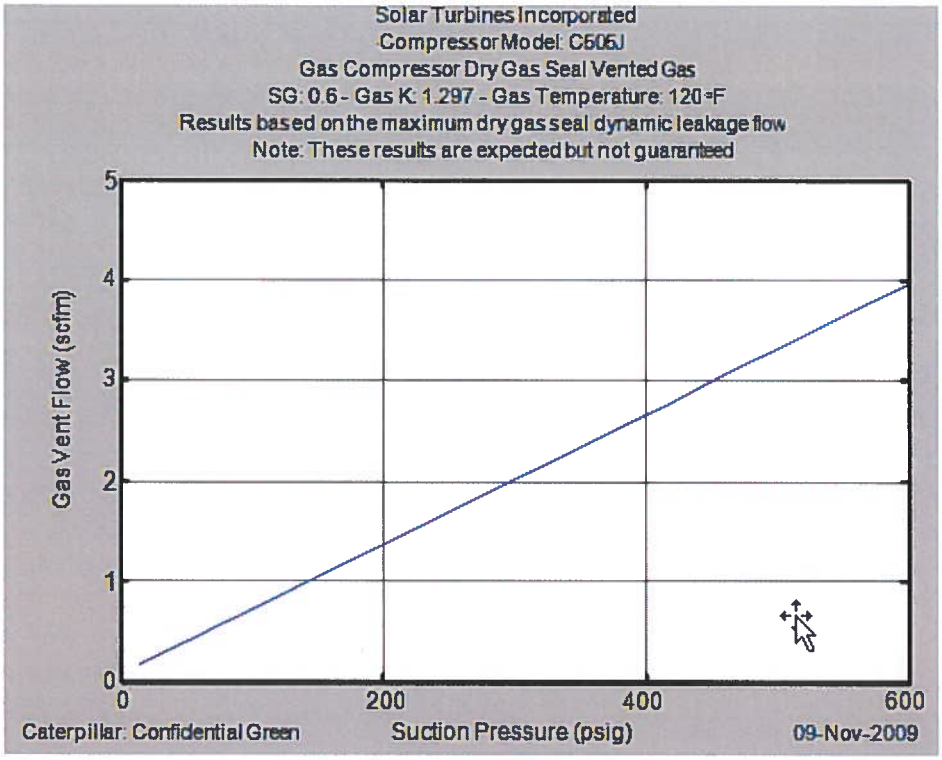

Figure 9 C505J

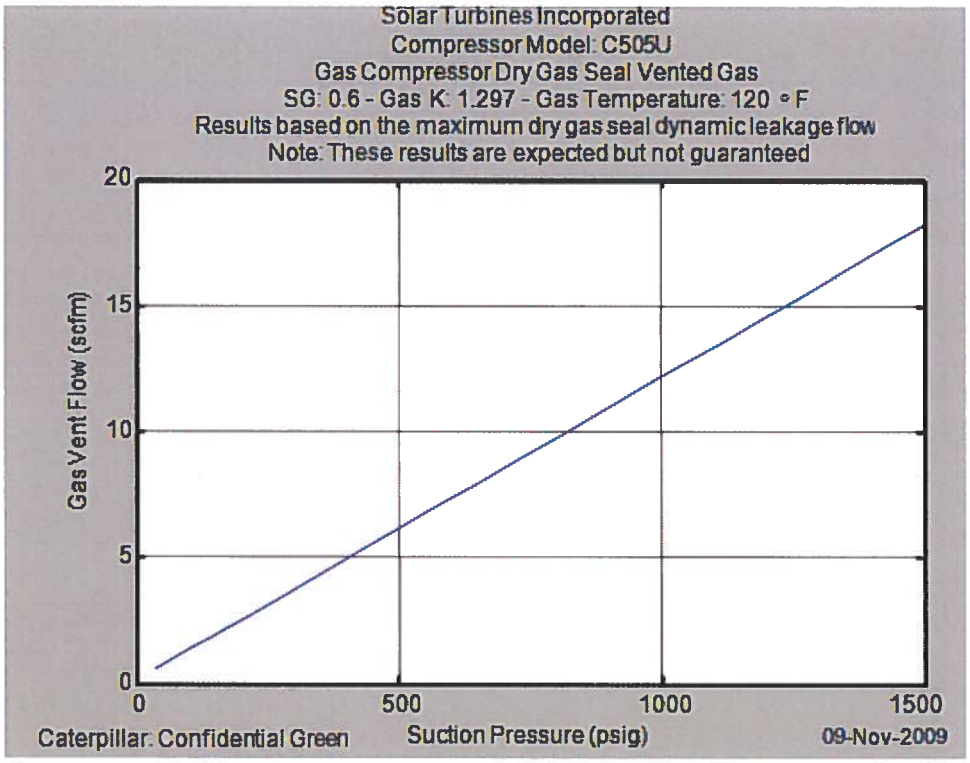

Figure 10 C505U

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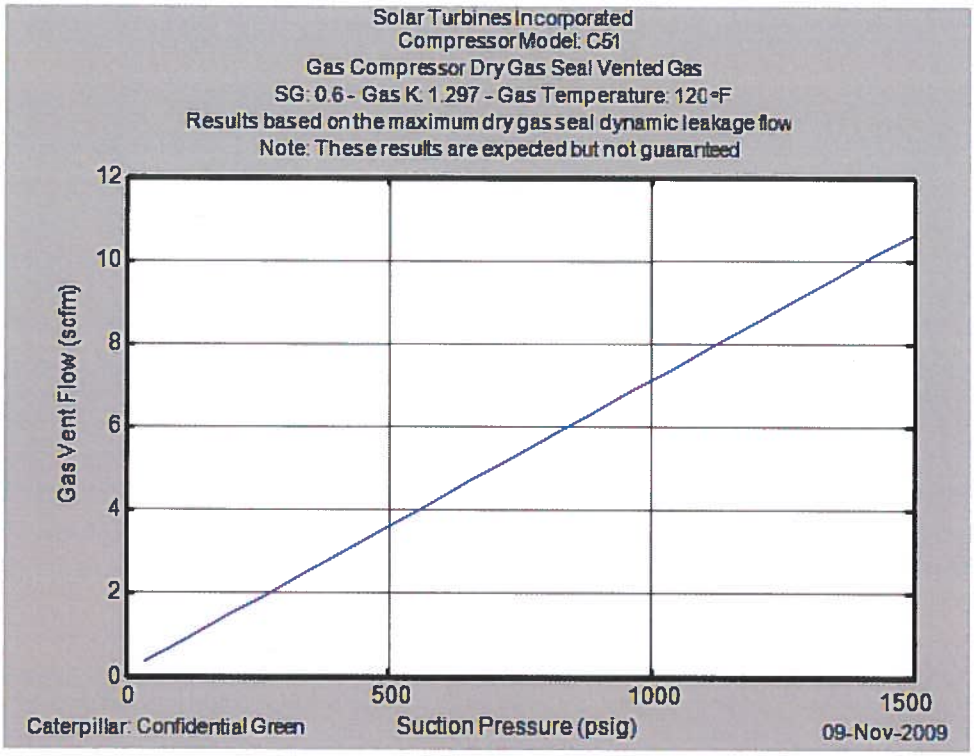

Figure 11 C51

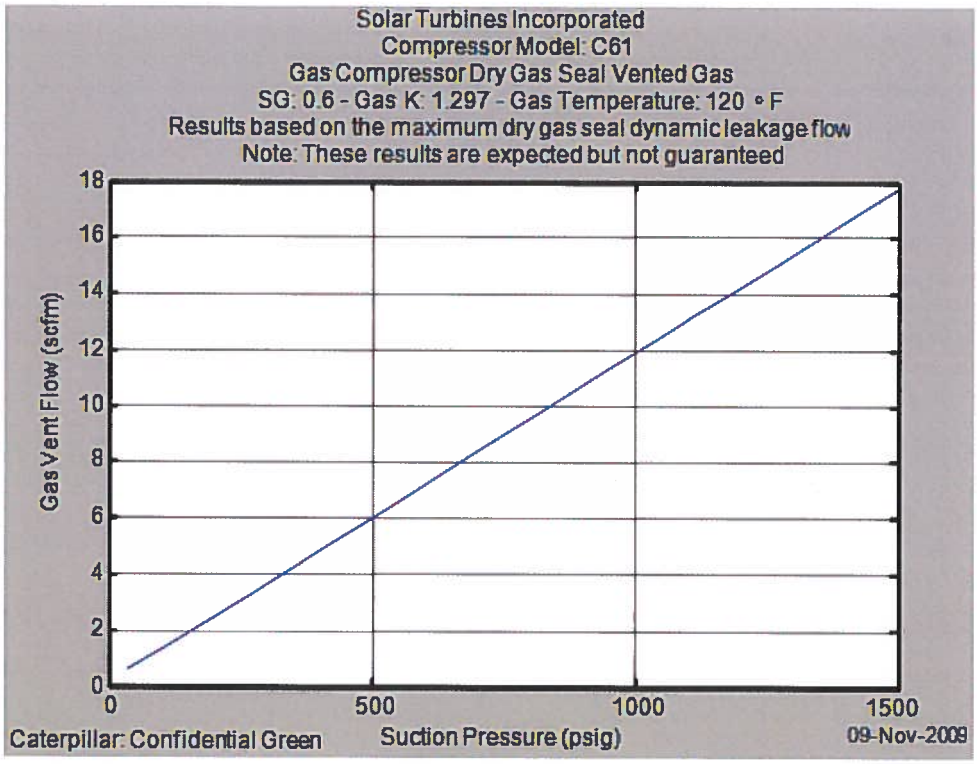

Figure 12 C61

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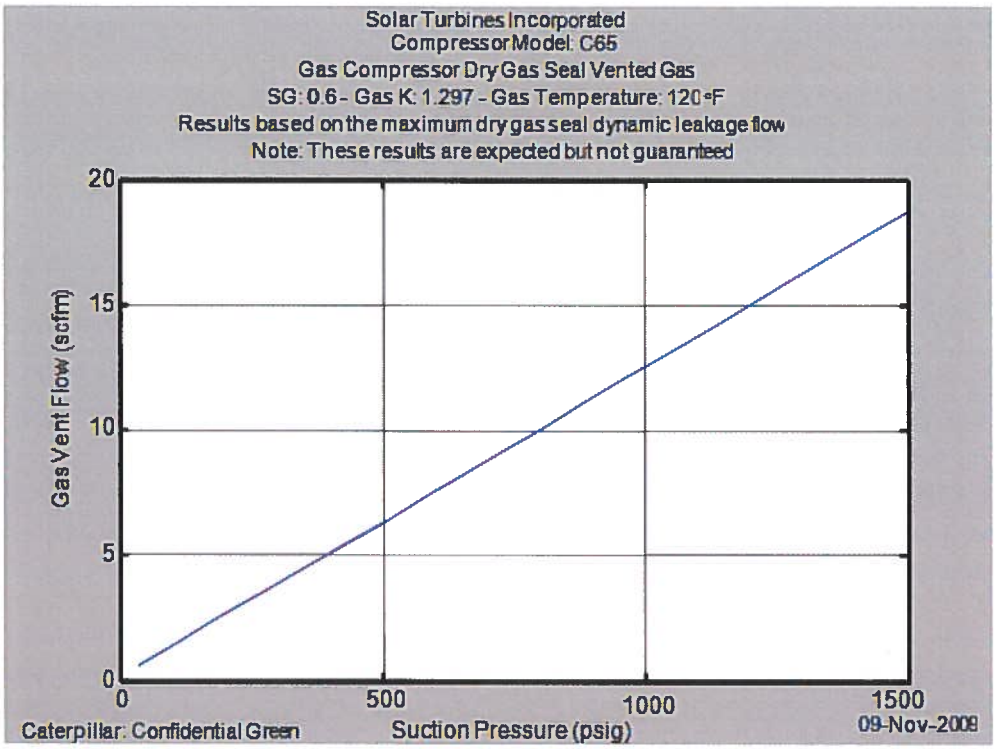

Figure 13 C65

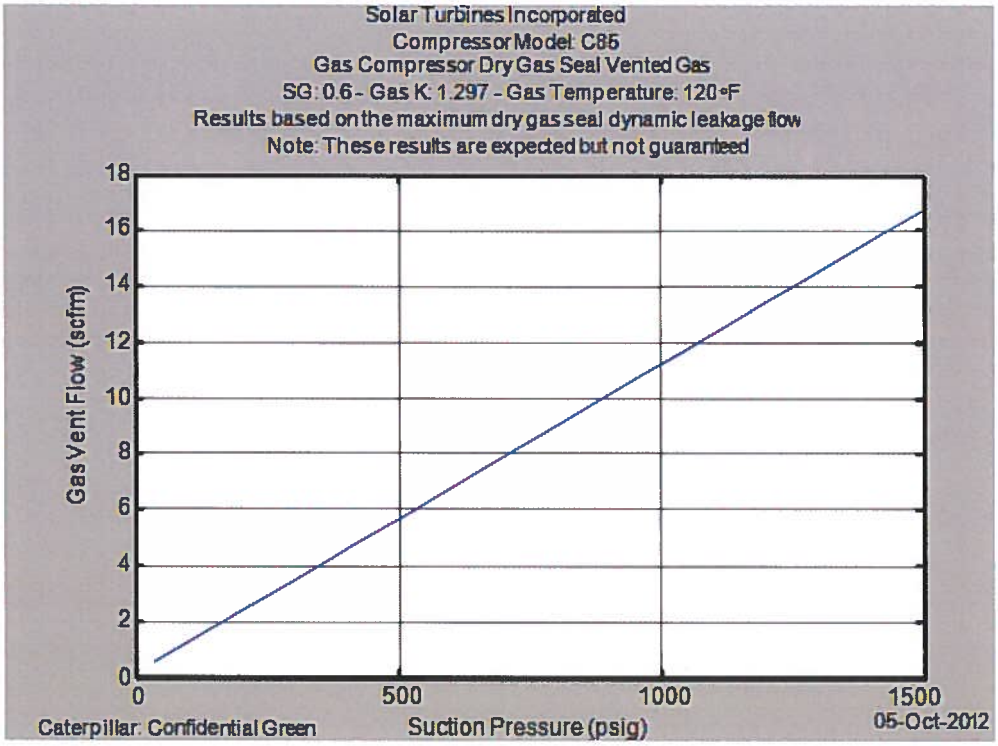

Figure 14 C85

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C200 MicroTurbine
High-pressure Natural Gas

World's largest air-bearing microturbine produces 200kW of clean, green, and reliable power.

- Ultra-low emissions
- One moving part – minimal maintenance and downtime
- Patented air bearing – no lubricating oil or coolant
- 5 and 9 year Factory Protection Plans available
- Remote monitoring and diagnostic capabilities
- Integrated utility synchronization and protection
- Small, modular design allows for easy, low-cost installation
- Proven technology with tens of millions of run hours and counting
- Internal fuel gas compressor available for low fuel pressure natural gas applications



C200 MicroTurbine

Electrical Performance[1]

Electrical Power Output	200kW
Voltage	400–480 VAC
Electrical Service	3-Phase, 4 wire
Frequency	50/60 Hz, grid connect operation
	10–60 Hz, stand alone operation
Maximum Output Current	290A RMS @ 400V, grid connect operation
	240A RMS @ 480V, grid connect operation
	310A RMS, stand alone operation[2]
Electrical Efficiency LHV	33%

Fuel/Engine Characteristics[1]

Natural Gas HHV	30.7–47.5 MJ/m³ (825–1,275 BTU/scf)
Inlet Pressure[3]	517–552 kPa gauge (75–80 psig)
Fuel Flow HHV	2,400 MJ/hr (2,280,000 BTU/hr)
Net Heat Rate LHV	10.9 MJ/kWh (10,300 BTU/kWh)

Exhaust Characteristics[1]

NOx Emissions @ 15% O_2[4]	< 9 ppmvd (18 mg/m³)
NOx / Electrical Output[4]	0.14 g/bhp-hr (0.4 lb/MWhe)
Exhaust Gas Flow	1.3 kg/s (2.9 lbm/s)
Exhaust Gas Temperature	280°C (535°F)
Exhaust Energy	1,420 MJ/hr (1,350,000 BTU/hr)

Reliable power when and where you need it. Clean and simple.

Dimensions & Weight[5]

Width x Depth x Height[6]	1.7 x 3.8 x 2.5 m (67 x 150 x 98 in)
Weight – Grid Connect Model	2776 kg (6,120 lb)
Weight – Dual Mode Model	3413 kg (7,525 lb)

Minimum Clearance Requirements[7]

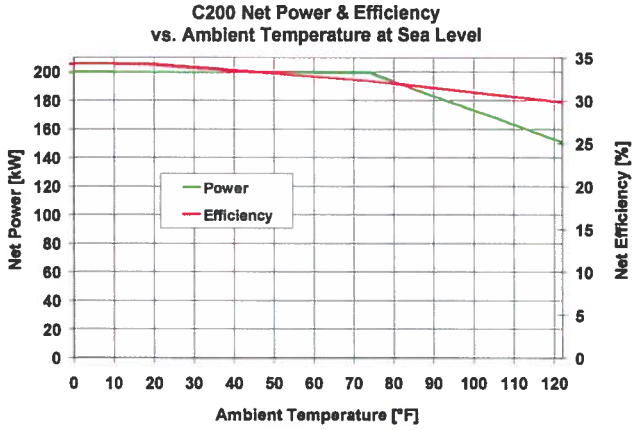
Vertical Clearance	0.6 m (24 in)
Horizontal Clearance	
Left & Right	1.1 m (42 in)
Front	1.1 m (42 in)
Rear	1.8 m (70 in)

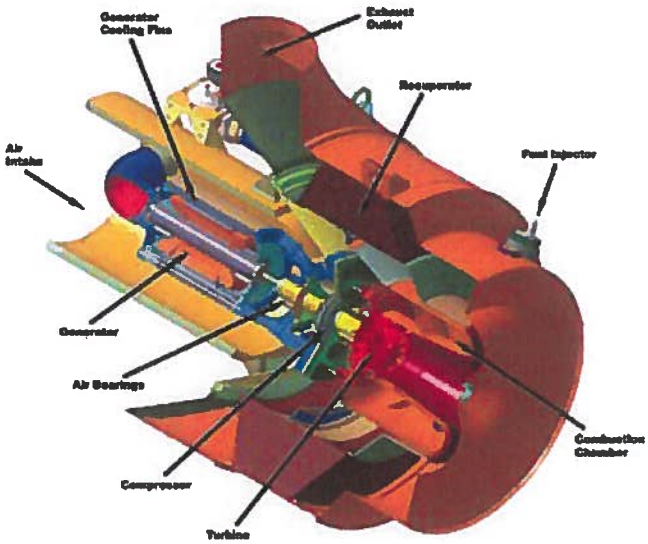
Sound Levels

Acoustic Emissions at Full Load Power	
Nominal at 10 m (33 ft)	65 dBA

Certifications

- UL 2200 and UL 1741 natural gas operation[8]
- Complies with IEEE 1547 and meets statewide utility interconnection requirements for California Rule 21 and the New York State Public Service Commission
- CE certified





(1) Nominal full power performance at ISO conditions: 59°F, 14.696 psia, 60% RH
(2) With linear load
(3) Inlet pressure for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(4) Emissions for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(5) Approximate dimensions and weight
(6) Height dimensions are to the roof line. Exhaust outlet extends at least 8 inches above the roof line
(7) Clearance requirements may increase due to local code considerations
(8) All natural gas models are planned to be UL Listed

Specifications are not warranted and are subject to change without notice.

21211 Nordhoff Street • Chatsworth • CA • 91311 • 866.422.7786 • 818.734.5300 • www.capstoneturbine.com
©2010 Capstone Turbine Corporation. P0911 C200 HP Natural Gas Data Sheet CAP146 | Capstone P/N 331042E

Capstone Turbine Corporation • 21211 Nordhoff Street • Chatsworth • CA 91311 • USA
Phone: (818) 734-5300 • Fax: (818) 734-5320 • Web: www.microturbine.com

Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are "output based"; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	0.64	1.8	0.23
CR30 MBTU	Landfill Gas (2)	0.64	22.0	1.00
CR30 MBTU	Digester Gas (3)	0.64	11.0	1.00
C30 Liquid	Diesel #2 (4)	2.60	0.41	0.23
C65 NG Standard	Natural Gas (1)	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas (1)	0.17	1.30	0.10
C65 NG CARB	Natural Gas (1)	0.17	0.24	0.05
CR65 Landfill	Landfill Gas (2)	0.46	4.0	0.10
CR65 Digester	Digester Gas (3)	0.46	4.0	0.10
C200 NG	Natural Gas (1)	0.40	1.10	0.10
C200 NG CARB	Natural Gas (1)	0.14	0.20	0.04
CR200 Digester	Digester Gas (3)	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

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Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]

Model	Fuel	NOx	CO	VOC [5]
C30 NG	Natural Gas [1]	0.22	0.60	0.078
CR30 MBTU	Landfill Gas [2]	0.22	7.4	0.340
CR30 MBTU	Digester Gas [3]	0.22	3.7	0.340
C30 Liquid	Diesel #2 [4]	0.90	0.14	0.078
C65 NG Standard	Natural Gas [1]	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas [1]	0.06	0.44	0.034
C65 NG CARB	Natural Gas [1]	0.06	0.08	0.017
CR65 Landfill	Landfill Gas [2]	0.16	1.4	0.034
CR65 Digester	Digester Gas [3]	0.16	1.4	0.034
C200 NG	Natural Gas [1]	0.14	0.37	0.034
C200 NG CARB	Natural Gas [1]	0.05	0.07	0.014
CR200 Digester	Digester Gas [3]	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is "ppmvd" (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expresses as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New } O_2 = \frac{(20.9 - \text{New } O_2 \text{ Percent})}{(20.9 - \text{Current } O_2 \text{ Percent})} \text{ X Emissions at Current } O_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% } O_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \text{ X } 9 = 27 \text{ ppmvd}$$

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Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O2

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas (1)	9	40	9
CR30 MBTU	Landfill Gas (2)	9	500	40
CR30 MBTU	Digester Gas (3)	9	250	40
C30 Liquid	Diesel #2 (4)	35	9	9
C65 NG Standard	Natural Gas (1)	9	40	7
C65 NG Low NOx	Natural Gas (1)	4	40	7
C65 NG CARB	Natural Gas (1)	4	8	3
CR65 Landfill	Landfill Gas (2)	9	130	7
CR65 Digester	Digester Gas (3)	9	130	7
C200 NG	Natural Gas (1)	9	40	7
C200 NG CARB	Natural Gas (1)	4	8	3
CR200 Digester	Digester Gas (3)	9	130	7

Notes: same as Table 1

Table 4. Emission for Different Capstone Microturbine Models in [mg/m3] at 15% O2

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	18	50	6
CR30 MBTU	Landfill Gas (2)	18	620	30
CR30 MBTU	Digester Gas (3)	18	310	30
C30 Liquid	Diesel #2 (4)	72	11	6
C65 NG Standard	Natural Gas (1)	19	50	5
C65 NG Low NOx	Natural Gas (1)	8	50	5
C65 NG CARB	Natural Gas (1)	8	9	2
CR65 Landfill	Landfill Gas (2)	18	160	5
CR65 Digester	Digester Gas (3)	18	160	5
C200 NG	Natural Gas (1)	18	50	5
C200 NG CARB	Natural Gas (1)	8	9	2
CR200 Digester	Digester Gas (3)	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

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Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NOx). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWhe times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NOx emissions rate of:

NOx = .17 X (65/1000) X 24 = .27 pounds per day

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NOx output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

NOx = .17 X 28/70 = .068 pounds per MWh (based on total system output)

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NOx and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

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Greenhouse Gas Emissions

Many gasses are considered "greenhouse gasses", and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO_2), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NOx and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO_2, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO_2. Emission of CO_2 depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO_2 emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO_2 that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO_2 released is substantially less when useful thermal output is also considered in the measurement.

Table 5. CO_2 Emission for Capstone Microturbine Models in [lb/MWh]

Model	Fuel	CO_2	
		Electric Only	70% Total CHP
C30 NG	Natural Gas (1)	1,690	625
CR30 MBTU	Landfill Gas (1)	1,690	625
CR30 MBTU	Digester Gas (1)	1,690	625
C30 Liquid	Diesel #2 (2)	2,400	855
C65 NG Standard	Natural Gas (1)	1,520	625
C65 NG Low NOx	Natural Gas (1)	1,570	625
C65 NG CARB	Natural Gas (1)	1,570	625
CR65 Landfill	Landfill Gas (1)	1,520	625
CR65 Digester	Digester Gas (1)	1,520	625
C200 NG	Natural Gas (1)	1,330	625
C200 NG CARB	Natural Gas (1)	1,330	625
CR200 Digester	Digester Gas (1)	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO_2 content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO_2 content of 160 lb/MMBTU (HHV)

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Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

Table 6. Useful Unit Conversions

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW_{th}: Kilowatt (thermal)
- kW_e : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as "electric horsepower-hour")
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m3: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: applications@capstoneturbine.com

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ATTACHMENT O

Monitoring/Recordkeeping/Reporting/Testing Plans

ATTACHMENT O - MONITORING, RECORDING, REPORTING, AND TESTING PLANS

Plan Type	Emission unit	Pollutant	Requirements	Frequency	Method of Measurement	Regulatory Reference
Monitoring, Recordkeeping	Compressor Turbines S001-S004	NO_X	Performance test	Annual	EPA Test Methods	NSPS KKKK
Monitoring	Compressor Turbines S001-S004		Amount of natural gas consumed, hours of operation	Monthly	N/A	Monitoring
Monitoring, Recordkeeping	Liquid Loading (S025)	VOC	Monitor throughput of loading	Monthly	Records	

See Attachment D for additional information.

ATTACHMENT P

Public Notice

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that Mountain Valley Pipeline, LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a construction permit (R-13) to construct a new natural gas transmission compressor station (Bradshaw Station) located on Bear Run Rd 3 miles northeast of Smithfield in Wetzel County, West Virginia. The site latitude and longitude coordinates are: 39.53288 N, - 80.53298 W.

The applicant estimates the potential increase in the following Regulated Air Pollutants associated with the project after the installation of the proposed equipment:

Particulate Matter (PM) = 47.47 tpy
Sulfur Dioxide (SO2) = 10.98 tpy
Volatile Organic Compounds (VOC) = 31.94 tpy
Carbon Monoxide (CO) = 197.78 tpy
Nitrogen Oxides (NOx) = 178.62 tpy
Hazardous Air Pollutants (HAPs) = 10.79 tpy
Carbon Dioxide Equivalents (CO_2e) = 391,794 tpy

Startup of operation will begin around the 4th quarter of 2017. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1250, during normal business hours.

Dated on October XX, 2015.

By: Mountain Valley Pipeline, LLC
Shawn Posey, Senior Vice President – Engineering and Construction
625 Liberty Avenue Suite 1700
Pittsburgh, PA 15222

Harris Compressor Station

Mountain Valley PIPELINE

October 21, 2015

Via Certified Mail
Return Receipt Requested
No. 7015 0640 0000 9694 1228

Mr. William Durham
WVDEP – Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Re: R13 Permit Application
Mountain Valley Pipeline, LLC – Harris Compressor Station
Braxton County, WV

Dear Mr. Durham:

Mountain Valley Pipeline, LLC (MVP) is submitting this request to the West Virginia Department of Environmental Protection (WVDEP) for the construction of a new natural gas transmission compressor station located in Braxton County, West Virginia (Harris Compressor Station). MVP is submitting this application to install the following equipment:

- Two (2) Solar Titan 130 natural gas-fired turbines each rated at 20,455 horsepower (hp) at site-specific conditions (ISO rating at 20,500 hp each);
- Nine (9) Capstone C200 natural gas-fired microturbines each rated at 200 kW;
- Two (2) natural gas-fired, fuel gas heaters each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input);
- One (1) natural gas-fired, office building heater rated at 0.12 MMBtu/hr, heat input; and
- Two (2) miscellaneous storage tanks with capacities less than 15, 000 gallons

The construction of the facility will not trigger prevention of significant deterioration, and the facility will not be a major source with respect to the Title V permit program.

Enclosed are two electronic copies and one original hard copy of the R13 application. The legal advertisement is scheduled to be published in the next few days. The affidavit of publication will be forwarded to WVDEP as soon as it is received from the newspaper. The fees will be paid by credit card once the application is received by your office.

625 Liberty Ave., Suite 1700, Pittsburgh PA 15222
Tel 304.848.0061 | Fax 412.395.3166 www.mountainvalleypipeline.info

MVP appreciates your review of this application. If you have any questions or comments about the attached information or have additional information requirements, please, feel free to contact me at (412) 553-7848.

Sincerely,

Regina Henry
Supervisor, Environmental

Attachments

R13 PERMIT APPLICATION

Mountain Valley Pipeline, LLC
Harris Compressor Station

Mountain Valley PIPELINE LLC

Braxton County, West Virginia

Prepared By:

TRINITY CONSULTANTS
4500 Brooktree Rd.
Suite 103
Wexford, PA 15090
(724) 935-2611

October 2015

Trinity Consultants

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

1. INTRODUCTION 3

1.1. Facility and Project Description 3

1.1.1. Turbines 3

1.1.2. Storage Tanks 3

1.1.3. Heaters 3

1.1.4. Microturbine Generators 3

1.2. R-13 APPLICATION ORGANIZATION 4

2. SAMPLE EMISSION SOURCE CALCULATIONS 5

2.1. Turbines 5

2.2. Heaters 5

2.3. Microturbine Generator 5

2.4. Storage Tanks 6

2.5. Fugitive Emissions 6

3. R13 APPLICATION FORM 7

ATTACHMENT A: CURRENT BUSINESS CERTIFICATE

ATTACHMENT B: MAP

ATTACHMENT C: INSTALLATION AND START UP SCHEDULE

ATTACHMENT D: REGULATORY DISCUSSION

ATTACHMENT E: PLOT PLAN

ATTACHMENT F: DETAILED PROCESS FLOW DIAGRAM

ATTACHMENT G: PROCESS DESCRIPTION

ATTACHMENT I: EMISSION UNITS TABLE

ATTACHMENT J: EMISSION POINTS DATA SUMMARY SHEET

ATTACHMENT K: FUGITIVE EMISSIONS DATA SUMMARY SHEET

ATTACHMENT L: EMISSIONS UNIT DATA SHEETS

ATTACHMENT N: SUPPORTING EMISSION CALCULATIONS

ATTACHMENT O: MONITORING/RECORDKEEPING/REPORTING/TESTING PLANS

ATTACHMENT P: PUBLIC NOTICE

Mountain Valley Pipeline, LLC (MVP), a subsidiary of EQT Corporation (EQT), is submitting this application to the West Virginia Department of Environmental Protection (WVDEP) for the construction of a new natural gas transmission compressor station located in Braxton County, West Virginia (Harris Compressor Station).

1.1. FACILITY AND PROJECT DESCRIPTION

The Harris Compressor Station is a natural gas transmission facility that will compress natural gas along the Mountain Valley Pipeline. The station has the potential to operate 24 hours per day, 7 days per week. The Harris Compressor station will consist of the following equipment

- Two (2) Solar Titan 130 natural gas-fired turbines each rated at 20,455 horsepower (hp) at site-specific conditions (ISO rating at 20,500 hp each);
- Nine (9) Capstone C200 natural gas-fired microturbines each rated at 200 kW;
- Two (2) natural gas-fired, fuel gas heaters each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input);
- One (1) natural gas-fired, office building heater rated at 0.12 MMBtu/hr, heat input; and
- Two (2) miscellaneous storage tanks with capacities less than 15, 000 gallons

There will be one (1) natural gas-fired, pipeline heater rated at 9.0 MMBtu/hr, heat input located at an interconnect near the Harris station (i.e., within approximately ¼ mile). This unit has been included as part of the Harris Compressor Station. There are no other facilities located within ¼ mile of the Harris Compressor Station.

A description of each source category is included below. A process flow diagram is included as Attachment F.

1.1.1. Turbines

MVP is proposing to install two (2) natural gas-fired turbines for the compression and transmission of natural gas. The turbines are each rated at 20,455 hp at site-specific conditions, and equipped with SoLoNOx combustion technology. The function of these turbines is to raise the discharge pressure of the gas to overcome the effect of frictional losses in the pipeline upstream of the station.

1.1.2. Storage Tanks

The Harris Compressor Station will operate one (1) produced fluids storage tank, and one (1) used oil storage tank. Once the tanks are filled, the contents are loaded into trucks for transport.

1.1.3. Heaters

MVP is proposing to add four (4) natural gas-fired heaters that consists of two (2) fuel gas heaters (each rated at 2.31MMBtu/hr) and one (1) office building heater rated at 0.12 MMBtu/hr) at the Harris Compressor Station and one (1) pipeline heater rated at 9.0 MMBtu/hr of heat input at a nearby interconnect. The fuel heaters will operate continuously (i.e., 8760 hours per year) and preheat natural gas to maintain temperature above dewpoint prior to combustion.

1.1.4. Microturbine Generators

There will be nine (9) microturbine generators at the Harris Compressor Station. The microturbine generators are a Model C1000 and C800 low-NO_x generators (5 identical units of 200 kW, each for C100 and 4 for C800) manufactured

by Capstone and will provide electrical power and backup power to the station. One unit will provide main electrical power, while the second will provide backup power to the station.

1.2. R-13 APPLICATION ORGANIZATION

This R-13 permit application is organized as follows:

- Section 2: Sample Emission Source Calculations;
- Section 3: R-13 Application Forms;
- Attachment A: Business Certificate;
- Attachment B: Map;
- Attachment C: Installation and Start Up Schedule;
- Attachment D: Regulatory Discussion;
- Attachment E: Plot Plan;
- Attachment F: Detailed Process Flow Diagram;
- Attachment G: Process Description;
- Attachment I: Emission Units Table;
- Attachment J: Emission Points Data Summary Sheet;
- Attachment K: Fugitive Emissions Data Summary Sheet;
- Attachment L: Emissions Unit Data Sheets;
- Attachment N: Supporting Emission Calculations;
- Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans;
- Attachment P: Public Notice; and
- Application Fee

2. SAMPLE EMISSION SOURCE CALCULATIONS

The characteristics of air emissions from the Harris Compressor Station, along with the methodology used for calculating emissions from the proposed new sources, are described in narrative form below. Detailed supporting calculations are also provided in Attachment N.

Emissions from the Harris Compressor Station will result from natural gas combustion in the turbines, fuel gas heaters, office building heater, microturbine generators, and flashing, working, and breathing losses from the storage tanks. Emissions will also result from the operation of the pipeline heater at the nearby interconnect. In addition, fugitive emissions from component leaks will result from the operation of the station. The methodologies employed in calculating emissions from these sources have been summarized below, with specific citations included in Attachment N.

2.1. TURBINES

Potential emissions of nitrogen oxides (NO_X), CO, VOC, and CH_4 are calculated using factors provided by the turbine manufacturer. Potential emissions of sulfur dioxide (SO_2), particulate matter ($PM/PM_{10}/PM_{2.5}$), and formaldehyde are calculated using factors from Product Information Letters published by the turbine manufacturer. All hazardous air pollutants (HAPs), with the exception of formaldehyde, are calculated using U.S. EPA's AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines". Potential emissions of greenhouse gas pollutants (GHGs) are calculated using manufacturer's data as available (CH_4 in this case) and U.S. EPA's emission factors from 40 CFR Part 98, Subpart C for all others.

Emissions concentrations from the turbine may vary due to operational load and ambient temperature. The vendor guarantees emissions of the SoLoNOx system at and above 0°F. The vendor has also provided estimated emissions from subzero temperatures, which are expected to occur infrequently. To calculate potential emissions, the vendor guaranteed emission rates at 0°F and maximum operating load (on a lb/hr basis) were assumed continuously (i.e., 8,760 hour per year). This calculation resulted in a more conservative (i.e., higher) annual emission rate compared to assuming nominal operation below 0°F and the remainder of the year at annual average temperature.

Annual emissions also include emissions from startup and shutdown, which are calculated by multiplying emissions per startup by the number of estimated startups per year.

2.2. HEATERS

Potential emissions of all criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas combustion equipment. These calculations assume a site-specific heat content. Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C. Although the operation of these sources may be intermittent, potential emissions are calculated assuming continuous operation (i.e., 8,760 hours per year).

2.3. MICROTURBINE GENERATOR

Potential emissions of NO_X, CO, VOC, methane, and CO_2 are calculated using manufacturer's emission data. Emissions of all other criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas internal combustion engines. These calculations use a site specific heat content. Although one unit will provide backup power, potential emissions of all units are calculated assuming continuous operation (i.e., 8,760 hours per year).

2.4. STORAGE TANKS

Working, standing, and flash loss emissions of VOC and HAPs from the produced fluids storage tanks are calculated using E&P Tank v2.0. Liquid loading emissions are calculated using EPA AP-42 emission factors.

2.5. FUGITIVE EMISSIONS

Emissions from fugitive equipment leaks are calculated using published EPA emission factors and 40 CFR Part 98, Subpart W emission factors. Emissions from blowdown events are calculated using engineering estimates of the amount of gas vented during each event. Site specific gas analyses were used to speciate VOC, HAP, and GHG emissions.

3. R13 APPLICATION FORM

The WVDEP permit application forms contained in this application include all applicable R13 application forms including the required attachments.

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT AND TITLE V PERMIT REVISION (OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):

☒ **CONSTRUCTION** ☐ **MODIFICATION** ☐ **RELOCATION**
☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**
☐ **CLASS II ADMINISTRATIVE UPDATE** ☐ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30 (TITLE V)** REVISION (IF ANY):

☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**
☐ **SIGNIFICANT MODIFICATION**

IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant *(as registered with the WV Secretary of State's Office):*
Mountain Valley Pipeline, LLC

2. Federal Employer ID No. ***(FEIN):***
61-1744744

3. Name of facility *(if different from above):*
Harris Compressor Station

4. The applicant is the:
☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**

5A. Applicant's mailing address:
625 Liberty Avenue, Suite 1700
Pittsburgh, PA 15222

5B. Facility's present physical address:
County Route 24/5, Flatwoods, WV 26621

6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☒ **YES** ☐ **NO**
- If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
- If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**

7. If applicant is a subsidiary corporation, please provide the name of parent corporation: EQT Corporation

8. Does the applicant own, lease, have an option to buy or otherwise have control of the *proposed site?* ☒ **YES** ☐ **NO**
- If **YES,** please explain: Applicant owns the site
- If **NO,** you are not eligible for a permit for this source.

9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): Natural Gas Compressor Station

10. North American Industry Classification System **(NAICS)** code for the facility:
486210

11A. DAQ Plant ID No. (for existing facilities only):

11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only):

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

12A.

- For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the *present location* of the facility from the nearest state road;
- For **Construction** or **Relocation permits,** please provide directions to the *proposed new site location* from the nearest state road. Include a **MAP** as **Attachment B**.

From Charleston, WV take I-79 N for approximately 70 miles. Take exit 67 for US-19 toward W Virginia 15/Flatwoods. Turn right onto US-19 N (signs for Flatwoods/Sutton). Turn right onto WV-4 S. Turn left onto Days Dr then turn right to stay on Days Dr. and continue 1.1 miles. Then, turn left onto WV-15 E and continue for 6.3 miles. Next, slight left onto Airport Rd/Laurel Path Rd and continue 1.5 miles. Then continue straight onto Vernon Rd for 2.1 miles. Finally, turn left onto Co Rte 24/5 and continue for 0.6 miles. The site will be on your right.

12.B. New site address (if applicable):	12C. Nearest city or town: Flatwoods, WV 26621	12D. County: Braxton
12.E. UTM Northing (KM): 4,286.10	12F. UTM Easting (KM): 543.22	12G. UTM Zone: 17

13. Briefly describe the proposed change(s) at the facility:

MVP is constructing a new natural gas transmission compressor station as part of the Mountain Valley Pipleline (MVP).

14A. Provide the date of anticipated installation or change: October 2014 – If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen:	14B. Date of anticipated Start-Up if a permit is granted: 12/2017

14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).

15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day 24 Days Per Week 7 Weeks Per Year 52

16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**

17. **Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.

18. **Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process *(if known)*. A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance *(if known)*. Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

20. Include a **Table of Contents** as the first page of your application package.

21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to ***Plot Plan Guidance***) .
– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).

22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**

23. Provide a **Process Description** as **Attachment G.**
– Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**

– For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

☒ Bulk Liquid Transfer Operations	☒ Haul Road Emissions	☐ Quarry
☒ Chemical Processes	☐ Hot Mix Asphalt Plant	☐ Solid Materials Sizing, Handling and Storage Facilities
☐ Concrete Batch Plant	☐ Incinerator	☒ Storage Tanks
☐ Grey Iron and Steel Foundry	☐ Indirect Heat Exchanger	

☒ General Emission Unit, specify Microturbines, Fuel Gas Heater, Office Building Heater, Pipeline Heater and Turbines

Fill out and provide the **Emissions Unit Data Sheet(s)** as **Attachment L.**

29. Check all applicable **Air Pollution Control Device Sheets** listed below:

☐ Absorption Systems	☐ Baghouse	☐ Flare
☐ Adsorption Systems	☐ Condenser	☐ Mechanical Collector
☐ Afterburner	☐ Electrostatic Precipitator	☐ Wet Collecting System

☐ Other Collectors, specify

Fill out and provide the **Air Pollution Control Device Sheet(s)** as **Attachment M.**

30. Provide all **Supporting Emissions Calculations** as **Attachment N,** or attach the calculations directly to the forms listed in Items 28 through 31.

31. **Monitoring, Recordkeeping, Reporting and Testing Plans.** Attach proposed monitoring, recordkeeping, reporting and testing plans in order to demonstrate compliance with the proposed emissions limits and operating parameters in this permit application. Provide this information as **Attachment O.**

➢ Please be aware that all permits must be practically enforceable whether or not the applicant chooses to propose such measures. Additionally, the DAQ may not be able to accept all measures proposed by the applicant. If none of these plans are proposed by the applicant, DAQ will develop such plans and include them in the permit.

32. **Public Notice.** At the time that the application is submitted, place a **Class I Legal Advertisement** in a newspaper of general circulation in the area where the source is or will be located (See 45CSR§13-8.3 through 45CSR§13-8.5 and ***Example Legal Advertisement*** for details). Please submit the **Affidavit of Publication** as **Attachment P** immediately upon receipt.

33. **Business Confidentiality Claims.** Does this application include confidential information (per 45CSR31)?

☐ **YES** ☒ **NO**

➢ If **YES,** identify each segment of information on each page that is submitted as confidential and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's ***"Precautionary Notice – Claims of Confidentiality"*** guidance found in the ***General Instructions*** as **Attachment Q.**

Section III. Certification of Information

34. **Authority/Delegation of Authority.** Only required when someone other than the responsible official signs the application. Check applicable **Authority Form** below:

☐ Authority of Corporation or Other Business Entity	☐ Authority of Partnership
☐ Authority of Governmental Agency	☐ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

35A. **Certification of Information.** To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☒ **Responsible Official** / ☐ **Authorized Representative,** hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE Shawn Posey DATE: 10-20-15

(Please use blue ink) *(Please use blue ink)*

35B. Printed name of signee: Shawn Posey		35C. Title: Sr. Vice President – Engineering and Construction
35D. E-mail: sposey@eqt.com	36E. Phone:	36F. FAX:
36A. Printed name of contact person (if different from above): Regina Henry		36B. Title: Supervisor - Environmental
36C. E-mail: rhenry@eqt.com	36D. Phone: 412-553-7848	36E. FAX:

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

- ☒ **Attachment A: Business Certificate**
- ☒ **Attachment B: Map(s)**
- ☒ **Attachment C: Installation and Start Up Schedule**
- ☒ **Attachment D: Regulatory Discussion**
- ☒ **Attachment E: Plot Plan**
- ☒ **Attachment F: Detailed Process Flow Diagram(s)**
- ☒ **Attachment G: Process Description**
- ☐ **Attachment H: Material Safety Data Sheets (MSDS)**
- ☒ **Attachment I: Emission Units Table**
- ☒ **Attachment J: Emission Points Data Summary Sheet**
- ☒ **Attachment K: Fugitive Emissions Data Summary Sheet**
- ☒ **Attachment L: Emissions Unit Data Sheet(s)**
- ☐ **Attachment M: Air Pollution Control Device Sheet(s)**
- ☒ **Attachment N: Supporting Emissions Calculations**
- ☒ **Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans**
- ☒ **Attachment P: Public Notice**
- ☐ **Attachment Q: Business Confidential Claims**
- ☐ **Attachment R: Authority Forms**
- ☐ **Attachment S: Title V Permit Revision Information**
- ☒ **Application Fee**

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

- ☐ ***Forward 1 copy of the application to the Title V Permitting Group and:***
- ☐ ***For Title V Administrative Amendments:***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit,***
- ☐ ***For Title V Minor Modifications:***
  - ☐ ***Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt,***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit.***
- ☐ ***For Title V Significant Modifications processed in parallel with NSR Permit revision:***
  - ☐ ***NSR permit writer should notify a Title V permit writer of draft permit,***
  - ☐ ***Public notice should reference both 45CSR13 and Title V permits,***
  - ☐ ***EPA has 45 day review period of a draft permit.***

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

ATTACHMENT A

Current Business Certificate

WEST VIRGINIA
STATE TAX DEPARTMENT
BUSINESS REGISTRATION
CERTIFICATE

ISSUED TO:
MOUNTAIN VALLEY PIPELINE, LLC
625 LIBERTY AVE, SUITE 1700
PITTSBURGH, PA 15222-0000

BUSINESS REGISTRATION ACCOUNT NUMBER: **2305-4787**

This certificate is issued on: **04/8/2015**

This certificate is issued by
the West Virginia State Tax Commissioner
in accordance with Chapter 11, Article 12, of the West Virginia Code

The person or organization identified on this certificate is registered to conduct business in the State of West Virginia at the location above.

This certificate is not transferrable and must be displayed at the location for which issued

This certificate shall be permanent until cessation of the business for which the certificate of registration was granted or until it is suspended, revoked or cancelled by the Tax Commissioner.

Change in name or change of location shall be considered a cessation of the business and a new certificate shall be required.

TRAVELING/STREET VENDORS: Must carry a copy of this certificate in every vehicle operated by them. CONTRACTORS, DRILLING OPERATORS, TIMBER/LOGGING OPERATIONS: Must have a copy of this certificate displayed at every job site within West Virginia.

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ATTACHMENT B

Map

ATTACHMENT B - AREA MAP



Figure 1 - Map of Harris Station and Nearby WB Interconnect

UTM Northing (KM):	4,286.101
UTM Easting (KM):	543.215
Elevation:	~1,465 ft

ATTACHMENT C

Startup and Installation Schedule

ATTACHMENT C

Schedule of Planned Installation and Start-Up

Unit	Installation Schedule	Startup Schedule
Two (2) Solar Titan 130 Turbines – Each rated 20,455 HP at site specific conditions (20,500 HP ISO)	2016-2017	4Q 2017
Nine (9)200 KW Capstone Microturbines	2016-2017	4Q 2017
Two (2) Fuel Gas Heater – Each rated 2.31 MMBtu/hr	2016-2017	4Q 2017
One (1) Pipeline Heater – Each rated 9.00 MMBtu/hr (located at Interconnect station)	2016-2017	4Q 2017
One (1) 10,080 gallon Produced Fluids Tank	2016-2017	4Q 2017
One (1) 4,200 gallon Used Oil Tank	2016-2017	4Q 2017
Office Building Heater – Rated 0.12 MMBtu/hr	2016-2017	4Q 2017

ATTACHMENT D

Regulatory Discussion

ATTACHMENT D - REGULATORY APPLICABILITY

This section documents the applicability determinations made for Federal and State air quality regulations. The monitoring, recordkeeping, reporting, and testing plan is presented in Attachment O. In this section, applicability or non-applicability of the following regulatory programs is addressed:

- Prevention of Significant Deterioration (PSD) permitting;
- Non-Attainment New Source Review (NNSR) permitting;
- Title V of the 1990 Clean Air Act Amendments;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP); and
- West Virginia State Implementation Plan (SIP) regulations.

This review is presented to supplement and/or add clarification to the information provided in the WVDEP R13 permit application forms, which fulfill the requirement to include citations and descriptions of applicable statutory and administrative code requirements.

In addition to providing a summary of applicable requirements, this section of the application also provides non-applicability determinations for certain regulations, allowing the WVDEP to confirm that identified regulations are not applicable to the station. Note that explanations of non-applicability are limited to those regulations for which there may be some question of applicability specific to the operations at the station. Regulations that are categorically non-applicable are not discussed (e.g., NSPS Subpart J, Standards of Performance for Petroleum Refineries).

Prevention of Significant Deterioration Source Classification

Federal construction permitting programs regulate new and modified sources of attainment pollutants under PSD and new and modified sources of non-attainment pollutants under NNSR. PSD regulations apply when a new source is constructed in which emissions exceed PSD major source thresholds, an existing minor source undergoes a modification in which emission increases exceed PSD major source thresholds, or an existing major source undergoes a modification in which emission increases exceed PSD significant emission rates. The Harris Station will be a minor source with respect to PSD, as shown in Attachment N. As such, PSD permitting is not triggered.

NNSR regulations apply only in areas designated as non-attainment. The Harris Station will be located in Braxton County, which is designated as attainment/unclassifiable for all criteria pollutants.[1] Therefore, NNSR regulations do not apply to the Harris Station.

Title V Operating Permit Program

Title 40 of the Code of Federal Regulations, Chapter 70 (40 CFR 70) establishes the Federal Title V operating permit program. West Virginia has incorporated the provisions of this Federal program in its Title V operating permit program in West Virginia 45CSR30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAP and 100 tpy of all other regulated pollutants.[2] The potential emissions of all regulated pollutants are below

[1] U.S. EPA Greenbook, http://www.epa.gov/airquality/greenbook/anayo_wv.html, as of January 30, 2015.
[2] On June 23, 2014, the U.S Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA* effectively changed the permitting procedures for GHGs under the PSD and Title V programs.

the corresponding thresholds for the proposed project. Therefore, the Harris Station is not a major source for Title V purposes.

New Source Performance Standards

NSPS, located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the facility.

NSPS Subpart Dc - Steam Generating Units

Subpart Dc, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, applies to all steam generating units with a heat input greater than or equal to 10 MMBtu/hr and less than 100 MMBtu/hr. No units at the proposed facility meet the definition of a steam generating unit and have a heat input greater than 10 MMBtu/hr; therefore, the requirements of this subpart will not apply.

NSPS Subpart GG - Stationary Gas Turbines

Subpart GG, Standards of Performance for Stationary Gas Turbines, applies to all gas turbines with a heat input at peak load greater than or equal to 10 MMBtu/hr based on the lower heating value of the fuel fired. This standard was promulgated in 1979. The applicability of Subpart KKKK, promulgated in 2006, is similar to that of Subpart GG and applies to stationary combustion turbines that commence construction after February 18, 2005. Turbines subject to Subpart KKKK are specifically exempt from the requirements of Subpart GG per 40 CFR § 60.4305(b). As such, this subpart does not apply to the proposed Solar turbines at the Harris Compressor station as they are subject to the requirements of Subpart KKKK as discussed in the following section. The proposed microturbines have a heat input below 10 MMBtu/hr and are not subject to the requirements of Subpart GG.

NSPS Subparts K, Ka, and Kb - Storage Vessels for Petroleum Liquids/Volatile Organic Liquids

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. Subpart K applies to storage tanks constructed, reconstructed, or modified prior to 1978, and Subpart Ka to those constructed, reconstructed, or modified prior to 1984. All storage tanks located at the Harris Compressor Station will be constructed after these dates; therefore, the requirements of Subparts K and Ka do not apply. Subpart Kb applies to volatile organic liquid (VOL) storage tanks constructed, reconstructed, or modified after July 23, 1984 with a capacity equal to or greater than 75 m^3 (~19,813 gallons). All storage tanks at the Harris Compressor Station will be constructed after this date, but will not have a capacity greater than 75 m^3. Therefore, Subpart Kb does not apply to the storage tanks at the Harris Compressor Station.

NSPS Subpart IIII - Compression Ignition Internal Combustion Engines

Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of compression ignition (CI) engines. There will be no CI engines installed at the Harris Compressor Station. Therefore, this subpart is not applicable to the station

NSPS Subpart JJJJ - Stationary Spark Ignition Internal Combustion Engines

Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of stationary spark (SI) engines. There will be no SI engines installed at the Harris Compressor Station. Therefore, this subpart is not applicable to the station.

NSPS Subpart KKKK - Stationary Combustion Turbines

Subpart KKKK, Standards of Performance for Stationary Combustion Turbines, applies to stationary combustion units with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the higher heating value of the fuel, commencing construction after February 18, 2005. The microturbines at the Harris Compressor station will each have a heat input less than 10 MMbtu/hr. Therefore, they are not subject to this standard.

The proposed Solar turbines for the Harris Compressor Station will be subject to the NO_X emissions limitations in §60.4320(a). Turbines with a rated capacity of 50 < MMBtu/hr ≤ 850 MMBtu/hr at peak load are limited to NO_X emissions of 25 ppm at 15% O_2 when firing natural gas. The Solar turbines that will be installed at the station are equipped with lean pre-mix combustion technology and are guaranteed by the manufacturer to emit a maximum of 15 ppm of NO_X at 15% O_2 under variable turbine load conditions when firing natural gas. This vendor guarantee is well below the NSPS KKKK standard.

Mountain Valley Pipeline (MVP) will perform annual performance tests in accordance with §60.4340(a) and §60.4400 to demonstrate compliance with the NO_X emission limitations, or as an alternative, will continuously monitor the appropriate parameters to determine whether the turbine is operating in low-NO_X mode in accordance with §60.4340(b)(2)(ii) and §60.4355(a). The Solar turbines must also comply with the SO_2 emission limits in §60.4330. MVP will comply with the SO_2 requirements by the exclusive use of natural gas which contains total potential sulfur emissions less than 0.060 lb SO_2/MMBtu heat input in accordance with §60.4330(a)(2).

NSPS Subpart OOOO - Natural Gas Production, Transmission, and Storage

Subpart OOOO, Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011. This NSPS was published in the Federal Register on August 16, 2012, and subsequently amended. The list of potentially affected facilities includes:

- Gas wellheads ;
- Centrifugal compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Reciprocating compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Continuous bleed natural gas-driven pneumatic controllers with a bleed rate of > 6 scfh located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment (excluding natural gas processing plants);
- Continuous bleed natural gas-driven pneumatic controllers located at natural gas processing plants;
- Storage vessels in the production, processing, or transmission and storage segments; and
- Sweetening units located onshore that process natural gas produced from either onshore or offshore wells.

Since the proposed Harris Compressor Station will be a transmission facility located after the point of custody transfer, the only potentially applicable requirements for the proposed equipment are those for new storage vessels where construction commenced after August 23, 2011.

The standards applicable to storage vessels are detailed in 40 CFR §60.5395. The only tank that falls under the Subpart's definition of a 'storage vessel' is the produced fluid storage tank, however, this tank will have potential VOC emissions below 6 tpy. As such, per 60.5365(e), the tank is not a storage vessel affected facility under the rule.

It is important to note that updates to NSPS OOOO have been proposed. However, as the changes are not finalized, applicability will be reviewed once the rules have been finalized.

National Emission Standards for Hazardous Air Pollutants

Regulatory requirements for facilities subject to NESHAP standards, otherwise known as Maximum Available Control Technology (MACT) Standards for source categories, are contained in 40 CFR Part 63. 40 CFR Part 61 NESHAP standards are defined for specific pollutants while Part 63 NESHAPs are defined for source categories where allowable emission limits are established on the basis of a MACT determination for a particular major source. A major source of HAP is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. Part 63 NESHAPs apply to sources in specifically regulated industrial source categories (CAA Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type.

Potential HAP emissions from the proposed Harris Compressor Station will be below the major source thresholds (i.e., less than 10 tpy of individual HAP and 25 tpy of total HAP) and therefore the facility will be an area source of HAP. The potential applicability of specific MACT standards to the Harris Compressor Station is discussed below.

NESHAP Subpart HH - Natural Gas Production Facilities

This standard applies to sources at natural gas production facilities that are major or area sources of HAP emissions. The proposed Harris Station is a transmission facility; therefore, this facility will not be subject to Subpart HH.

NESHAP Subpart HHH - Natural Gas Transmission and Storage Facilities

This standard applies to sources at natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and/or treatment in the production sector), but upstream of the distribution sector. The proposed Harris Compressor Station is a transmission facility and is an area source of HAP emissions. Therefore, this facility will not be subject to Subpart HHH.

NESHAP Subpart YYYY - Stationary Combustion Turbines.

Stationary combustion turbines located at facilities that are major sources of HAPs are potentially subject to Subpart YYYY, NESHAP for Stationary Combustion Turbines. Subpart YYYY establishes emissions and operating limitations for lean premix gas-fired, lean premix oil-fired, diffusion flame gas-fired and diffusion flame oil-fired stationary combustion turbines. The proposed Harris Station is an area source of HAP and therefore is not subject to the requirements of this subpart.

NESHAP Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines

Stationary reciprocating internal combustion engines (RICE) at both area and major sources of HAP emissions are potentially subject to Subpart ZZZZ – *NESHAP for Stationary Reciprocating Internal Combustion Engines (RICE).* There are no proposed RICE at the Harris Compressor Station. Therefore, the station is not subject to this subpart.

NESHAP Subpart DDDDD - Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types at major sources of HAP. The proposed facility is an area source of HAP; therefore, the requirements of this subpart will not apply.

NESHAP Subpart JJJJJJ - Industrial, Commercial, and Institutional Boilers (Area Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types. The proposed fuel heaters are natural gas-fired and are specifically exempt from this subpart. Therefore, the requirements of this subpart will not apply.

West Virginia SIP Regulations

The station is potentially subject to regulations contained in the West Virginia Code of State Regulations, Title 45. The Code of State Regulations fall under two main categories: those regulations that are generally applicable (e.g., permitting requirements), and those that have specific applicability (e.g., PM standards for manufacturing equipment).

45 CSR 2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The proposed interconnect pipeline heater, fuel heaters and office building heater are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from this unit shall not exceed 10 percent.

45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

The station is generally subject to this requirement. MVP will operate all equipment in a manner as to avoid causing or contributing to an objectionable odor at any location occupied by the public.

45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall be considered incineration." The facility will not operate any incinerators under this definition and, as such, has no requirements under this rule.

45 CSR 10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides

This rule applies to specific emission sources that are listed by name in the rule, to sulfuric acid manufacturing plants, and to sources that combust any refinery process gas stream or any other process gas stream that

contains hydrogen sulfide in a concentration greater than 50 grains per 100 cubic feet. The Harris Station does not meet any of the categories subject to the rule, and as such is not subject to comply.

45 CSR 13: Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, Permission to Commence Construction, and Procedures for Evaluation

This rule establishes procedures for permitting and reporting of stationary sources. MVP will comply with the requirements of this rule by complying with the applicable general provisions in the facility's construction and operating permits.

45 CSR 16: Standards of Performance for New Stationary Sources

45 CSR 16-1 incorporates the federal Clean Air Act (CAA) standards of performance for new stationary sources set forth in 40 CPR Part 60 by reference. As noted above, the facility will comply with all applicable NSPS subparts.

45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

No person shall cause, suffer, allow or permit fugitive particulate matter to be discharged beyond the boundary lines of the property lines of the property on which the discharge originates or at any public or residential location, which causes or contributes to statutory air pollution.

Due to the nature of the activities at the station, it is unlikely that fugitive particulate matter emissions will be emitted under normal operating conditions. However, MVP will take measures to ensure any fugitive particulate matter emissions will not cross the property boundary should any such emissions occur.

45 CSR 21: To Prevent and Control Air Pollution from the Emission of Volatile Organic Compounds

45 CSR 21 applies only to sources located in Putnam County, Kanawha County, Cabell County, Wayne County, and Wood County, West Virginia. The Harris Station will be located in Braxton County. Therefore, the requirements of this section to not apply to the station.

45 CSR 22: Air Quality Management Fee Program

This regulation establishes a program to collect fees for certificates to operate and for permits to construct, modify or relocate sources of air pollution. MVP will comply with this rule by paying all required permitting fees.

45 CSR 34: Emissions Standards for Hazardous Air Pollutants

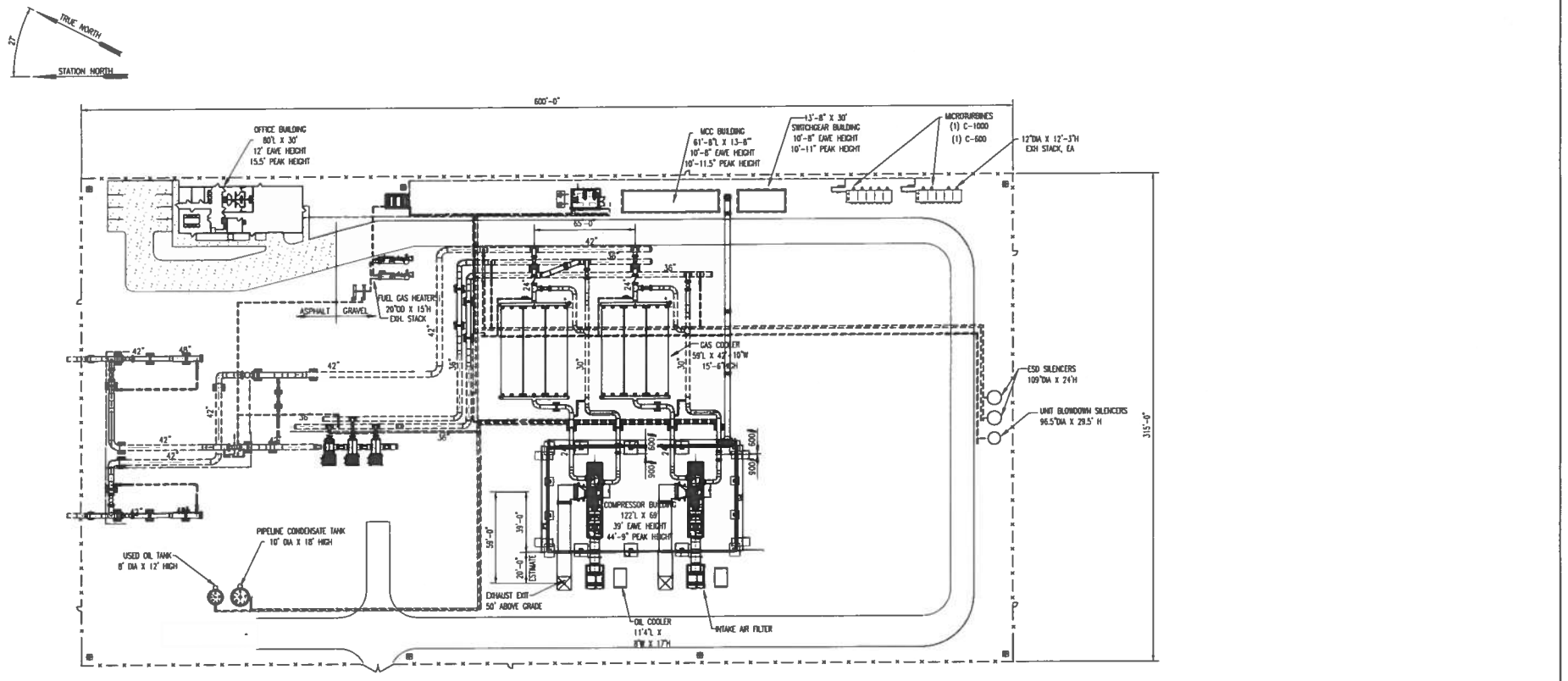
45 CSR 34-1 incorporates the federal Clean Air Act (CAA) national emissions standards for hazardous air pollutants (NESHAPs) as set forth in 40 CPR Parts 61 and 63 by reference. As noted above, no NESHAP are applicable to the station.

Non-Applicability of Other SIP Rules

A thorough examination of the West Virginia SIP rules with respect to applicability at the station reveals many SIP regulations that do not apply or impose additional requirements on operations. Such SIP rules include those specific to a particular type of industrial operation that is categorically not applicable to the station.

ATTACHMENT E

Plot Plan



REFERENCE DRAWINGS		NO	DATE	REVISION	BY	CHK	APPD	NO	DATE	REVISION	BY	CHK	APPD
DRAWING NUMBER	DRAWING TITLE	P	06/18/2015	ISSUED FOR BUDGETARY #01	CET	WJJ	RLM	-					

TO THE BEST OF MY KNOWLEDGE, ALL COMPONENTS OF THIS DRAWING ARE DESIGNED IN ACCORDANCE WITH APPLICABLE GUIDELINES AND SPECIFICATIONS

BYRON MOORE — MECHANICAL DESIGN ENGINEER — DATE

JOE HAUGHT — ELECTRICAL DESIGN ENGINEER — DATE

NOTE ANY CHANGES TO THE DESIGN SHOWN ON THIS DRAWING MUST BE APPROVED BY THE DESIGN ENGINEER

Mountain Valley Pipeline, LLC

PROJECT ID

DRAWING SCALE: 1"=30'

DRAWING TITLE:
MOUNTAIN VALLEY PIPELINE
HARRIS COMPRESSOR STATION
PIPING
PLOT PLAN

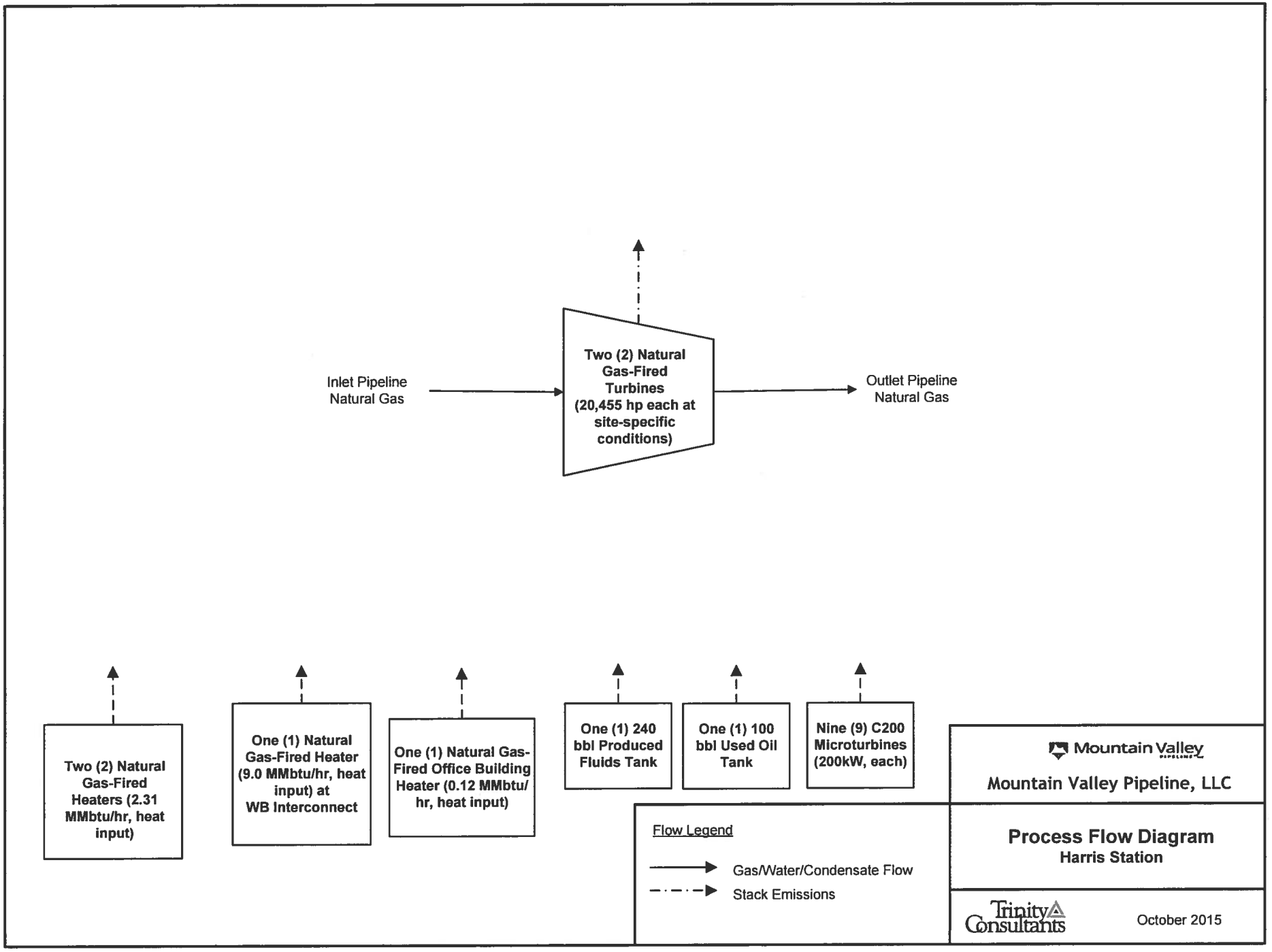
FACILITY	STATE	IDENTIFICATION	SERIES	SHEET	REVISION
C	W	HAR01	1100	01	P

Plotted by: Thompson, Carl on: July 9, 2015 - 4:14 PM

File Path: C:\Vault Working\3DMVP\Harris Compressor Station\Drawing Files\Design Files\Mechanical\2Model\C-W-HAR01-1100-01.dwg

ATTACHMENT F

Detailed Process Flow Diagram


Inlet Pipeline Natural Gas
Two (2) Natural Gas-Fired Turbines (20,455 hp each at site-specific conditions)
Outlet Pipeline Natural Gas
Two (2) Natural Gas-Fired Heaters (2.31 MMbtu/hr, heat input)
One (1) Natural Gas-Fired Heater (9.0 MMbtu/hr, heat input) at WB Interconnect
One (1) Natural Gas-Fired Office Building Heater (0.12 MMbtu/hr, heat input)
One (1) 240 bbl Produced Fluids Tank
One (1) 100 bbl Used Oil Tank
Nine (9) C200 Microturbines (200kW, each)
Flow Legend
Gas/Water/Condensate Flow
Stack Emissions
Mountain Valley
Mountain Valley Pipeline, LLC
Process Flow Diagram
Harris Station
Trinity Consultants
October 2015

ATTACHMENT G

Process Description

ATTACHMENT G - PROCESS DESCRIPTION

Mountain Valley Pipeline, LLC (MVP) is submitting this application for the construction of a new natural gas transmission compressor station located in Braxton County, West Virginia (Harris Compressor Station).

Natural gas enters the station via the transmission pipeline system and is compressed using one of the two (2) natural gas-fired turbines (each rated at 20,455 hp at site-specific conditions, and ISO rated at 20,500 hp each). The compressed natural gas flows into the pipeline to be transported further along the transmission system. The station is also equipped with two (2) fuel gas heaters, one (1) pipeline heater located at a nearby interconnect, one (1) office building heater, one (1) produced fluids storage tank, one (1) used oil storage tank, and nine (9) natural gas-fired microturbine generators (each rated at 200 kW) providing electricity to the station. Once the tanks are filled, the contents are loaded into trucks for transport.

A process flow diagram is included as Attachment F.

ATTACHMENT I

Emission Units Table

Attachment I

Emission Units Table

(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device[4]
S001	E001	Solar Turbine #1	2016/2017	20,455 HP (site-specific conditions)	New	N/A
S002	E002	Solar Turbine #2	2016/2017	20,455 HP (site-specific conditions)	New	N/A
S003	E003	Microturbine Generator #1	2016/2017	200 KW	New	N/A
S004	E004	Microturbine Generator #2	2016/2017	200 KW	New	N/A
S005	E005	Microturbine Generator #3	2016/2017	200 KW	New	N/A
S006	E006	Microturbine Generator #4	2016/2017	200 KW	New	N/A
S007	E007	Microturbine Generator #5	2016/2017	200 KW	New	N/A
S008	E008	Microturbine Generator #6	2016/2017	200 KW	New	N/A
S009	E009	Microturbine Generator #7	2016/2017	200 KW	New	N/A
S010	E010	Microturbine Generator #8	2016/2017	200 KW	New	N/A
S011	E011	Microturbine Generator #9	2016/2017	200 KW	New	N/A
S012	E012	Fuel Gas Heater	2016/2017	2.31 MMBtu/hr	New	N/A
S013	E013	Fuel Gas Heater	2016/2017	2.31 MMBtu/hr	New	N/A
S014	E014	Office Building Heater	2016/2017	0.12 MMBtu/hr	New	N/A
S015	E015	WB Pipeline Heater (at interconnect)	2016/2017	9.0 MMBtu/hr	New	N/A
S016	E016	Produced Fluids Tank	2016/2017	10,080 gallons	New	N/A
S017	E017	Used Oil Tank	2016/2017	4,200 gallons	New	N/A
S018	E018	Fugitives	2016/2017	N/A	New	N/A
S019	E019	Liquid Loading	2016/2017	126,000 gal/yr	New	N/A

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

ATTACHMENT J

Emission Points Data Summary Sheet

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 1: Emissions Data

Emission Point ID No. *(Must match Emission Units Table & Plot Plan)*	Emission Point Type[1]	Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)*		Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)*		Vent Time for Emission Unit *(chemical processes only)*		All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions [4]		Maximum Potential Controlled Emissions [5]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used [6]	Emission Concentration [7] (ppmv or mg/m[4])
		ID No.	Source	ID No.	Device Type	Short Term[2]	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
S001	Upward Vertical stack	E001	Solar Turbine	NA	NA	NA	NA	NOx	8.90	39.01	8.90	39.01	Gas/Vapor	O[A]	
								CO	9.03	41.86	9.03	41.86		O[A]	
								VOC	1.03	4.56	1.03	4.56		O[A]	
								SO2	0.53	2.30	0.53	2.30		O[A]	
								PM/PM10/PM2.5	2.32	10.17	2.32	10.17		O[A]	
								HAPs	0.49	2.17	0.49	2.17		O[A,B]	
								CO2e	18,363	80,555	18,363	80,555		O[A,C]	
S002	Upward Vertical stack	E002	Solar Turbine	NA	NA	NA	NA	NOx	8.90	39.01	8.90	39.01	Gas/Vapor	O[A]	
								CO	9.03	41.86	9.03	41.86		O[A]	
								VOC	1.03	4.56	1.03	4.56		O[A]	
								SO2	0.53	2.30	0.53	2.30		O[A]	
								PM/PM10/PM2.5	2.32	10.17	2.32	10.17		O[A]	
								HAPs	0.49	2.17	0.49	2.17		O[A,B]	
								CO2e	18,363	80,555	18,363	80,555		O[A,C]	
S003	Upward Vertical Stack	E003	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S004	Upward Vertical Stack	E004	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S005	Upward Vertical Stack	E005	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	

S006	Upward Vertical Stack	E006	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S007	Upward Vertical Stack	E007	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S008	Upward Vertical Stack	E008	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S009	Upward Vertical Stack	E009	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S010	Upward Vertical Stack	E010	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S011	Upward Vertical Stack	E011	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S012	Upward Vertical stack	E012	Fuel Gas Heater	NA	NA	NA	NA	NOx	0.21	0.93	0.21	0.93	Gas/Vapor	O[F]	
								CO	0.18	0.78	0.18	0.78		O[F]	
								VOC	0.01	0.05	0.01	0.05		O[F]	
								SO2	<0.01	0.01	<0.01	0.01		O[F]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[F]	
								CO2e	270	1,184	270	1,184		O[C]	
S013	Upward Vertical stack	E013	Fuel Gas Heater	NA	NA	NA	NA	NOx	0.21	0.93	0.21	0.93	Gas/Vapor	O[F]	
								CO	0.18	0.78	0.18	0.78		O[F]	
								VOC	0.01	0.05	0.01	0.05		O[F]	
								SO2	<0.01	0.01	<0.01	0.01		O[F]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[F]	
								CO2e	270	1,184	270	1,184		O[C]	

S014	Upward Vertical stack	E014	Office Building Heater	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.01 0.01 <0.01 <0.01 <0.01 14	0.05 0.04 <0.01 <0.01 <0.01 62	0.01 0.01 <0.01 <0.01 <0.01 14	0.05 0.04 <0.01 <0.01 <0.01 62	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S015	Upward Vertical stack	E015	WB Pipeline Heater (at interconnect)	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.83 0.70 0.05 <0.01 0.06 1,054	3.64 3.06 0.20 0.02 0.28 4,617	0.83 0.70 0.05 <0.01 0.06 1,054	3.64 3.06 0.20 0.02 0.28 4,617	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S016	Upward Vertical Stack	E016	Produced Fluids Storage Tank	NA	NA	NA	NA	VOC HAP	0.05 0.00	0.21 0.00	0.05 0.00	0.21 0.00	Gas/Vapor	O[E]	
S017	Upward Vertical Stack	E017	Used Oil Storage Tank	NA	NA	NA	NA	VOC HAP	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	Gas/Vapor	O[E]	
S018	Fugitives	E018	Fugitives including Haul Roads	NA	NA	NA	NA	VOC PM/PM10/PM2.5 HAP CO2e	0.80 0.01 0.03 504	3.52 0.04 0.13 2,207	0.80 0.01 0.03 504	3.52 0.04 0.13 2,207	Gas/Vapor	O[G] O[H] O[G] O[C]	
S019	Liquid Loading	E019	Liquid Loading	NA	NA	NA	NA	VOC	NA	0.05	NA	0.05	Gas/Vapor	O[I]	

A- Manufacturer's specific pollutant emission factor
B- AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000, except for Formaldehyde which is manufacturer's spec.
C- 40 CFR 98, Subpart C for natural gas fired combustion.
D- AP-42 Section 3.1 Table 3.1-2a
E- API E&P Tanks/EPA TANKS 9.0d
F- AP-42 Section 1.4 Tables 1.4-1, 1.4-2 and 1.4-3, July 1998.
G- EPA Leak Protocol, Table 2-4, 40 CFR 98 Subpart W & Site-Specific Gas Analysis
H- AP-42 Table 13.2.2-2 (Final, 11/06)
I- AP-42 Section 5.2 Table 5.2-1

The EMISSION POINTS DATA SUMMARY SHEET provides a summation of emissions by emission unit. Note that uncaptured process emission unit emissions are not typically considered to be fugitive and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET. Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions). Please complete the FUGITIVE EMISSIONS DATA SUMMARY SHEET for fugitive emission activities.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] Indicate by "C" if venting is continuous. Otherwise, specify the average short-term venting rate with units, for intermittent venting (ie., 15 min/hr). Indicate as many rates as needed to clarify frequency of venting (e.g., 5 min/day, 2 days/wk).

[3] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases.

[4] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

6 Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

7 Provide for all pollutant emissions. Typically, the units of parts per million by volume (ppmv) are used. If the emission is a mineral acid (sulfuric, nitric, hydrochloric or phosphoric) use units of milligram per dry cubic meter (mg/m^3) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO_2, use units of ppmv (See 45CSR10).

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 2: Release Parameter Data								
Emission Point ID No. *(Must match Emission Units Table)*	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (°F)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2] *(Release height of emissions above ground level)*	Northing	Easting

[1] Give at operating conditions. Include inerts.
[2] Release height of emissions above ground level.

ATTACHMENT K

Fugitive Emissions Data Summary Sheet

Attachment K

FUGITIVE EMISSIONS DATA SUMMARY SHEET

The FUGITIVE EMISSIONS SUMMARY SHEET provides a summation of fugitive emissions. Fugitive emissions are those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Note that uncaptured process emissions are not typically considered to be fugitive, and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET.

Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions).

APPLICATION FORMS CHECKLIST - FUGITIVE EMISSIONS
1.) Will there be haul road activities? ☒ Yes ☐ No ☐ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☒ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☒ Yes ☐ No ☐ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☒ Yes ☐ No ☐ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered "NO" to all of the items above, it is not necessary to complete the following table, "Fugitive Emissions Summary."

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads	NA	--	--	--	--	--
Unpaved Haul Roads	PM PM_{10} $PM_{2.5}$	0.04 0.01 <0.01	0.15 0.04 <0.01	0.04 0.01 <0.01	0.15 0.04 <0.01	O[C]
Storage Pile Emissions	NA	---	---	---	---	---
Loading/Unloading Operations	VOC	N/A	0.05	N/A	0.05	O[B]
Wastewater Treatment Evaporation & Operations	NA	---	---	---	---	---
Equipment Leaks (includes blowdowns and maintenance)	VOC HAP	N/A	3.52 0.26	N/A	3.52 0.26	O[A]
General Clean-up VOC Emissions	NA	---	---	---	---	---
Other	NA	---	---	---	---	---

A – Oil *and Gas Production Operations Average Emission Factors*, Protocol for Equipment Leak Emission Estimates, EPA 453/R-95-017, Table 2-4, November 1995, 40 CFR 98 Subpart W, and mass balance.

B- AP 42 Section 5.2.1

C – AP 42 Section 13.2.2.

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. DO NOT LIST H_2, H_2O, N_2, O_2, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

ATTACHMENT L

Emission Unit Data Sheet

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S001 to S002

1. Name or type and model of proposed affected source: Two (2) Natural Gas-Fired Solar Titan 130 Turbines– Each rated at 20,455 HP at site-specific conditions. ISO rating is 20,500 HP (each)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. The turbines compress natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 151,731 scf/hr (each)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Two (2) 148.59 MMBtu/hr stationary gas turbines

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 148.59 (each) × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
Monitor sulfur content of the fuel per 60.4360	Maintain records of fuel consumption (scf/yr)
REPORTING	TESTING
Submit report of initial compliance testing in accordance with 40 CFR 60.4375(b) within 60 days of the performance test	Annual performance testing in accordance with 40 CFR 60.4340(a) to demonstrate compliance with NOx emission limitations

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S003 to S011

1. Name or type and model of proposed affected source: Natural Gas-fired combustion Capstone Microturbines (each rated at 200kW) – Consist of nine (9) identical units
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Electrical generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 2,106 scf/hr (each)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Nine (9) 2.28 MMBtu/hr stationary gas turbines

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.28 (each) × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N.**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S012 to S013

1. Name or type and model of proposed affected source: Two (2) Natural gas-fired fuel gas heaters (2.31 MMBtu/hr, heat input each)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Thermal generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 2,100 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Two (2) 2.31 MMBtu/hr, natural gas fired external combustion heaters

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.31 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S014

1. Name or type and model of proposed affected source: Natural gas-fired office building heater (0.12 MMBtu/hr, heat input)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Thermal generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 110 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

One (1) 0.12 MMBtu/hr, natural gas fired external combustion heater

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 0.12 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S015

1. Name or type and model of proposed affected source: Natural gas-fired pipeline heater (9.0 MMBtu/hr, heat input) at WB Interconnect
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Thermal generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 8,300 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

One (1) 9.0 MMBtu/hr, natural gas fired external combustion heater

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 9.0 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT www.epa.gov/tnn/tanks.html), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (http://www.epa.gov/tnn/chief/).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Harris Compressor Station	2. Tank Name Produced Fluids Storage Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) S016	4. Emission Point Identification No. (as assigned on *Equipment List Form*) E016
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. S016: 240 bbl	
9A. Tank Internal Diameter (ft) ~10	9B. Tank Internal Height (or Length) (ft) ~18
10A. Maximum Liquid Height (ft) ~17	10B. Average Liquid Height (ft) ~ 10
11A. Maximum Vapor Space Height (ft) ~18	11B. Average Vapor Space Height (ft) ~5
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 240 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
126,000	345

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 12.5

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):
- ☒ Fixed Roof _x_ vertical __ horizontal ___ flat roof _x_ cone roof ___ dome roof ___ other (describe)
- ☐ External Floating Roof ___ pontoon roof ___ double deck roof
- ☐ Domed External (or Covered) Floating Roof
- ☐ Internal Floating Roof ___ vertical column support ___ self-supporting
- ☐ Variable Vapor Space ___ lifter roof ___ diaphragm
- ☐ Pressurized ___ spherical ___ cylindrical
- ☐ Underground
- ☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color Gray	20B. Roof Color Gray	20C. Year Last Painted

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): -0.30 to 0.70 psig

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft) 0.0625

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one)
☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal
☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:		
ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:
LADDER WELL		
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:	
GAUGE-HATCH/SAMPLE PORT		
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:	
ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)
VACUUM BREAKER		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
RIM VENT		
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
DECK DRAIN (3-INCH DIAMETER)		
OPEN:	90% CLOSED:	
STUB DRAIN		
1-INCH DIAMETER:		
OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)		

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F) 54.98	
29. Annual Average Maximum Temperature (°F) 65.75	
30. Annual Average Minimum Temperature (°F) 44.22	
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,251
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: 56.74	
34A. Minimum (°F)	34B. Maximum (°F) 61.79
35. Average operating pressure range of tank:	
35A. Minimum (psig)	35B. Maximum (psig)
36A. Minimum Liquid Surface Temperature (°F)	36B. Corresponding Vapor Pressure (psia)
37A. Average Liquid Surface Temperature (°F) 56.74	37B. Corresponding Vapor Pressure (psia)
38A. Maximum Liquid Surface Temperature (°F) 61.79	38B. Corresponding Vapor Pressure (psia)

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.

39A. Material Name or Composition	Produced Fluids		
39B. CAS Number	TBD		
39C. Liquid Density (lb/gal)	TBD		
39D. Liquid Molecular Weight (lb/lb-mole)	TBD		
39E. Vapor Molecular Weight (lb/lb-mole)	36.25		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	TBD TBD		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☒ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☒ Conservation Vent (psig) – Enardo Valve
  - Vacuum Setting 0.30 Pressure Setting 0.70
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☐ Other[1] (describe):

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
See attached emission calculations					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT www.epa.gov/tnn/tanks.html), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (http://www.epa.gov/tnn/chief/).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Harris Compressor Station	2. Tank Name Used Oil Storage Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) S017	4. Emission Point Identification No. (as assigned on *Equipment List Form*) E017
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. S017: 100 bbl	
9A. Tank Internal Diameter (ft) ~7.7	9B. Tank Internal Height (or Length) (ft) ~12
10A. Maximum Liquid Height (ft) ~12	10B. Average Liquid Height (ft) ~ 6
11A. Maximum Vapor Space Height (ft) ~12	11B. Average Vapor Space Height (ft) ~6
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 100 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
3,150	8.6

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume)
<1

15. Maximum tank fill rate (gal/min) TBD

16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):
- ☒ Fixed Roof _x_ vertical __ horizontal ___ flat roof _x_ cone roof ___ dome roof
  ___ other (describe)
- ☐ External Floating Roof ___ pontoon roof ___ double deck roof
- ☐ Domed External (or Covered) Floating Roof
- ☐ Internal Floating Roof ___ vertical column support ___ self-supporting
- ☐ Variable Vapor Space ___ lifter roof ___ diaphragm
- ☐ Pressurized ___ spherical ___ cylindrical
- ☐ Underground
- ☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color Gray	20B. Roof Color Gray	20C. Year Last Painted

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): -0.30 to 0.25 psig

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft) 0.0625

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one)
☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal
☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:		
ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:
LADDER WELL		
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:	
GAUGE-HATCH/SAMPLE PORT		
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:	
ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)
VACUUM BREAKER		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
RIM VENT		
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
DECK DRAIN (3-INCH DIAMETER)		
OPEN:	90% CLOSED:	
STUB DRAIN		
1-INCH DIAMETER:		
OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)		

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply			
26A. Deck Type: ☐ Bolted ☐ Welded			
26B. For Bolted decks, provide deck construction:			
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)			
26D. Deck seam length (ft)		26E. Area of deck (ft^2)	
For column supported tanks: 26F. Number of columns:		26G. Diameter of each column:	

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F) 54.98	
29. Annual Average Maximum Temperature (°F) 65.75	
30. Annual Average Minimum Temperature (°F) 44.22	
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,251
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: **See TANKS Summary Sheets**			
34A. Minimum (°F)		34B. Maximum (°F)	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F)		37B. Corresponding Vapor Pressure (psia)	
38A. Maximum Liquid Surface Temperature (°F)		38B. Corresponding Vapor Pressure (psia)	

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Used Oil		
39B. CAS Number			
39C. Liquid Density (lb/gal)			
39D. Liquid Molecular Weight (lb/lb-mole)			
39E. Vapor Molecular Weight (lb/lb-mole)			

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)			
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting — Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☐ Other[1] (describe):

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
See attached emission calculations					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
BULK LIQUID TRANSFER OPERATIONS

Furnish the following information for each new or modified bulk liquid transfer area or loading rack, as shown on the *Equipment List Form* and other parts of this application. This form is to be used for bulk liquid transfer operations such as to and from drums, marine vessels, rail tank cars, and tank trucks.

Identification Number (as assigned on *Equipment List Form*): S019

1. Loading Area Name: Liquid Loading

2. Type of cargo vessels accommodated at this rack or transfer point (check as many as apply):
☐Drums ☐ Marine Vessels ☐Rail Tank Cars ☒Tank Trucks

3. Loading Rack or Transfer Point Data:

Number of pumps	1
Number of liquids loaded	1
Maximum number of marine vessels, tank trucks, tank cars, and/or drums loading at one time	1

4. Does ballasting of marine vessels occur at this loading area?
☐ Yes ☐ No ☒ Does not apply

5. Describe cleaning location, compounds and procedure for cargo vessels using this transfer point:

6. Are cargo vessels pressure tested for leaks at this or any other location?
☐ Yes ☒ No
If YES, describe:

7. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.

hours/day	24	24	24	24
days/week	7	7	7	7
weeks/quarter	13	13	13	13

8. Bulk Liquid Data *(add pages as necessary):*							
Pump ID No.		NA					
Liquid Name		Produced Fluids					
Max. daily throughput (1000 gal/day)							
Max. annual throughput (1000 gal/yr)		126					
Loading Method [1]		Splash Fill					
Max. Fill Rate (gal/min)		TBD					
Average Fill Time (min/loading)		TBD					
Max. Bulk Liquid Temperature (°F)		~70					
True Vapor Pressure [2]		0.21 psia					
Cargo Vessel Condition [3]		Unknown					
Control Equipment or Method [4]		NA					
Minimum control efficiency (%)		0					
Maximum Emission Rate	Loading (lb/hr)	0.01					
	Annual (lb/yr)	106					
Estimation Method [5]		AP-42					

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets*):CA = Carbon Adsorption LOA = Lean Oil AdsorptionCO = Condensation SC = Scrubber (Absorption)CRA = Compressor-Refrigeration-Absorption TO = Thermal Oxidation or Incineration

CRC = Compression-Refrigeration-Condensation VB = Dedicated Vapor Balance (closed system) O = other (descibe)
[5] EPA = EPA Emission Factor as stated in AP-42 MB = Material Balance TM = Test Measurement based upon test data submittal O = other (describe)

9. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**

Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING Liquid throughput (gal/yr)	RECORDKEEPING None
REPORTING None	TESTING None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

Attachment L
FUGITIVE EMISSIONS FROM UNPAVED HAULROADS

UNPAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

		PM	PM-10
k =	Particle size multiplier	0.80	0.36
s =	Silt content of road surface material (%)	4.8	
p =	Number of days per year with precipitation >0.01 in.	150	150

Item Number	Description	Number of Wheels	Mean Vehicle Weight (tons)	Mean Vehicle Speed (mph)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	Service Truck		4	15	0.25	TBD	365	N/A	0
2	Liquid Hauling – Vendor Fluids		16	15	0.25	TBD	2	N/A	0
3	Liquid Hauling – Produced Fluids		26	15	0.25	TBD	32	N/A	0
4	Employee Vehicles		2	15	0.25	TBD	365	N/A	0
5									
6									
7									
8									

Source: *AP-42 Fifth Edition – 13.2.2 Unpaved Roads*

$E = k \times 5.9 \times (s \div 12) \times (S \div 30) \times (W \div 3)^{0.7} \times (w \div 4)^{0.5} \times ((365 - p) \div 365) =$ lb/Vehicle Mile Traveled (VMT)

Where:

		PM	PM-10
k =	Particle size multiplier	4.9	1.5
s =	Silt content of road surface material (%)	4.8	
S =	Mean vehicle speed (mph)		
W =	Mean vehicle weight (tons)		
w =	Mean number of wheels per vehicle		
p =	Number of days per year with precipitation >0.01 in.	150	150

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF UNPAVED HAULROAD EMISSIONS

Item No.	PM				PM-10			
	Uncontrolled		Controlled		Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
1	0.02	0.08			<0.01	0.02		
2	<0.01	<0.01			<0.01	<0.01		
3	<0.01	0.02			<0.01	<0.01		
4	0.01	0.06			<0.01	0.01		
5								
6								
7								
8								
TOTALS	0.04	0.15			0.01	0.04		

FUGITIVE EMISSIONS FROM PAVED HAULROADS

INDUSTRIAL PAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

I =	Industrial augmentation factor (dimensionless)	N/A
n =	Number of traffic lanes	
s =	Surface material silt content (%)	
L =	Surface dust loading (lb/mile)	

Item Number	Description	Mean Vehicle Weight (tons)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	N/A						
2							
3							
4							
5							
6							
7							
8							

Source: *AP-42 Fifth Edition – 11.2.6 Industrial Paved Roads*

$E = 0.077 \times I \times (4 \div n) \times (s \div 10) \times (L \div 1000) \times (W \div 3)^{0.7}$ = lb/Vehicle Mile Traveled (VMT)

Where:

I =	Industrial augmentation factor (dimensionless)	N/A
n =	Number of traffic lanes	
s =	Surface meterial silt content (%)	
L =	Surface dust loading (lb/mile)	
W =	Average vehicle weight (tons)	

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF PAVED HAULROAD EMISSIONS

Item No.	Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY
1	N/A		N/A	
2				
3				
4				
5				
6				
7				
8				
TOTALS				

Attachment L
EMISSIONS UNIT DATA SHEET
CHEMICAL PROCESS

For chemical processes please fill out this sheet and all supplementary forms (see below) that apply. Please check all supplementary forms that have been completed.

- ☐ *Emergency Vent Summary Sheet*
- ☒ *Leak Sources Data Sheet*
- ☐ *Toxicology Data Sheet*
- ☐ *Reactor Data Sheet*
- ☐ *Distillation Column Data Sheet*

1. Chemical process area name and equipment ID number (as shown in *Equipment List Form*)
   Fugitives

2. Standard Industrial Classification Codes (SICs) for process(es)
   4922

3. List raw materials and ☐ attach MSDSs
   NA

4. List Products and Maximum Production and ☐ attach MSDSs

Description and CAS Number	Maximum Hourly (lb/hr)	Maximum Annual (ton/year)
NA		

5. Complete the *Emergency Vent Summary Sheet* for all emergency relief devices.

6. Complete the *Leak Source Data Sheet* and describe below or attach to application the leak detection or maintenance program to minimize fugitive emissions. Include detection instruments, calibration gases or methods, planned inspection frequency, and record-keeping, and similar pertinent information. If subject to a rule requirement (e.g. 40CFR60, Subpart VV), please list those here.
   LDAR program in accordance with 40 CFR 98 Subpart W

7. Clearly describe below or attach to application Accident Procedures to be followed in the event of an accidental spill or release.
   NA

8A. Complete the *Toxicology Data Sheet* or attach to application a toxicology report (an up-to-date material safety data sheets (MSDS) may be used) outlining the currently known acute and chronic health effects of each compound or chemical entity emitted to the air. If these compounds have already been listed in Item 3, then a duplicate MSDS sheet is not required. Include data such as the OSHA time weighted average (TWA) or mutagenicity, teratogenicity, irritation, and other known or suspected effects should be addressed. Indicate where these are unknown, and provide references.

8B. Describe any health effects testing or epidemiological studies on these compounds that are being or may be conducted by the company or required under TSCA, RCRA or other federal regulations. Discuss the persistence in the environment of any emission (e.g. pesticides, etc.).

9. **Waste Products** - Waste products status: (If source is subject to RCRA or 45CSR25, please contact the Hazardous Waste Section of WVDEP, OAQ at (304) 926-3647.) NA

9A. Types and amounts of wastes to be disposed:

9B. Method of disposal and location of waste disposal facilities:

Carrier: Phone:

9C. Check here if approved USEPA/State Hazardous Waste Landfill will be used ☐

10. Maximum and Projected Typical Operating Schedule for process or project as a whole (circle appropriate units).

circle units:	(hrs/day) (hr/batch)	(days), (batches/day), (batches/week)	(days/yr), (weeks/year)
10A. Maximum			
10B. Typical			

11. Complete a *Reactor Data Sheet* for each reactor in this chemical process.

12. Complete a *Distillation Column Data Sheet* for each distillation column in this chemical process.

13. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	**TESTING**
None	None

MONITORING. Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment operation or air pollution control device.

RECORDKEEPING. Please describe the proposed recordkeeping that will accompany the monitoring.

REPORTING. Please describe the proposed frequency of reporting of the recordkeeping.

TESTING. Please describe any proposed emissions testing for this process equipment or air pollution control device.

14. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
NA

LEAK SOURCE DATA SHEET

Source Category	Pollutant	Number of Source Components[1]	Number of Components Monitored by Frequency[2]	Average Time to Repair (days)[3]	Estimated Annual Emission Rate (lb/yr)[4]
Pumps[5]	light liquid VOC[6,7]				
	heavy liquid VOC[8]				
	Non-VOC[9]				
Valves[10]	Gas VOC	210	TBD	TBD	607
	Light Liquid VOC				
	Heavy Liquid VOC				
	Non-VOC				
Safety Relief Valves[11]	Gas VOC				
	Non VOC				
Open-ended Lines[12]	VOC	20	TBD	TBD	26
	Non-VOC				
Sampling Connections[13]	VOC				
	Non-VOC				
Compressors	VOC				
	Non-VOC				
Flanges	VOC	575	TBD	TBD	101
	Non-VOC				
Other	VOC				
	Non-VOC				

[1 - 13] See notes on the following page.

Notes for Leak Source Data Sheet

1. For VOC sources include components on streams and equipment that contain greater than 10% w/w VOC, including feed streams, reaction/separation facilities, and product/by-product delivery lines. Do not include certain leakless equipment as defined below by category.

2. By monitoring frequency, give the number of sources routinely monitored for leaks, using a portable detection device that measures concentration in ppm. Do not include monitoring by visual or soap-bubble leak detection methods. "M/Q(M)/Q/SA/A/O" means the time period between inspections as follows:

   Monthly/Quarterly, with Monthly follow-up of repaired leakers/Quarterly/Semi-annual/Annually/Other (specify time period)

   If source category is not monitored, a single zero in the space will suffice. For example, if 50 gas-service valves are monitored quarterly, with monthly follow-up of those repaired, 75 are monitored semi-annually, and 50 are checked bimonthly (alternate months), with non checked at any other frequency, you would put in the category "valves, gas service:" 0/50/0/75/0/50 (bimonthly).

3. Give the average number of days, after a leak is discovered, that an attempt will be made to repair the leak.

4. Note the method used: MB - material balance; EE - engineering estimate; EPA - emission factors established by EPA (cite document used); O - other method, such as in-house emission factor (specify).

5. Do not include in the equipment count sealless pumps (canned motor or diaphragm) or those with enclosed venting to a control device. (Emissions from vented equipment should be included in the estimates given in the Emission Points Data Sheet.)

6. Volatile organic compounds (VOC) means the term as defined in 40 CFR □51.100 (s).

7. A light liquid is defined as a fluid with vapor pressure equal to or greater than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if 20% w/w or more of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a light liquid.

8. A heavy liquid is defined as a fluid with a vapor pressure less than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if less than 20% w/w of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a heavy liquid.

9. LIST CO, H_2S, mineral acids, NO, NO_2, SO_3, etc. DO NOT LIST CO_2, H_2, H_2O, N_2, O_2, and Noble Gases.

10. Include all process valves whether in-line or on an open-ended line such as sample, drain and purge valves. Do not include safety-relief valves, or leakless valves such as check, diaphragm, and bellows seal valves.

11. Do not include a safety-relief valve if there is a rupture disk in place upstream of the valve, or if the valve vents to a control device.

12 Open-ended lines include purge, drain and vent lines. Do not include sampling connections, or lines sealed by plugs, caps, blinds or second valves.

13. Do not include closed-purge sampling connections.

ATTACHMENT N

Supporting Emission Calculations

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 1. Internal Combustion Turbine Emissions Calculations

Turbine Information:

Source ID:	S001-S002
Manufacturer:	Solar
Model No.:	Titan 130
Year Installed:	TBD
Fuel Used:	Natural Gas
Fuel Heating Value (Btu/scf):	979
Rated Horsepower (bhp at site conditions):	20455
Maximum Fuel Consumption at 100% Load (scf/hr):	151731
Heat Input (MMBtu/hr)	148.59
Control Device:	None

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	1,329.16
Potential Startup/Shutdown Events (per year):	12

Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units	Emission Factor Source
NO_X	8.900	lb/hr	Manufacturer
CO	9.030	lb/hr	Manufacturer
SO_2	3.54E-03	lb/MMBtu	Manufacturer
PM_{10}	0.016	lb/MMBtu	Manufacturer, PIL 171
$PM_{2.5}$	0.016	lb/MMBtu	Manufacturer, PIL 171
VOC	1.034	lb/hr	20% of UHC per Manufacturer
Formaldehyde	0.003	lb/MMBtu	Manufacturer, PIL 168
CO_2	122.82	lb/MMBtu	40 CFR 98, Subpart C, Table C-1
CH_4	4.136	lb/hr	80% of UHC per Manufacturer
N_2O	2.3E-04	lb/MMBtu	40 CFR 98, Subpart C, Table C-2

*Emission factors from AP-42 and Subpart C are based on HHV. To calculate a LHV emission factor, emissions are multiplied by (HHV/LHV). For AP-42 HHV is 1020 Btu/scf, for Subpart C HHV is 1028 Btu/scf. PM and HCHO emission factors are provided in HHV in the specifications and were converted to LHV using a HHV value of 1020 Btu/scf.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 1. Internal Combustion Turbine Emissions Calculations

Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2]
NO_x	8.90	39.01
CO	9.03	41.86
SO_2	0.53	2.30
PM_{10}	2.32	10.17
$PM_{2.5}$	2.32	10.17
VOC	1.03	4.56
Formaldehyde	0.45	1.95
CO_2	18,249	79,946
CH_4	4.14	22.57
N_2O	0.03	0.15
GHG (CO2e)	18,363	80,555

*Annual emissions shown above include startup/shutdown events.

Hazardous Air Pollutant (HAP) Emission Rates:

Pollutant	Emission Factor (lb/MMBtu)[3]	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2,4]
HAPs:			
Acetaldehyde	4.17E-05	6.19E-03	2.71E-02
Acrolein	6.67E-06	9.90E-04	4.34E-03
Benzene	1.25E-05	1.86E-03	8.13E-03
1,3-Butadiene	4.48E-07	6.65E-05	2.91E-04
Propylene Oxide	2.90E-05	4.31E-03	1.89E-02
Ethylbenzene	3.33E-05	4.95E-03	2.17E-02
Toluene	1.35E-04	2.01E-02	8.81E-02
Xylene	6.67E-05	9.90E-03	4.34E-02
Polycyclic Organic Matter:			
Naphthalene	1.35E-06	2.01E-04	8.81E-04
PAH	2.29E-06	3.40E-04	1.49E-03
Total HAP (Including HCHO)		**0.49**	**2.17**

1. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (lb/MMBtu)
2. Emission Rate (tpy) = Emission Rate (lb/hr) × Hours of Operation (hr/yr) / 2000 (tons/lb) + SU/SD emissions, as applicable
3. Emission factors from AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000. Factors are based on HHV. Therefore, they were converted to LHV by multiplying by (HHV/LHV).
4. Emission calculations are based on maximum operating load of 100% load, ambient temperature 0°F and site elevation. The turbine ratings can vary with ambient conditions. Each Turbine is ISO rated at 20,500 HP

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 1. Internal Combustion Turbine Emissions Calculations

Startup/Shutdown Combustion Emission Factors:

Pollutant	Startup Emissions[1] (lbs/event)	Shutdown Emissions[1] (lbs/event)	Emission Factor Source
NO_X	1.9	2.4	Manufacturer
CO	176.9	207.6	Manufacturer
VOC	2.0	2.38	20% of UHC per Manufacturer
CO_2	1161	1272	Manufacturer

1. Each startup and shutdown event is estimated to last approximately 10 minutes, per manufacturer.

Pneumatic Start Venting Emissions		
Natural Gas Purged During Startup	4500	scfm
Duration of Normal Purge	4.0	min
Total Gas Purged (Per Startup)	18000	scf
VOC Purged (Per Startup)	27	lbs/startup
CO_2 Purged (Per Startup)	6	lbs/startup
CH_4 Purged (Per Startup)	742	lbs/startup

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 2. Microturbine Emissions Calculations

Microturbine Unit Information:

Engine ID:	S003-S011
Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	9

Microturbine Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Rated Electrical Power Output (kW):	200	1,800
Rated Electrical Power Output (MW):	0.2	1.8
Rated Horsepower (bhp):	268.2	2,414
Heat Input (MMBtu/hr)	2.28	20.52
Potential Fuel Consumption (MMBtu/yr):	19,973	179,755
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Microturbine Emissions Data:

Pollutant	Emission Factors	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO_x	0.40	lb/MWhe	0.08	0.35	0.72	3.15	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.02	0.09	0.18	0.79	Manufacturer's Specifications
CO	1.10	lb/MWhe	0.22	0.96	1.98	8.67	Manufacturer's Specifications
SO_x	0.0034	lb/MMBtu	0.01	0.03	0.07	0.31	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.02	0.07	0.14	0.59	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.02	0.07	0.14	0.59	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		266	1,166	2,396	10,497	Manufacturer's Specifications / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.00	0.01	0.02	0.09	AP-42, Table 3.1-3 (Apr-2000)

Notes:
1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHC

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO_2	1330	lb/MWhe	266	1,165	2,394	10,486	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.01	0.02	0.05	0.20	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	0.00	0.02	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**266**	**1,166**	**2,396**	**10,497**	
HAPs:							
1,3-Butadiene	4.3E-07	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	0.00	0.01	0.01	0.06	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.002**	**0.010**	**0.021**	**0.09**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 3. Fuel Gas Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S012-S013
Projected Startup Date:	Upon Approval
Number of Units:	2

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	2.31
Potential Fuel Consumption (MMBtu/yr):	20,215
Max. Fuel Consumption (MMscf/hr):	0.0021
Max. Fuel Consumption (MMscf/yr):	18.7
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.21	0.93	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.01	0.05	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.18	0.78	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.01	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		270	1,184	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.02	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 3. Fuel Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	269.99	1,183	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**270**	**1,184**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.02	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.004**	**0.02**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 4. Office Building Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S014
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	0.12
Potential Fuel Consumption (MMBtu/yr):	1,051
Max. Fuel Consumption (MMscf/hr):	0.0001
Max. Fuel Consumption (MMscf/yr):	1.0
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.01	0.05	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.01	0.04	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		14	62	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 4. Office Building Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	14.04	61	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**14**	**62**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.000**	**0.00**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 5. WB Interconnect Line Heater (off station)

Fuel Gas Heater Information:

Source ID:	S015
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	9.00
Potential Fuel Consumption (MMBtu/yr):	78,840
Max. Fuel Consumption (MMscf/hr):	0.0083
Max. Fuel Consumption (MMscf/yr):	72.8
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.83	3.64	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.05	0.20	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.70	3.06	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.02	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.06	0.28	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.06	0.28	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		1,054	4,617	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.02	0.07	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 5. WB Interconnect Line Heater (off station)

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	1052.98	4,612	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.02	0.09	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**1,054**	**4,617**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.01	0.07	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.015**	**0.07**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 6. Storage Tank Emissions Calculations - Produced Fluids Tank

Storage Tank Information:

Source ID:	S016
Tank Capacity (gallons):	10,080
Tank Contents:	Produced Water
Annual Throughput (gallons/year):	126,000
Daily Throughput (bbl/day)	8
Percent Condensate	1%
Condensate Throughput (bbl/day)	0.1
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.05	0.21	0.05	0.21	E&P TANK 2.0
HAPs	0.00	0.00	0.00	0.00	E&P TANK 2.0
GHG (CO2e)	0.48	2.10	0.48	2.10	E&P TANK 2.0

E & P Tanks Emissions Data:

Pollutant	Total Emissions (Working + Breathing + Flashing)			Total Emissions		
	lbs/hr	lbs/yr	tpy	lbs/hr	lbs/yr	tpy
VOC	0.05	429.24	0.21	0.05	429.24	0.21
HAPs	0.00	0.00	0.00	0.00	0.00	0.00
GHG (CO_2e)	0.48	4,161.00	2.10	0.48	4,161.00	2.10

Notes:

1. E & P TANKS software estimates working, breathing, and flashing losses and reports as one total. Emissions are based on a conservative estimate of 99 % water and 1% condensate
2. This tank does contain hydrocarbons that could be flashed off at tank operating conditions

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 7. Storage Tank Emissions Calculations - Used Oil Tank

Storage Tank Information:

Source ID:	S017
Tank Capacity (gallons):	4,200
Tank Contents:	Used Oil
Annual Throughput (gallons/year):	3,150
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
HAPs	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
GHG (CO_2e)	N/A	N/A	N/A	N/A	N/A

Notes:
1. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

EPA TANKS Emissions Data - Glycol Tank:

Pollutant	Working Losses	Breathing Losses	Flashing Losses	Total Emissions		
	lbs/yr	lbs/yr	lbs/yr	lbs/hr	lbs/yr	tpy
VOC	0.05	0.08	N/A	0.00	0.13	0.00
HAPs	0.05	0.08	N/A	0.00	0.13	0.00

Notes:
1. Working and breathing losses estimated using EPA TANKS 4.0.9d software based on Distillate fuel oil No. 2.
2. This tank does not contain hydrocarbons that would be expected to be flashed off at tank operating conditions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 8. Fugitive Emissions Calculations

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor		Average Gas Leak Rate	Max Gas Leak Rate	Potential VOC Emissions	Potential HAP Emissions
		(lb/hr/component)	Factor Source	(lb/hr)	(tpy)	(tpy)	(tpy)
Connectors	355	0.0004	EPA Protocol, Table 2-4	0.16	0.75	0.02	0.00
Flanges	220	0.001	EPA Protocol, Table 2-4	0.19	0.91	0.03	0.00
Open-Ended Lines	20	0.004	EPA Protocol, Table 2-4	0.09	0.42	0.01	0.00
Pump Seals	0	0.005	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Valves	210	0.010	EPA Protocol, Table 2-4	2.08	10.04	0.30	0.02
Other	0	0.019	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Total				**2.52**	**12.13**	**0.37**	**0.03**

Notes:
1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
2. The component count is a preliminary estimate based on the proposed design of the station.
3. Conservatively assumed that maximum leak rate is 10% greater than measured average leak rate for the purposes of establishing PTE.
4. VOC and HAP emissions are based on fractions of these pollutants in the site-specific gas analysis.

Dry Seal Emissions

Number of Compressors	Number of seals Per Compressor	Leak Rate (scf/hr/seal)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
2	2	6	210,240	0.16	0.01	0.03	11.02	275.60
Total				**0.16**	**0.01**	**0.03**	**11.02**	**275.60**

1. Leak rate and seal information from EPA Natural Gas Star Program (http://www.epa.gov/gasstar/documents/ll_wetseals.pdf)
2. Emission calculations for VOC are calculated assuming a desnity of natural gas of 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)
Sample calculation: Volume vented (scf/yr) x density of natural gas (lb/scf) x wt % VOC / 2000 lb/ton
3. GHG emissions calculated in accordance with EquationsW-35 and W-36 in Subpart W of 40 CFR 98.
Sample calculation: Volume vented (scf/yr) x density of GHG (kg/scf) x mol % VOC x 2.2 lb/kg / 2000 lb/ton

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	1.06	0.08
Compressors	320,000	8	2,560,000	1.94	0.14
Total				**3.00**	**0.22**

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	26.79	0.21	670
Compressors	320,000	8	2,560,000	48.99	0.39	1225
Total				**75.8**	**0.60**	**1895**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor		CH_4 Emissions	CO_2 Emissions	CO_2e Emissions
		(scf/hr/component)	Factor Source	(tpy)	(tpy)	(tpy)
Connectors	355	0.003	40 CFR 98, Table W-1A	0.18	0.001	4.46
Flanges	220	0.003	40 CFR 98, Table W-1A	0.11	0.001	2.77
Open-Ended Lines	20	0.061	40 CFR 98, Table W-1A	0.20	0.002	5.11
Pump Seals	0	13.3	40 CFR 98, Table W-1A	0.00	0.000	0.00
Valves	210	0.03	40 CFR 98, Table W-1A	0.95	0.008	23.77
Other	0	0.04	40 CFR 98, Table W-1A	0.00	0.000	0.00
Total				**1.44**	**0.01**	**36.12**

Notes:
1. The component count is a preliminary estimate based on the proposed design of the station.
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis.
3. Emissions are calculated in accordance with Equations W-32a, W-35 and W-36 in Subpart W of 40 CFR 98.
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	0.80	3.52	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.06	0.26	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	504	2,207	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 9. Liquid Loading Emissions Calculations

Liquid Loading Information:

Parameter	Value	Description
S	1.45	saturation factor for splash loading (AP-42 Table 5.2-1]
Collection Efficiency	0.0%	
Control Efficiency	0%	
P	0.21	true vapor pressure of liquid loaded (psia) - assume octane
M	114.23	molecular weight of vapors (lb/lb-mol) - assume octane
T	516.4	temperature of liquids loaded (deg R) - TANKS Data

Description	Loading Losses	Maximum Throughput[2]	VOC Emissions	
	($lb/10^3$ gal)[1]	(gal)	(lb/hr)	(tpy)
Liquids Hauling	0.8	126,000	0.01	0.05

Notes:

1. Uncontrolled Loading Losses: L_L ($lb/10^3$ gal) = 12.46 (SPM)/T
2. Produced fluids throughput.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 10. Haul Road Emission Calculations

Unpaved Road Information:

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM	PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9	1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8 %			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150			AP-42 Figure 13.2.1-2
a	0.7	0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45	0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Service Truck	4	4	4	0.25	365	91	0	0.08	0.02	0.00
Liquids Hauling - Vendor Fluid	12	20	16	0.25	2	1	0	0.00	0.00	0.00
Liquids Hauling - Produced Fluid	20	32	26	0.25	32	8	0	0.02	0.00	0.00
Employee Vehicles	2	2	2	0.25	365	91	0	0.06	0.01	0.00
Total Potential Emissions								**0.15**	**0.04**	**0.00**

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 11. Potential Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																	
	VOC		NO_X		CO		PM_{10}		$PM_{2.5}$		SO_X		HCHO		Total HAPs		GHG (CO_2e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Turbine 1 (S001)	1.03	4.56	8.90	39.01	9.03	41.86	2.32	10.17	2.32	10.17	0.53	2.30	0.45	1.95	0.49	2.17	18,363	80,555
Turbine 2 (S002)	1.03	4.56	8.90	39.01	9.03	41.86	2.32	10.17	2.32	10.17	0.53	2.30	0.45	1.95	0.49	2.17	18,363	80,555
Microturbine 1 (S003)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 2 (S004)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 3 (S005)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 4 (S006)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 5 (S007)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 6 (S008)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 7 (S009)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 8 (S010)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 9 (S011)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Fuel Gas Heater (S012)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Fuel Gas Heater (S013)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Office Building Heater (S014)	0.00	0.00	0.01	0.05	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	62
WB Pipeline Heater (S015)	0.05	0.20	0.83	3.64	0.70	3.06	0.06	0.28	0.06	0.28	0.00	0.02	0.00	0.00	0.02	0.07	1,054	4,617
Produced Fluids Tank (S016)	0.05	0.21	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0	2
Used Oil Tank (S017)	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	--	--
Fugitive Leaks (S018)	0.80	3.52	--	--	--	--	0.01	0.04	0.00	0.00	--	--	--	--	0.06	0.26	504	2,207
Liquid Loading (S019)	0.01	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable
2. VOC emissions for the engines are conservatively estimated as: VOC=NMNEHC+HCHO (Formaldehyde
3. Fugitive emissions include haul road emissions

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 11. Total Potential Emissions from All Sources at the Facility

Pollutants	Estimated Site-Wide Emissions	
	lb/hr	tpy
VOC	3.18	13.99
NO_x	19.79	86.73
CO	21.11	97.06
SO_x	1.13	4.95
PM_{10}	4.88	21.39
$PM_{2.5}$	4.88	21.36
Formaldehyde (HCHO)	0.91	3.97
Total HAPs	1.09	4.79
GHG (CO_2e)	41,235	180,861

Notes:

1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Harris Compressor Station
Project Description: R13 Permit Application

TABLE 12. Site-Specific Gas Analysis

Sample Location: Multiple Locations
HHV (Btu/scf): 1,083

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)
N2	0.4949	0.788
METHANE	90.4241	82.411
CO2	0.2608	0.652
ETHANE	7.6812	13.124
PROPANE	0.6778	1.698
I-BUTANE	0.0754	0.249
N-BUTANE	0.1355	0.447
I-PENTANE	0.054	0.223
N-PENTANE	0.045	0.186
I-H EXAN ES	0.000	0.000
N-HEXANE	0.045	0.222
BENZENE	0.000	0.000
CYCLOHEXANE	0.000	0.000
HEPTANES	0.000	0.000
TOLUENE	0.000	0.000
2,2,4 Trimethylpentane	0.000	0.000
N-OCTANE	0.000	0.000
*E-BENZENE	0.000	0.000
*m,o,&p-XYLENE	0.000	0.000
I-NONANES	0.000	0.000
N-NONANE	0.000	0.000
I-DECANES	0.000	0.000
N-DECANE	0.000	0.000
I-UNDECANES +	0.000	0.000
Totals	99.895	100

*Gas Analysis showed no detectable compounds above hexane +, conservatively assumed all hexane + was n-hexane

TOC (Total)	99.14	98.56
VOC (Total)	1.03	3.03
HAP (Total)	0.05	0.22

****
* Project Setup Information *
****

Project File : \\Pit-dc1\p\Client\EQT Corporation\Corporate\02 Projects\143901.0087 Mountain Valley Project\04 Draft\2015-0312 Harris R13\2015-0312 Harris PF Tank v1.0.ept
Flowsheet Selection : Oil Tank with Separator
Calculation Method : RVP Distillation
Control Efficiency : 0.0%
Known Separator Stream : Low Pressure Oil
Entering Air Composition : No

Filed Name : Harris Produced Fluid Tanks
Well Name : PTE
Date : 2015.03.12

****
* Data Input *
****

Separator Pressure : 414.00[psig]
Separator Temperature : 60.00[F]
Ambient Pressure : 14.70[psia]
Ambient Temperature : 55.00[F]
C10+ SG : 0.8024
C10+ MW : 163.342

-- Low Pressure Oil ----------

No.	Component	mol %
1	H2S	0.0000
2	O2	0.0000
3	CO2	0.0840
4	N2	0.0000
5	C1	9.9570
6	C2	8.1140
7	C3	6.8240
8	i-C4	1.8640
9	n-C4	4.8700
10	i-C5	2.9440
11	n-C5	3.3610
12	C6	2.2410
13	C7	9.7080
14	C8	11.4500
15	C9	8.4380
16	C10+	25.3730
17	Benzene	0.0910
18	Toluene	0.7580
19	E-Benzene	0.1130
20	Xylenes	1.3570
21	n-C6	2.4330
22	224Trimethylp	0.0200

-- Sales Oil ----------
Production Rate : 0.1[bbl/day]
Days of Annual Operation : 365 [days/year]
API Gravity : 59.11
Reid Vapor Pressure : 10.60[psia]

****
* Calculation Results *
****

-- Emission Summary ----------

Item	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
Total HAPs	0.000	0.000	0.000	0.000
Page 1---------- E&P TANK				
Total HC	0.423	0.097	0.423	0.097
VOCs, C2+	0.339	0.077	0.339	0.077
VOCs, C3+	0.213	0.049	0.213	0.049

Uncontrolled Recovery Info.
Vapor 28.1600 x1E-3 [MSCFD]
HC Vapor 28.0700 x1E-3 [MSCFD]
GOR 281.60 [SCF/bbl]

-- Emission Composition ----------

No	Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
1	H2S	0.000	0.000	0.000	0.000
2	O2	0.000	0.000	0.000	0.000
3	CO2	0.002	0.000	0.002	0.000
4	N2	0.000	0.000	0.000	0.000
5	C1	0.084	0.019	0.084	0.019
6	C2	0.125	0.029	0.125	0.029
7	C3	0.109	0.025	0.109	0.025
8	i-C4	0.023	0.005	0.023	0.005
9	n-C4	0.045	0.010	0.045	0.010
10	i-C5	0.014	0.003	0.014	0.003
11	n-C5	0.012	0.003	0.012	0.003
12	C6	0.003	0.001	0.003	0.001
13	C7	0.004	0.001	0.004	0.001
14	C8	0.001	0.000	0.001	0.000
15	C9	0.000	0.000	0.000	0.000
16	C10+	0.000	0.000	0.000	0.000
17	Benzene	0.000	0.000	0.000	0.000
18	Toluene	0.000	0.000	0.000	0.000
19	E-Benzene	0.000	0.000	0.000	0.000
20	Xylenes	0.000	0.000	0.000	0.000
21	n-C6	0.002	0.000	0.002	0.000
22	224Trimethylp	0.000	0.000	0.000	0.000
	Total	0.424	0.097	0.424	0.097

-- Stream Data ----------

No.	Component	MW	LP Oil	Flash Oil	Sale Oil	Flash Gas	W&S Gas	Total Emissions

			mol %	mol %	mol %	mol %	mol %	mol %
1	H2S	34.80	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	O2	32.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	CO2	44.01	0.0840	0.0069	0.0001	0.3251	0.3289	0.3254
4	N2	28.01	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	C1	16.04	9.9570	0.2491	0.0001	40.3145	12.0792	38.6045
6	C2	30.07	8.1140	1.3061	0.2375	29.4027	52.0759	30.7759
7	C3	44.10	6.8240	3.2946	2.8877	17.8607	22.6275	18.1494
8	i-C4	58.12	1.8640	1.5368	1.5034	2.8873	3.1206	2.9014
9	n-C4	58.12	4.8700	4.6049	4.5743	5.6989	6.0623	5.7209
10	i-C5	72.15	2.9440	3.4237	3.4639	1.4439	1.5163	1.4483
11	n-C5	72.15	3.3610	4.0550	4.1140	1.1907	1.2521	1.1944
12	C6	86.16	2.2410	2.8819	2.9372	0.2370	0.2510	0.2378
13	C7	100.20	9.7080	12.7165	12.9774	0.3002	0.3211	0.3015
14	C8	114.23	11.4500	15.0807	15.3960	0.0965	0.1043	0.0969
15	C9	128.28	8.4380	11.1296	11.3633	0.0212	0.0250	0.0215
16	C10+	163.34	25.3730	33.4860	34.1908	0.0030	0.0034	0.0030
17	Benzene	78.11	0.0910	0.1181	0.1204	0.0064	0.0068	0.0064
18	Toluene	92.13	0.7580	0.9963	1.0170	0.0128	0.0138	0.0128
19	E-Benzene	106.17	0.1130	0.1490	0.1521	0.0005	0.0006	0.0005
20	Xylenes	106.17	1.3570	1.7892	1.8267	0.0056	0.0061	0.0056
21	n-C6	86.18	2.4330	3.1494	3.2114	0.1926	0.2046	0.1933
22	224Trimethylp	114.24	0.0200	0.0262	0.0268	0.0005	0.0005	0.0005

MW		95.74	116.43	118.13	31.04	35.93	31.33
Stream Mole Ratio		1.0000	0.7577	0.7421	0.2423	0.0156	0.2579
Heating Value	[BTU/SCF]				1808.07	2072.28	1824.07
Gas Gravity	[Gas/Air]				1.07	1.24	1.08
Bubble Pt. @ 100F	[psia]	406.75	28.61	13.23			
RVP @ 100F	[psia]	101.88	15.92	10.81			

Spec. Gravity @ 100F	0.685	0.715	0.717

TANKS 4.0.9d
Emissions Report - Summary Format
Tank Indentification and Physical Characteristics

Identification		
User Identification:	S017 - MVP	
City:		
State:	West Virginia	
Company:	Mountain Valley Pipeline LLC	
Type of Tank:	Vertical Fixed Roof Tank	
Description:	4,200 gallon Used Oil Tank	
Tank Dimensions		
Shell Height (ft):		12.00
Diameter (ft):		7.70
Liquid Height (ft) :		12.00
Avg. Liquid Height (ft):		12.00
Volume (gallons):		4,200.00
Turnovers:		0.75
Net Throughput(gal/yr):		3,150.00
Is Tank Heated (y/n):	N	
Paint Characteristics		
Shell Color/Shade:	Gray/Light	
Shell Condition	Good	
Roof Color/Shade:	Gray/Light	
Roof Condition:	Good	
Roof Characteristics		
Type:	Dome	
Height (ft)		0.00
Radius (ft) (Dome Roof)		0.00
Breather Vent Settings		
Vacuum Settings (psig):		-0.03
Pressure Settings (psig)		0.03

Meterological Data used in Emissions Calculations: Elkins, West Virginia (Avg Atmospheric Pressure = 13.73 psia)

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

S017 - MVP - Vertical Fixed Roof Tank

Mixture/Component	Month	Daily Liquid Surf Temperature (deg F) Avg	Min	Max	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg	Min	Max	Vapor Mol Weight	Liquid Mass Fract	Vapor Mass Fract	Mol. Weight	Basis for Vapor Pressure Calculations
Distillate fuel oil no. 2	All	55.41	46.54	64.27	51.30	0.0056	0.0040	0.0076	130.0000			188.00	Option 1: VP50 = .0045 VP60 = .0065

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

Emissions Report for: Annual

S017 - MVP - Vertical Fixed Roof Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	0.05	0.08	0.13

MVP Turbine/Compressor Package Performance Evaluation Sheet

Constants		
Elevation (fasl)	1455	
Relative Humidity	80%	
Fuel HHV (BTU/SCF)	1085	
Fuel LHV (BTU/SCF)	979.3	
Emissions Load Range	50-100%	Guaranteed
Turbine ISO Rating (HP)	20,500	T130
Number of Units	2	Station 2

Ambient Temp			50% Load	75% Load	100% Load
0°F	Turbine Performance	Output Shaft Speed (RPM)	6507	7899	8299
		Output Shaft Power (HP)	10227	15341	20455
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	8391	8483	7264
		Unit Fuel Consumption (MMSCF/D)	2.103	3.19	3.641
		Engine Thermal Efficiency (%)	30.3	30	35
		Exhaust Temp (°F)	707	901	902
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.13	7.79	8.9
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.2	7.91	9.03
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	2.98	4.53	5.17

Ambient Temp			50% Load	75% Load	100% Load
20°F	Turbine Performance	Output Shaft Speed (RPM)	7117	7882	8319
		Output Shaft Power (HP)	10067	15101	20135
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	10602	8363	7141
		Unit Fuel Consumption (MMSCF/D)	2.615	3.095	3.523
		Engine Thermal Efficiency (%)	24	30.4	35.6
		Exhaust Temp (°F)	939	920	909
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	6.38	7.55	8.61
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	6.48	7.67	8.73
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.71	4.39	5

Ambient Temp			50% Load	75% Load	100% Load
40°F	Turbine Performance	Output Shaft Speed (RPM)	7064	7844	8333
		Output Shaft Power (HP)	9812	14718	19624
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	10536	8303	7090
		Unit Fuel Consumption (MMSCF/D)	2.532	2.995	3.41
		Engine Thermal Efficiency (%)	24.1	30.6	35.9
		Exhaust Temp (°F)	969	938	923
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	7.29	7.29	8.31
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	7.4	7.4	8.43
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	4.24	4.24	4.83

MVP Turbine/Compressor Package Performance Evaluation Sheet

Ambient Temp			50% Load	75% Load	100% Load
60°F	Turbine Performance	Output Shaft Speed (RPM)	6971	7763	8322
		Output Shaft Power (HP)	9361	14041	18722
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	10670	8359	7176
		Unit Fuel Consumption (MMSCF/D)	2.45	2.875	3.29
		Engine Thermal Efficiency (%)	23.8	30.4	35.4
		Exhaust Temp (°F)	996	960	948
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.93	6.97	7.98
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	6.02	7.07	8.1
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.45	4.05	4.64

Ambient Temp			50% Load	75% Load	100% Load
80°F	Turbine Performance	Output Shaft Speed (RPM)	6835	7611	8202
		Output Shaft Power (HP)	8577	12865	17153
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	11186	8662	7386
		Unit Fuel Consumption (MMSCF/D)	2.35	2.73	3.104
		Engine Thermal Efficiency (%)	22.7	29.4	34.4
		Exhaust Temp (°F)	1025	988	969
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.65	6.56	7.46
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.73	6.66	7.57
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.28	3.81	4.34

Ambient Temp			50% Load	75% Load	100% Load
100°F	Turbine Performance	Output Shaft Speed (RPM)	6664	7404	8012
		Output Shaft Power (HP)	7627	11440	15253
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	11989	9125	7794
		Unit Fuel Consumption (MMSCF/D)	2.24	2.56	2.913
		Engine Thermal Efficiency (%)	21.2	27.9	32.6
		Exhaust Temp (°F)	1055	1025	998
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.29	6.05	6.89
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.37	6.13	6.99
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.08	3.51	4

Particulate Matter Emission Estimates

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

This document summarizes Solar's recommended $PM_{10/2.5}$ emission levels for our combustion turbines. The recommended levels are based on an analysis of emissions tests collected from customer sites.

Particulate Matter Definition

National Ambient Air Quality Standards (NAAQS) for particulate matter were first set in 1971. Total suspended particulate (TSP) was the first indicator used to represent suspended particles in the ambient air. Since July 1, 1987, the Environmental Protection Agency (EPA) has used the indicator PM_{10}, which includes only the particles with aerodynamic diameter smaller than 10 micrometers. PM_{10} (coarse particles) come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads by vehicle traffic.

The EPA added a $PM_{2.5}$ ambient air standard in 1997. $PM_{2.5}$ includes particles with an aerodynamic diameter less than 2.5 micrometers. $PM_{2.5}$ (fine particles) are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds, emitted by combustion activities, are transformed by chemical reactions.

Nearly all particulate matter from gas turbine exhaust is less than one micrometer (micron) in diameter. Thus the emission rates of TSP, PM_{10}, and $PM_{2.5}$ from gas turbines are theoretically equivalent although source testing will show variation due to test method detection levels and processes.

TESTING FOR PARTICULATE MATTER

The turbine combustion process has little effect on the particulate matter generated and measured. The largest contributor to particulate matter emissions for gas and liquid fired combustion turbines is measurement technique and error. Other, minor contributing, sources of particulate matter emissions include carbon, ash, fuel-bound sulfur, artifact sulfate formation, compressor/lubricating oils, and inlet air.

Historical customer particulate matter source test data show that there is significant variability from test to test. The source test results support the common industry argument that particulate matter from natural gas fired combustion sources is difficult to measure accurately. The reference test methods for particulate matter were developed primarily for measuring emissions from coal-fired power plants and other major emitters of particulates. Particulate concentrations from gas turbine can be 100 to 10,000 times lower than the "traditional" particulate sources. The test methods were not developed or verified for low emission levels. There are interferences, insignificant at higher exhaust particulate matter concentrations that result in emissions greater than the actual emissions from gas turbines. New methods are being developed to address this problem.

Due to measurement and procedural errors, the measured results, in most cases, may not be representative of actual particulate matter emitted. There are many potential error sources in measuring particulate matter. Most of these have to do with contamination of the samples, material from the sampling apparatus getting into the samples, and general human error in samples and analysis.

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Recommended Particulate Matter Emission Factors

When necessary to support the air permitting process Solar recommends the following $PM_{10/2.5}$ emission factors:

- Natural Gas: 0.015 lb/MMBtu fuel input (HHV)
- Landfill Gas: 0.03 lb/MMBtu fuel input (HHV)
- Liquid Fuel: 0.06 lb/MMBtu fuel input (HHV). The liquid fuel emission factor assumes fuel sulfur content is <500 ppm and ash content is <0.005% by wt.

The emission levels cited above are only for engine operation with the fuels listed. Other fuels may not yield similar results.

Recent customer source testing has shown that AP-42 (EPA AP-42 "Compilation of Air Pollutant Emission Factors.") emission factors for natural gas are achievable in the field, when the test method recommendations shown below are followed. Historically, Solar did not recommend using AP-42 because while some source test firms have measured below AP-42 levels, others have measured higher. Because particulate matter emissions levels are highly dependent on the test firm and have very little to do with the turbine, Solar does not warrant AP-42 levels but does recognize they are achievable in the field. Customers generally choose a particulate matter emissions factor at or above the AP-42 level that works for their site permitting recognizing that the lower the emissions factor the higher the risk for source testing. Any Solar warranty on particulate matter would be at the recommended levels above, e.g. 0.015 lb/MMBtu (HHV) for natural gas.

Test Method Recommendation

Solar recommends that EPA Methods 201/201A[1] be used to measure the "front half". "Front half" represents filterable particulate matter.

EPA Method 202[2] (with nitrogen purge and field blanks) should be used to measure the "back half". "Back half" measurements represent the condensable portion of particulate matter.

EPA Method 5[3], which measures the front and back halves may be substituted (e.g. where exhaust temperatures do not allow the use of Method 202).

Testing should include three test runs of 4 hours each.

Solar recommends using the aforementioned test methods until more representative test methods are developed and made commercially available.

References

[1] EPA Method 201, Determination of PM10 Emissions, Exhaust Gas Recycle Procedure. EPA Method 201A, Determination of PM10 Emissions, Constant Sampling Rate Procedure, 40 CFR 60, Part 60, Appendix A.

[2] EPA Method 202, Determination of Condensible Particulate Emissions from Stationary Sources, 40 CFR 60, Part 60, Appendix A.

[3] EPA Method 5, Determination of Particulate Emissions from Stationary Sources, 40 CFR 60, Part 60, Appendix

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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-

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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% load[1] 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).

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[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).

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Table 1. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
10 Minute Start-up and 10 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S				Taurus 65 8401S			
	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)	0.6	58.1	3.3	359	0.8	75.0	4.3	454	0.8	78.5	4.5	482	0.9	85.8	4.9	523
Total Emissions per Shutdown (lbs)	0.3	25.5	1.5	160	0.4	31.1	1.8	194	0.4	34.7	2.0	217	0.4	38.2	2.2	237

	Taurus 70 10801S				Mars 90 13002S GSC				Mars 100 16002S GSC				Titan 130 20501S				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)	1.1	103.9	5.9	634	1.4	129.0	7.4	868	1.6	151.2	8.6	952	2.1	195.6	11.2	1,194	2.5	22.7	1.5	1,925
Total Emissions per Shutdown (lbs)	1.3	110.7	6.3	689	1.7	147.9	8.4	912	1.9	166.8	9.5	1,026	2.4	210.0	12.0	1,303	3.0	19.9	1.5	1,993

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.

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Table 2. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
60 Minute Start-up and 30 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S				Taurus 65 8401S			
	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)	4.1	219.4	13.0	3,420	5.0	272.4	16.1	4,219	5.7	299.8	17.8	4,780	6.1	326.5	19.3	5,074
Total Emissions per Shutdown (lbs)	1.8	121.1	7.1	1,442	2.3	163.3	9.5	1,834	2.5	163.5	9.6	1,994	2.6	177.2	10.4	2,119

	Taurus 70 10801S				Mars 90 13002S				Mars 100 16002S				Titan 130 20501S				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)	7.6	410.3	24.2	6,164	10.5	570.8	33.7	8,641	11.3	583.5	34.6	9,691	13.8	740.4	43.8	11,495	14.6	75.5	7.3	16,253
Total Emissions per Shutdown (lbs)	3.3	223.0	13.0	2,588	4.3	277.0	16.2	3,685	4.8	308.1	18.0	4,056	6.0	405.3	23.7	4,826	6.2	52.6	4.1	7,222

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.

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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.

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Table 4. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
10 Minute Start-up and 10 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S			
	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)	1.3	44.5	7.4	473	1.7	59.0	9.8	601	1.7	59.8	9.9	636
Total Emissions per Shutdown (lbs)	0.6	17.3	2.8	211	0.7	21.2	3.4	256	0.8	23.5	3.8	286

	Taurus 70 10801S				Mars 100 16002S GSC				Titan 130 20501S			
	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)	2.3	78.5	13.0	823	3.4	114.1	18.8	1,239	4.3	147.5	24.4	1,547
Total Emissions per Shutdown (lbs)	2.5	73.6	12.0	889	3.8	111.4	18.1	1,331	4.7	139.1	22.6	1,677

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

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

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Table 5. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
60 Minute Start-up and 30 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S			
	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)	11.7	194.7	30.9	4,255	15.2	271.9	43.3	5,302	14.7	282.6	45.0	5,962
Total Emissions per Shutdown (lbs)	4.4	84.7	13.6	1,816	6.7	164.3	27.0	2,334	6.3	159.0	26.0	2,515

	Taurus 70 10801S				Mars 100 16002S				Titan 130 20501S			
	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)	18.4	360.3	57.4	7,375	29.1	552.0	87.7	11,685	34.4	677.0	108.0	13,731
Total Emissions per Shutdown (lbs)	8.0	207.8	34.1	3,156	12.3	302.6	49.4	4,970	15.0	388.5	63.7	5,876

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

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

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PIL 168
Product Information Letter

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

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PURPOSE

This Product Information Letter summarizes methods that are available to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO_2), and formaldehyde from gas turbines. Emissions estimates of these pollutants are often necessary during the air permitting process.

INTRODUCTION

In absence of site-specific or representative source test data, Solar refers customers to a United States Environmental Protection Agency (EPA) document titled "AP-42" or other appropriate EPA reference documents. AP-42 is a collection of emission factors for different emission sources. The emission factors found in AP-42 provide a generally accepted way of estimating emissions when more representative data are not available. The most recent version of AP-42 (dated April 2000) can be found at:

http://www.epa.gov/ttn/chief/ap42/ch03/index.html

Solar does not typically warranty the emission rates for VOC, SO_2 or formaldehyde.

Volatile Organic Compounds

Many permitting agencies require gas turbine users to estimate emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are some of the many ways of referring to the non-methane (and non-ethane) portion of an "unburned hydrocarbon" emission estimate.

For natural gas fuel, Solar's customers use 10-20% of the UHC emission rate to represent VOC emissions. The estimate of 10-20% is based on a ratio of total non-methane hydrocarbons to total organic compounds. The use of 10-20% provides a conservative estimate of VOC emissions. The balance of the UHC is assumed to be primarily methane.

For liquid fuel, it is appropriate to estimate that 100% of the UHC emission estimate is VOC.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of sulfur in the fuel to SO_2. Since Solar does not control the amount of sulfur in the fuel, we are unable to predict SO_2 emissions without a site fuel composition analysis. Customers generally estimate SO_2 emissions with a mass balance calculation by assuming that any sulfur in the fuel will convert to SO_2. For reference, the typical mass balance equation is shown below.

Variables: wt % of sulfur in fuel
Btu/lb fuel (LHV*)
MMBtu/hr fuel flow (LHV)

$$\frac{\text{lb } SO_2}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100}\right)\left(\frac{\text{lb fuel}}{\text{Btu}}\right)\left(\frac{10^6 \text{ Btu}}{\text{MMBtu}}\right)\left(\frac{\text{MMBtu fuel}}{\text{hr}}\right)\left(\frac{\text{MW } SO_2}{\text{MW Sulfur}}\right)$$

As an alternative to the mass balance calculation, EPA's AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.0034 lb/MMBtu for gas fuel (HHV*) and 0.033 lb/MMBtu for liquid fuel (HHV).

*LHV = Lower Heating Value; HHV = Higher Heating Value

Formaldehyde

In gas turbines, formaldehyde emissions are a result of incomplete combustion. Formaldehyde

in the exhaust stream is unstable and very difficult to measure. In addition to turbine characteristics including combustor design, size, maintenance history, and load profile, the formaldehyde emission level is also affected by:

- Ambient temperature
- Humidity
- Atmospheric pressure
- Fuel quality
- Formaldehyde concentration in the ambient air
- Test method measurement variability
- Operational factors

The emission factor data in Table 1 is an excerpt from an EPA memo: "Revised HAP Emission Factors for Stationary Combustion Turbines, 8/22/03." The memo presents hazardous air pollutant (HAP) emission factor data in several categories including: mean, median, maximum, and minimum. The emission factors in the memo are a compilation of the HAP data EPA collected during the Maximum Achievable Control Technology (MACT) standard development process. The emission factor documentation shows there is a high degree of variability in formaldehyde emissions from gas turbines, depending on the manufacturer, rating size of equipment, combustor design, and testing events. To estimate formaldehyde emissions from gas turbines, users should use the emission factor(s) that best represent the gas turbines actual / planned operating profile. Refer to the memo for alternative emission factors.

Table 1. EPA's Total HAP and Formaldehyde Emission Factors for <50 MW Lean-Premix Gas Turbines burning Natural Gas

(Source: Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09, 8/22/03)

Pollutant	Engine Load	95% Upper Confidence of Mean, lb/MMBtu HHV	95% Upper Confidence of Data, lb/MMBtu HHV	Memo Reference
Total HAP	> 90%	0.00144	0.00258	Table 19
Total HAP	All	0.00160	0.00305	Table 16
Formaldehyde	> 90%	0.00127	0.00241	Table 19
Formaldehyde	All	0.00143	0.00288	Table 16

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Emissions from Centrifugal Compressor Gas Seal Systems

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PURPOSE

The U.S. Environmental Protection Agency ("EPA") has recently established regulations related to monitoring, reporting and control of Greenhouse Gas (GHG) emissions from industrial sources. Methane, the main constituent of natural gas, is a GHG which may escape from various points along the gas turbine package and the driven equipment. One source of 'fugitive' emissions under regulatory scrutiny includes the gas seal systems installed in centrifugal gas compressors. As natural gas is used as seal gas there will be some emission of methane through the seal vents. The purpose of this PIL is to provide information pertaining to expected emissions leakage from Solar compressor dry gas seals. Regulatory requirements for wet seal systems are also briefly summarized.

DRY GAS SEAL LEAKAGE DATA

The figures in the Appendix may be used to estimate dry gas seal leakage through the primary and secondary (combined) vents based on the compressor suction pressure (P1). The charts show the expected leakage rate per each compressor. Leakage rates are not be guaranteed.

For further technical information on Dry Gas Seal systems refer to PIL 140 Dry Gas Face Seals for Solar Gas Compressors.

Note on PIL 140: The maximum dynamic leakage from Tables 3 and 4 are the maximum possible dynamic leakage rates at maximum allowable speed and pressure and should not be utilized for emission inventories or expected emissions from Solar compressors.

REGULATIONS CONCERNING CENTRIFUGAL COMPRESSOR GAS SEAL EMISSIONS

There are two EPA regulations in Title 40 of the Code of Federal Regulations (CFR) which concern emissions from centrifugal compressor gas seal systems: Part 98, Subpart W (40 CFR §§ 98.230 – 98.238) and Part 60, Subpart OOOO (40 CFR §§ 60.5360 – 60.5423). The final rule that promulgated Subpart W was published in in November 2010 and requires reporting of GHG emissions for oil and gas operations beginning in September 2012. Subpart OOOO, New Source Performance Standards for Crude Oil and Natural Gas Production, Transmission and Distribution, requires the reduction of volatile organic compounds (VOCs) from oil and gas operations and became effective October 15, 2012.

Neither regulation requires actual measurement of emissions from compressor dry gas seal systems.

Although measurement of dry gas seal emissions is not required by EPA, several US state environmental agencies are requiring customers to estimate dry gas seal vent emissions as part of the air permitting process. Dry gas seal vent emissions estimates are provided in the Appendix. A brief summary of the regulations follows.

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Subpart W - Mandatory Reporting of Greenhouse Gases: Petroleum and Natural Gas Systems

Subpart W is included in the EPA's Mandatory Reporting of Greenhouse Gases regulation. While there is no requirement for measurement of dry gas seal emissions, emissions from wet gas seal de-gas systems are required to be measured by operators in the gas processing, transmission, storage and LNG segments of the industry. Or, as applicable, estimates from Best Available Monitoring Methods (BAMM) may be used. BAMM may be very common in the initial years (e.g., 2011 and 2012 GHG inventories) but EPA does not anticipate long term BAMM, so measurements in future years will be required. Production operators use an emission factor rather than measurement and the distribution segment does not report wet seal system emissions. See 40 CFR §§ 98.236 for details on reporting. Subpart W also requires reporting of emissions from blowdown vents and leakage from unit isolation valves (note that these emission sources are not directly emitted from the compressor). See 40 CFR §§ 98.233(o) and 98.234 for further details.

Subpart OOOO - Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution

40 CFR Part 60, Subpart OOOO impacts centrifugal compressors with wet gas seal systems that are new, modified, or reconstructed after August 23, 2011, that are used in natural gas gathering and processing. Compressors located at well-heads or in the transmission, distribution or storage segments are not affected by Subpart OOOO.

Compliance with Subpart OOOO requires a dry seal system, or a wet seal system that reduces VOC emissions by 95% (through routing of seal de-gas emissions through a closed vent system to a control device or recirculation to the compressor suction). Note that although Subpart OOOO mentions flaring, flares may present a safety hazard and should not be used with wet seal applications.

Subpart OOOO applicability to Solar equipment would be limited to new, modified, or reconstructed (since August 23, 2011) centrifugal compressors with wet seal systems in use at gathering facilities or gas processing plants.

Under Subpart OOOO if a control device (such as an adsorbent chiller) is used, monitoring and performance testing to verify 95% VOC reduction is required. See 40 CFR § 60.5413 for further details. Inspections of closed vent systems are required per 40 CFR § 60.5416.

At this time EPA has not provided an interpretation of what constitutes a 'modified' or 'reconstructed' centrifugal compressor, and guidance is not likely until an operator requests an applicability determination from EPA. According to the NSPS definitions, a compressor restage would be considered a modification if there is an increase in emissions; or reconstruction would apply in cases where the restage costs are greater than 50% of a comparable new compressor.

SUMMARY

Per Subpart W, wet seal de-gas emissions from centrifugal compressors must be measured (or estimated with BAMM) for all sources except those in the offshore production or distribution segments. Onshore production uses emission factors rather than direct measurement. Emissions estimates from blowdown vents and isolation valves, although not emitted directly from the compressor, are also required.

Per Subpart OOOO, new, modified, or reconstructed centrifugal compressors as of August 23, 2011 at gas gathering or production sites must use dry seals or reduce VOC emissions from wet seal systems by 95%.

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No specific requirements apply to emissions from dry gas seal systems although state environmental agencies may require estimates of these emissions for air permitting purposes. Emissions estimates are included in the Appendix.

Table of Figures

Centrifugal Compressor Dry Gas Seal Leakage Estimates

Figure 1 C16 4
Figure 2 C160K, C166K 4
Figure 3 C160R, C160, C166S, C166V, C168V, C169V 5
Figure 4 C28 5
Figure 5 C304, C306, C33, C33i, C33E, C33EL, C337i, C401 6
Figure 6 C33EH, C404A, C404B, 406A, 406B 6
Figure 7 C41 7
Figure 8 C45 7
Figure 9 C505J 8
Figure 10 C505U 8
Figure 11 C51 9
Figure 12 C61 9
Figure 13 C65 10
Figure 14 C85 10

APPENDIX

The charts shown below are the total seal / process gas that leaks across the two primary dry gas seals and is vented through the primary and secondary vents on a Solar Gas Compressor. The dry gas seal leakage flow is a function of the compressor suction pressure. The charts show seal gas vented flow (scfm) vs. compressor suction pressure (psig)

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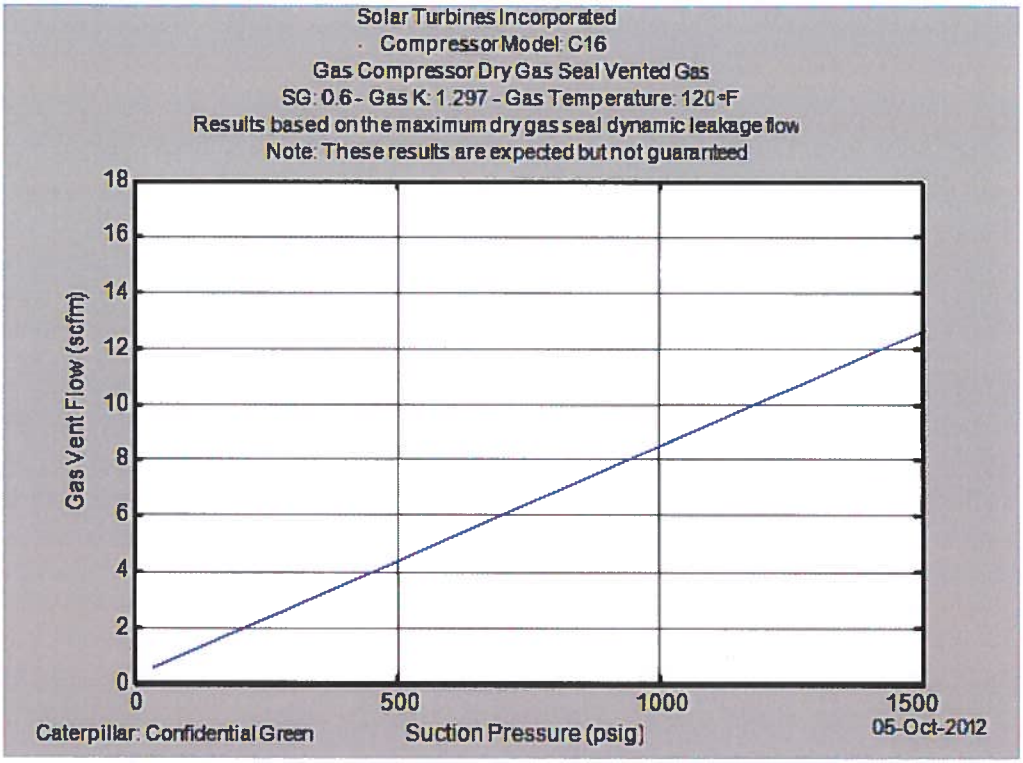

Figure 1 C16

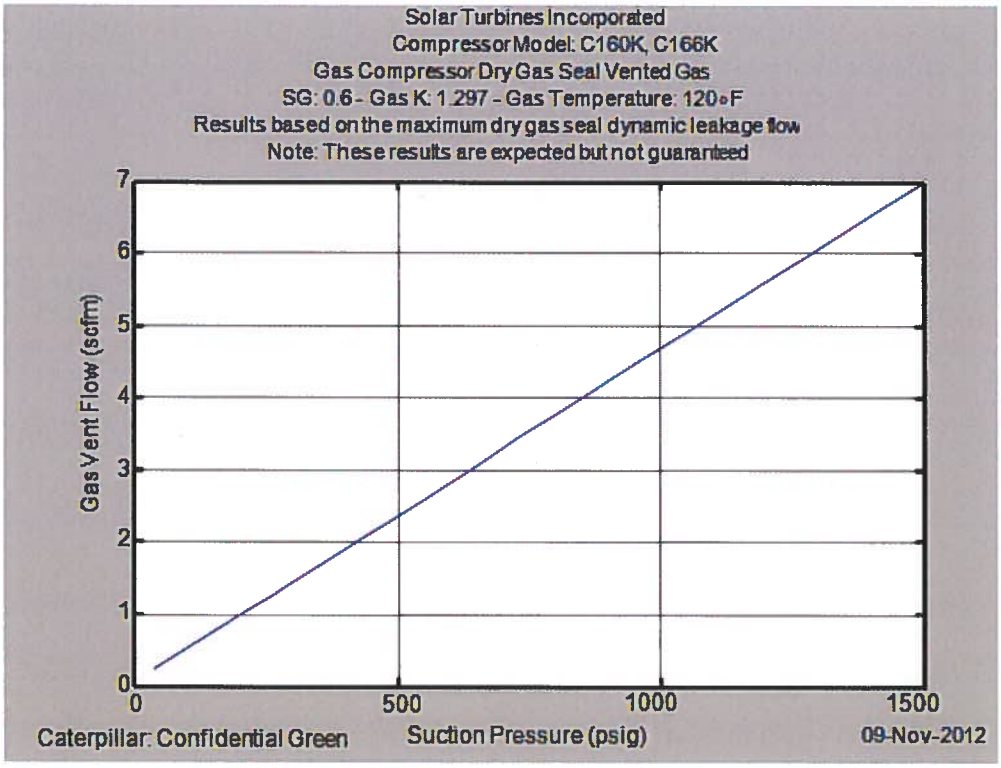

Figure 2 C160K, C166K

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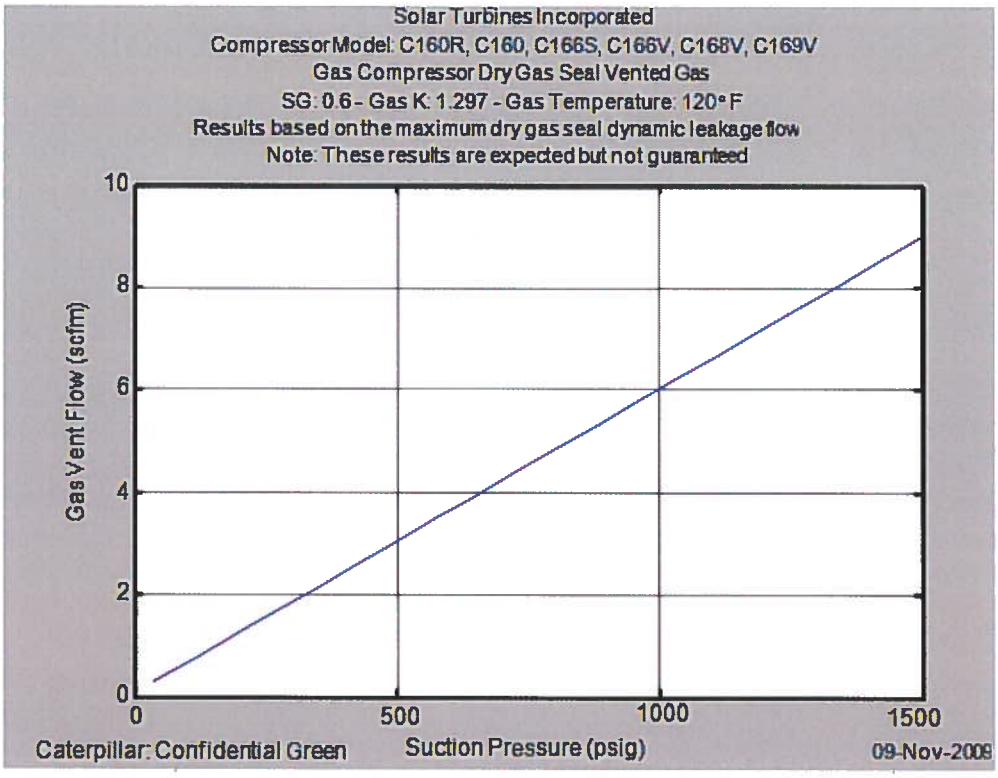

Figure 3 C160R, C160, C166S, C166V, C168V, C169V

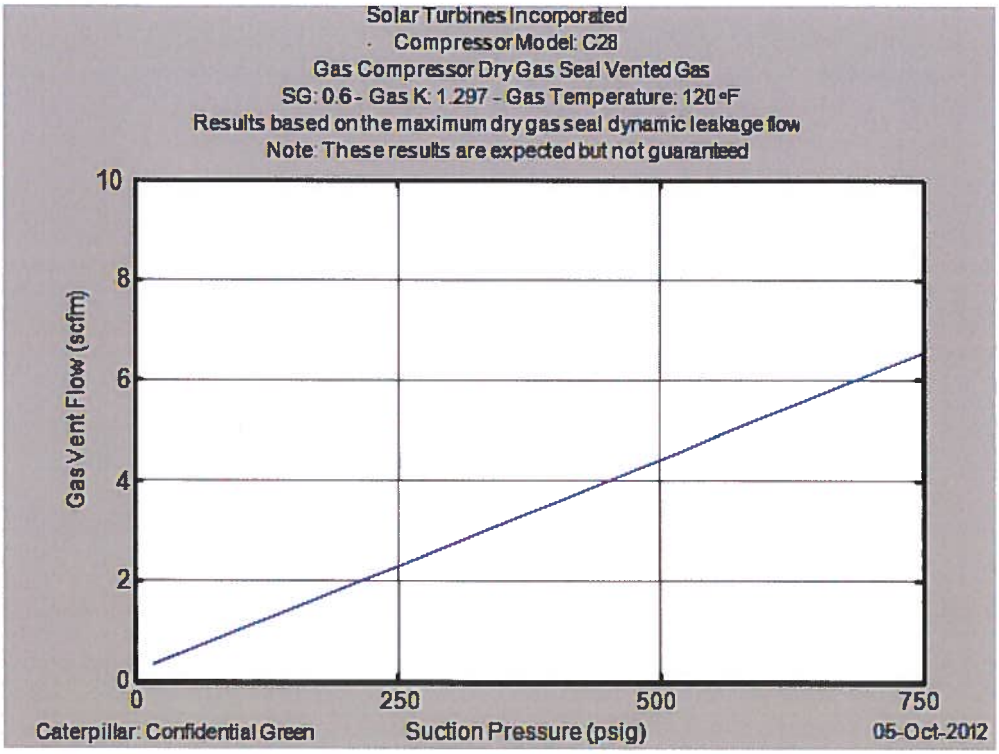

Figure 4 C28

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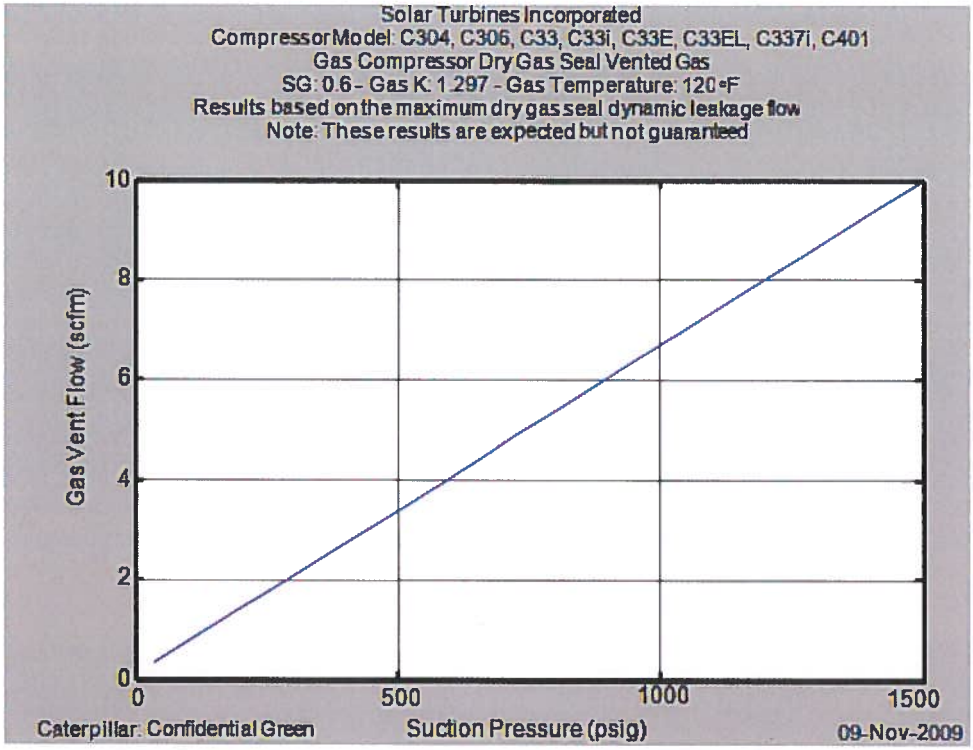

Figure 5 C304, C306, C33, C33i, C33E, C33EL, C337i, C401

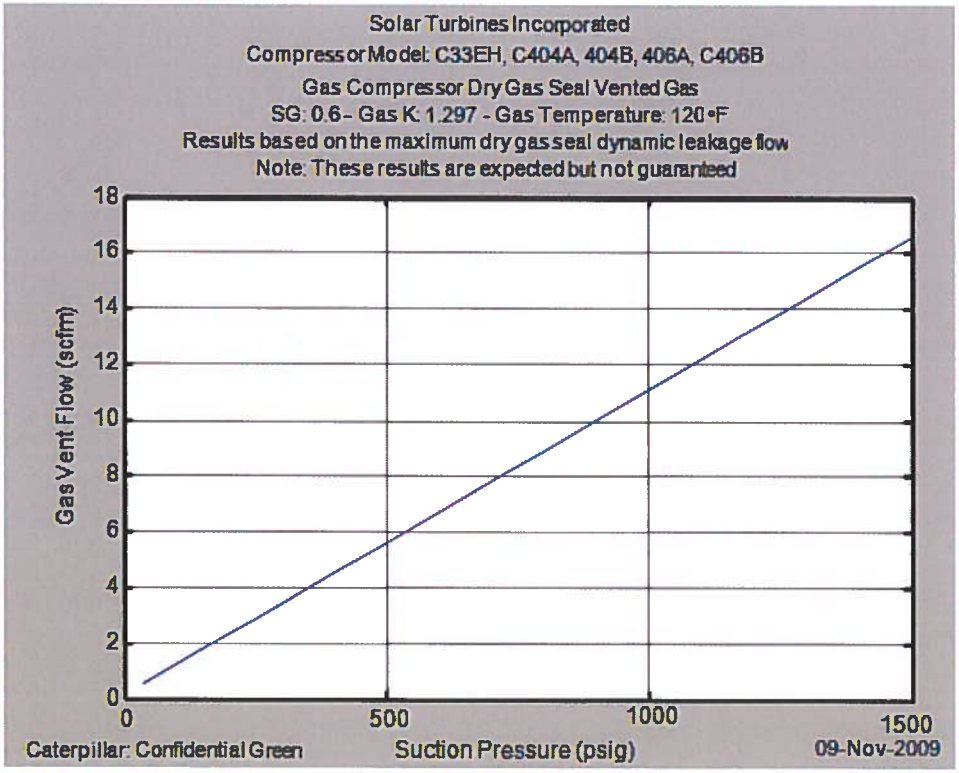

Figure 6 C33EH, C404A, C404B, 406A, 406B

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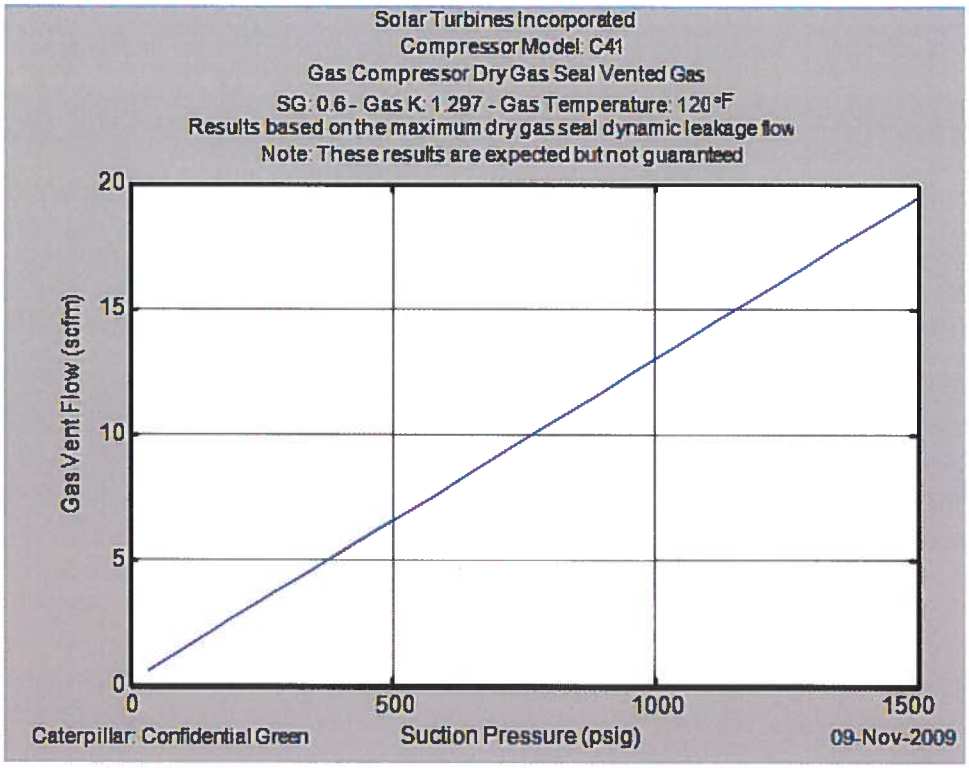

Figure 7 C41

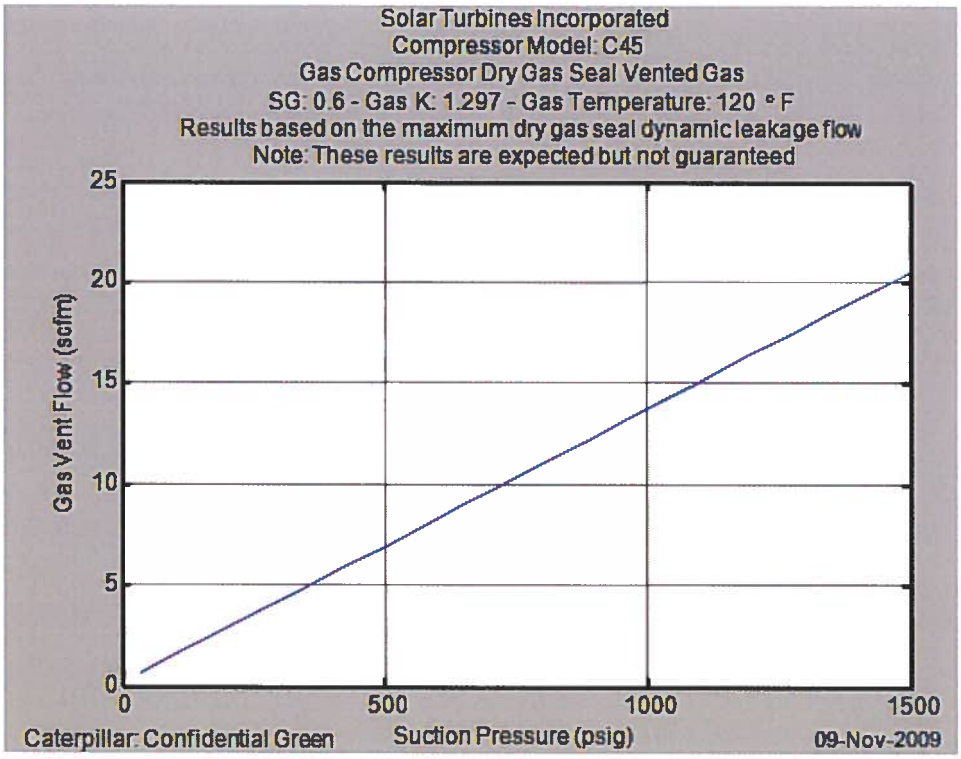

Figure 8 C45

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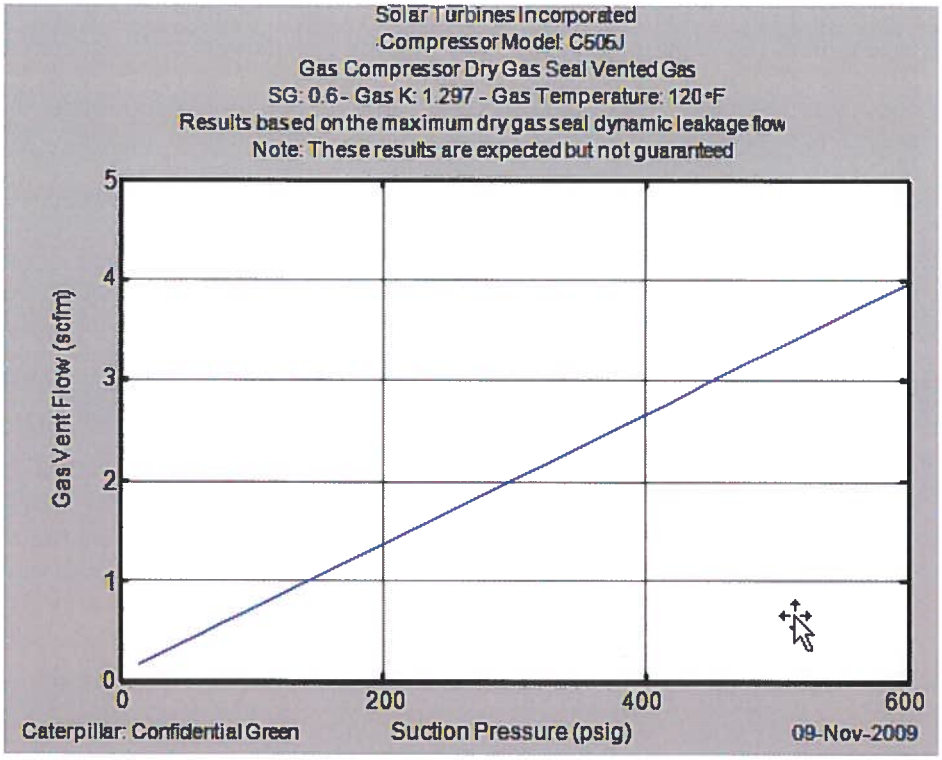

Figure 9 C505J

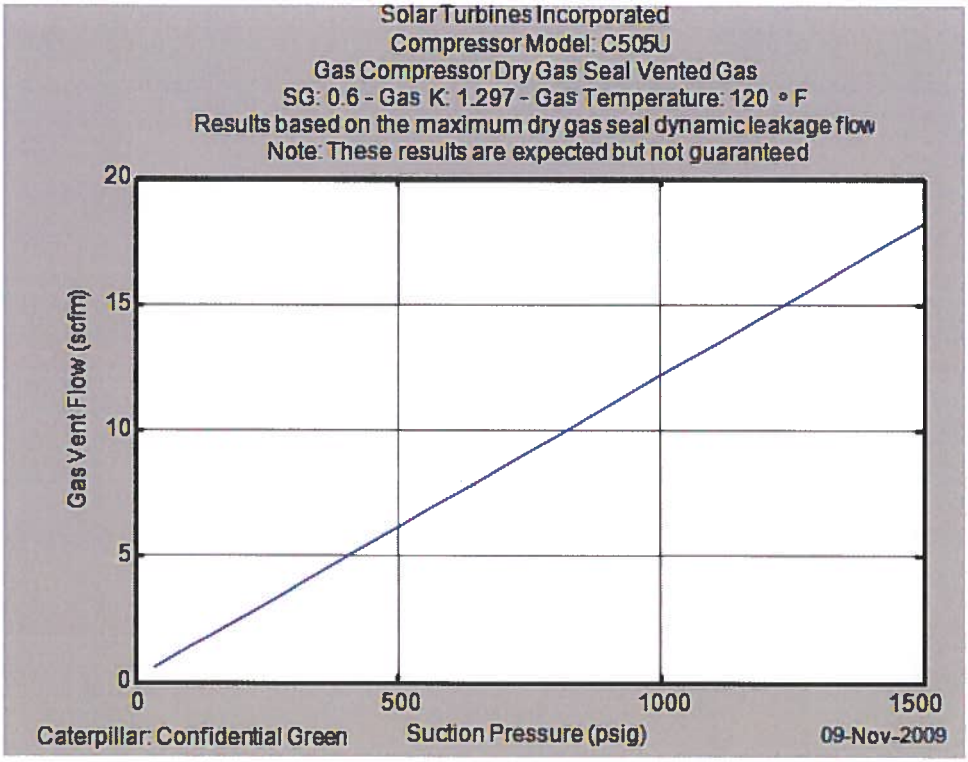

Figure 10 C505U

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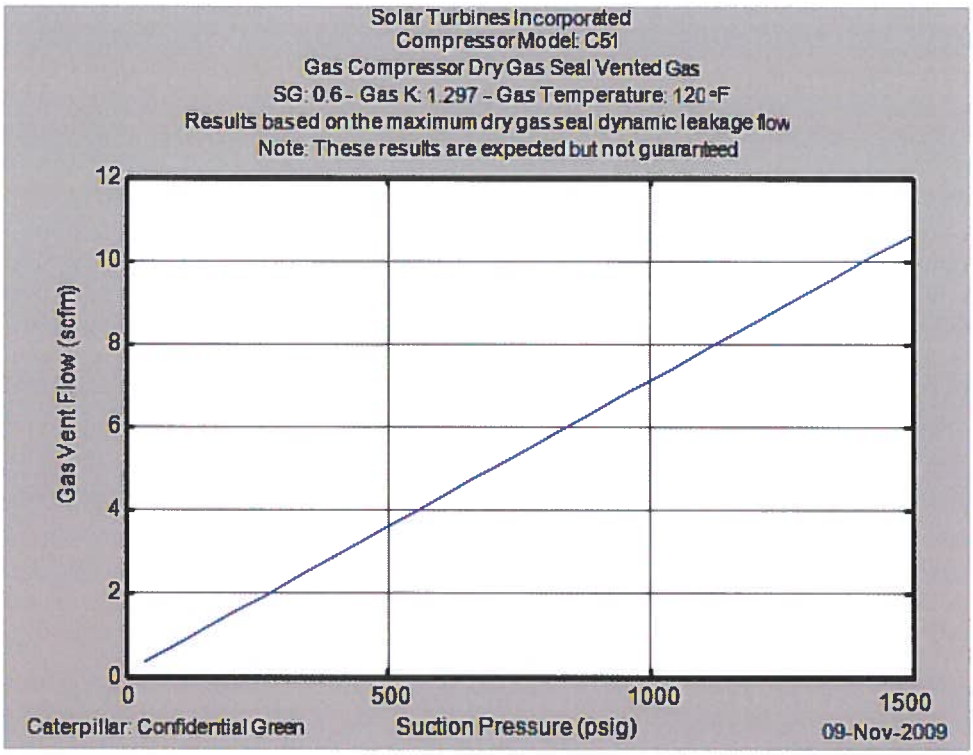

Figure 11 C51

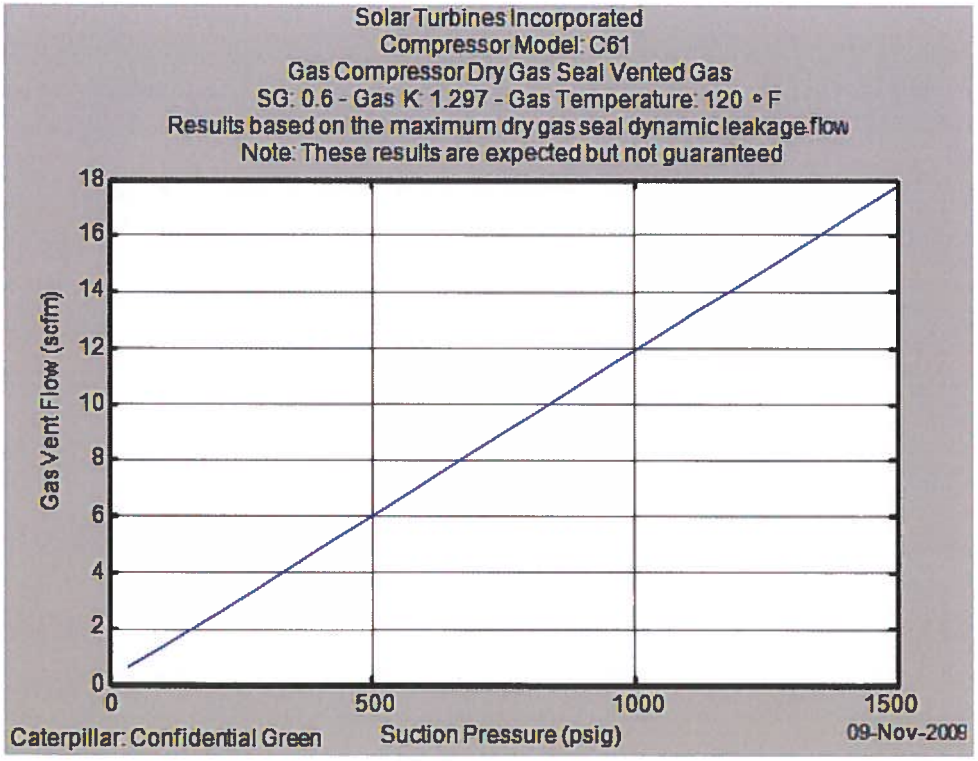

Figure 12 C61

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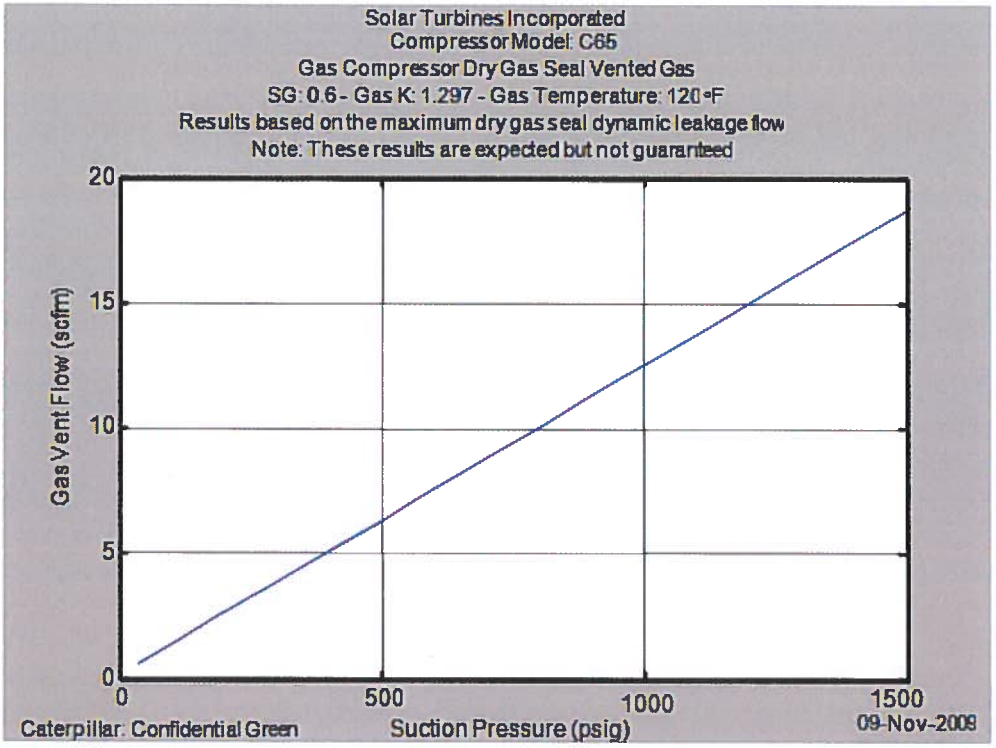

Figure 13 C65

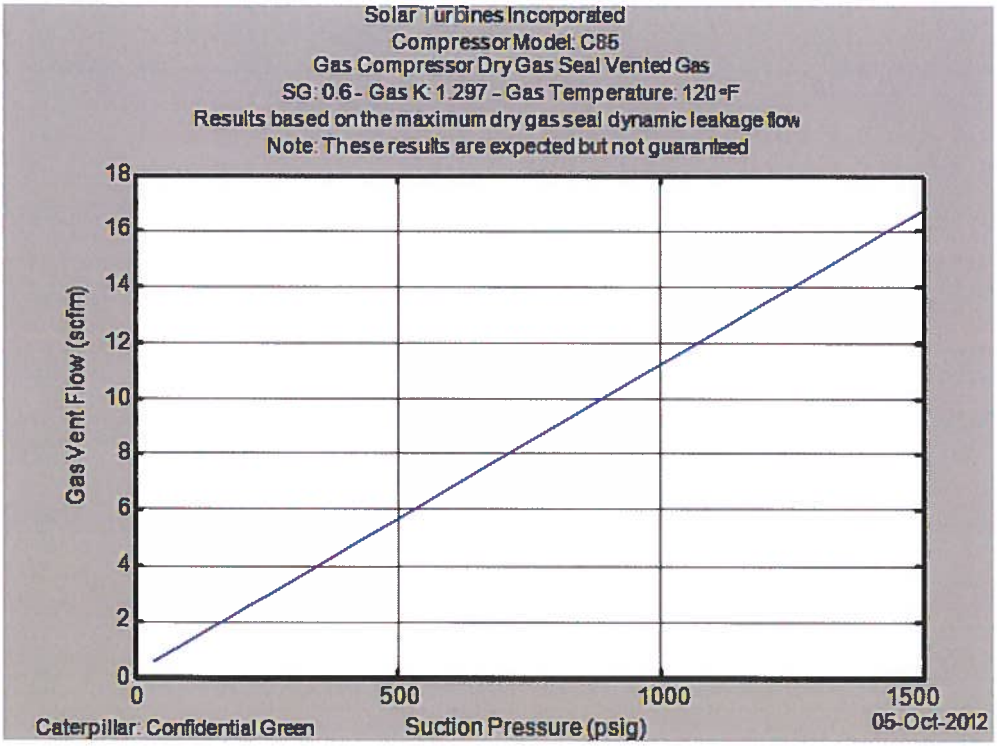

Figure 14 C85

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SoLoNOx Products: Emissions in Non-SoLoNOx Modes

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

Solar's gas turbine dry low NOx emissions combustion systems, known as *SoLoNOx*™, have been developed to provide the lowest emissions possible during normal operating conditions. In order to optimize the performance of the turbine, the combustion and fuel systems are designed to reduce NOx, CO and unburned hydrocarbons (UHC) without penalizing stability or transient capabilities. At very low load and cold temperature extremes, the *SoLoNOx* system must be controlled differently in order to assure stable operation. The required adjustments to the turbine controls at these conditions cause emissions to increase.

The purpose of this Product Information Letter is to provide emissions estimates, and in some cases warrantable emissions for NOx, CO and UHC, at off-design conditions.

Historically, regulatory agencies have not required a specific emissions level to be met at low load or cold ambient operating conditions, but have asked what emissions levels are expected. The expected values are necessary to appropriately estimate emissions for annual emissions inventory purposes and for New Source Review applicability determinations and permitting.

COLD AMBIENT EMISSIONS ESTIMATES

Solar's standard temperature range warranty for gas turbines with *SoLoNOx* combustion is ≥ 0°F (–20°C). The *Titan*™ 250 is an exception, with a lower standard warranty at ≥ –20°F (–29°C). At ambient temperatures below 0°F, many of Solar's turbine engine models are controlled to increase pilot fuel to improve flame stability and emissions are higher. Without the increase in pilot fuel at temperatures below 0°F the engines may exhibit combustor rumble, as operation may be near the lean stability limit.

If a cold ambient emissions warranty is requested, a new production turbine configured with the latest combustion hardware is required. For most models this refers to the inclusion of Cold Ambient Fuel Control Logic.

Emissions warranties are not offered for ambient temperatures below –20°F (–29°C). In addition, cold ambient emissions warranties cannot be offered for the *Centaur*® 40 turbine.

Table 1 provides expected and warrantable (upon Solar's documented approval) emissions levels for Solar's *SoLoNOx* combustion turbines. All emissions levels are in ppm at 15% O_2. Refer to Product Information Letter 205 for *Mercury*™ 50 turbine emissions estimates.

For information on the availability and approvals for cold ambient temperature emissions warranties, please contact Solar's sales representatives.

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Table 2 summarizes "expected" emissions levels for ambient temperatures below 0°F (–20°C) for Solar's *SoLoNOx* turbines that do not have current production hardware or for new production hardware that is not equipped with the cold ambient fuel control logic. The emissions levels are extrapolated from San Diego factory tests and may vary at extreme temperatures and as a result of variations in other parameters, such as fuel composition, fuel quality, etc.

For more conservative NOx emissions estimate for new equipment, customers can refer to the New Source Performance Standard (NSPS) 40CFR60, subpart KKKK, where the allowable NOx emissions level for ambient temperatures < 0°F (–20°F) is 150 ppm NOx at 15% O_2. For pre-February 18, 2005, *SoLoNOx* combustion turbines subject to 40CFR60 subpart GG, a conservative estimate is the appropriate subpart GG emissions level. Subpart GG levels range from 150 to 214 ppm NOx at 15% O_2 depending on the turbine model.

Table 3 summarizes emissions levels for ambient temperatures below –20°F (–29°C) for the *Titan* 250.

Table 1. Warrantable Emissions Between 0°F and –20°F (–20° to –29°C) for New Production

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 50	Gas Only	Gas	50 to 100% load	42	100	50
	Dual Fuel	Gas	50 to 100% load	72	100	50
Taurus™ 60	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Taurus 65	Gas Only	Gas	50 to 100% load	42	100	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Mars® 90	Gas Only	Gas	50 to 100% load	42	100	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 250	Gas Only	Gas	40 to 100% load	25	50	25
	Gas Only	Gas	40 to 100% load	15	25	25
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

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EMISSIONS ESTIMATES IN NON-SOLONOX MODE (LOW LOAD)

At operating loads < 50% (<40% load for the *Titan* 250) on natural gas fuel and < 65% (< 80% load for *Centaur* 40) on liquid fuels, *SoLoNOx* engines are controlled to increase stability and transient response capability. The control steps that are required affect emissions in two ways: 1) pilot fuel flow is increased, increasing NOx emissions, and 2) airflow through the combustor is increased, increasing CO emissions. Note that the load levels are approximate. Engine controls are triggered either by power output for single-shaft engines or gas producer speed for two-shaft engines.

A conservative method for estimating emissions of NOx at low loads is to use the applicable NSPS: 40CFR60 subpart GG or KKKK. For projects that commence construction after February 18, 2005, subpart KKKK is the applicable NSPS and contains a NOx level of 150 ppm @ 15% O_2 for operating loads less than 75%.

Table 4 provides estimates of NOx, CO, and UHC emissions when operating in non-SoLoNOx mode for natural gas or liquid fuel. The estimated emissions can be assumed to vary linearly as load is decreased from just below 50% load for natural gas (or 65% load for liquid fuel) to idle.

The estimates in Table 4 apply for any product for gas only or dual fuel systems using pipeline quality natural gas. Refer to Product Information Letter 205 for *Mercury* 50 emissions estimates.

Table 4. Estimated Emissions in non-SoLoNOx Mode

Ambient	Fuel System	Engine Load	NOx, ppm	CO, ppm	UHC, ppm
***Centaur* 40/50, *Taurus* 60/65/70, *Mars* 90/100, *Titan* 130**					
≥ –20°F (–29°C)	Natural Gas	Less than 50%	70	8,000	800
		Idle	50	10,000	1,000
< –20°F (–29°C)	Natural Gas	Less than 50%	120	8,000	800
		Idle	120	10,000	1,000
***Titan* 250**					
≥ –20°F (–29°C)	Natural Gas	Less than 40%	50	25	20
		Idle	50	2,000	200
< –20°F (–29°C)	Natural Gas	Less than 40%	70	150	50
		Idle	70	2,000	200
***Centaur* 50, *Taurus* 60/70, *Mars* 100, *Titan* 130**					
≥ –20°F (–29°C)	Liquid	Less than 65%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 65%	120	1,000	150
		Idle	120	10,000	3,000
***Centaur* 40**					
≥ –20°F (–29°C)	Liquid	Less than 80%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 80%	120	1,000	150
		Idle	120	10,000	3,000

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Table 2. Expected Emissions below 0°F (–20°C) for SoLoNOx Combustion Turbines

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 40	Gas Only or Dual Fuel	Gas	80 to 100% load	120	150	50
Centaur 50	Gas Only	Gas	50 to 100% load	120	150	50
	Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 60	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 65	Gas Only	Gas	50 to 100% load	120	150	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Mars 90	Gas Only	Gas	80 to 100% load	120	150	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Centaur 40	Dual Fuel	Liquid	80 to 100% load	120	150	75
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

Table 3. Expected Emissions below –20°F (–29°C) for the Titan 250 SoLoNOx Combustion Turbine

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Titan 250	Gas Only	Gas	40 to 100% load	70	150	50

COLD AMBIENT PERMITTING STRATEGY

There are several permitting options to consider when permitting in cold ambient climates. Customers can use a tiered permitting approach or choose to permit a single emission rate over all temperatures. Historically, most construction and operating permits were silent on the ambient temperature boundaries for *SoLoNOx* operation.

Some customers have used a tiered permitting strategy. For purposes of compliance and annual emissions inventories, a digital thermometer is installed to record ambient temperature. The amount of time is recorded that the ambient temperature falls below 0°F. The amount of time below 0°F is then used with the emissions estimates shown in Tables 1 and 2 to estimate "actual" emissions during sub-zero operation.

A conservative alternative to using the NOx values in Tables 1, 2 and 3 is to reference 40CFR60 subpart KKKK, which allows 150 ppm NOx at 15% O_2 for sub-zero operation.

For customers who wish to permit at a single emission rate over all ambient temperatures, inlet air heating can be used to raise the engine inlet air temperature (T_1) above 0°F. With inlet air heating to keep T_1 above 0°F, standard emission warranty levels may be offered.

Inlet air heating technology options include an electric resistance heater, an inlet air to exhaust heat exchanger and a glycol heat exchanger.

If an emissions warranty is desired and ambient temperatures are commonly below –20°F (–29°C), inlet air heating can be used to raise the turbine inlet temperature (T_1) to at least –20°F. In such cases, the values shown in Table 1 can be warranted for new production.

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Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are "output based"; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	0.64	1.8	0.23
CR30 MBTU	Landfill Gas (2)	0.64	22.0	1.00
CR30 MBTU	Digester Gas (3)	0.64	11.0	1.00
C30 Liquid	Diesel #2 (4)	2.60	0.41	0.23
C65 NG Standard	Natural Gas (1)	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas (1)	0.17	1.30	0.10
C65 NG CARB	Natural Gas (1)	0.17	0.24	0.05
CR65 Landfill	Landfill Gas (2)	0.46	4.0	0.10
CR65 Digester	Digester Gas (3)	0.46	4.0	0.10
C200 NG	Natural Gas (1)	0.40	1.10	0.10
C200 NG CARB	Natural Gas (1)	0.14	0.20	0.04
CR200 Digester	Digester Gas (3)	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

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Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]

Model	Fuel	NOx	CO	VOC [5]
C30 NG	Natural Gas [1]	0.22	0.60	0.078
CR30 MBTU	Landfill Gas [2]	0.22	7.4	0.340
CR30 MBTU	Digester Gas [3]	0.22	3.7	0.340
C30 Liquid	Diesel #2 [4]	0.90	0.14	0.078
C65 NG Standard	Natural Gas [1]	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas [1]	0.06	0.44	0.034
C65 NG CARB	Natural Gas [1]	0.06	0.08	0.017
CR65 Landfill	Landfill Gas [2]	0.16	1.4	0.034
CR65 Digester	Digester Gas [3]	0.16	1.4	0.034
C200 NG	Natural Gas [1]	0.14	0.37	0.034
C200 NG CARB	Natural Gas [1]	0.05	0.07	0.014
CR200 Digester	Digester Gas [3]	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is "ppmvd" (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expresses as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New } O_2 = \frac{(20.9 - \text{New } O_2 \text{ Percent})}{(20.9 - \text{Current } O_2 \text{ Percent})} \text{ X Emissions at Current } O_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% } O_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \text{ X } 9 = 27 \text{ ppmvd}$$

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Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O2

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas (1)	9	40	9
CR30 MBTU	Landfill Gas (2)	9	500	40
CR30 MBTU	Digester Gas (3)	9	250	40
C30 Liquid	Diesel #2 (4)	35	9	9
C65 NG Standard	Natural Gas (1)	9	40	7
C65 NG Low NOx	Natural Gas (1)	4	40	7
C65 NG CARB	Natural Gas (1)	4	8	3
CR65 Landfill	Landfill Gas (2)	9	130	7
CR65 Digester	Digester Gas (3)	9	130	7
C200 NG	Natural Gas (1)	9	40	7
C200 NG CARB	Natural Gas (1)	4	8	3
CR200 Digester	Digester Gas (3)	9	130	7

Notes: same as Table 1

Table 4. Emission for Different Capstone Microturbine Models in [mg/m3] at 15% O2

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	18	50	6
CR30 MBTU	Landfill Gas (2)	18	620	30
CR30 MBTU	Digester Gas (3)	18	310	30
C30 Liquid	Diesel #2 (4)	72	11	6
C65 NG Standard	Natural Gas (1)	19	50	5
C65 NG Low NOx	Natural Gas (1)	8	50	5
C65 NG CARB	Natural Gas (1)	8	9	2
CR65 Landfill	Landfill Gas (2)	18	160	5
CR65 Digester	Digester Gas (3)	18	160	5
C200 NG	Natural Gas (1)	18	50	5
C200 NG CARB	Natural Gas (1)	8	9	2
CR200 Digester	Digester Gas (3)	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

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Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NOx). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWhe times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NOx emissions rate of:

NOx = .17 X (65/1000) X 24 = .27 pounds per day

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NOx output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

NOx = .17 X 28/70 = .068 pounds per MWh (based on total system output)

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NOx and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

Capstone reserves the right to change or modify, without notice, the design, specifications, and/or contents of this document without incurring any obligation either with respect to equipment previously sold or in the process of construction.

Greenhouse Gas Emissions

Many gasses are considered "greenhouse gasses", and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO_2), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NOx and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO_2, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO_2. Emission of CO_2 depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO_2 emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO_2 that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO_2 released is substantially less when useful thermal output is also considered in the measurement.

Table 5. CO_2 Emission for Capstone Microturbine Models in [lb/MWh]

Model	Fuel	CO_2	
		Electric Only	70% Total CHP
C30 NG	Natural Gas (1)	1,690	625
CR30 MBTU	Landfill Gas (1)	1,690	625
CR30 MBTU	Digester Gas (1)	1,690	625
C30 Liquid	Diesel #2 (2)	2,400	855
C65 NG Standard	Natural Gas (1)	1,520	625
C65 NG Low NOx	Natural Gas (1)	1,570	625
C65 NG CARB	Natural Gas (1)	1,570	625
CR65 Landfill	Landfill Gas (1)	1,520	625
CR65 Digester	Digester Gas (1)	1,520	625
C200 NG	Natural Gas (1)	1,330	625
C200 NG CARB	Natural Gas (1)	1,330	625
CR200 Digester	Digester Gas (1)	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO_2 content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO_2 content of 160 lb/MMBTU (HHV)

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Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

Table 6. Useful Unit Conversions

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW_{th}: Kilowatt (thermal)
- kW_e : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as "electric horsepower-hour")
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m3: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: applications@capstoneturbine.com

Capstone reserves the right to change or modify, without notice, the design, specifications, and/or contents of this document without incurring any obligation either with respect to equipment previously sold or in the process of construction.

ATTACHMENT O

Monitoring/Recordkeeping/Reporting/Testing Plans

ATTACHMENT O - MONITORING, RECORDING, REPORTING, AND TESTING PLANS

Plan Type	Emission unit	Pollutant	Requirements	Frequency	Method of Measurement	Regulatory Reference
Monitoring, Recordkeeping	Compressor Turbines S001, S002	NO_X	Performance test	Annual	EPA Test Methods	NSPS KKKK
Monitoring	Compressor Turbines S001, S002		Amount of natural gas consumed, hours of operation	Monthly	N/A	
Monitoring, Recordkeeping	Liquid Loading (S019)	VOC	Monitor throughput of loading	Monthly	Records	

See Attachment D for additional information.

ATTACHMENT P

Public Notice

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that Mountain Valley Pipeline, LLC. has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a construction permit (R-13) to construct a new natural gas transmission compressor station (Harris Station) located on County Route 24/5 eight miles east of Flatwoods in Braxton County, West Virginia. The site latitude and longitude coordinates are: 38.72251 N, - 80.50286 W.

The applicant estimates the potential increase in the following Regulated Air Pollutants associated with the project after the installation of the proposed equipment:

Particulate Matter (PM) = 21.39 tpy
Sulfur Dioxide (SO2) = 4.95 tpy
Volatile Organic Compounds (VOC) = 13.99 tpy
Carbon Monoxide (CO) = 97.06 tpy
Nitrogen Oxides (NOx) = 86.73 tpy
Hazardous Air Pollutants (HAPs) = 4.79 tpy
Carbon Dioxide Equivalents (CO_2e) = 180,861 tpy

Startup of operation will begin around the 4th quarter of 2017. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1250, during normal business hours.

Dated on October XX, 2015.

By: Mountain Valley Pipeline, LLC
Shawn Posey, Senior Vice President – Engineering and Construction
625 Liberty Avenue Suite 1700
Pittsburgh, PA 15222

Stallworth Compressor Station

Mountain Valley PIPELINE

October 21, 2015

Via Certified Mail
Return Receipt Requested
No. 7015 0640 0000 9694 1211

Mr. William Durham
WVDEP – Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

Re: R13 Permit Application
Mountain Valley Pipeline, LLC – Stallworth Compressor Station
Fayette County, WV

Dear Mr. Durham:

Mountain Valley Pipeline, LLC (MVP) is submitting this request to the West Virginia Department of Environmental Protection (WVDEP) for the construction of a new natural gas transmission compressor station located in Fayette County, West Virginia (Stallworth Compressor Station). MVP is submitting this application to install the following equipment:

- Two (2) Solar Titan 130 natural gas-fired turbines each rated at 19,483 horsepower (hp) at site-specific conditions (ISO rating at 20,500 hp each);
- Ten (10) Capstone C200 natural gas-fired microturbines each rated at 200 kW;
- Two (2) natural gas-fired, fuel gas heaters each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input);
- One (1) natural gas-fired, office building heater rated at 0.12 MMBtu/hr, heat input; and
- Two (2) miscellaneous storage tanks with capacities less than 15, 000 gallons

The construction of the facility will not trigger prevention of significant deterioration, and the facility will not be a major source with respect to the Title V permit program.

Enclosed are two electronic copies and one original hard copy of the R13 application. The legal advertisement is scheduled to be published in the next few days. The affidavit of publication will be forwarded to WVDEP as soon as it is received from the newspaper. The fees will be paid by credit card once the application is received by your office.

625 Liberty Ave., Suite 1700, Pittsburgh PA 15222
Tel 304.848.0061 | Fax 412.395.3166 www.mountainvalleypipeline.info

MVP appreciates your review of this application. If you have any questions or comments about the attached information or have additional information requirements, please, feel free to contact me at (412) 553-7848.

Sincerely,

Regina Henry
Supervisor, Environmental

Attachments

R13 PERMIT APPLICATION

Mountain Valley Pipeline, LLC
Stallworth Compressor Station

Mountain Valley PIPELINE LLC

Fayette County, West Virginia

Prepared By:

TRINITY CONSULTANTS
4500 Brooktree Rd.
Suite 103
Wexford, PA 15090
(724) 935-2611

October 2015

Trinity Consultants

Environmental solutions delivered uncommonly well

TABLE OF CONTENTS

1. INTRODUCTION 3

1.1. Facility and Project Description 3

1.1.1. Turbines 3

1.1.2. Storage Tanks 3

1.1.3. Heaters 3

1.1.4. Microturbine Generators 3

1.2. R-13 APPLICATION ORGANIZATION 4

2. SAMPLE EMISSION SOURCE CALCULATIONS 5

2.1. Turbines 5

2.2. Fuel Gas and Office Heaters 5

2.3. Microturbine Generators 5

2.4. Storage Tanks 5

2.5. Fugitive Emissions 6

3. R13 APPLICATION FORM 7

ATTACHMENT A: CURRENT BUSINESS CERTIFICATE

ATTACHMENT B: MAP

ATTACHMENT C: INSTALLATION AND START UP SCHEDULE

ATTACHMENT D: REGULATORY DISCUSSION

ATTACHMENT E: PLOT PLAN

ATTACHMENT F: DETAILED PROCESS FLOW DIAGRAM

ATTACHMENT G: PROCESS DESCRIPTION

ATTACHMENT I: EMISSION UNITS TABLE

ATTACHMENT J: EMISSION POINTS DATA SUMMARY SHEET

ATTACHMENT K: FUGITIVE EMISSIONS DATA SUMMARY SHEET

ATTACHMENT L: EMISSIONS UNIT DATA SHEETS

ATTACHMENT N: SUPPORTING EMISSION CALCULATIONS

ATTACHMENT O: MONITORING/RECORDKEEPING/REPORTING/TESTING PLANS

ATTACHMENT P: PUBLIC NOTICE

Mountain Valley Pipeline, LLC (MVP), a subsidiary of EQT Corporation (EQT) is submitting this application to the West Virginia Department of Environmental Protection (WVDEP) for the construction of a new natural gas transmission compressor station located in Fayette County, West Virginia (Stallworth Compressor Station).

1.1. FACILITY AND PROJECT DESCRIPTION

The Stallworth Compressor Station is a natural gas transmission facility that will compress natural gas along the Mountain Valley Pipeline. The station has the potential to operate 24 hours per day, 7 days per week. The Stallworth Compressor Station will consist of the following equipment

- Two (2) Solar Titan 130 natural gas-fired turbines each rated at 19,483 horsepower (hp) at site-specific conditions (ISO rating at 20,500 hp each);
- Ten (10) Capstone C200 natural gas-fired microturbines each rated at 200 kW;
- Two (2) natural gas-fired, fuel gas heaters each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input);
- One (1) natural gas-fired, office building heater rated at 0.12 MMBtu/hr, heat input; and
- Two (2) miscellaneous storage tanks with capacities less than 15,000 gallons

A description of each source category is included below. A process flow diagram is included as Attachment F. There are no other facilities located within ¼ mile of the Stallworth Compressor Station.

1.1.1. Turbines

MVP is proposing to install two (2) natural gas-fired turbines for the compression and transmission of natural gas. The turbines are each rated at 19,483 hp at site-specific conditions, and equipped with SoLoNOx combustion technology. The function of these turbines is to raise the discharge pressure of the gas to overcome the effect of frictional losses in the pipeline upstream of the station.

1.1.2. Storage Tanks

The Stallworth Compressor Station will operate one (1) produced fluids storage tank, and one (1) used oil storage tank. Once the tanks are filled, the contents are loaded into trucks for transport.

1.1.3. Heaters

MVP is proposing to add two (2) natural gas-fired heaters rated at 2.31 MMBtu/hr of heat input and an office heater rated at 0.12 MMBtu/hr at the Stallworth Compressor Station. The fuel heaters will operate continuously (i.e., 8,760 hours per year) and preheat natural gas to maintain temperature above dewpoint prior to combustion. The office heater will provide comfort heating for the building and will operate as needed.

1.1.4. Microturbine Generators

There will be ten (10) microturbine generators at the Stallworth Compressor Station. The microturbine generators are two (2) Model C1000 low-NO_x generators (5 identical units of 200 kW, each) manufactured by Capstone. One unit will provide main electrical power, while the second will provide backup power to the station.

1.2. R-13 APPLICATION ORGANIZATION

This R-13 permit application is organized as follows:

- Section 2: Sample Emission Source Calculations;
- Section 3: R-13 Application Forms;
- Attachment A: Business Certificate;
- Attachment B: Map;
- Attachment C: Installation and Start Up Schedule;
- Attachment D: Regulatory Discussion;
- Attachment E: Plot Plan;
- Attachment F: Detailed Process Flow Diagram;
- Attachment G: Process Description;
- Attachment I: Emission Units Table;
- Attachment J: Emission Points Data Summary Sheet;
- Attachment K: Fugitive Emissions Data Summary Sheet;
- Attachment L: Emissions Unit Data Sheets;
- Attachment N: Supporting Emission Calculations;
- Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans;
- Attachment P: Public Notice; and
- Application Fee

2. SAMPLE EMISSION SOURCE CALCULATIONS

The characteristics of air emissions from the Stallworth Compressor Station, along with the methodology used for calculating emissions from the proposed new sources, are described in narrative form below. Detailed supporting calculations are also provided in Attachment N.

Emissions from the Stallworth Compressor Station will result from natural gas combustion in the turbines, fuel gas heaters, Office heaters microturbine generators, and flashing, working, and breathing losses from the storage tanks. In addition, fugitive emissions from component leaks will result from the operation of the station. The methodologies employed in calculating emissions from these sources have been summarized below, with specific citations included in Attachment N.

2.1. TURBINES

Potential emissions of nitrogen oxides (NO_X), CO, VOC, and CH_4 are calculated using factors provided by the turbine manufacturer. Potential emissions of sulfur dioxide (SO_2), particulate matter ($PM/PM_{10}/PM_{2.5}$), and formaldehyde are calculated using factors from Product Information Letters published by the turbine manufacturer. All hazardous air pollutants (HAPs), with the exception of formaldehyde, are calculated using U.S. EPA's AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines". Potential emissions of greenhouse gas pollutants (GHGs) are calculated using manufacturer's data as available (CH_4 in this case) and U.S. EPA's emission factors from 40 CFR Part 98, Subpart C for all others.

Emissions from the turbine may vary due to operational load and ambient temperature. The vendor guarantees emissions concentrations of the SoLoNOx system at and above 0°F. The vendor has also provided estimated emissions from subzero temperatures, which are expected to occur infrequently. To calculate potential emissions, the vendor guaranteed emission rates at 0°F and maximum operating load (on a lb/hr basis) were assumed continuously (i.e., 8,760 hour per year). This calculation resulted in a more conservative (i.e., higher) annual emission rate compared to assuming nominal operation below 0°F and the remainder of the year at annual average temperature.

Annual emissions also include emissions from startup and shutdown, which are calculated by multiplying emissions per startup by the number of estimated startups per year.

2.2. FUEL GAS AND OFFICE HEATERS

Potential emissions of all criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas combustion equipment. These calculations assume a site-specific heat content. Greenhouse gas emissions are calculated according to 40 CFR 98 Subpart C. Although the operation of these sources may be intermittent, potential emissions are calculated assuming continuous operation (i.e., 8,760 hours per year).

2.3. MICROTURBINE GENERATORS

Potential emissions of NO_X, CO, VOC, methane, and CO_2 are calculated using manufacturer's emission data. Emissions of all other criteria pollutants and HAPs are calculated using U.S. EPA's AP-42 factors for natural gas internal combustion engines. These calculations use a site specific heat content. Although one unit will provide backup power, potential emissions of all units are calculated assuming continuous operation (i.e., 8,760 hours per year).

2.4. STORAGE TANKS

Working, standing, and flash loss emissions of VOC and HAPs from the produced fluids storage tank are calculated using E&P Tank v2.0. Liquid loading emissions are calculated using EPA AP-42 emission factors.

2.5. FUGITIVE EMISSIONS

Emissions from fugitive equipment leaks are calculated using published EPA emission factors and 40 CFR Part 98, Subpart W emission factors. Emissions from blowdown events are calculated using engineering estimates of the amount of gas vented during each event. Site specific gas analyses were used to speciate VOC, HAP, and GHG emissions.

3. R13 APPLICATION FORM

The WVDEP permit application forms contained in this application include all applicable R13 application forms including the required attachments.

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT AND TITLE V PERMIT REVISION (OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):

☒ **CONSTRUCTION** ☐ **MODIFICATION** ☐ **RELOCATION**
☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**
☐ **CLASS II ADMINISTRATIVE UPDATE** ☐ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30 (TITLE V)** REVISION (IF ANY):

☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**
☐ **SIGNIFICANT MODIFICATION**

IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant *(as registered with the WV Secretary of State's Office)*:
Mountain Valley Pipeline, LLC

2. Federal Employer ID No. ***(FEIN):***
61-1744744

3. Name of facility *(if different from above)*:
Stallworth Compressor Station

4. The applicant is the:
☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**

5A. Applicant's mailing address:
625 Liberty Avenue, Suite 1700
Pittsburgh, PA 15222

5B. Facility's present physical address:
Dawson-Springdale Rd, Meadow Bridge, WV 25976

6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☒ **YES** ☐ **NO**
- If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
- If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**

7. If applicant is a subsidiary corporation, please provide the name of parent corporation: EQT Corporation

8. Does the applicant own, lease, have an option to buy or otherwise have control of the *proposed site?* ☒ **YES** ☐ **NO**
- If **YES,** please explain: Applicant owns the site
- If **NO,** you are not eligible for a permit for this source.

9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): Natural Gas Compressor Station

10. North American Industry Classification System **(NAICS)** code for the facility:
486210

11A. DAQ Plant ID No. (for existing facilities only):

11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only):

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

12A.

- For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the *present location* of the facility from the nearest state road;
- For **Construction** or **Relocation permits,** please provide directions to the *proposed new site location* from the nearest state road. Include a **MAP** as **Attachment B**.

From Charleston, WV take I-64 E/I-77 S for 90 miles to Morris Branch Rd in Western. Then take exit 150 toward Dawson/State Route 29/4. Next, Turn right onto Morris Branch Rd. Then, Turn left onto County Rd 27/3. Finally, turn left and travel 2.8 miles on Dawson-Springdale. The site will be on your right.

12.B. New site address (if applicable):	12C. Nearest city or town: Meadow Bridge, WV 25976	12D. County: Fayette
12.E. UTM Northing (KM): 4,191.20	12F. UTM Easting (KM): 521.31	12G. UTM Zone: 17

13. Briefly describe the proposed change(s) at the facility:

Mountain Valley Pipeline, LLC is constructing a new natural gas transmission compressor station as part of the Mountain Valley Pipeline (MVP).

14A. Provide the date of anticipated installation or change: October 2014 – If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen:	14B. Date of anticipated Start-Up if a permit is granted: 12/2017

14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).

15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day 24 Days Per Week 7 Weeks Per Year 52

16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**

17. **Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.

18. **Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process *(if known)*. A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance *(if known)*. Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

20. Include a **Table of Contents** as the first page of your application package.

21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to ***Plot Plan Guidance***) .
– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).

22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**

23. Provide a **Process Description** as **Attachment G.**
– Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**

– For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

☒ Bulk Liquid Transfer Operations	☒ Haul Road Emissions	☐ Quarry
☒ Chemical Processes	☐ Hot Mix Asphalt Plant	☐ Solid Materials Sizing, Handling and Storage Facilities
☐ Concrete Batch Plant	☐ Incinerator	☒ Storage Tanks
☐ Grey Iron and Steel Foundry	☐ Indirect Heat Exchanger	

☒ General Emission Unit, specify Microturbines, Fuel Gas Heater, Office Building Heaters and Turbines

Fill out and provide the **Emissions Unit Data Sheet(s)** as **Attachment L.**

29. Check all applicable **Air Pollution Control Device Sheets** listed below:

☐ Absorption Systems	☐ Baghouse	☐ Flare
☐ Adsorption Systems	☐ Condenser	☐ Mechanical Collector
☐ Afterburner	☐ Electrostatic Precipitator	☐ Wet Collecting System

☐ Other Collectors, specify

Fill out and provide the **Air Pollution Control Device Sheet(s)** as **Attachment M.**

30. Provide all **Supporting Emissions Calculations** as **Attachment N,** or attach the calculations directly to the forms listed in Items 28 through 31.

31. **Monitoring, Recordkeeping, Reporting and Testing Plans.** Attach proposed monitoring, recordkeeping, reporting and testing plans in order to demonstrate compliance with the proposed emissions limits and operating parameters in this permit application. Provide this information as **Attachment O.**

➢ Please be aware that all permits must be practically enforceable whether or not the applicant chooses to propose such measures. Additionally, the DAQ may not be able to accept all measures proposed by the applicant. If none of these plans are proposed by the applicant, DAQ will develop such plans and include them in the permit.

32. **Public Notice.** At the time that the application is submitted, place a **Class I Legal Advertisement** in a newspaper of general circulation in the area where the source is or will be located (See 45CSR§13-8.3 through 45CSR§13-8.5 and ***Example Legal Advertisement*** for details). Please submit the **Affidavit of Publication** as **Attachment P** immediately upon receipt.

33. **Business Confidentiality Claims.** Does this application include confidential information (per 45CSR31)?

☐ **YES** ☒ **NO**

➢ If **YES,** identify each segment of information on each page that is submitted as confidential and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's ***"Precautionary Notice – Claims of Confidentiality"*** guidance found in the ***General Instructions*** as **Attachment Q.**

Section III. Certification of Information

34. **Authority/Delegation of Authority.** Only required when someone other than the responsible official signs the application. Check applicable **Authority Form** below:

☐ Authority of Corporation or Other Business Entity	☐ Authority of Partnership
☐ Authority of Governmental Agency	☐ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

35A. **Certification of Information.** To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☒ **Responsible Official** / ☐ **Authorized Representative,** hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE _____ *(Please use blue ink)* DATE: 10-20-15 *(Please use blue ink)*

35B. Printed name of signee: Shawn Posey		35C. Title: Sr. Vice President – Engineering and Construction
35D. E-mail: sposey@eqt.com	36E. Phone:	36F. FAX:
36A. Printed name of contact person (if different from above): Regina Henry		36B. Title: Supervisor - Environmental
36C. E-mail: rhenry@eqt.com	36D. Phone: 412-553-7848	36E. FAX:

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

- ☒ **Attachment A: Business Certificate**
- ☒ **Attachment B: Map(s)**
- ☒ **Attachment C: Installation and Start Up Schedule**
- ☒ **Attachment D: Regulatory Discussion**
- ☒ **Attachment E: Plot Plan**
- ☒ **Attachment F: Detailed Process Flow Diagram(s)**
- ☒ **Attachment G: Process Description**
- ☐ **Attachment H: Material Safety Data Sheets (MSDS)**
- ☒ **Attachment I: Emission Units Table**
- ☒ **Attachment J: Emission Points Data Summary Sheet**
- ☒ **Attachment K: Fugitive Emissions Data Summary Sheet**
- ☒ **Attachment L: Emissions Unit Data Sheet(s)**
- ☐ **Attachment M: Air Pollution Control Device Sheet(s)**
- ☒ **Attachment N: Supporting Emissions Calculations**
- ☒ **Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans**
- ☒ **Attachment P: Public Notice**
- ☐ **Attachment Q: Business Confidential Claims**
- ☐ **Attachment R: Authority Forms**
- ☐ **Attachment S: Title V Permit Revision Information**
- ☒ **Application Fee**

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

- ☐ ***Forward 1 copy of the application to the Title V Permitting Group and:***
- ☐ ***For Title V Administrative Amendments:***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit,***
- ☐ ***For Title V Minor Modifications:***
  - ☐ ***Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt,***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit.***
- ☐ ***For Title V Significant Modifications processed in parallel with NSR Permit revision:***
  - ☐ ***NSR permit writer should notify a Title V permit writer of draft permit,***
  - ☐ ***Public notice should reference both 45CSR13 and Title V permits,***
  - ☐ ***EPA has 45 day review period of a draft permit.***

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

ATTACHMENT A

Current Business Certificate

WEST VIRGINIA
STATE TAX DEPARTMENT
BUSINESS REGISTRATION CERTIFICATE

ISSUED TO:
MOUNTAIN VALLEY PIPELINE, LLC
625 LIBERTY AVE, SUITE 1700
PITTSBURGH, PA 15222-0000

BUSINESS REGISTRATION ACCOUNT NUMBER: **2305-4787**

This certificate is issued on: **04/8/2015**

This certificate is issued by
the West Virginia State Tax Commissioner
in accordance with Chapter 11, Article 12, of the West Virginia Code

The person or organization identified on this certificate is registered to conduct business in the State of West Virginia at the location above.

This certificate is not transferrable and must be displayed at the location for which issued

This certificate shall be permanent until cessation of the business for which the certificate of registration was granted or until it is suspended, revoked or cancelled by the Tax Commissioner.

Change in name or change of location shall be considered a cessation of the business and a new certificate shall be required.

TRAVELING/STREET VENDORS: Must carry a copy of this certificate in every vehicle operated by them. CONTRACTORS, DRILLING OPERATORS, TIMBER/LOGGING OPERATIONS: Must have a copy of this certificate displayed at every job site within West Virginia.

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ATTACHMENT B

Map

ATTACHMENT B - AREA MAP



Figure 1 - Map of Stallworth Station

UTM Northing (KM):	4,191.198
UTM Easting (KM):	521.305
Elevation:	~2,785 ft

ATTACHMENT C

Startup and Installation Schedule

ATTACHMENT C

Schedule of Planned Installation and Start-Up

Unit	Installation Schedule	Startup Schedule
Two (2) Solar Titan 130 Turbines – Each rated 19,483 HP at site-specific conditions (20,500 HP ISO)	2016-2017	4Q 2017
Ten (10) 200 KW Capstone Microturbines	2016-2017	4Q 2017
Two (2) Fuel Gas Heaters – Each rated 2.31 MMBtu/hr	2016-2017	4Q 2017
One (1) 10,080 gallon Produced Fluids Tank	2016-2017	4Q 2017
One (1) 4,200 gallon Used Oil Tank	2016-2017	4Q 2017
Office Building Heater – Rated 0.120 MMBtu/hr	2016-2017	4Q 2017

ATTACHMENT D

Regulatory Discussion

ATTACHMENT D - REGULATORY APPLICABILITY

This section documents the applicability determinations made for Federal and State air quality regulations. The monitoring, recordkeeping, reporting, and testing plan is presented in Attachment O. In this section, applicability or non-applicability of the following regulatory programs is addressed:

- Prevention of Significant Deterioration (PSD) permitting;
- Non-Attainment New Source Review (NNSR) permitting;
- Title V of the 1990 Clean Air Act Amendments;
- New Source Performance Standards (NSPS);
- National Emission Standards for Hazardous Air Pollutants (NESHAP); and
- West Virginia State Implementation Plan (SIP) regulations.

This review is presented to supplement and/or add clarification to the information provided in the WVDEP R13 permit application forms, which fulfill the requirement to include citations and descriptions of applicable statutory and administrative code requirements.

In addition to providing a summary of applicable requirements, this section of the application also provides non-applicability determinations for certain regulations, allowing the WVDEP to confirm that identified regulations are not applicable to the station. Note that explanations of non-applicability are limited to those regulations for which there may be some question of applicability specific to the operations at the station. Regulations that are categorically non-applicable are not discussed (e.g., NSPS Subpart J, Standards of Performance for Petroleum Refineries).

Prevention of Significant Deterioration Source Classification

Federal construction permitting programs regulate new and modified sources of attainment pollutants under PSD and new and modified sources of non-attainment pollutants under NNSR. PSD regulations apply when a new source is constructed in which emissions exceed PSD major source thresholds, an existing minor source undergoes a modification in which emission increases exceed PSD major source thresholds, or an existing major source undergoes a modification in which emission increases exceed PSD significant emission rates. The Stallworth Station will be a minor source with respect to PSD, as shown in Attachment N. As such, PSD permitting is not triggered.

NNSR regulations apply only in areas designated as non-attainment. The Stallworth Station will be located in Fayette County, which is designated as attainment/unclassifiable for all criteria pollutants.[1] Therefore, NNSR regulations do not apply to the Stallworth Station.

Title V Operating Permit Program

Title 40 of the Code of Federal Regulations, Chapter 70 (40 CFR 70) establishes the Federal Title V operating permit program. West Virginia has incorporated the provisions of this Federal program in its Title V operating permit program in West Virginia 45CSR30. The major source thresholds with respect to the West Virginia Title V operating permit program regulations are 10 tons per year (tpy) of a single HAP, 25 tpy of any combination of HAP, and 100 tpy of all other regulated pollutants.[2] The potential emissions of all regulated pollutants are below

[1] U.S. EPA Greenbook, http://www.epa.gov/airquality/greenbook/anayo_wv.html, as of January 30, 2015.
[2] On June 23, 2014, the U.S Supreme Court decision in the case of *Utility Air Regulatory Group v. EPA* effectively changed the permitting procedures for GHGs under the PSD and Title V programs.

the corresponding thresholds for the proposed project. Therefore, the Stallworth Station is not a major source for Title V purposes.

New Source Performance Standards

NSPS, located in 40 CFR 60, require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. Moreover, any source subject to an NSPS is also subject to the general provisions of NSPS Subpart A, except where expressly noted. The following is a summary of applicability and non-applicability determinations for NSPS regulations of relevance to the facility.

NSPS Subpart Dc - Steam Generating Units

Subpart Dc, Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units, applies to all steam generating units with a heat input greater than or equal to 10 MMBtu/hr and less than 100 MMBtu/hr. No units at the proposed facility meet the definition of a steam generating unit and have a heat input greater than 10 MMBtu/hr; therefore, the requirements of this subpart will not apply.

NSPS Subpart GG - Stationary Gas Turbines

Subpart GG, Standards of Performance for Stationary Gas Turbines, applies to all gas turbines with a heat input at peak load greater than or equal to 10 MMBtu/hr based on the lower heating value of the fuel fired. This standard was promulgated in 1979. The applicability of Subpart KKKK, promulgated in 2006, is similar to that of Subpart GG and applies to stationary combustion turbines that commence construction after February 18, 2005. Turbines subject to Subpart KKKK are specifically exempt from the requirements of Subpart GG per 40 CFR § 60.4305(b). As such, this subpart does not apply to the proposed Solar turbines at the Stallworth Compressor station as they are subject to the requirements of Subpart KKKK as discussed in the following section. The proposed microturbines have a heat input below 10 MMBtu/hr and are not subject to the requirements of Subpart GG.

NSPS Subparts K, Ka, and Kb - Storage Vessels for Petroleum Liquids/Volatile Organic Liquids

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. Subpart K applies to storage tanks constructed, reconstructed, or modified prior to 1978, and Subpart Ka to those constructed, reconstructed, or modified prior to 1984. All storage tanks located at the Stallworth Compressor Station will be constructed after these dates; therefore, the requirements of Subparts K and Ka do not apply. Subpart Kb applies to volatile organic liquid (VOL) storage tanks constructed, reconstructed, or modified after July 23, 1984 with a capacity equal to or greater than 75 m^3 (~19,813 gallons). All storage tanks at the Stallworth Compressor Station will be constructed after this date, but will not have a capacity greater than 75 m^3. Therefore, Subpart Kb does not apply to the storage tanks at the Stallworth Compressor Station.

NSPS Subpart IIII - Compression Ignition Internal Combustion Engines

Subpart IIII, Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of compression ignition (CI) engines. There will be no CI engines installed at the Stallworth Compressor Station. Therefore, this subpart is not applicable to the station.

NSPS Subpart JJJJ - Stationary Spark Ignition Internal Combustion Engines

Subpart JJJJ, Standards of Performance for Stationary Spark Ignition Internal Combustion Engines, applies to manufacturers, owners and operators of stationary spark (SI) engines. There will be no SI engines installed at the Stallworth Compressor Station. Therefore, this subpart is not applicable to the station.

NSPS Subpart KKKK - Stationary Combustion Turbines

Subpart KKKK, Standards of Performance for Stationary Combustion Turbines, applies to stationary combustion units with a heat input at peak load equal to or greater than 10 MMBtu/hr, based on the higher heating value of the fuel, commencing construction after February 18, 2005. The microturbines at the Stallworth Compressor station will each have a heat input less than 10 MMbtu/hr. Therefore, they are not subject to this standard.

The proposed Solar turbines for the Stallworth Compressor Station will be subject to the NO_X emissions limitations in §60.4320(a). Turbines with a rated capacity of 50 < MMBtu/hr ≤ 850 MMBtu/hr at peak load are limited to NO_X emissions of 25 ppm at 15% O_2 when firing natural gas. The Solar turbines that will be installed at the station are equipped with lean pre-mix combustion technology and are guaranteed by the manufacturer to emit a maximum of 15 ppm of NO_X at 15% O_2 under variable turbine load conditions when firing natural gas. This vendor guarantee is well below the NSPS KKKK standard.

Mountain Valley Pipeline (MVP) will perform annual performance tests in accordance with §60.4340(a) and §60.4400 to demonstrate compliance with the NO_X emission limitations, or as an alternative, will continuously monitor the appropriate parameters to determine whether the turbine is operating in low-NO_X mode in accordance with §60.4340(b)(2)(ii) and §60.4355(a). The Solar turbines must also comply with the SO_2 emission limits in §60.4330. MVP will comply with the SO_2 requirements by the exclusive use of natural gas which contains total potential sulfur emissions less than 0.060 lb SO_2/MMBtu heat input in accordance with §60.4330(a)(2).

NSPS Subpart OOOO - Natural Gas Production, Transmission, and Storage

Subpart OOOO, Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution, applies to affected facilities that commenced construction, reconstruction, or modification after August 23, 2011. This NSPS was published in the Federal Register on August 16, 2012, and subsequently amended. The list of potentially affected facilities includes:

- Gas wellheads ;
- Centrifugal compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Reciprocating compressors located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment;
- Continuous bleed natural gas-driven pneumatic controllers with a bleed rate of > 6 scfh located between the wellhead and the point of custody transfer to the natural gas transmission and storage segment (excluding natural gas processing plants);
- Continuous bleed natural gas-driven pneumatic controllers located at natural gas processing plants;
- Storage vessels in the production, processing, or transmission and storage segments; and
- Sweetening units located onshore that process natural gas produced from either onshore or offshore wells.

Since the proposed Stallworth Compressor Station will be a transmission facility located after the point of custody transfer, the only potentially applicable requirements for the proposed equipment are those for new storage vessels where construction commenced after August 23, 2011.

The standards applicable to storage vessels are detailed in 40 CFR §60.5395. The only tank that falls under the Subpart's definition of a 'storage vessel' is the produced fluid storage tank, however, this tank will have potential VOC emissions below 6 tpy. As such, per 60.5365(e), the tank is not a storage vessel affected facility under the rule.

It is important to note that updates to NSPS OOOO have been proposed. However, as the changes are not finalized, applicability will be reviewed once the rules have been finalized.

National Emission Standards for Hazardous Air Pollutants

Regulatory requirements for facilities subject to NESHAP standards, otherwise known as Maximum Available Control Technology (MACT) Standards for source categories, are contained in 40 CFR Part 63. 40 CFR Part 61 NESHAP standards are defined for specific pollutants while Part 63 NESHAPs are defined for source categories where allowable emission limits are established on the basis of a MACT determination for a particular major source. A major source of HAP is defined as having potential emissions in excess of 25 tpy for total HAP and/or potential emissions in excess of 10 tpy for any individual HAP. Part 63 NESHAPs apply to sources in specifically regulated industrial source categories (CAA Section 112(d)) or on a case-by-case basis (Section 112(g)) for facilities not regulated as a specific industrial source type.

Potential HAP emissions from the proposed Stallworth Compressor Station will be below the major source thresholds (i.e., less than 10 tpy of individual HAP and 25 tpy of total HAP) and therefore the facility will be an area source of HAP. The potential applicability of specific MACT standards to the Stallworth Compressor Station is discussed below.

NESHAP Subpart HH - Natural Gas Production Facilities

This standard applies to sources at natural gas production facilities that are major or area sources of HAP emissions. The proposed Stallworth Station is a transmission facility; therefore, this facility will not be subject to Subpart HH.

NESHAP Subpart HHH - Natural Gas Transmission and Storage Facilities

This standard applies to sources at natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and/or treatment in the production sector), but upstream of the distribution sector. The proposed Stallworth Compressor Station is a transmission facility and is an area source of HAP emissions. Therefore, this facility will not be subject to Subpart HHH.

NESHAP Subpart YYYY - Stationary Combustion Turbines.

Stationary combustion turbines located at facilities that are major sources of HAPs are potentially subject to Subpart YYYY, NESHAP for Stationary Combustion Turbines. Subpart YYYY establishes emissions and operating limitations for lean premix gas-fired, lean premix oil-fired, diffusion flame gas-fired and diffusion flame oil-fired stationary combustion turbines. The proposed Stallworth Station is an area source of HAP and therefore is not subject to the requirements of this subpart.

NESHAP Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines

Stationary reciprocating internal combustion engines (RICE) at both area and major sources of HAP emissions are potentially subject to Subpart ZZZZ – *NESHAP for Stationary Reciprocating Internal Combustion Engines*

(RICE). There are no proposed RICE at the Stallworth Compressor Station. Therefore, the station is not subject to this subpart.

NESHAP Subpart DDDDD - Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types at major sources of HAP. The proposed facility is an area source of HAP; therefore, the requirements of this subpart will not apply.

NESHAP Subpart JJJJJJ - Industrial, Commercial, and Institutional Boilers (Area Source Boiler MACT)

This MACT standard applies to industrial, commercial, and institutional boilers of various sizes and fuel types. The proposed fuel heaters are natural gas-fired and are specifically exempt from this subpart. Therefore, the requirements of this subpart will not apply.

West Virginia SIP Regulations

The station is potentially subject to regulations contained in the West Virginia Code of State Regulations, Title 45. The Code of State Regulations fall under two main categories: those regulations that are generally applicable (e.g., permitting requirements), and those that have specific applicability (e.g., PM standards for manufacturing equipment).

45 CSR 2: To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers

45 CSR 2 applies to fuel burning units, defined as equipment burning fuel "for the primary purpose of producing heat or power by indirect heat transfer". The proposed fuel heaters and office building heater are fuel burning units and therefore must comply with this regulation. Per 45 CSR 2-3, opacity of emissions from this unit shall not exceed 10 percent.

45 CSR 4: To Prevent and Control the Discharge of Air Pollutants into the Air Which Causes or Contributes to an Objectionable Odor

According to 45 CSR 4-3:

No person shall cause, suffer, allow or permit the discharge of air pollutants which cause or contribute to an objectionable odor at any location occupied by the public.

The station is generally subject to this requirement. MVP will operate all equipment in a manner as to avoid causing or contributing to an objectionable odor at any location occupied by the public.

45 CSR 6: Control of Air Pollution from the Combustion of Refuse

45 CSR 6 applies to activities involving incineration of refuse, defined as "the destruction of combustible refuse by burning in a furnace designed for that purpose. For the purposes of this rule, the destruction of any combustible liquid or gaseous material by burning in a flare or flare stack, thermal oxidizer or thermal catalytic oxidizer stack shall be considered incineration." The facility will not operate any incinerators under this definition and, as such, has no requirements under this rule.

45 CSR 10: To Prevent and Control Air Pollution from the Emission of Sulfur Oxides

This rule applies to specific emission sources that are listed by name in the rule, to sulfuric acid manufacturing plants, and to sources that combust any refinery process gas stream or any other process gas stream that contains hydrogen sulfide in a concentration greater than 50 grains per 100 cubic feet. The Stallworth Station does not meet any of the categories subject to the rule, and as such is not subject to comply.

45 CSR 13: Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, Permission to Commence Construction, and Procedures for Evaluation

This rule establishes procedures for permitting and reporting of stationary sources. MVP will comply with the requirements of this rule by complying with the applicable general provisions in the facility's construction and operating permits.

45 CSR 16: Standards of Performance for New Stationary Sources

45 CSR 16-1 incorporates the federal Clean Air Act (CAA) standards of performance for new stationary sources set forth in 40 CPR Part 60 by reference. As noted above, the facility will comply with all applicable NSPS subparts.

45 CSR 17: To Prevent and Control Particulate Matter Air Pollution from Materials Handling, Preparation, Storage and Other Sources of Fugitive Particulate Matter

According to 45 CSR 17-3.1:

No person shall cause, suffer, allow or permit fugitive particulate matter to be discharged beyond the boundary lines of the property lines of the property on which the discharge originates or at any public or residential location, which causes or contributes to statutory air pollution.

Due to the nature of the activities at the station, it is unlikely that fugitive particulate matter emissions will be emitted under normal operating conditions. However, MVP will take measures to ensure any fugitive particulate matter emissions will not cross the property boundary should any such emissions occur.

45 CSR 21: To Prevent and Control Air Pollution from the Emission of Volatile Organic Compounds

45 CSR 21 applies only to sources located in Putnam County, Kanawha County, Cabell County, Wayne County, and Wood County, West Virginia. The Stallworth Station will be located in Fayette County. Therefore, the requirements of this section to not apply to the station.

45 CSR 22: Air Quality Management Fee Program

This regulation establishes a program to collect fees for certificates to operate and for permits to construct, modify or relocate sources of air pollution. MVP will comply with this rule by paying all required permitting fees.

45 CSR 34: Emissions Standards for Hazardous Air Pollutants

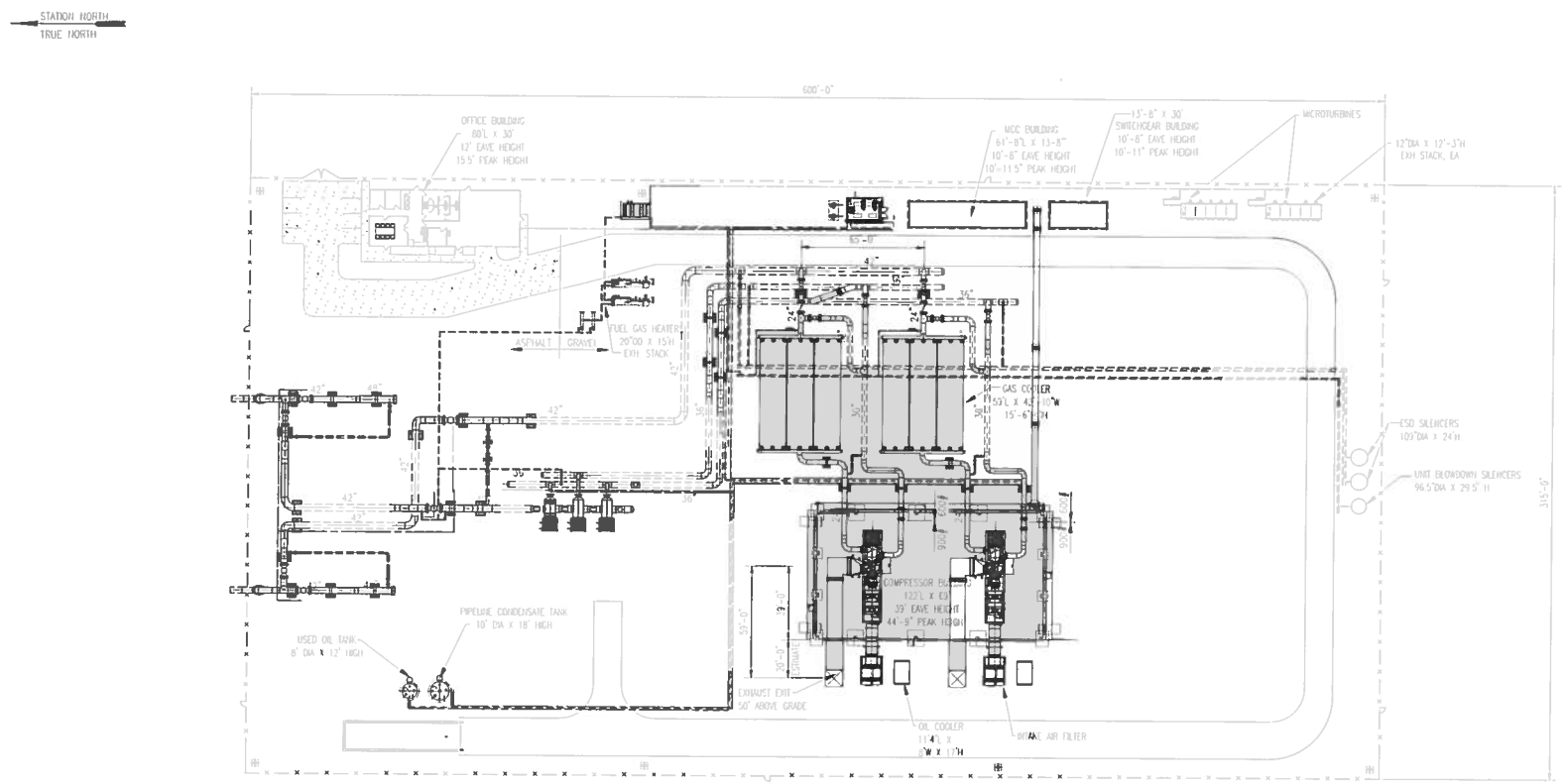
45 CSR 34-1 incorporates the federal Clean Air Act (CAA) national emissions standards for hazardous air pollutants (NESHAPs) as set forth in 40 CPR Parts 61 and 63 by reference. As noted above, no NESHAP are applicable to the station.

Non-Applicability of Other SIP Rules

A thorough examination of the West Virginia SIP rules with respect to applicability at the station reveals many SIP regulations that do not apply or impose additional requirements on operations. Such SIP rules include those specific to a particular type of industrial operation that is categorically not applicable to the station.

ATTACHMENT E

Plot Plan



REFERENCE DRAWINGS		NO	DATE	REVISION	BY	CHK	APP'D	NO	DATE	REVISION	BY	CHK	APP'D
DRAWING NUMBER	DRAWING TITLE	P		PRELIMINARY				–					
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TO THE BEST OF MY KNOWLEDGE, ALL COMPONENTS OF THIS DRAWING ARE DESIGNED IN ACCORDANCE WITH APPLICABLE GUIDELINES AND SPECIFICATIONS

MECHANICAL DESIGN ENGINEER — DATE

ELECTRICAL DESIGN ENGINEER — DATE

NOTE: ANY CHANGES TO THE DESIGN SHOWN ON THIS DRAWING MUST BE APPROVED BY THE DESIGN ENGINEER

Mountain Valley PIPELINE

PROJECT ID

DRAWING SCALE 1"=30'

DRAWING TITLE

MOUNTAIN VALLEY PIPELINE
MECHANICAL
PIPING
PLOT PLAN

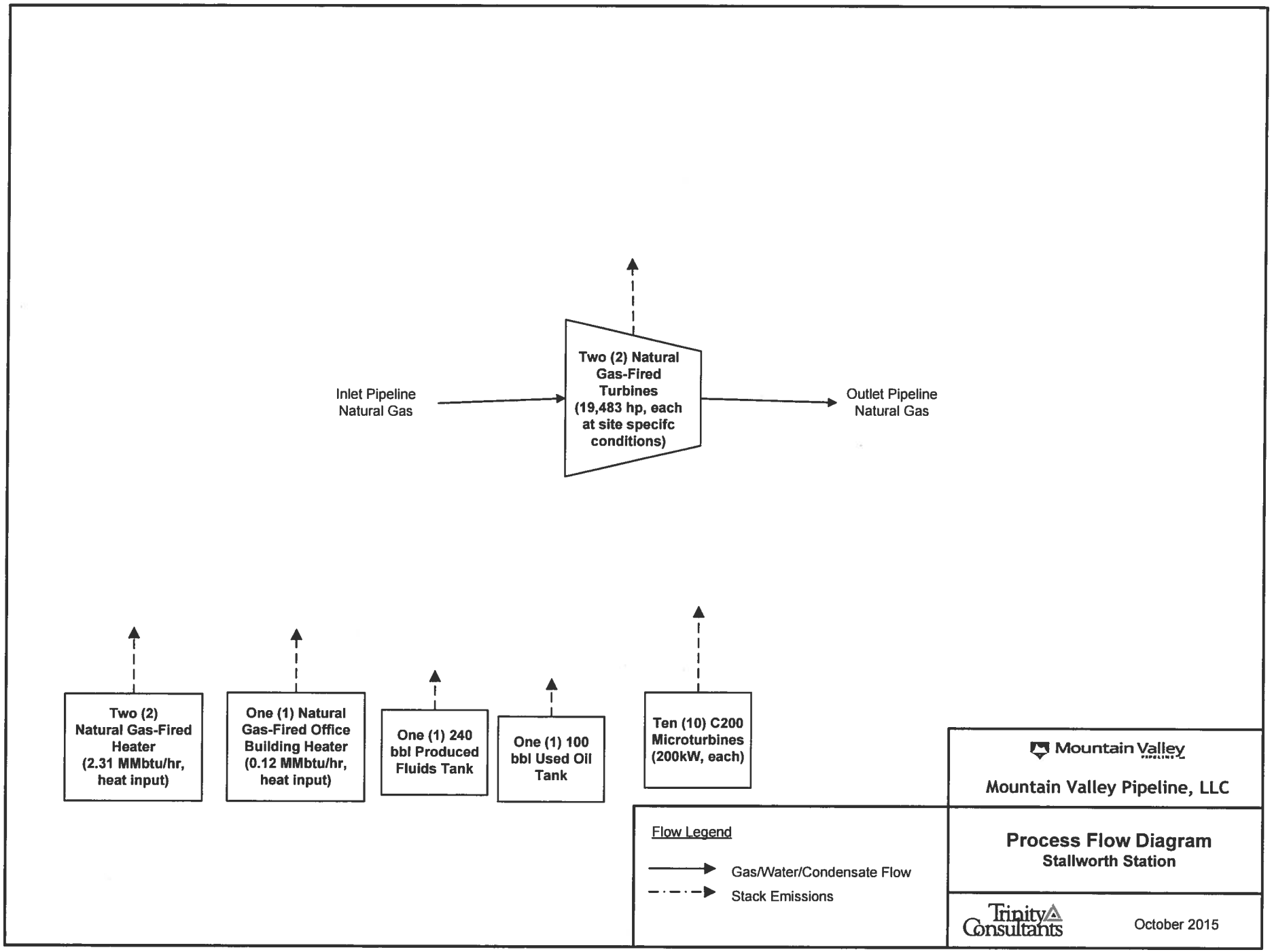
FACILITY	STATE	IDENTIFICATION	SERIES	SHEET	REVISION
C	W	STW01	1100	01	P

Plotted by Thompson, Carlson July 9, 2015 - 4:18 PM

File Path: C:\Vault Working\3D\MVP\Stallworth Compressor Station\Drawing Files\Design Files\Mechanical\2Dmodel\C-W-STW01-1100-01.dwg

ATTACHMENT F

Detailed Process Flow Diagram


Inlet Pipeline Natural Gas
Two (2) Natural Gas-Fired Turbines (19,483 hp, each at site specifc conditions)
Outlet Pipeline Natural Gas
Two (2) Natural Gas-Fired Heater (2.31 MMbtu/hr, heat input)
One (1) Natural Gas-Fired Office Building Heater (0.12 MMbtu/hr, heat input)
One (1) 240 bbl Produced Fluids Tank
One (1) 100 bbl Used Oil Tank
Ten (10) C200 Microturbines (200kW, each)
Flow Legend
Gas/Water/Condensate Flow
Stack Emissions
Mountain Valley
Mountain Valley Pipeline, LLC
Process Flow Diagram
Stallworth Station
Trinity Consultants
October 2015

ATTACHMENT G

Process Description

ATTACHMENT G - PROCESS DESCRIPTION

Mountain Valley Pipeline, LLC (MVP) is submitting this application for the construction of a new natural gas transmission compressor station located in Fayette County, West Virginia (Stallworth Station).

Natural gas from enters the station via the transmission pipeline system and is compressed using one of the two (2) natural gas-fired turbines (each rated at 19,483 hp at site-specific conditions, and ISO rated at 20,500 hp each). The compressed natural gas flows into the pipeline to be transported further along the transmission system. The station is also equipped with two (2) fuel gas heaters, one (1) office building heater, one (1) produced fluids storage tank, one (1) used oil storage tank, and ten (10) natural gas-fired microturbine generators (each rated at 200 kW) providing electricity to the station. Once the tanks are filled, the contents are loaded into trucks for transport.

A process flow diagram is included as Attachment F.

ATTACHMENT I

Emission Units Table

Attachment I

Emission Units Table

(includes all emission units and air pollution control devices that will be part of this permit application review, regardless of permitting status)

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed/ Modified	Design Capacity	Type[3] and Date of Change	Control Device[4]
S001	E001	Solar Turbine #1	2016/2017	19,483 HP (site-specific conditions)	New	N/A
S002	E002	Solar Turbine #2	2016/2017	19,483 HP (site-specific conditions)	New	N/A
S003	E003	Microturbine Generator #1	2016/2017	200 KW	New	N/A
S004	E004	Microturbine Generator #2	2016/2017	200 KW	New	N/A
S005	E005	Microturbine Generator #3	2016/2017	200 KW	New	N/A
S006	E006	Microturbine Generator #4	2016/2017	200 KW	New	N/A
S007	E007	Microturbine Generator #5	2016/2017	200 KW	New	N/A
S008	E008	Microturbine Generator #6	2016/2017	200 KW	New	N/A
S009	E009	Microturbine Generator #7	2016/2017	200 KW	New	N/A
S010	E010	Microturbine Generator #8	2016/2017	200 KW	New	N/A
S011	E011	Microturbine Generator #9	2016/2017	200 KW	New	N/A
S012	E012	Microturbine Generator #10	2016/2017	200 KW	New	N/A
S013	E013	Fuel Gas Heater	2016/2017	2.31 MMBtu/hr	New	N/A
S014	E014	Fuel Gas Heater	2016/2017	2.31 MMBtu/hr	New	N/A
S015	E015	Produced Fluids Tank	2016/2017	10,080 gallons	New	N/A
S016	E016	Used Oil Tank	2016/2017	4,200 gallons	New	N/A
S017	E017	Office Building Heater	2016/2017	0.120 MMBtu/hr	New	N/A
S018	E018	Fugitives Components	2016/2017	N/A	New	N/A
S019	E019	Liquid Loading	2016/2017	126,000 gal/yr	New	N/A

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] New, modification, removal
[4] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.

ATTACHMENT J

Emission Points Data Summary Sheet

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 1: Emissions Data

Emission Point ID No. *(Must match Emission Units Table & Plot Plan)*	Emission Point Type[1]	Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)*		Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)*		Vent Time for Emission Unit *(chemical processes only)*		All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions [4]		Maximum Potential Controlled Emissions [5]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used [6]	Emission Concentration [7] (ppmv or mg/m[4])
		ID No.	Source	ID No.	Device Type	Short Term[2]	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
S001	Upward Vertical stack	E001	Solar Turbine	NA	NA	NA	NA	NOx	8.49	37.21	8.49	37.21	Gas/Vapor	O[A]	
								CO	8.61	40.02	8.61	40.02		O[A]	
								VOC	0.99	4.35	0.99	4.35		O[A]	
								SO2	0.50	2.20	0.50	2.20		O[A]	
								PM/PM10/PM2.5	2.21	9.69	2.21	9.69		O[A]	
								HAPs	0.47	2.06	0.47	2.06		O[A,B]	
								CO2e	17,502	76,782	17,502	76,782		O[A,C]	
S002	Upward Vertical stack	E002	Solar Turbine	NA	NA	NA	NA	NOx	8.49	37.21	8.49	37.21	Gas/Vapor	O[A]	
								CO	8.61	40.02	8.61	40.02		O[A]	
								VOC	0.99	4.35	0.99	4.35		O[A]	
								SO2	0.50	2.20	0.50	2.20		O[A]	
								PM/PM10/PM2.5	2.21	9.69	2.21	9.69		O[A]	
								HAPs	0.47	2.06	0.47	2.06		O[A,B]	
								CO2e	17,502	76,782	17,502	76,782		O[A,C]	
S003	Upward Vertical Stack	E003	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S004	Upward Vertical Stack	E004	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S005	Upward Vertical Stack	E005	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	

S006	Upward Vertical Stack	E006	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S007	Upward Vertical Stack	E007	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S008	Upward Vertical Stack	E008	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S009	Upward Vertical Stack	E009	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S010	Upward Vertical Stack	E010	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S011	Upward Vertical Stack	E011	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S012	Upward Vertical Stack	E012	Microturbine	NA	NA	NA	NA	NOx	0.08	0.35	0.08	0.35	Gas/Vapor	O[A]	
								CO	0.22	0.96	0.22	0.96		O[A]	
								VOC	0.02	0.09	0.02	0.09		O[A]	
								SO2	0.01	0.03	0.01	0.03		O[D]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[D]	
								HAPs	0.002	0.01	0.002	0.01		O[D]	
								CO2e	266	1,166	266	1,166		O[A,C]	
S013	Upward Vertical stack	E013	Fuel Gas Heater	NA	NA	NA	NA	NOx	0.21	0.93	0.21	0.93	Gas/Vapor	O[F]	
								CO	0.18	0.78	0.18	0.78		O[F]	
								VOC	0.01	0.05	0.01	0.05		O[F]	
								SO2	<0.01	0.01	<0.01	0.01		O[F]	
								PM/PM10/PM2.5	0.02	0.07	0.02	0.07		O[F]	
								CO2e	270	1,184	270	1,184		O[C]	

S014	Upward Vertical stack	E014	Fuel Gas Heater	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.21 0.18 0.01 <0.01 0.02 270	0.93 0.78 0.05 0.01 0.07 1,184	0.21 0.18 0.01 <0.01 0.02 270	0.93 0.78 0.05 0.01 0.07 1,184	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S-015	Upward Vertical Stack	E-015	Produced Fluids Storage Tank	NA	NA	NA	NA	VOC HAP	0.05 <0.01	0.21 <0.01	0.05 <0.01	0.21 <0.01	Gas/Vapor	O[E]	
S-016	Upward Vertical Stack	E-016	Used Oil Storage Tank	NA	NA	NA	NA	VOC HAP	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	<0.01 <0.01	Gas/Vapor	O[E]	
S-017	Upward Vertical stack	E-017	Office Building Heater	NA	NA	NA	NA	NOx CO VOC SO2 PM/PM10/PM2.5 CO2e	0.01 0.01 <0.01 <0.01 <0.01 14	0.05 0.04 <0.01 <0.01 <0.01 64	0.01 0.01 <0.01 <0.01 <0.01 14	0.05 0.04 <0.01 <0.01 <0.01 64	Gas/Vapor	O[F] O[F] O[F] O[F] O[F] O[C]	
S-018	Fugitives	E-018	Fugitives including Haul Roads	NA	NA	NA	NA	VOC PM/PM10/PM2.5 HAP CO2e	0.80 0.03 0.06 504	3.52 0.12 0.26 2,207	0.80 0.03 0.06 504	3.52 0.12 0.26 2,207	Gas/Vapor	O[G] O[H] O[G] O[C]	
S-019	Liquid Loading	L1	Liquid Loading	NA	NA	NA	NA	VOC	NA	0.05	NA	0.05	Gas/Vapor	O[I]	

A- Manufacturer's specific pollutant emission factor
B- AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000, except for Formaldehyde which is manufacturer's spec.
C- 40 CFR 98, Subpart C for natural gas fired combustion.
D- AP-42 Section 3.1 Table 3.1-2a
E- API E&P Tanks/EPA TANKS 4.09d
F- AP-42 Section 1.4 Tables 1.4-1, 1.4-2 and 1.4-3, July 1998.
G- EPA Leak Protocol, Table 2-4, 40 CFR 98 Subpart W, & Site-Specific Gas Analysis
H- AP-42 Table 13.2.2-2 (Final, 11/06)
I- AP-42 Section 5.2 Table 5.2-1

The EMISSION POINTS DATA SUMMARY SHEET provides a summation of emissions by emission unit. Note that uncaptured process emission unit emissions are not typically considered to be fugitive and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET. Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions). Please complete the FUGITIVE EMISSIONS DATA SUMMARY SHEET for fugitive emission activities.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] Indicate by "C" if venting is continuous. Otherwise, specify the average short-term venting rate with units, for intermittent venting (ie., 15 min/hr). Indicate as many rates as needed to clarify frequency of venting (e.g., 5 min/day, 2 days/wk).

[3] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases.

[4] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

6 Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

7 Provide for all pollutant emissions. Typically, the units of parts per million by volume (ppmv) are used. If the emission is a mineral acid (sulfuric, nitric, hydrochloric or phosphoric) use units of milligram per dry cubic meter (mg/m^3) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO_2, use units of ppmv (See 45CSR10).

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 2: Release Parameter Data								
Emission Point ID No. *(Must match Emission Units Table)*	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (°F)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2] *(Release height of emissions above ground level)*	Northing	Easting

[1] Give at operating conditions. Include inerts.
[2] Release height of emissions above ground level.

ATTACHMENT K

Fugitive Emissions Data Summary Sheet

Attachment K

FUGITIVE EMISSIONS DATA SUMMARY SHEET

The FUGITIVE EMISSIONS SUMMARY SHEET provides a summation of fugitive emissions. Fugitive emissions are those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Note that uncaptured process emissions are not typically considered to be fugitive, and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET.

Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions).

APPLICATION FORMS CHECKLIST - FUGITIVE EMISSIONS
1.) Will there be haul road activities? ☒ Yes ☐ No ☐ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☒ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☒ Yes ☐ No ☐ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☒ Yes ☐ No ☐ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered "NO" to all of the items above, it is not necessary to complete the following table, "Fugitive Emissions Summary."

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads	NA	--	--	--	--	--
Unpaved Haul Roads	PM PM_{10} $PM_{2.5}$	0.11 0.03 <0.01	0.46 0.12 0.01	0.11 0.03 <0.01	0.46 0.12 0.01	O[C]
Storage Pile Emissions	NA	---	---	---	---	---
Loading/Unloading Operations	VOC	N/A	0.05	N/A	0.05	O[B]
Wastewater Treatment Evaporation & Operations	NA	---	---	---	---	---
Equipment Leaks (includes blowdowns and maintenance)	VOC HAP	N/A	3.52 0.26	N/A	3.52 0.26	O[A]
General Clean-up VOC Emissions	NA	---	---	---	---	---
Other	NA	---	---	---	---	---

A – Oil *and Gas Production Operations Average Emission Factors*, Protocol for Equipment Leak Emission Estimates, EPA 453/R-95-017, Table 2-4, November 1995, 40 CFR 98 Subpart W, and mass balance.

B- AP 42 Section 5.2.1

C – AP 42 Section 13.2.2.

[1] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. DO NOT LIST H_2, H_2O, N_2, O_2, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

ATTACHMENT L

Emission Unit Data Sheet

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S001 to S002

1. Name or type and model of proposed affected source:

   Two (2) Natural Gas-Fired Solar Titan 130 Turbines – Each rated at 19,483 HP at site-specific conditions. ISO rating is 20,500 HP (each)

2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.

3. Name(s) and maximum amount of proposed process material(s) charged per hour:

   NA

4. Name(s) and maximum amount of proposed material(s) produced per hour:

   Does not produce any materials. The turbines compress natural gas.

5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:

   External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 144,613 scf/hr (each)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Two (2) 141.62 MMBtu/hr stationary gas turbines

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 141.62 (each) × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
Monitor sulfur content of the fuel per 60.4360	Maintain records of fuel consumption
REPORTING	**TESTING**
Submit report of initial compliance testing in accordance with 40 CFR 60.4375(b) within 60 days of the performance test	Annual performance testing in accordance with 40 CFR 60.4340(a) to demonstrate compliance with NOx emission limitations

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S003 to S012

1. Name or type and model of proposed affected source: Ten (10) natural gas-fired combustion capstone microturbines (each rated at 200kW) – Consists of 10 identical 200kW units
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Electrical generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 2,106 scf/hr (each)

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Ten (10) 2.28 MMBtu/hr stationary gas turbines

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.28 (each) × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N.**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S013 to S014

1. Name or type and model of proposed affected source:

   Two (2) Natural gas-fired fuel gas heaters (2.31 MMBtu/hr, heat input)

2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.

3. Name(s) and maximum amount of proposed process material(s) charged per hour:

   NA

4. Name(s) and maximum amount of proposed material(s) produced per hour:

   Does not produce any materials. Thermal generation from natural gas.

5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:

   External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 2,100 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

Two (2) 2.31 MMBtu/hr, natural gas fired external combustion heaters

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 2.31 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT www.epa.gov/tnn/tanks.html), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (http://www.epa.gov/tnn/chief/).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Stallworth Compressor Station	2. Tank Name Produced Fluids Storage Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) S015	4. Emission Point Identification No. (as assigned on *Equipment List Form*) E015
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. S015: 240 bbl	
9A. Tank Internal Diameter (ft) ~10	9B. Tank Internal Height (or Length) (ft) ~18
10A. Maximum Liquid Height (ft) ~17	10B. Average Liquid Height (ft) ~ 10
11A. Maximum Vapor Space Height (ft) ~18	11B. Average Vapor Space Height (ft) ~5
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 240 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
126,000	345

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 12.5

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):

☒ Fixed Roof _x_ vertical __ horizontal ___ flat roof _x_ cone roof ___ dome roof
___ other (describe)

☐ External Floating Roof ___ pontoon roof ___ double deck roof

☐ Domed External (or Covered) Floating Roof

☐ Internal Floating Roof ___ vertical column support ___ self-supporting

☐ Variable Vapor Space ___ lifter roof ___ diaphragm

☐ Pressurized ___ spherical ___ cylindrical

☐ Underground

☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color Gray	20B. Roof Color Gray	20C. Year Last Painted

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): -0.30 to 0.70 psig

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft) 0.0625

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:		
ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:
COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:
LADDER WELL		
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:	
GAUGE-HATCH/SAMPLE PORT		
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:	
ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)
VACUUM BREAKER		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
RIM VENT		
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	
DECK DRAIN (3-INCH DIAMETER)		
OPEN:	90% CLOSED:	
STUB DRAIN		
1-INCH DIAMETER:		
OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)		

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply		
26A. Deck Type: ☐ Bolted ☐ Welded		
26B. For Bolted decks, provide deck construction:		
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)		
26D. Deck seam length (ft)	26E. Area of deck (ft^2)	
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:	

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F) 54.98	
29. Annual Average Maximum Temperature (°F) 65.75	
30. Annual Average Minimum Temperature (°F) 44.22	
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,251
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid:			
34A. Minimum (°F)		34B. Maximum (°F)	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F)		37B. Corresponding Vapor Pressure (psia)	
38A. Maximum Liquid Surface Temperature (°F)		38B. Corresponding Vapor Pressure (psia)	
39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Produced Fluids		
39B. CAS Number	TBD		
39C. Liquid Density (lb/gal)	TBD		
39D. Liquid Molecular Weight (lb/lb-mole)	TBD		
39E. Vapor Molecular Weight (lb/lb-mole)	36.25		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	TBD TBD		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☒ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☒ Conservation Vent (psig) – Enardo Valve
  - Vacuum Setting 0.30 Pressure Setting 0.70
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☐ Other[1] (describe):

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
See attached emission calculations					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT www.epa.gov/tnn/tanks.html), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (http://www.epa.gov/tnn/chief/).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Stallworth Compressor Station	2. Tank Name Used Oil Storage Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) S016	4. Emission Point Identification No. (as assigned on *Equipment List Form*) E016
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable) Not Applicable	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. S016: 100 bbl	
9A. Tank Internal Diameter (ft) ~7.7	9B. Tank Internal Height (or Length) (ft) ~12
10A. Maximum Liquid Height (ft) ~12	10B. Average Liquid Height (ft) ~ 6
11A. Maximum Vapor Space Height (ft) ~12	11B. Average Vapor Space Height (ft) ~6
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 100 bbl	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
3,150	8.6

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume)
<1

15. Maximum tank fill rate (gal/min) TBD

16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☐ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year
TBD	TBD

18. Type of tank (check all that apply):
☐ Fixed Roof _ vertical _X_ horizontal ___ flat roof __ cone roof ___ dome roof
___ other (describe)
☐ External Floating Roof ___ pontoon roof ___ double deck roof
☐ Domed External (or Covered) Floating Roof
☐ Internal Floating Roof ___ vertical column support ___ self-supporting
☐ Variable Vapor Space ___ lifter roof ___ diaphragm
☐ Pressurized ___ spherical ___ cylindrical
☐ Underground
☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color Gray	20B. Roof Color Gray	20C. Year Last Painted

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): -0.30 to 0.25 psig

24. Complete the following section for **Vertical Fixed Roof Tanks** ☒ Does Not Apply

24A. For dome roof, provide roof radius (ft)

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☒ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one)
☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal
☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

25D. If YES, how is the secondary seal mounted? (check one) ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL	
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT	
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER	
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT	
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)	
OPEN:	90% CLOSED:

STUB DRAIN
1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☒ Does Not Apply		
26A. Deck Type: ☐ Bolted ☐ Welded		
26B. For Bolted decks, provide deck construction:		
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 x 7.5 feet wide ☐ Continuous sheet construction 5 x 12 feet wide ☐ Other (describe)		
26D. Deck seam length (ft)	26E. Area of deck (ft^2)	
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:	

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F) 54.98	
29. Annual Average Maximum Temperature (°F) 65.75	
30. Annual Average Minimum Temperature (°F) 44.22	
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,251
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: **See TANKS Summary Sheets**			
34A. Minimum (°F)		34B. Maximum (°F)	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F)		37B. Corresponding Vapor Pressure (psia)	
38A. Maximum Liquid Surface Temperature (°F)		38B. Corresponding Vapor Pressure (psia)	
39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Used Oil		
39B. CAS Number			
39C. Liquid Density (lb/gal)	TBD		
39D. Liquid Molecular Weight (lb/lb-mole)	TBD		
39E. Vapor Molecular Weight (lb/lb-mole)	TBD		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)	<1.5 psia		
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☒ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting — Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☐ Other[1] (describe):

[1] Complete appropriate Air Pollution Control Device Sheet.

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application).

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
See attached emission calculations					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
GENERAL

To be used for affected sources other than asphalt plants, foundries, incinerators, indirect heat exchangers, and quarries.

Identification Number (as assigned on *Equipment List Form*): S017

1. Name or type and model of proposed affected source: Natural gas-fired office building heater (0.12 MMBtu/hr, heat input)
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: NA
4. Name(s) and maximum amount of proposed material(s) produced per hour: Does not produce any materials. Thermal generation from natural gas.
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: External combustion of natural gas

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

6. Combustion Data (if applicable):

(a) Type and amount in appropriate units of fuel(s) to be burned:

Natural gas – 110 scf/hr

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Natural gas with negligible H_2S and ash content.

(c) Theoretical combustion air requirement (ACF/unit of fuel):

Unknown @ °F and psia.

(d) Percent excess air: Unknown

(e) Type and BTU/hr of burners and all other firing equipment planned to be used:

One (1) 0.12 MMBtu/hr, natural gas fired external combustion heater

(f) If coal is proposed as a source of fuel, identify supplier and seams and give sizing of the coal as it will be fired:

NA

(g) Proposed maximum design heat input: 0.12 × 10^6 BTU/hr.

7. Projected operating schedule:

Hours/Day	24	Days/Week	7	Weeks/Year	52

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@ Unknown °F and psia

a.	NO_X	**See Emission Calculations in Attachment N**	lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs		lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	HAP		lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	TESTING
None	None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS PROCESS EQUIPMENT OPERATION/AIR POLLUTION CONTROL DEVICE.

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
None

Attachment L
EMISSIONS UNIT DATA SHEET
BULK LIQUID TRANSFER OPERATIONS

Furnish the following information for each new or modified bulk liquid transfer area or loading rack, as shown on the *Equipment List Form* and other parts of this application. This form is to be used for bulk liquid transfer operations such as to and from drums, marine vessels, rail tank cars, and tank trucks.

Identification Number (as assigned on *Equipment List Form*): S019

1. Loading Area Name: Liquid Loading

2. Type of cargo vessels accommodated at this rack or transfer point (check as many as apply):

☐Drums ☐ Marine Vessels ☐Rail Tank Cars ☒Tank Trucks

3. Loading Rack or Transfer Point Data:

Number of pumps	1
Number of liquids loaded	1
Maximum number of marine vessels, tank trucks, tank cars, and/or drums loading at one time	1

4. Does ballasting of marine vessels occur at this loading area?

☐ Yes ☐ No ☒ Does not apply

5. Describe cleaning location, compounds and procedure for cargo vessels using this transfer point:

6. Are cargo vessels pressure tested for leaks at this or any other location?

☐ Yes ☒ No

If YES, describe:

7. Projected Maximum Operating Schedule (for rack or transfer point as a whole):

Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.

hours/day	24	24	24	24
days/week	7	7	7	7
weeks/quarter	13	13	13	13

8. Bulk Liquid Data *(add pages as necessary):*							
Pump ID No.		NA					
Liquid Name		Produced Fluids					
Max. daily throughput (1000 gal/day)							
Max. annual throughput (1000 gal/yr)		126					
Loading Method [1]		Splash Fill					
Max. Fill Rate (gal/min)		TBD					
Average Fill Time (min/loading)		TBD					
Max. Bulk Liquid Temperature (°F)		~70					
True Vapor Pressure [2]		0.21 psia					
Cargo Vessel Condition [3]		Unknown					
Control Equipment or Method [4]		NA					
Minimum control efficiency (%)		0					
Maximum Emission Rate	Loading (lb/hr)	0.01					
	Annual (lb/yr)	106					
Estimation Method [5]		AP-42					

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets*):CA = Carbon Adsorption LOA = Lean Oil AdsorptionCO = Condensation SC = Scrubber (Absorption)CRA = Compressor-Refrigeration-Absorption TO = Thermal Oxidation or Incineration

CRC = Compression-Refrigeration-Condensation VB = Dedicated Vapor Balance (closed system) O = other (descibe)
[5] EPA = EPA Emission Factor as stated in AP-42 MB = Material Balance TM = Test Measurement based upon test data submittal O = other (describe)

9. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**

Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING Liquid throughput (gal/yr)	RECORDKEEPING None
REPORTING None	TESTING None

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.

REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.

TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

Attachment L
FUGITIVE EMISSIONS FROM UNPAVED HAULROADS

UNPAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

		PM	PM-10
k =	Particle size multiplier	0.80	0.36
s =	Silt content of road surface material (%)	4.8	
p =	Number of days per year with precipitation >0.01 in.	150	150

Item Number	Description	Number of Wheels	Mean Vehicle Weight (tons)	Mean Vehicle Speed (mph)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	Service Truck		4	15	0.75	TBD	365	N/A	0
2	Liquid Hauling – Vendor Fluids		16	15	0.75	TBD	2	N/A	0
3	Liquid Hauling – Produced Fluids		26	15	0.75	TBD	32	N/A	0
4	Employee Vehicles		2	15	0.75	TBD	365	N/A	0
5									
6									
7									
8									

Source: *AP-42 Fifth Edition – 13.2.2 Unpaved Roads*

$E = k \times 5.9 \times (s \div 12) \times (S \div 30) \times (W \div 3)^{0.7} \times (w \div 4)^{0.5} \times ((365 - p) \div 365) =$ lb/Vehicle Mile Traveled (VMT)

Where:

		PM	PM-10
k =	Particle size multiplier	4.9	1.5
s =	Silt content of road surface material (%)	4.8	
S =	Mean vehicle speed (mph)		
W =	Mean vehicle weight (tons)		
w =	Mean number of wheels per vehicle		
p =	Number of days per year with precipitation >0.01 in.	150	150

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF UNPAVED HAULROAD EMISSIONS

Item No.	PM				PM-10			
	Uncontrolled		Controlled		Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
1	0.05	0.24			0.01	0.06		
2	0.00	0.00			0.00	0.00		
3	0.01	0.05			0.00	0.01		
4	0.04	0.17			0.01	0.04		
5								
6								
7								
8								
TOTALS	0.11	0.46			0.03	0.12		

FUGITIVE EMISSIONS FROM PAVED HAULROADS

INDUSTRIAL PAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

I =	Industrial augmentation factor (dimensionless)	N/A
n =	Number of traffic lanes	
s =	Surface material silt content (%)	
L =	Surface dust loading (lb/mile)	

Item Number	Description	Mean Vehicle Weight (tons)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	N/A						
2							
3							
4							
5							
6							
7							
8							

Source: *AP-42 Fifth Edition – 11.2.6 Industrial Paved Roads*

$E = 0.077 \times I \times (4 \div n) \times (s \div 10) \times (L \div 1000) \times (W \div 3)^{0.7}$ = lb/Vehicle Mile Traveled (VMT)

Where:

I =	Industrial augmentation factor (dimensionless)	N/A
n =	Number of traffic lanes	
s =	Surface meterial silt content (%)	
L =	Surface dust loading (lb/mile)	
W =	Average vehicle weight (tons)	

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF PAVED HAULROAD EMISSIONS

Item No.	Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY
1	N/A		N/A	
2				
3				
4				
5				
6				
7				
8				
TOTALS				

Attachment L
EMISSIONS UNIT DATA SHEET
CHEMICAL PROCESS

For chemical processes please fill out this sheet and all supplementary forms (see below) that apply. Please check all supplementary forms that have been completed.

- ☐ *Emergency Vent Summary Sheet*
- ☒ *Leak Sources Data Sheet*
- ☐ *Toxicology Data Sheet*
- ☐ *Reactor Data Sheet*
- ☐ *Distillation Column Data Sheet*

1. Chemical process area name and equipment ID number (as shown in *Equipment List Form*)
   Fugitives

2. Standard Industrial Classification Codes (SICs) for process(es)
   4922

3. List raw materials and ☐ attach MSDSs
   NA

4. List Products and Maximum Production and ☐ attach MSDSs

Description and CAS Number	Maximum Hourly (lb/hr)	Maximum Annual (ton/year)
NA		

5. Complete the *Emergency Vent Summary Sheet* for all emergency relief devices.

6. Complete the *Leak Source Data Sheet* and describe below or attach to application the leak detection or maintenance program to minimize fugitive emissions. Include detection instruments, calibration gases or methods, planned inspection frequency, and record-keeping, and similar pertinent information. If subject to a rule requirement (e.g. 40CFR60, Subpart VV), please list those here.
   LDAR program in accordance with 40 CFR 98 Subpart W

7. Clearly describe below or attach to application Accident Procedures to be followed in the event of an accidental spill or release.
   NA

8A. Complete the *Toxicology Data Sheet* or attach to application a toxicology report (an up-to-date material safety data sheets (MSDS) may be used) outlining the currently known acute and chronic health effects of each compound or chemical entity emitted to the air. If these compounds have already been listed in Item 3, then a duplicate MSDS sheet is not required. Include data such as the OSHA time weighted average (TWA) or mutagenicity, teratogenicity, irritation, and other known or suspected effects should be addressed. Indicate where these are unknown, and provide references.

8B. Describe any health effects testing or epidemiological studies on these compounds that are being or may be conducted by the company or required under TSCA, RCRA or other federal regulations. Discuss the persistence in the environment of any emission (e.g. pesticides, etc.).

9. **Waste Products** - Waste products status: (If source is subject to RCRA or 45CSR25, please contact the Hazardous Waste Section of WVDEP, OAQ at (304) 926-3647.) NA

9A. Types and amounts of wastes to be disposed:

9B. Method of disposal and location of waste disposal facilities:
Carrier: Phone:

9C. Check here if approved USEPA/State Hazardous Waste Landfill will be used ☐

10. Maximum and Projected Typical Operating Schedule for process or project as a whole (circle appropriate units).

circle units:	(hrs/day) (hr/batch)	(days), (batches/day), (batches/week)	(days/yr), (weeks/year)
10A. Maximum			
10B. Typical			

11. Complete a *Reactor Data Sheet* for each reactor in this chemical process.

12. Complete a *Distillation Column Data Sheet* for each distillation column in this chemical process.

13. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
None	None
REPORTING	**TESTING**
None	None

MONITORING. Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment operation or air pollution control device.

RECORDKEEPING. Please describe the proposed recordkeeping that will accompany the monitoring.

REPORTING. Please describe the proposed frequency of reporting of the recordkeeping.

TESTING. Please describe any proposed emissions testing for this process equipment or air pollution control device.

14. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty
NA

LEAK SOURCE DATA SHEET

Source Category	Pollutant	Number of Source Components[1]	Number of Components Monitored by Frequency[2]	Average Time to Repair (days)[3]	Estimated Annual Emission Rate (lb/yr)[4]
Pumps[5]	light liquid VOC[6,7]				
	heavy liquid VOC[8]				
	Non-VOC[9]				
Valves[10]	Gas VOC	210	TBD	TBD	607
	Light Liquid VOC				
	Heavy Liquid VOC				
	Non-VOC				
Safety Relief Valves[11]	Gas VOC				
	Non VOC				
Open-ended Lines[12]	VOC	20	TBD	TBD	26
	Non-VOC				
Sampling Connections[13]	VOC				
	Non-VOC				
Compressors	VOC				
	Non-VOC				
Flanges	VOC	575	TBD	TBD	101
	Non-VOC				
Other	VOC				
	Non-VOC				

[1 - 13] See notes on the following page.

Notes for Leak Source Data Sheet

1. For VOC sources include components on streams and equipment that contain greater than 10% w/w VOC, including feed streams, reaction/separation facilities, and product/by-product delivery lines. Do not include certain leakless equipment as defined below by category.

2. By monitoring frequency, give the number of sources routinely monitored for leaks, using a portable detection device that measures concentration in ppm. Do not include monitoring by visual or soap-bubble leak detection methods. "M/Q(M)/Q/SA/A/O" means the time period between inspections as follows:

   Monthly/Quarterly, with Monthly follow-up of repaired leakers/Quarterly/Semi-annual/Annually/Other (specify time period)

   If source category is not monitored, a single zero in the space will suffice. For example, if 50 gas-service valves are monitored quarterly, with monthly follow-up of those repaired, 75 are monitored semi-annually, and 50 are checked bimonthly (alternate months), with non checked at any other frequency, you would put in the category "valves, gas service:" 0/50/0/75/0/50 (bimonthly).

3. Give the average number of days, after a leak is discovered, that an attempt will be made to repair the leak.

4. Note the method used: MB - material balance; EE - engineering estimate; EPA - emission factors established by EPA (cite document used); O - other method, such as in-house emission factor (specify).

5. Do not include in the equipment count sealless pumps (canned motor or diaphragm) or those with enclosed venting to a control device. (Emissions from vented equipment should be included in the estimates given in the Emission Points Data Sheet.)

6. Volatile organic compounds (VOC) means the term as defined in 40 CFR □51.100 (s).

7. A light liquid is defined as a fluid with vapor pressure equal to or greater than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if 20% w/w or more of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a light liquid.

8. A heavy liquid is defined as a fluid with a vapor pressure less than 0.04 psi (0.3 Kpa) at 20°C. For mixtures, if less than 20% w/w of the stream is composed of fluids with vapor pressures greater than 0.04 psi (0.3 Kpa) at 20 °C, then the fluid is defined as a heavy liquid.

9. LIST CO, H_2S, mineral acids, NO, NO_2, SO_3, etc. DO NOT LIST CO_2, H_2, H_2O, N_2, O_2, and Noble Gases.

10. Include all process valves whether in-line or on an open-ended line such as sample, drain and purge valves. Do not include safety-relief valves, or leakless valves such as check, diaphragm, and bellows seal valves.

11. Do not include a safety-relief valve if there is a rupture disk in place upstream of the valve, or if the valve vents to a control device.

12 Open-ended lines include purge, drain and vent lines. Do not include sampling connections, or lines sealed by plugs, caps, blinds or second valves.

13. Do not include closed-purge sampling connections.

ATTACHMENT N

Supporting Emission Calculations

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 1. Internal Combustion Turbine Emissions Calculations

Turbine Information:

Source ID:	S001-S002
Manufacturer:	Solar
Model No.:	Titan 130
Year Installed:	TBD
Fuel Used:	Natural Gas
Fuel Heating Value (Btu/scf):	979
Rated Horsepower (bhp at site conditions):	19483
Maximum Fuel Consumption at 100% Load (scf/hr):	144613
Heat Input (MMBtu/hr)	141.62
Control Device:	None
Stack Designation:	TBD

Operational Details:

Potential Annual Hours of Operation (hr/yr):	8,760
Potential Fuel Consumption (MMscf/yr):	1,266.81
Potential Startup/Shutdown Events (per year):	12

Manufacturer Specific Pollutant Emission Factors:

Pollutant	Emission Factors	Units	Emission Factor Source
NO_x	8.490	lb/hr	Manufacturer
CO	8.610	lb/hr	Manufacturer
SO_2	3.54E-03	lb/MMBtu	Manufacturer
PM_{10}	0.016	lb/MMBtu	Manufacturer, PIL 171
$PM_{2.5}$	0.016	lb/MMBtu	Manufacturer, PIL 171
VOC	0.986	lb/hr	20% of UHC per Manufacturer
Formaldehyde	0.003	lb/MMBtu	Manufacturer, PIL 168
CO_2	122.82	lb/MMBtu	40 CFR 98, Subpart C, Table C-1
CH_4	3.944	lb/hr	80% of UHC per Manufacturer
N_2O	2.3E-04	lb/MMBtu	40 CFR 98, Subpart C, Table C-2

*Emission factors from AP-42 and Subpart C are based on HHV. To calculate a LHV emission factor, emissions are multiplied by (HHV/LHV). For AP-42 HHV is 1020 Btu/scf, for Subpart C HHV is 1028 Btu/scf. PM and HCHO emission factors are provided in HHV in the specifications and were converted to LHV using a HHV value of 1020 Btu/scf.

Pollutant Emission Rates:

Pollutant	Potential Emissions (lb/hr)[1]	(tpy)[2]
NO_x	8.49	37.21
CO	8.61	40.02
SO_2	0.50	2.20
PM_{10}	2.21	9.69
$PM_{2.5}$	2.21	9.69
VOC	0.99	4.35
Formaldehyde	0.42	1.86
CO_2	17,393	76,197
CH_4	3.94	21.72
N_2O	0.03	0.14
GHG (CO2e)	17502	76782

*Annual emissions shown above include startup/shutdown events.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 1. Internal Combustion Turbine Emissions Calculations

Hazardous Air Pollutant (HAP) Emission Rates:

Pollutant	Emission Factor (lb/MMBtu)[3]	Potential Emissions (lb/hr)[1]	Potential Emissions (tpy)[2,4]
HAPs:			
Acetaldehyde	4.17E-05	5.90E-03	2.58E-02
Acrolein	6.67E-06	9.44E-04	4.13E-03
Benzene	1.25E-05	1.77E-03	7.75E-03
1,3-Butadiene	4.48E-07	6.34E-05	2.78E-04
Propylene Oxide	2.90E-05	4.11E-03	1.80E-02
Ethylbenzene	3.33E-05	4.72E-03	2.07E-02
Toluene	1.35E-04	1.92E-02	8.40E-02
Xylene	6.67E-05	9.44E-03	4.13E-02
Polycyclic Organic Matter:			
Naphthalene	1.35E-06	1.92E-04	8.40E-04
PAH	2.29E-06	3.25E-04	1.42E-03
Total HAP (Including HCHO)		**0.47**	**2.06**

1. Emission Rate (lb/hr) = Rated Capacity (MMBtu/hr) × Emission Factor (lb/MMBtu)
2. Emission Rate (tpy) = Emission Rate (lb/hr) × Hours of Operation (hr/yr) / 2000 (tons/lb) + SU/SD emissions, as applicable
3. Emission factors from AP-42 Section 3.1, Table 3.1-3 "Emission Factors for HAPs from Natural Gas Fired Stationary Gas Turbines", April 2000. Factors are based on HHV. Therefore, they were converted to LHV by multiplying by (HHV/LHV).
4. Emission calculations are based on maximum operating load of 100% load, ambient temperature 0°F and site elevation. The turbine ratings can vary with ambient conditions. Each Turbine is ISO rated at 20,500 HP

Startup/Shutdown Combustion Emission Factors:

Pollutant	Startup Emissions[1] (lbs/event)	Shutdown Emissions[1] (lbs/event)	Emission Factor Source
NO_X	1.9	2.4	Manufacturer
CO	176.9	207.6	Manufacturer
VOC	2.0	2.38	20% of UHC per Manufacturer
CO_2	1161	1272	Manufacturer

1. Each startup and shutdown event is estimated to last approximately 10 minutes, per manufacturer.

Pneumatic Start Venting Emissions		
Natural Gas Purged During Startup	4500	scfm
Duration of Normal Purge	4.0	min
Total Gas Purged (Per Startup)	18000	scf
VOC Purged (Per Startup)	27	lbs/startup
CO_2 Purged (Per Startup)	6	lbs/startup
CH_4 Purged (Per Startup)	742	lbs/startup

Density of natural gas: 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 2. Microturbine Emissions Calculations

Microturbine Unit Information:

Engine ID:	S003-S012
Manufacturer:	Capstone
Model No.:	C200
Projected Startup Date:	Upon Approval
Number of Units:	10

Microturbine Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Rated Electrical Power Output (kW):	200	2,000
Rated Electrical Power Output (MW):	0.2	2
Rated Horsepower (bhp):	268.2	2,682
Heat Input (MMBtu/hr)	2.28	22.8
Potential Fuel Consumption (MMBtu/yr)	19,973	199,728
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Microturbine Emissions Data:

Pollutant	Emission Factors	Units	Maximum Potential Emissions		Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO_X	0.40	lb/MWhe	0.08	0.35	0.80	3.50	Manufacturer's Specifications
VOC	0.10	lb/MWhe	0.02	0.09	0.20	0.88	Manufacturer's Specifications
CO	1.10	lb/MWhe	0.22	0.96	2.20	9.64	Manufacturer's Specifications
SO_X	0.0034	lb/MMBtu	0.01	0.03	0.08	0.34	AP-42, Table 3.1-2a (Apr-2000)
PM_{10}	0.0066	lb/MMBtu	0.02	0.07	0.15	0.66	AP-42, Table 3.1-2a (Apr-2000)
$PM_{2.5}$	0.0066	lb/MMBtu	0.02	0.07	0.15	0.66	AP-42, Table 3.1-2a (Apr-2000)
GHG (CO_2e)	See Table Below		266	1,166	2,663	11,663	Manufacturer's Specifications / 40 CFR 98, Table C-2
Other (Total HAP)	See Table Below		0.00	0.01	0.02	0.10	AP-42, Table 3.1-3 (Apr-2000)

Notes:
1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable).
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this engine type, including HCHO.

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO_2	1330	lb/MWhe	266	1,165	2,660	11,651	Manufacturer's Specifications
CH_4	0.001	kg/MMBtu	0.01	0.02	0.05	0.22	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	0.01	0.02	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**266**	**1,166**	**2,663**	**11,663**	
HAPs:							
1,3-Butadiene	4.3E-07	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acetaldehyde	4.0E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Acrolein	6.4E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Benzene	1.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Ethylbenzene	3.2E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Formaldehyde	7.1E-04	lb/MMBtu	0.00	0.01	0.02	0.07	AP-42, Table 3.1-3 (Apr-2000)
Naphthalene	1.3E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
PAH	2.2E-06	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Propylene oxide	2.9E-05	lb/MMBtu	0.00	0.00	0.00	0.00	AP-42, Table 3.1-3 (Apr-2000)
Toluene	1.3E-04	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Xylene	6.4E-05	lb/MMBtu	0.00	0.00	0.00	0.01	AP-42, Table 3.1-3 (Apr-2000)
Total HAP			**0.002**	**0.010**	**0.023**	**0.10**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 3. Fuel Gas Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S013-S014
Projected Startup Date:	Upon Approval
Number of Units:	2

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	2.31
Potential Fuel Consumption (MMBtu/yr):	20,215
Max. Fuel Consumption (MMscf/hr):	0.0021
Max. Fuel Consumption (MMscf/yr):	18.7
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_X	100	lb/MMScf	0.21	0.93	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.01	0.05	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.18	0.78	AP-42, Table 1.4-1 (Jul-1998)
SO_X	0.6	lb/MMScf	0.00	0.01	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.02	0.07	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		270	1,184	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.02	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable)
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 3. Fuel Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	269.99	1,183	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.01	0.02	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**270**	**1,184**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.02	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.004**	**0.02**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 4. Storage Tank Emissions Calculations - Produced Fluids Tank

Storage Tank Information:

Source ID:	S015
Tank Capacity (gallons):	10,080
Tank Contents:	Produced Water
Annual Throughput (gallons/year):	126,000
Daily Throughput (bbl/day)	8
Percent Condensate	1%
Condensate Throughput (bbl/day)	0.1
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.05	0.21	0.05	0.21	E&P TANK 2.0
HAPs	0.00	0.00	0.00	0.00	E&P TANK 2.0
GHG (CO2e)	0.48	2.10	0.48	2.10	E&P TANK 2.0

E & P Tanks Emissions Data:

Pollutant	Total Emissions (Working + Breathing + Flashing)			Total Emissions		
	lbs/hr	lbs/yr	tpy	lbs/hr	lbs/yr	tpy
VOC	0.05	429.24	0.21	0.05	429.24	0.21
HAPs	0.00	0.00	0.00	0.00	0.00	0.00
GHG (CO_2e)	0.48	4,161.00	2.10	0.48	4,161.00	2.10

Notes:
1. E & P TANKS software estimates working, breathing, and flashing losses and reports as one total. Emissions are based on a conservative estimate of 99% water and 1% condensate
2. This tank does contain hydrocarbons that could be flashed off at tank operating conditions

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 5. Storage Tank Emissions Calculations - Used Oil Tank

Storage Tank Information:

Source ID:	S016
Tank Capacity (gallons):	4,200
Tank Contents:	Used Oil
Annual Throughput (gallons/year):	3,150
Control Type:	None
Control Efficiency:	N/A
Max. Annual Hours of Operation (hr/yr):	8,760

Tank Emissions Data:

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
HAPs	0.00	0.00	0.00	0.00	EPA TANKS 4.0.9d
GHG (CO_2e)	N/A	N/A	N/A	N/A	N/A

Notes:
1. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

EPA TANKS Emissions Data - Glycol Tank:

Pollutant	Working Losses	Breathing Losses	Flashing Losses	Total Emissions		
	lbs/yr	lbs/yr	lbs/yr	lbs/hr	lbs/yr	tpy
VOC	0.06	1.28	N/A	0.00	1.34	0.00
HAPs	0.06	1.28	N/A	0.00	1.34	0.00

Notes:
1. Working and breathing losses estimated using EPA TANKS 4.0.9d software based on Distillate fuel oil No. 2.
2. This tank does not contain hydrocarbons that would be expected to be flashed off at tank operating conditions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 6. Office Building Heater Emissions Calculations

Fuel Gas Heater Information:

Source ID:	S017
Projected Startup Date:	Upon Approval
Number of Units:	1

Fuel Gas Heater Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,083
Heat Input (MMBtu/hr)	0.12
Potential Fuel Consumption (MMBtu/yr):	1,051
Max. Fuel Consumption (MMscf/hr):	0.0001
Max. Fuel Consumption (MMscf/yr):	1.0
Max. Annual Hours of Operation (hr/yr):	8,760

Fuel Gas Heater Information:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO_x	100	lb/MMScf	0.01	0.05	AP-42, Table 1.4-1 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMScf	0.01	0.04	AP-42, Table 1.4-1 (Jul-1998)
SO_x	0.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM_{10}	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
$PM_{2.5}$	7.6	lb/MMScf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.08	lb/MMScf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO_2e)	See Table Below		14	62	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM_{10} and $PM_{2.5}$ are total values (filterable + condensable)
2. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CC_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 6. Office Building Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO_2	53.06	kg/MMBtu	14.04	61	40 CFR 98, Tables C-1 & C-2
CH_4	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N_2O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO_2e)			**14**	**62**	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Acenapthylene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Anthracene	2.40E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benz(a)anthracene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dichlorobenzene	1.20E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP			**0.000**	**0.00**	

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 7. Fugitive Emissions Calculations

Fugitive Component Information:

Component Type	Estimated Component Count	Gas Leak Emission Factor		Average Gas Leak Rate	Max Gas Leak Rate	Potential VOC Emissions	Potential HAP Emissions
		(lb/hr/component)	Factor Source	(lb/hr)	(tpy)	(tpy)	(tpy)
Connectors	355	0.0004	EPA Protocol, Table 2-4	0.16	0.75	0.02	0.00
Flanges	220	0.001	EPA Protocol, Table 2-4	0.19	0.91	0.03	0.00
Open-Ended Lines	20	0.004	EPA Protocol, Table 2-4	0.09	0.42	0.01	0.00
Pump Seals	0	0.005	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Valves	210	0.010	EPA Protocol, Table 2-4	2.08	10.04	0.30	0.02
Other	0	0.019	EPA Protocol, Table 2-4	0.00	0.00	0.00	0.00
Total				**2.52**	**12.13**	**0.37**	**0.03**

Notes:
1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
2. The component count is a preliminary estimate based on the proposed design of the station.
3. Conservatively assumed that maximum leak rate is 10% greater than measured average leak rate for the purposes of establishing PTE.
4. VOC and HAP emissions are based on fractions of these pollutants in the site-specific gas analysis.

Dry Seal Emissions

Number of Compressors	Number of seals Per Compressor	Leak Rate (scf/hr/seal)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO_2 Emissions (tpy)	Potential CH_4 Emissions (tpy)	Potential CO_2e Emissions (tpy)
2	2	6	210,240	0.16	0.01	0.03	11.02	275.60
Total				**0.16**	**0.01**	**0.03**	**11.02**	**275.60**

1. Leak rate and seal information from EPA Natural Gas Star Program (http://www.epa.gov/gasstar/documents/ll_wetseals.pdf)
2. Emission calculations for VOC are calculated assuming a desnity of natural gas of 0.05 lb/ft^3 @ STP (www.engineeringtoolbox.com)
Sample calculation: Volume vented (scf/yr) x density of natural gas (lb/scf) x wt % VOC / 2000 lb/ton
3. GHG emissions calculated in accordance with EquationsW-35 and W-36 in Subpart W of 40 CFR 98.
Sample calculation: Volume vented (scf/yr) x density of GHG (kg/scf) x mol % VOC x 2.2 lb/kg / 2000 lb/ton

VOC and HAP Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	1.06	0.08
Compressors	320,000	8	2,560,000	1.94	0.14
Total				**3.00**	**0.22**

GHG Vented Blowdown Emissions

Blowdown Emissions Sources	Vented Gas Volume Per Blowdown Event (scf)	Number of Blowdown Events per year	Total Volume NG Emitted (scf/yr)	Potential CH_4 Emissions[1] (tpy)	Potential CO_2 Emissions[1] (tpy)	Potential CO_2e Emissions (tpy)
Station ESD Vent	1,400,000	1	1,400,000	26.79	0.21	670
Compressors	320,000	8	2,560,000	48.99	0.39	1225
Total				**75.8**	**0.60**	**1895**

1. Calculated in accordance with Equations W-35 and W-36 in Subpart W of 40 CFR 98.

GHG Fugitive Emissions from Component Leaks:

Component Type	Estimated Component Count	GHG Emission Factor		CH_4 Emissions	CO_2 Emissions	CO_2e Emissions
		(scf/hr/component)	Factor Source	(tpy)	(tpy)	(tpy)
Connectors	355	0.003	40 CFR 98, Table W-1A	0.18	0.001	4.46
Flanges	220	0.003	40 CFR 98, Table W-1A	0.11	0.001	2.77
Open-Ended Lines	20	0.061	40 CFR 98, Table W-1A	0.20	0.002	5.11
Pump Seals	0	13.3	40 CFR 98, Table W-1A	0.00	0.000	0.00
Valves	210	0.03	40 CFR 98, Table W-1A	0.95	0.008	23.77
Other	0	0.04	40 CFR 98, Table W-1A	0.00	0.000	0.00
Total				**1.44**	**0.01**	**36.12**

Notes:
1. The component count is a preliminary estimate based on the proposed design of the station.
2. CH_4 and CO_2 emissions are based on fractions of these pollutants in the site-specific gas analysis.
3. Emissions are calculated in accordance with Equations W-32a, W-35 and W-36 in Subpart W of 40 CFR 98.
4. GHG (CO_2e) is carbon dioxide equivalent, which is the summation of CO_2 (GWP = 1) + CH_4 (GWP = 25) + N_2O (GWP = 298).

Fugitive Component Emissions Data:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	0.80	3.52	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.06	0.26	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
GHG (CO_2e)	504	2,207	40 CFR 98, Table W-1A and Site-Specific Gas Analysis

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 8. Liquid Loading Emissions Calculations

Liquid Loading Information:

Parameter	Value	Description
S	1.45	saturation factor for splash loading (AP-42 Table 5.2-1)
Collection Efficiency	0.0%	No Control
Control Efficiency	0%	No Control
P	0.21	true vapor pressure of liquid loaded (psia) - assume octane
M	114.23	molecular weight of vapors (lb/lb-mol) - assume octane
T	516.4	temperature of liquids loaded (deg R) - TANKS Data

Description	Loading Losses	Maximum Throughput[2]	VOC Emissions	
	(lb/10^3 gal)[1]	(gal)	(lb/hr)	(tpy)
Liquids Hauling	0.8	126,000	0.01	0.05

Notes:

1. Uncontrolled Loading Losses: L_L (lb/10^3 gal) = 12.46 (SPM)/T
2. Engineering Estimates of Produced fluids throughput at the Facility. Produced Water will not compose of HAP

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 9. Haul Road Emission Calculations

Unpaved Road Information:

Unpaved Roads: $E\ (lb/VMT) = k(s/12)^a(W/3)^b)*[(365-p)/365]$

	PM	PM_{10}	$PM_{2.5}$	
k Factor (lb/VMT)	4.9	1.5	0.15	AP-42 Table 13.2.2-2 (Final, 11/06)
Silt content, s	4.8 %			AP-42 Table 13.2.2-1 (11/06), for Sand and Gravel Processing
Number of Rain Days, p	150			AP-42 Figure 13.2.1-2
a	0.7	0.9	0.9	AP-42 Table 13.2.2-2 (Final, 11/06)
b	0.45	0.45	0.45	AP-42 Table 13.2.2-2 (Final, 11/06)

Description	Weight of Empty Truck (tons)	Weight of Truck w/ Max Load (tons)	Mean Vehicle Weight (tons)	Length of Unpaved Road Traveled (mile/trip)	Trips Per Year	Mileage Per Year	Control (%)	Emissions (tpy) PM	PM_{10}	$PM_{2.5}$
Service Truck	4	4	4	0.75	365	274	0	0.24	0.06	0.01
Liquids Hauling - Vendor Fluid	12	20	16	0.75	2	2	0	0.00	0.00	0.00
Liquids Hauling - Produced Fluid	20	32	26	0.75	32	24	0	0.05	0.01	0.00
Employee Vehicles	2	2	2	0.75	365	274	0	0.17	0.04	0.00
Total Potential Emissions								**0.46**	**0.12**	**0.01**

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 10. Site-Specific Gas Analysis

Sample Location: Multiple Locations
HHV (Btu/scf): 1,083

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)
N2	0.4949	0.788
METHANE	90.4241	82.411
CO2	0.2608	0.652
ETHANE	7.6812	13.124
PROPANE	0.6778	1.698
I-BUTANE	0.0754	0.249
N-BUTANE	0.1355	0.447
I-PENTANE	0.054	0.223
N-PENTANE	0.045	0.186
I-H EXAN ES	0.000	0.000
N-HEXANE	0.045	0.222
BENZENE	0.000	0.000
CYCLOHEXANE	0.000	0.000
HEPTANES	0.000	0.000
TOLUENE	0.000	0.000
2,2,4 Trimethylpentane	0.000	0.000
N-OCTANE	0.000	0.000
*E-BENZENE	0.000	0.000
*m,o,&p-XYLENE	0.000	0.000
I-NONANES	0.000	0.000
N-NONANE	0.000	0.000
I-DECANES	0.000	0.000
N-DECANE	0.000	0.000
I-UNDECANES +	0.000	0.000
Totals	99.895	100

*Gas Analysis showed no detectable compounds above hexane +, conservatively assumed all hexane + was n-hexar

TOC (Total)	99.14	98.56
VOC (Total)	1.03	3.03
HAP (Total)	0.05	0.22

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 11. Potential Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																	
	VOC		NO_x		CO		PM_{10}		$PM_{2.5}$		SO_x		HCHO		Total HAPs		GHG (CO_2e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Turbine 1 (S001)	0.99	4.35	8.49	37.21	8.61	40.02	2.21	9.69	2.21	9.69	0.50	2.20	0.42	1.86	0.47	2.06	17,502	76,782
Turbine 2 (S002)	0.99	4.35	8.49	37.21	8.61	40.02	2.21	9.69	2.21	9.69	0.50	2.20	0.42	1.86	0.47	2.06	17,502	76,782
Microturbine 1 (S003)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 2 (S004)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 3 (S005)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 4 (S006)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 5 (S007)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 6 (S008)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 7 (S009)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 8 (S010)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 9 (S011)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Microturbine 10 (S012)	0.02	0.09	0.08	0.35	0.22	0.96	0.02	0.07	0.02	0.07	0.01	0.03	0.00	0.01	0.00	0.01	266	1,166
Fuel Gas Heater (S013)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Fuel Gas Heater (S014)	0.01	0.05	0.21	0.93	0.18	0.78	0.02	0.07	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.02	270	1,184
Produced Fluids Tank (S015)	0.05	0.21	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0	2
Used Oil Tank (S016)	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--	0.00	0.00	--	--
Office Building Heater (S017)	0.00	0.00	0.01	0.05	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	62
Fugitives (S018)	0.80	3.52	--	--	--	--	0.03	0.12	0.00	0.01	--	--	--	--	0.06	0.26	504	2,207
Liquid Loading (S019)	0.01	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable.
2. VOC emissions for the engines are conservatively estimated as: VOC=NMNEHC+HCHO (Formaldehyde)
3. Fugitives emissions include haul road emissions.

Company Name: Mountain Valley Pipeline, LLC
Facility Name: Stallworth Compressor Station
Project Description: R13 Permit Application

TABLE 12. Total Potential Emissions from All Sources at the Facility

Pollutants	Estimated Site-Wide Emissions	
	lb/hr	tpy
VOC	3.06	13.46
NO_X	18.22	79.84
CO	19.79	91.28
SO_X	1.08	4.74
PM_{10}	4.64	20.30
$PM_{2.5}$	4.61	20.20
Formaldehyde (HCHO)	0.87	3.79
Total HAPs	1.03	4.53
GHG (CO_2e)	38,725	169,866

Notes:
1. PM_{10} and $PM_{2.5}$ emissions are filterable + condensable

****
* Project Setup Information *
****

Project File : \\Pit-dc1\p\Client\EQT Corporation\Corporate\02 Projects\143901.0087 Mountain Valley Project\04 Draft\2015-0312 Harris R13\2015-0312 Harris PF Tank v1.0.ept
Flowsheet Selection : Oil Tank with Separator
Calculation Method : RVP Distillation
Control Efficiency : 0.0%
Known Separator Stream : Low Pressure Oil
Entering Air Composition : No

Filed Name : EQT - Stallworth Produced Fluid Tanks
Well Name : PTE
Date : 2015.03.12

****
* Data Input *
****

Separator Pressure : 414.00[psig]
Separator Temperature : 60.00[F]
Ambient Pressure : 14.70[psia]
Ambient Temperature : 55.00[F]
C10+ SG : 0.8024
C10+ MW : 163.342

-- Low Pressure Oil ----------

No.	Component	mol %
1	H2S	0.0000
2	O2	0.0000
3	CO2	0.0840
4	N2	0.0000
5	C1	9.9570
6	C2	8.1140
7	C3	6.8240
8	i-C4	1.8640
9	n-C4	4.8700
10	i-C5	2.9440
11	n-C5	3.3610
12	C6	2.2410
13	C7	9.7080
14	C8	11.4500
15	C9	8.4380
16	C10+	25.3730
17	Benzene	0.0910
18	Toluene	0.7580
19	E-Benzene	0.1130
20	Xylenes	1.3570
21	n-C6	2.4330
22	224Trimethylp	0.0200

-- Sales Oil ----------
Production Rate : 0.1[bbl/day]
Days of Annual Operation : 365 [days/year]
API Gravity : 59.11
Reid Vapor Pressure : 10.60[psia]

****
* Calculation Results *
****

-- Emission Summary ----------

Item	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
Total HAPs	0.000	0.000	0.000	0.000
Page 1----------				E&P TANK
Total HC	0.423	0.097	0.423	0.097
VOCs, C2+	0.339	0.077	0.339	0.077
VOCs, C3+	0.213	0.049	0.213	0.049

Uncontrolled Recovery Info.
Vapor 28.1600 x1E-3 [MSCFD]
HC Vapor 28.0700 x1E-3 [MSCFD]
GOR 281.60 [SCF/bbl]

-- Emission Composition ----------

No	Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
1	H2S	0.000	0.000	0.000	0.000
2	O2	0.000	0.000	0.000	0.000
3	CO2	0.002	0.000	0.002	0.000
4	N2	0.000	0.000	0.000	0.000
5	C1	0.084	0.019	0.084	0.019
6	C2	0.125	0.029	0.125	0.029
7	C3	0.109	0.025	0.109	0.025
8	i-C4	0.023	0.005	0.023	0.005
9	n-C4	0.045	0.010	0.045	0.010
10	i-C5	0.014	0.003	0.014	0.003
11	n-C5	0.012	0.003	0.012	0.003
12	C6	0.003	0.001	0.003	0.001
13	C7	0.004	0.001	0.004	0.001
14	C8	0.001	0.000	0.001	0.000
15	C9	0.000	0.000	0.000	0.000
16	C10+	0.000	0.000	0.000	0.000
17	Benzene	0.000	0.000	0.000	0.000
18	Toluene	0.000	0.000	0.000	0.000
19	E-Benzene	0.000	0.000	0.000	0.000
20	Xylenes	0.000	0.000	0.000	0.000
21	n-C6	0.002	0.000	0.002	0.000
22	224Trimethylp	0.000	0.000	0.000	0.000
	Total	0.424	0.097	0.424	0.097

-- Stream Data ----------

No.	Component	MW	LP Oil	Flash Oil	Sale Oil	Flash Gas	W&S Gas	Total Emissions

		mol %	mol %	mol %	mol %	mol %	mol %
1	H2S	34.80	0.0000	0.0000	0.0000	0.0000	0.0000
2	O2	32.00	0.0000	0.0000	0.0000	0.0000	0.0000
3	CO2	44.01	0.0840	0.0069	0.0001	0.3251	0.3289	0.3254
4	N2	28.01	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5	C1	16.04	9.9570	0.2491	0.0001	40.3145	12.0792	38.6045
6	C2	30.07	8.1140	1.3061	0.2375	29.4027	52.0759	30.7759
7	C3	44.10	6.8240	3.2946	2.8877	17.8607	22.6275	18.1494
8	i-C4	58.12	1.8640	1.5368	1.5034	2.8873	3.1206	2.9014
9	n-C4	58.12	4.8700	4.6049	4.5743	5.6989	6.0623	5.7209
10	i-C5	72.15	2.9440	3.4237	3.4639	1.4439	1.5163	1.4483
11	n-C5	72.15	3.3610	4.0550	4.1140	1.1907	1.2521	1.1944
12	C6	86.16	2.2410	2.8819	2.9372	0.2370	0.2510	0.2378
13	C7	100.20	9.7080	12.7165	12.9774	0.3002	0.3211	0.3015
14	C8	114.23	11.4500	15.0807	15.3960	0.0965	0.1043	0.0969
15	C9	128.28	8.4380	11.1296	11.3633	0.0212	0.0250	0.0215
16	C10+	163.34	25.3730	33.4860	34.1908	0.0030	0.0034	0.0030
17	Benzene	78.11	0.0910	0.1181	0.1204	0.0064	0.0068	0.0064
18	Toluene	92.13	0.7580	0.9963	1.0170	0.0128	0.0138	0.0128
19	E-Benzene	106.17	0.1130	0.1490	0.1521	0.0005	0.0006	0.0005
20	Xylenes	106.17	1.3570	1.7892	1.8267	0.0056	0.0061	0.0056
21	n-C6	86.18	2.4330	3.1494	3.2114	0.1926	0.2046	0.1933
22	224Trimethylp	114.24	0.0200	0.0262	0.0268	0.0005	0.0005	0.0005

MW	95.74	116.43	118.13	31.04	35.93	31.33
Stream Mole Ratio	1.0000	0.7577	0.7421	0.2423	0.0156	0.2579
Heating Value [BTU/SCF]				1808.07	2072.28	1824.07
Gas Gravity [Gas/Air]				1.07	1.24	1.08
Bubble Pt. @ 100F [psia]	406.75	28.61	13.23			
RVP @ 100F [psia]	101.88	15.92	10.81			

Spec. Gravity @ 100F	0.685	0.715	0.717

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

Identification

User Identification:	S016 - MVP
City:	
State:	West Virginia
Company:	Mountain Valley Pipeline, LLC
Type of Tank:	Horizontal Tank
Description:	4,200 gallon Used Oil Tank

Tank Dimensions

Shell Length (ft):	11.70
Diameter (ft):	7.80
Volume (gallons):	4,200.00
Turnovers:	0.75
Net Throughput(gal/yr):	3,150.00
Is Tank Heated (y/n):	N
Is Tank Underground (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Light
Shell Condition	Good

Breather Vent Settings

Vacuum Settings (psig):	0.00
Pressure Settings (psig)	0.00

Meterological Data used in Emissions Calculations: Elkins, West Virginia (Avg Atmospheric Pressure = 13.73 psia)

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

S016 - MVP - Horizontal Tank

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Distillate fuel oil no. 2	All	55.41	46.54	64.27	51.30	0.0061	0.0040	0.0081	130.0000			188.00	Option 1: VP50 = .0045 VP60 = .0074

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

S016 - MVP - Horizontal Tank

Annual Emission Calcaulations	
Standing Losses (lb):	1.2610
Vapor Space Volume (cu ft):	356.0945
Vapor Density (lb/cu ft):	0.0001
Vapor Space Expansion Factor:	0.0691
Vented Vapor Saturation Factor:	0.9987
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	356.0945
Tank Diameter (ft):	7.8000
Effective Diameter (ft):	10.7822
Vapor Space Outage (ft):	3.9000
Tank Shell Length (ft):	11.7000
Vapor Density	
Vapor Density (lb/cu ft):	0.0001
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0061
Daily Avg. Liquid Surface Temp. (deg. R):	515.0759
Daily Average Ambient Temp. (deg. F):	49.0583
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	510.9683
Tank Paint Solar Absorptance (Shell):	0.5400
Daily Total Solar Insulation Factor (Btu/sqft day):	1,193.8870

Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0691
Daily Vapor Temperature Range (deg. R):	35.4636
Daily Vapor Pressure Range (psia):	0.0041
Breather Vent Press. Setting Range(psia):	0.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0061
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0040
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0081
Daily Avg. Liquid Surface Temp. (deg R):	515.0759
Daily Min. Liquid Surface Temp. (deg R):	506.2100
Daily Max. Liquid Surface Temp. (deg R):	523.9417
Daily Ambient Temp. Range (deg. R):	24.1833
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9987
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0061
Vapor Space Outage (ft):	3.9000
Working Losses (lb):	0.0592
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0061
Annual Net Throughput (gal/yr.):	3,150.0000
Annual Turnovers:	0.7500
Turnover Factor:	1.0000
Tank Diameter (ft):	7.8000
Working Loss Product Factor:	1.0000
Total Losses (lb):	1.3402

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

Emissions Report for: Annual

S016 - MVP - Horizontal Tank

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	0.06	1.28	1.34

LAFAYETTE AREA LABORATORY
4790 N.E. EVANGELINE THRUWAY
CARENCRO, LA 70520
PHONE (337) 896-3055
FAX (337) 896-3077

Certificate of Analysis : 13050161-002A

Company:	Gas Analytical Services	**For:**	Gas Analytical Services
Well:	OXF 131 Pad		Alan Ball
Field:	EQT Production		PO Box 1028
Sample of:	Condensate-Spot		
Conditions:	414 @ N.G.		Bridgeport, WV, 26330
Sampled by:	GR-GAS		
Sample date:	5/14/2013	**Report Date:**	5/29/2013
Remarks:	Cylinder No.: GAS		
Remarks:			

Analysis: (*GPA 2186M*)	**Mol. %**	**MW**	**Wt. %**	**Sp. Gravity**	**L.V. %**
Nitrogen	0.000	28.013	0.000	0.8094	0.000
Methane	9.957	16.043	1.664	0.3000	3.884
Carbon Dioxide	0.084	44.010	0.039	0.8180	0.033
Ethane	8.114	30.070	2.542	0.3562	4.991
Propane	6.824	44.097	3.135	0.5070	4.324
Iso-butane	1.864	58.123	1.129	0.5629	1.403
N-butane	4.870	58.123	2.948	0.5840	3.533
Iso-pentane	2.944	72.150	2.213	0.6244	2.479
N-pentane	3.361	72.150	2.526	0.6311	2.801
i-Hexanes	2.241	86.177	1.990	0.6795	2.104
n-Hexane	2.433	85.734	2.184	0.6640	2.288
2,2,4 trimethylpentane	0.020	114.231	0.024	0.6967	0.024
Benzene	0.091	78.114	0.065	0.8846	0.059
Heptanes	9.708	98.181	9.953	0.7010	9.943
Toluene	0.758	92.141	0.641	0.8719	0.588
Octanes	11.450	107.956	13.087	0.7510	12.206
E-benzene	0.113	106.167	0.053	0.8718	0.102
M-,O-,P-xylene	1.357	106.167	1.501	0.8731	1.214
Nonanes	8.438	122.962	11.137	0.7603	10.366
Decanes Plus	25.373	163.342	43.169	0.8024	37.658
	100.000		100.000		100.000

Calculated Values	**Total Sample**	**Decanes Plus**
Specific Gravity at 60 °F	0.6999	0.8024
Api Gravity at 60 °F	70.675	44.841
Molecular Weight	96.001	163.342
Pounds per Gallon (in Vacuum)	5.835	6.690
Pounds per Gallon (in Air)	5.829	6.683
Cu. Ft. Vapor per Gallon @ 14.73 psia	23.120	15.507

Brian Gaspard

Southern Petroleum Laboratories, Inc.

LAFAYETTE AREA LABORATORY
4790 N.E. EVANGELINE THRUWAY
CARENCRO, LA 70520
PHONE (337) 896-3055
FAX (337) 896-3077

Certificate of Analysis : 13050161-002A

Company:	Gas Analytical Services	**For:**	Gas Analytical Services
Well:	OXF 131 Pad		Alan Ball
Field:	EQT Production		PO Box 1028
Sample of:	Condensate-Spot		
Conditions:	414 @ N.G.		Bridgeport, WV, 26330
Sampled by:	GR-GAS		
Sample date:	5/14/2013	**Report Date:**	5/29/2013
Remarks:	Cylinder No.: GAS		
Remarks:			

Analysis: (*GPA 2103*)	**Mol. %**	**MW**	**Wt. %**	**Sp. Gravity**	**L.V. %**
Nitrogen	0.000	28.013	0.000	0.8094	0.000
Methane	9.957	16.043	1.664	0.3000	3.884
Carbon Dioxide	0.084	44.010	0.039	0.8180	0.033
Ethane	8.114	30.070	2.542	0.3562	4.991
Propane	6.824	44.097	3.135	0.5070	4.324
Iso-butane	1.864	58.123	1.129	0.5629	1.403
N-butane	4.870	58.123	2.948	0.5840	3.533
Iso-pentane	2.944	72.150	2.213	0.6244	2.479
N-pentane	3.361	72.150	2.526	0.6311	2.801
Hexanes	4.674	85.734	4.174	0.6652	4.392
Heptanes Plus	57.308	98.181	79.630	0.7010	72.160
	100.000		100.000		100.000

Calculated Values	**Total Sample**	**Heptanes Plus**
Specific Gravity at 60 °F	0.6999	0.7741
Api Gravity at 60 °F	70.675	51.303
Molecular Weight	96.001	133.398
Pounds per Gallon (in Vacuum)	5.835	6.454
Pounds per Gallon (in Air)	5.829	6.447
Cu. Ft. Vapor per Gallon @ 14.73 psia	23.120	18.402
Standing-Katz Density (lb. / ft^3)		

Brian Gaspard

Southern Petroleum Laboratories, Inc.

Certificate of Analysis

Number: 2030-13050161-002A

Carencro Laboratory
4790 NE Evangeline Thruway
Carencro, LA 70520

Alan Ball
Gas Analytical Services
PO Box 1028
Bridgeport, WV 26330

May 22, 2013

Station Name: OXF 131 Pad
Station Number: 512441
Station Location: EQT Production
Sample Point: Wellhead

Sampled By: GR-GAS
Sample Of: Condensate Spot
Sample Date: 05/14/2013 13:00
Sample Conditions: 414 psig
Cylinder No: GAS

Analytical Data

Test	Method	Result	Units	Detection Limit	Lab Tech.	Analysis Date
Color-Visual	Proprietary	L STRAW			AR	05/22/2013
API Gravity @ 60° F	ASTM D-5002	61.22	°		AR	05/22/2013
Specific Gravity @ 60/60° F	ASTM D-5002	0.7342			AR	05/22/2013
Density @ 60° F	ASTM D-5002	0.7335	g/ml		AR	05/22/2013
Shrinkage Factor	Proprietary	0.9043			AR	05/22/2013
Flash Factor	Proprietary	256.6792	Cu. Ft./S.T. Bbl		AR	05/22/2013

Patti L. Perro

Hydrocarbon Laboratory Manager

Quality Assurance: The above analyses are performed in accordance with ASTM, UOP, GPA guidelines for quality assurance, unless otherwise stated.

MVP Turbine/Compressor Package Performance Evaluation Sheet

Constants		
Elevation (fasl)	2775	
Relative Humidity	80%	
Fuel HHV (BTU/SCF)	1085	
Fuel LHV (BTU/SCF)	979.3	
Emissions Load Range	50-100%	Guaranteed
Turbine ISO Rating (HP)	20500	T130
Number of Units	2	Station 3

Ambient Temp			50% Load	75% Load	100% Load
0°F	Turbine Performance	Output Shaft Speed (RPM)	6505	7896	8296
		Output Shaft Power (HP)	9742	14613	19483
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	8400	8490	7269
		Unit Fuel Consumption (MMSCF/D)	2.006	3.04	3.47
		Engine Thermal Efficiency (%)	30.3	30	35
		Exhaust Temp (°F)	708	902	903
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	4.89	7.43	8.49
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	4.96	7.54	8.61
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	2.84	4.32	4.93

Ambient Temp			50% Load	75% Load	100% Load
20°F	Turbine Performance	Output Shaft Speed (RPM)	7114	7879	8316
		Output Shaft Power (HP)	9578	14367	19156
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	10613	8371	7147
		Unit Fuel Consumption (MMSCF/D)	2.49	2.95	3.36
		Engine Thermal Efficiency (%)	24	30.4	35.6
		Exhaust Temp (°F)	940	920	910
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	6.08	7.19	8.19
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	6.17	7.3	8.31
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.53	4.18	4.76

Ambient Temp			50% Load	75% Load	100% Load
40°F	Turbine Performance	Output Shaft Speed (RPM)	7061	7841	8330
		Output Shaft Power (HP)	9334	14001	18668
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	10548	8312	7097
		Unit Fuel Consumption (MMSCF/D)	2.412	2.85	3.25
		Engine Thermal Efficiency (%)	24.1	30.6	35.9
		Exhaust Temp (°F)	969	939	924
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.87	6.94	7.91
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.96	7.05	8.02
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.41	4.04	4.6

MVP Turbine/Compressor Package Performance Evaluation Sheet

Ambient Temp			50% Load	75% Load	100% Load
60°F	Turbine Performance	Output Shaft Speed (RPM)	6968	7760	8319
		Output Shaft Power (HP)	8905	13357	17809
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	10683	8370	7184
		Unit Fuel Consumption (MMSCF/D)	2.33	2.74	3.135
		Engine Thermal Efficiency (%)	23.8	30.4	35.4
		Exhaust Temp (°F)	997	961	949
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.65	6.64	7.6
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.73	6.74	7.71
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.28	3.86	4.42

Ambient Temp			50% Load	75% Load	100% Load
80°F	Turbine Performance	Output Shaft Speed (RPM)	6833	7609	8200
		Output Shaft Power (HP)	8159	12238	16318
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	11204	8675	7396
		Unit Fuel Consumption (MMSCF/D)	2.24	2.6	2.96
		Engine Thermal Efficiency (%)	22.7	29.3	34.4
		Exhaust Temp (°F)	1025	989	969
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.38	6.24	7.1
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.45	6.34	7.2
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	3.12	3.63	4.13

Ambient Temp			50% Load	75% Load	100% Load
100°F	Turbine Performance	Output Shaft Speed (RPM)	6659	7399	8005
		Output Shaft Power (HP)	7237	10856	14474
		HP Utilization (%)	50.0%	75.0%	100.0%
		Heat Rate (BTU/HP-hr)	12035	9158	7814
		Unit Fuel Consumption (MMSCF/D)	2.134	2.44	2.77
		Engine Thermal Efficiency (%)	21.1	27.8	32.6
		Exhaust Temp (°F)	1056	1026	999
		Unit NO_x (PPMvd)	15	15	15
		Unit NO_x (lb/hr)	5.03	5.75	6.54
		Unit CO (PPMvd)	25	25	25
		Unit CO (lb/hr)	5.11	5.83	6.64
		Unit UHC (PPMvd)	25	25	25
		Unit UHC (lb/hr)	2.93	3.34	3.8

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PIL 167
Product Information Letter

SoLoNOx Products: Emissions in Non-SoLoNOx Modes

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

Solar's gas turbine dry low NOx emissions combustion systems, known as *SoLoNOx*™, have been developed to provide the lowest emissions possible during normal operating conditions. In order to optimize the performance of the turbine, the combustion and fuel systems are designed to reduce NOx, CO and unburned hydrocarbons (UHC) without penalizing stability or transient capabilities. At very low load and cold temperature extremes, the *SoLoNOx* system must be controlled differently in order to assure stable operation. The required adjustments to the turbine controls at these conditions cause emissions to increase.

The purpose of this Product Information Letter is to provide emissions estimates, and in some cases warrantable emissions for NOx, CO and UHC, at off-design conditions.

Historically, regulatory agencies have not required a specific emissions level to be met at low load or cold ambient operating conditions, but have asked what emissions levels are expected. The expected values are necessary to appropriately estimate emissions for annual emissions inventory purposes and for New Source Review applicability determinations and permitting.

COLD AMBIENT EMISSIONS ESTIMATES

Solar's standard temperature range warranty for gas turbines with *SoLoNOx* combustion is ≥ 0°F (–20°C). The *Titan*™ 250 is an exception, with a lower standard warranty at ≥ –20°F (–29°C). At ambient temperatures below 0°F, many of Solar's turbine engine models are controlled to increase pilot fuel to improve flame stability and emissions are higher. Without the increase in pilot fuel at temperatures below 0°F the engines may exhibit combustor rumble, as operation may be near the lean stability limit.

If a cold ambient emissions warranty is requested, a new production turbine configured with the latest combustion hardware is required. For most models this refers to the inclusion of Cold Ambient Fuel Control Logic.

Emissions warranties are not offered for ambient temperatures below –20°F (–29°C). In addition, cold ambient emissions warranties cannot be offered for the *Centaur*® 40 turbine.

Table 1 provides expected and warrantable (upon Solar's documented approval) emissions levels for Solar's *SoLoNOx* combustion turbines. All emissions levels are in ppm at 15% O_2. Refer to Product Information Letter 205 for *Mercury*™ 50 turbine emissions estimates.

For information on the availability and approvals for cold ambient temperature emissions warranties, please contact Solar's sales representatives.

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Table 2 summarizes "expected" emissions levels for ambient temperatures below 0°F (–20°C) for Solar's *SoLoNOx* turbines that do not have current production hardware or for new production hardware that is not equipped with the cold ambient fuel control logic. The emissions levels are extrapolated from San Diego factory tests and may vary at extreme temperatures and as a result of variations in other parameters, such as fuel composition, fuel quality, etc.

For more conservative NOx emissions estimate for new equipment, customers can refer to the New Source Performance Standard (NSPS) 40CFR60, subpart KKKK, where the allowable NOx emissions level for ambient temperatures < 0°F (–20°F) is 150 ppm NOx at 15% O_2. For pre-February 18, 2005, *SoLoNOx* combustion turbines subject to 40CFR60 subpart GG, a conservative estimate is the appropriate subpart GG emissions level. Subpart GG levels range from 150 to 214 ppm NOx at 15% O_2 depending on the turbine model.

Table 3 summarizes emissions levels for ambient temperatures below –20°F (–29°C) for the *Titan* 250.

Table 1. Warrantable Emissions Between 0°F and –20°F (–20° to –29°C) for New Production

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 50	Gas Only	Gas	50 to 100% load	42	100	50
	Dual Fuel	Gas	50 to 100% load	72	100	50
Taurus™ 60	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Taurus 65	Gas Only	Gas	50 to 100% load	42	100	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Mars® 90	Gas Only	Gas	50 to 100% load	42	100	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 250	Gas Only	Gas	40 to 100% load	25	50	25
	Gas Only	Gas	40 to 100% load	15	25	25
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

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EMISSIONS ESTIMATES IN NON-SOLONOX MODE (LOW LOAD)

At operating loads < 50% (<40% load for the *Titan* 250) on natural gas fuel and < 65% (< 80% load for *Centaur* 40) on liquid fuels, *SoLoNOx* engines are controlled to increase stability and transient response capability. The control steps that are required affect emissions in two ways: 1) pilot fuel flow is increased, increasing NOx emissions, and 2) airflow through the combustor is increased, increasing CO emissions. Note that the load levels are approximate. Engine controls are triggered either by power output for single-shaft engines or gas producer speed for two-shaft engines.

A conservative method for estimating emissions of NOx at low loads is to use the applicable NSPS: 40CFR60 subpart GG or KKKK. For projects that commence construction after February 18, 2005, subpart KKKK is the applicable NSPS and contains a NOx level of 150 ppm @ 15% O_2 for operating loads less than 75%.

Table 4 provides estimates of NOx, CO, and UHC emissions when operating in non-SoLoNOx mode for natural gas or liquid fuel. The estimated emissions can be assumed to vary linearly as load is decreased from just below 50% load for natural gas (or 65% load for liquid fuel) to idle.

The estimates in Table 4 apply for any product for gas only or dual fuel systems using pipeline quality natural gas. Refer to Product Information Letter 205 for *Mercury* 50 emissions estimates.

Table 4. Estimated Emissions in non-SoLoNOx Mode

Ambient	Fuel System	Engine Load	NOx, ppm	CO, ppm	UHC, ppm
***Centaur* 40/50, *Taurus* 60/65/70, *Mars* 90/100, *Titan* 130**					
≥ –20°F (–29°C)	Natural Gas	Less than 50%	70	8,000	800
		Idle	50	10,000	1,000
< –20°F (–29°C)	Natural Gas	Less than 50%	120	8,000	800
		Idle	120	10,000	1,000
***Titan* 250**					
≥ –20°F (–29°C)	Natural Gas	Less than 40%	50	25	20
		Idle	50	2,000	200
< –20°F (–29°C)	Natural Gas	Less than 40%	70	150	50
		Idle	70	2,000	200
***Centaur* 50, *Taurus* 60/70, *Mars* 100, *Titan* 130**					
≥ –20°F (–29°C)	Liquid	Less than 65%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 65%	120	1,000	150
		Idle	120	10,000	3,000
***Centaur* 40**					
≥ –20°F (–29°C)	Liquid	Less than 80%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 80%	120	1,000	150
		Idle	120	10,000	3,000

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Table 2. Expected Emissions below 0°F (–20°C) for SoLoNOx Combustion Turbines

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 40	Gas Only or Dual Fuel	Gas	80 to 100% load	120	150	50
Centaur 50	Gas Only	Gas	50 to 100% load	120	150	50
	Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 60	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 65	Gas Only	Gas	50 to 100% load	120	150	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Mars 90	Gas Only	Gas	80 to 100% load	120	150	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Centaur 40	Dual Fuel	Liquid	80 to 100% load	120	150	75
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

Table 3. Expected Emissions below –20°F (–29°C) for the Titan 250 SoLoNOx Combustion Turbine

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Titan 250	Gas Only	Gas	40 to 100% load	70	150	50

COLD AMBIENT PERMITTING STRATEGY

There are several permitting options to consider when permitting in cold ambient climates. Customers can use a tiered permitting approach or choose to permit a single emission rate over all temperatures. Historically, most construction and operating permits were silent on the ambient temperature boundaries for *SoLoNOx* operation.

Some customers have used a tiered permitting strategy. For purposes of compliance and annual emissions inventories, a digital thermometer is installed to record ambient temperature. The amount of time is recorded that the ambient temperature falls below 0°F. The amount of time below 0°F is then used with the emissions estimates shown in Tables 1 and 2 to estimate "actual" emissions during sub-zero operation.

A conservative alternative to using the NOx values in Tables 1, 2 and 3 is to reference 40CFR60 subpart KKKK, which allows 150 ppm NOx at 15% O_2 for sub-zero operation.

For customers who wish to permit at a single emission rate over all ambient temperatures, inlet air heating can be used to raise the engine inlet air temperature (T_1) above 0°F. With inlet air heating to keep T_1 above 0°F, standard emission warranty levels may be offered.

Inlet air heating technology options include an electric resistance heater, an inlet air to exhaust heat exchanger and a glycol heat exchanger.

If an emissions warranty is desired and ambient temperatures are commonly below –20°F (–29°C), inlet air heating can be used to raise the turbine inlet temperature (T_1) to at least –20°F. In such cases, the values shown in Table 1 can be warranted for new production.

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PIL 168
Product Information Letter

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

This Product Information Letter summarizes methods that are available to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO_2), and formaldehyde from gas turbines. Emissions estimates of these pollutants are often necessary during the air permitting process.

INTRODUCTION

In absence of site-specific or representative source test data, Solar refers customers to a United States Environmental Protection Agency (EPA) document titled "AP-42" or other appropriate EPA reference documents. AP-42 is a collection of emission factors for different emission sources. The emission factors found in AP-42 provide a generally accepted way of estimating emissions when more representative data are not available. The most recent version of AP-42 (dated April 2000) can be found at:

http://www.epa.gov/ttn/chief/ap42/ch03/index.html

Solar does not typically warranty the emission rates for VOC, SO_2 or formaldehyde.

Volatile Organic Compounds

Many permitting agencies require gas turbine users to estimate emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are some of the many ways of referring to the non-methane (and non-ethane) portion of an "unburned hydrocarbon" emission estimate.

For natural gas fuel, Solar's customers use 10-20% of the UHC emission rate to represent VOC emissions. The estimate of 10-20% is based on a ratio of total non-methane hydrocarbons to total organic compounds. The use of 10-20% provides a conservative estimate of VOC emissions. The balance of the UHC is assumed to be primarily methane.

For liquid fuel, it is appropriate to estimate that 100% of the UHC emission estimate is VOC.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of sulfur in the fuel to SO_2. Since Solar does not control the amount of sulfur in the fuel, we are unable to predict SO_2 emissions without a site fuel composition analysis. Customers generally estimate SO_2 emissions with a mass balance calculation by assuming that any sulfur in the fuel will convert to SO_2. For reference, the typical mass balance equation is shown below.

Variables: wt % of sulfur in fuel
Btu/lb fuel (LHV*)
MMBtu/hr fuel flow (LHV)

$$\frac{\text{lb } SO_2}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100}\right)\left(\frac{\text{lb fuel}}{\text{Btu}}\right)\left(\frac{10^6 \text{ Btu}}{\text{MMBtu}}\right)\left(\frac{\text{MMBtu fuel}}{\text{hr}}\right)\left(\frac{\text{MW } SO_2}{\text{MW Sulfur}}\right)$$

As an alternative to the mass balance calculation, EPA's AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.0034 lb/MMBtu for gas fuel (HHV*) and 0.033 lb/MMBtu for liquid fuel (HHV).

*LHV = Lower Heating Value; HHV = Higher Heating Value

Formaldehyde

In gas turbines, formaldehyde emissions are a result of incomplete combustion. Formaldehyde

in the exhaust stream is unstable and very difficult to measure. In addition to turbine characteristics including combustor design, size, maintenance history, and load profile, the formaldehyde emission level is also affected by:

- Ambient temperature
- Humidity
- Atmospheric pressure
- Fuel quality
- Formaldehyde concentration in the ambient air
- Test method measurement variability
- Operational factors

The emission factor data in Table 1 is an excerpt from an EPA memo: "Revised HAP Emission Factors for Stationary Combustion Turbines, 8/22/03." The memo presents hazardous air pollutant (HAP) emission factor data in several categories including: mean, median, maximum, and minimum. The emission factors in the memo are a compilation of the HAP data EPA collected during the Maximum Achievable Control Technology (MACT) standard development process. The emission factor documentation shows there is a high degree of variability in formaldehyde emissions from gas turbines, depending on the manufacturer, rating size of equipment, combustor design, and testing events. To estimate formaldehyde emissions from gas turbines, users should use the emission factor(s) that best represent the gas turbines actual / planned operating profile. Refer to the memo for alternative emission factors.

Table 1. EPA's Total HAP and Formaldehyde Emission Factors for <50 MW Lean-Premix Gas Turbines burning Natural Gas

(Source: Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09, 8/22/03)

Pollutant	Engine Load	95% Upper Confidence of Mean, lb/MMBtu HHV	95% Upper Confidence of Data, lb/MMBtu HHV	Memo Reference
Total HAP	> 90%	0.00144	0.00258	Table 19
Total HAP	All	0.00160	0.00305	Table 16
Formaldehyde	> 90%	0.00127	0.00241	Table 19
Formaldehyde	All	0.00143	0.00288	Table 16

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PIL 170
Product Information Letter

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-

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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% load[1] 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).

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[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).

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Table 1. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications
10 Minute Start-up and 10 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S				Taurus 65 8401S			
	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)	0.6	58.1	3.3	359	0.8	75.0	4.3	454	0.8	78.5	4.5	482	0.9	85.8	4.9	523
Total Emissions per Shutdown (lbs)	0.3	25.5	1.5	160	0.4	31.1	1.8	194	0.4	34.7	2.0	217	0.4	38.2	2.2	237

	Taurus 70 10801S				Mars 90 13002S GSC				Mars 100 16002S GSC				Titan 130 20501S				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)	1.1	103.9	5.9	634	1.4	129.0	7.4	868	1.6	151.2	8.6	952	2.1	195.6	11.2	1,194	2.5	22.7	1.5	1,925
Total Emissions per Shutdown (lbs)	1.3	110.7	6.3	689	1.7	147.9	8.4	912	1.9	166.8	9.5	1,026	2.4	210.0	12.0	1,303	3.0	19.9	1.5	1,993

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.

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Table 2. ***Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set Applications***
60 Minute Start-up and 30 Minute Shutdown
Natural Gas Fuel

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S				Taurus 65 8401S			
	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)	4.1	219.4	13.0	3,420	5.0	272.4	16.1	4,219	5.7	299.8	17.8	4,780	6.1	326.5	19.3	5,074
Total Emissions per Shutdown (lbs)	1.8	121.1	7.1	1,442	2.3	163.3	9.5	1,834	2.5	163.5	9.6	1,994	2.6	177.2	10.4	2,119

	Taurus 70 10801S				Mars 90 13002S				Mars 100 16002S				Titan 130 20501S				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)	7.6	410.3	24.2	6,164	10.5	570.8	33.7	8,641	11.3	583.5	34.6	9,691	13.8	740.4	43.8	11,495	14.6	75.5	7.3	16,253
Total Emissions per Shutdown (lbs)	3.3	223.0	13.0	2,588	4.3	277.0	16.2	3,685	4.8	308.1	18.0	4,056	6.0	405.3	23.7	4,826	6.2	52.6	4.1	7,222

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.

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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.

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Table 4. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
10 Minute Start-up and 10 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S			
	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)	1.3	44.5	7.4	473	1.7	59.0	9.8	601	1.7	59.8	9.9	636
Total Emissions per Shutdown (lbs)	0.6	17.3	2.8	211	0.7	21.2	3.4	256	0.8	23.5	3.8	286

	Taurus 70 10801S				Mars 100 16002S GSC				Titan 130 20501S			
	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)	2.3	78.5	13.0	823	3.4	114.1	18.8	1,239	4.3	147.5	24.4	1,547
Total Emissions per Shutdown (lbs)	2.5	73.6	12.0	889	3.8	111.4	18.1	1,331	4.7	139.1	22.6	1,677

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

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

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Table 5. Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx Generator Set
60 Minute Start-up and 30 Minute Shutdown
Liquid Fuel (Diesel #2)

Data will NOT be warranted under any circumstances

	Centaur 40 4701S				Centaur 50 6201S				Taurus 60 7901S			
	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)	11.7	194.7	30.9	4,255	15.2	271.9	43.3	5,302	14.7	282.6	45.0	5,962
Total Emissions per Shutdown (lbs)	4.4	84.7	13.6	1,816	6.7	164.3	27.0	2,334	6.3	159.0	26.0	2,515

	Taurus 70 10801S				Mars 100 16002S				Titan 130 20501S			
	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)	18.4	360.3	57.4	7,375	29.1	552.0	87.7	11,685	34.4	677.0	108.0	13,731
Total Emissions per Shutdown (lbs)	8.0	207.8	34.1	3,156	12.3	302.6	49.4	4,970	15.0	388.5	63.7	5,876

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

Assumes unit is operating at full load prior to shutdown.

Assumes #2 Diesel fuel; ES 9-98 compliant.

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Emissions from Centrifugal Compressor Gas Seal Systems

Anthony Pocengal
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PURPOSE

The U.S. Environmental Protection Agency ("EPA") has recently established regulations related to monitoring, reporting and control of Greenhouse Gas (GHG) emissions from industrial sources. Methane, the main constituent of natural gas, is a GHG which may escape from various points along the gas turbine package and the driven equipment. One source of 'fugitive' emissions under regulatory scrutiny includes the gas seal systems installed in centrifugal gas compressors. As natural gas is used as seal gas there will be some emission of methane through the seal vents. The purpose of this PIL is to provide information pertaining to expected emissions leakage from Solar compressor dry gas seals. Regulatory requirements for wet seal systems are also briefly summarized.

DRY GAS SEAL LEAKAGE DATA

The figures in the Appendix may be used to estimate dry gas seal leakage through the primary and secondary (combined) vents based on the compressor suction pressure (P1). The charts show the expected leakage rate per each compressor. Leakage rates are not be guaranteed.

For further technical information on Dry Gas Seal systems refer to PIL 140 Dry Gas Face Seals for Solar Gas Compressors.

Note on PIL 140: The maximum dynamic leakage from Tables 3 and 4 are the maximum possible dynamic leakage rates at maximum allowable speed and pressure and should not be utilized for emission inventories or expected emissions from Solar compressors.

REGULATIONS CONCERNING CENTRIFUGAL COMPRESSOR GAS SEAL EMISSIONS

There are two EPA regulations in Title 40 of the Code of Federal Regulations (CFR) which concern emissions from centrifugal compressor gas seal systems: Part 98, Subpart W (40 CFR §§ 98.230 – 98.238) and Part 60, Subpart OOOO (40 CFR §§ 60.5360 – 60.5423). The final rule that promulgated Subpart W was published in in November 2010 and requires reporting of GHG emissions for oil and gas operations beginning in September 2012. Subpart OOOO, New Source Performance Standards for Crude Oil and Natural Gas Production, Transmission and Distribution, requires the reduction of volatile organic compounds (VOCs) from oil and gas operations and became effective October 15, 2012.

Neither regulation requires actual measurement of emissions from compressor dry gas seal systems.

Although measurement of dry gas seal emissions is not required by EPA, several US state environmental agencies are requiring customers to estimate dry gas seal vent emissions as part of the air permitting process. Dry gas seal vent emissions estimates are provided in the Appendix. A brief summary of the regulations follows.

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Subpart W - Mandatory Reporting of Greenhouse Gases: Petroleum and Natural Gas Systems

Subpart W is included in the EPA's Mandatory Reporting of Greenhouse Gases regulation. While there is no requirement for measurement of dry gas seal emissions, emissions from wet gas seal de-gas systems are required to be measured by operators in the gas processing, transmission, storage and LNG segments of the industry. Or, as applicable, estimates from Best Available Monitoring Methods (BAMM) may be used. BAMM may be very common in the initial years (e.g., 2011 and 2012 GHG inventories) but EPA does not anticipate long term BAMM, so measurements in future years will be required. Production operators use an emission factor rather than measurement and the distribution segment does not report wet seal system emissions. See 40 CFR §§ 98.236 for details on reporting. Subpart W also requires reporting of emissions from blowdown vents and leakage from unit isolation valves (note that these emission sources are not directly emitted from the compressor). See 40 CFR §§ 98.233(o) and 98.234 for further details.

Subpart OOOO - Standards of Performance for Crude Oil and Natural Gas Production, Transmission and Distribution

40 CFR Part 60, Subpart OOOO impacts centrifugal compressors with wet gas seal systems that are new, modified, or reconstructed after August 23, 2011, that are used in natural gas gathering and processing. Compressors located at well-heads or in the transmission, distribution or storage segments are not affected by Subpart OOOO.

Compliance with Subpart OOOO requires a dry seal system, or a wet seal system that reduces VOC emissions by 95% (through routing of seal de-gas emissions through a closed vent system to a control device or recirculation to the compressor suction). Note that although Subpart OOOO mentions flaring, flares may present a safety hazard and should not be used with wet seal applications.

Subpart OOOO applicability to Solar equipment would be limited to new, modified, or reconstructed (since August 23, 2011) centrifugal compressors with wet seal systems in use at gathering facilities or gas processing plants.

Under Subpart OOOO if a control device (such as an adsorbent chiller) is used, monitoring and performance testing to verify 95% VOC reduction is required. See 40 CFR § 60.5413 for further details. Inspections of closed vent systems are required per 40 CFR § 60.5416.

At this time EPA has not provided an interpretation of what constitutes a 'modified' or 'reconstructed' centrifugal compressor, and guidance is not likely until an operator requests an applicability determination from EPA. According to the NSPS definitions, a compressor restage would be considered a modification if there is an increase in emissions; or reconstruction would apply in cases where the restage costs are greater than 50% of a comparable new compressor.

SUMMARY

Per Subpart W, wet seal de-gas emissions from centrifugal compressors must be measured (or estimated with BAMM) for all sources except those in the offshore production or distribution segments. Onshore production uses emission factors rather than direct measurement. Emissions estimates from blowdown vents and isolation valves, although not emitted directly from the compressor, are also required.

Per Subpart OOOO, new, modified, or reconstructed centrifugal compressors as of August 23, 2011 at gas gathering or production sites must use dry seals or reduce VOC emissions from wet seal systems by 95%.

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No specific requirements apply to emissions from dry gas seal systems although state environmental agencies may require estimates of these emissions for air permitting purposes. Emissions estimates are included in the Appendix.

Table of Figures

Centrifugal Compressor Dry Gas Seal Leakage Estimates

Figure 1 C16,.... 4
Figure 2 C160K, C166K.... 4
Figure 3 C160R, C160, C166S, C166V, C168V, C169V.... 5
Figure 4 C28.... 5
Figure 5 C304, C306, C33, C33i, C33E, C33EL, C337i, C401.... 6
Figure 6 C33EH, C404A, C404B, 406A, 406B.... 6
Figure 7 C41.... 7
Figure 8 C45.... 7
Figure 9 C505J.... 8
Figure 10 C505U.... 8
Figure 11 C51.... 9
Figure 12 C61.... 9
Figure 13 C65.... 10
Figure 14 C85.... 10

APPENDIX

The charts shown below are the total seal / process gas that leaks across the two primary dry gas seals and is vented through the primary and secondary vents on a Solar Gas Compressor. The dry gas seal leakage flow is a function of the compressor suction pressure. The charts show seal gas vented flow (scfm) vs. compressor suction pressure (psig)

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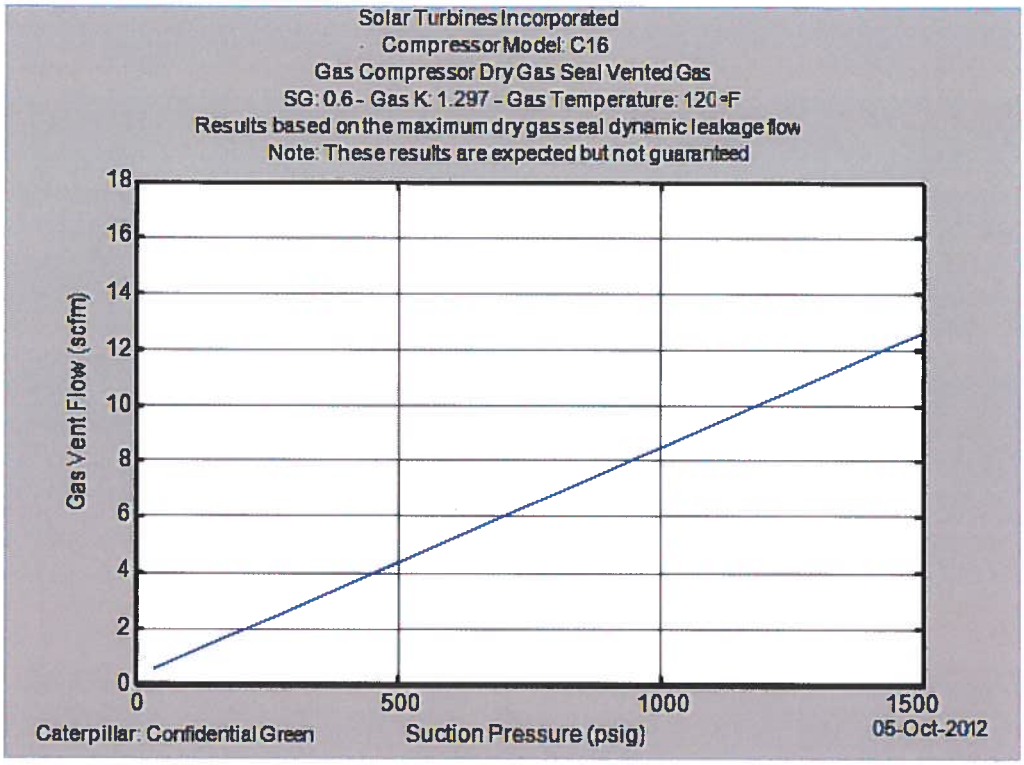

Figure 1 C16

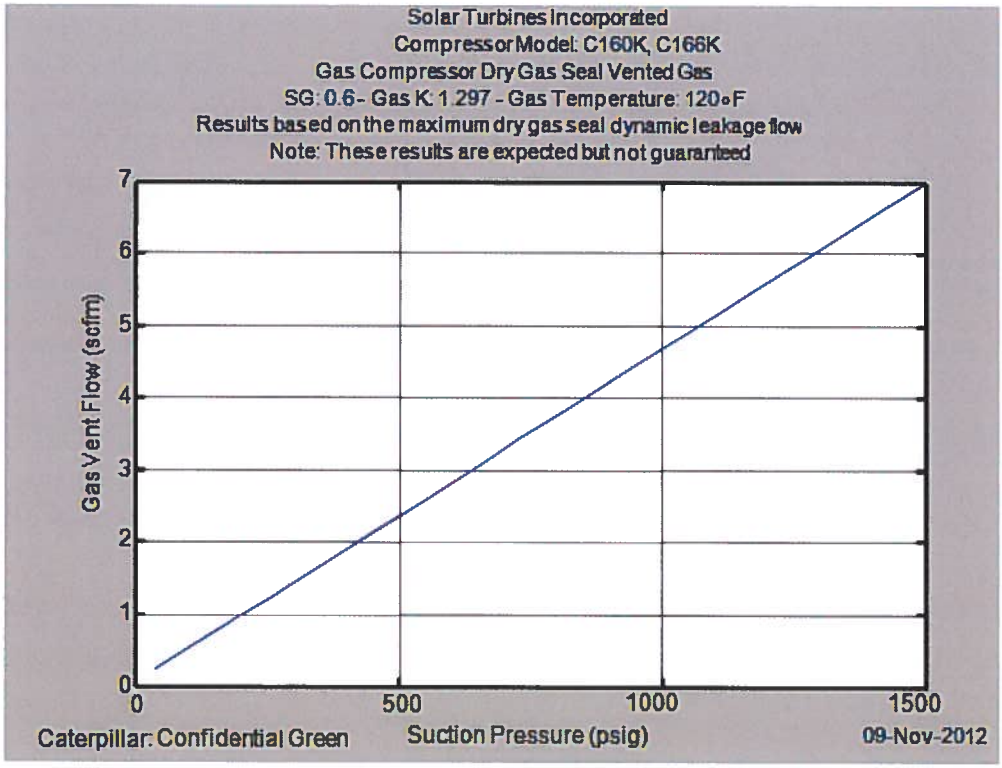

Figure 2 C160K, C166K

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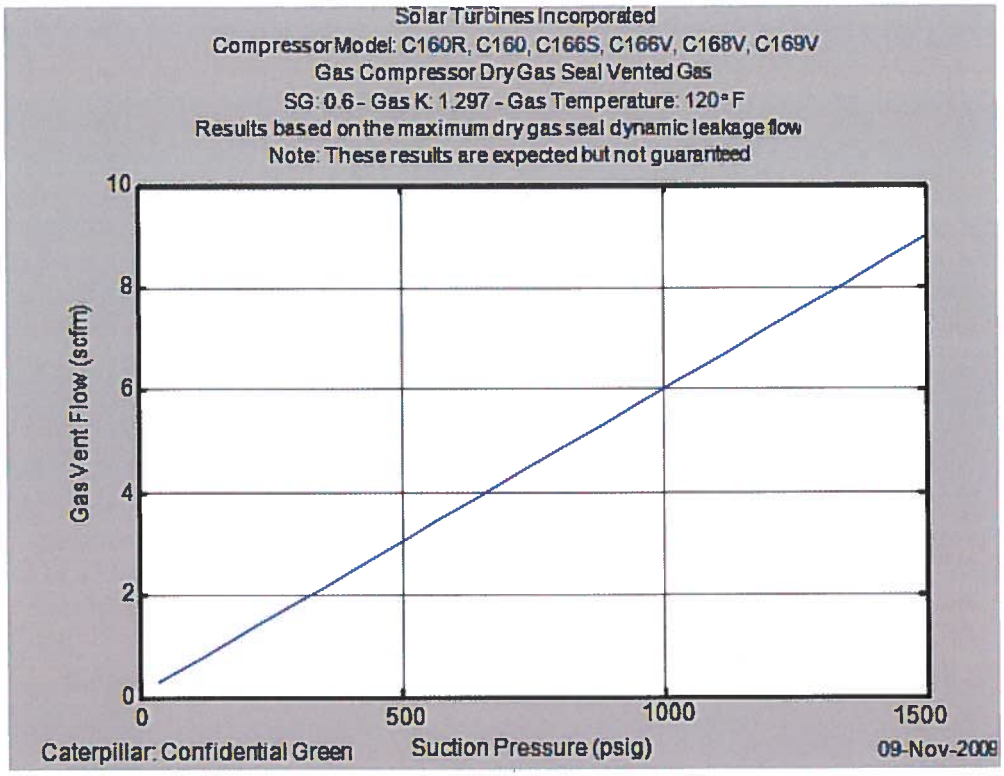

Figure 3 C160R, C160, C166S, C166V, C168V, C169V

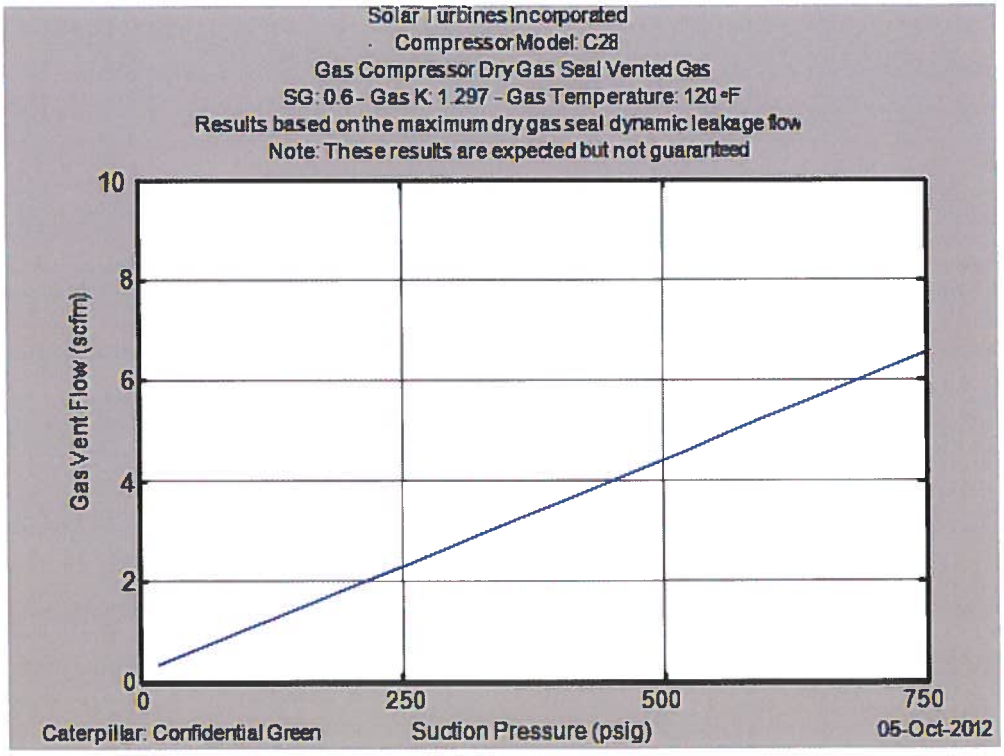

Figure 4 C28

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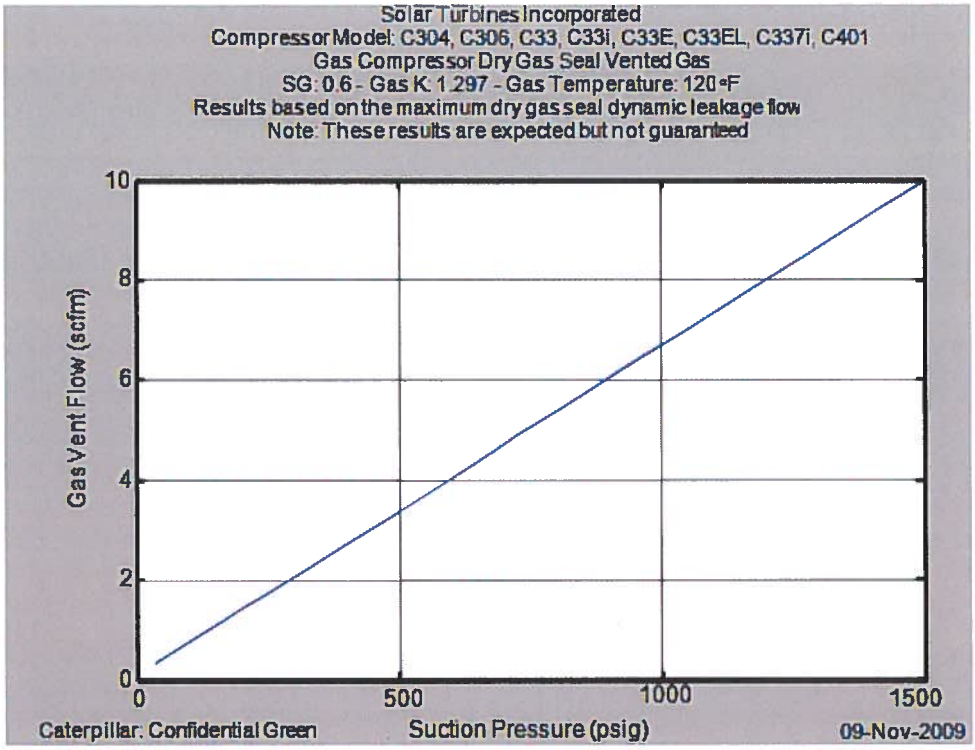

Figure 5 C304, C306, C33, C33i, C33E, C33EL, C337i, C401

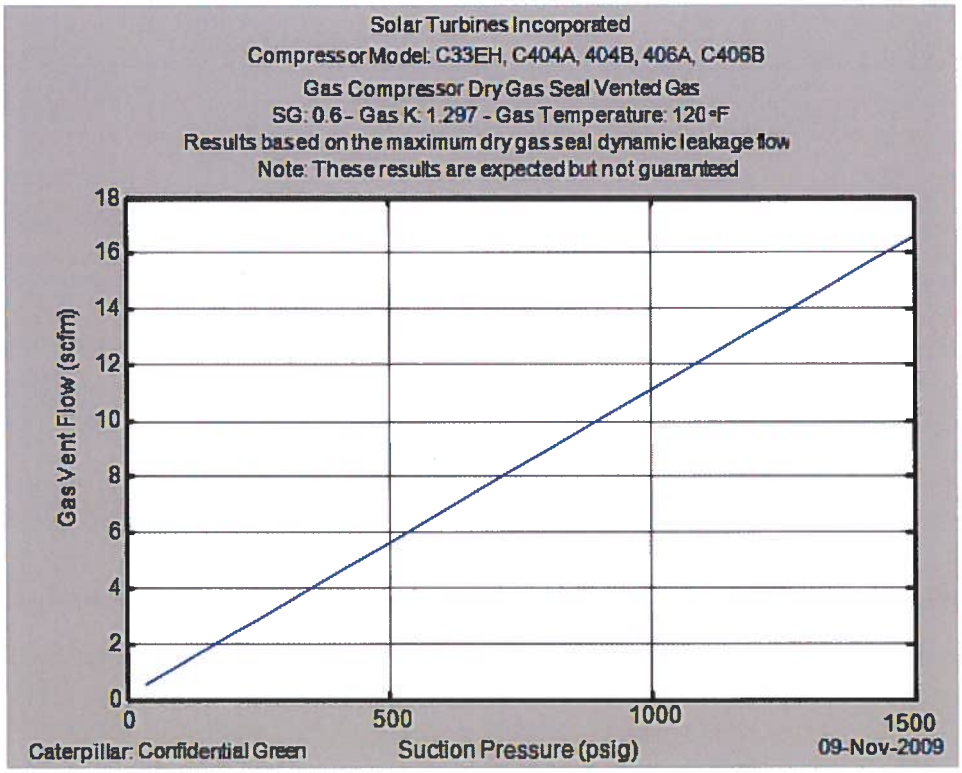

Figure 6 C33EH, C404A, C404B, 406A, 406B

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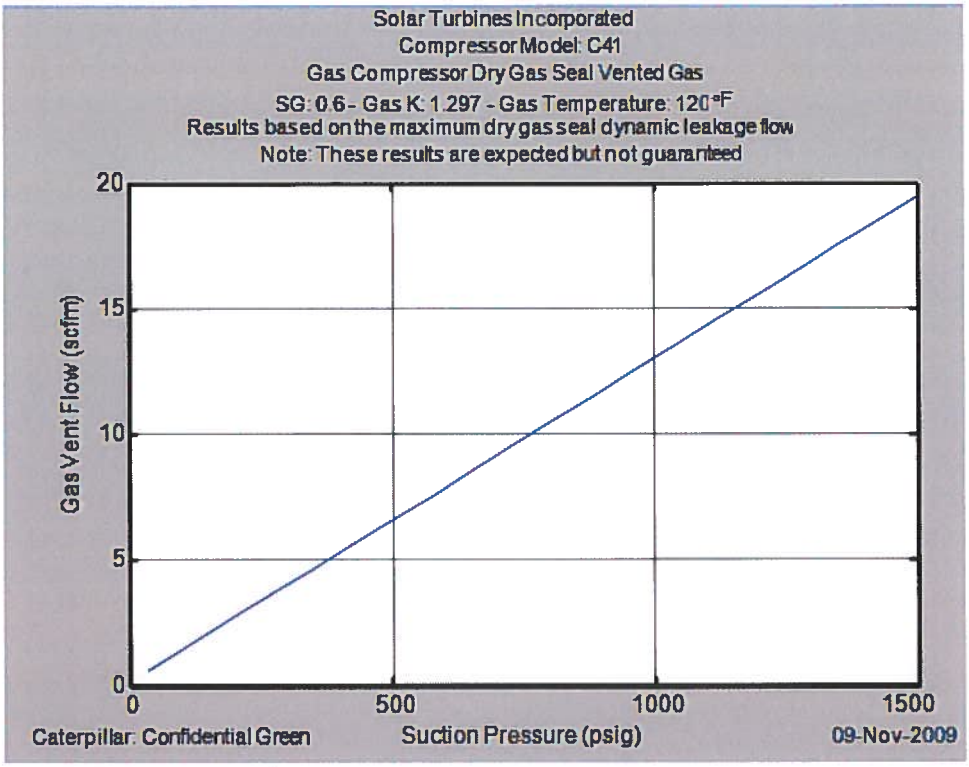

Figure 7 C41

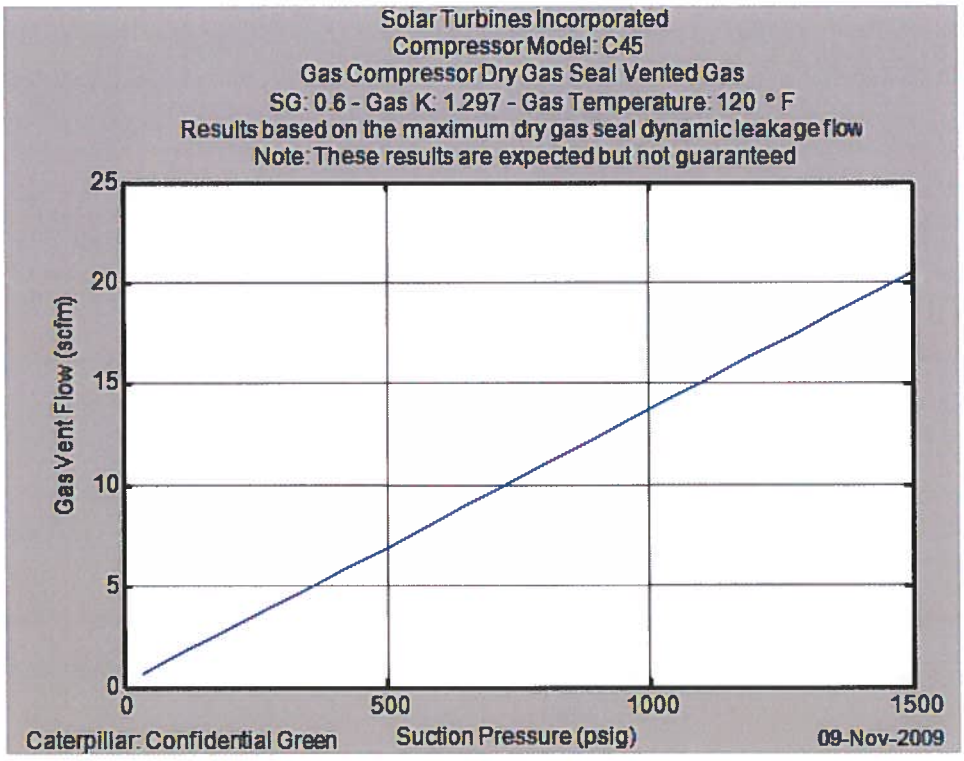

Figure 8 C45

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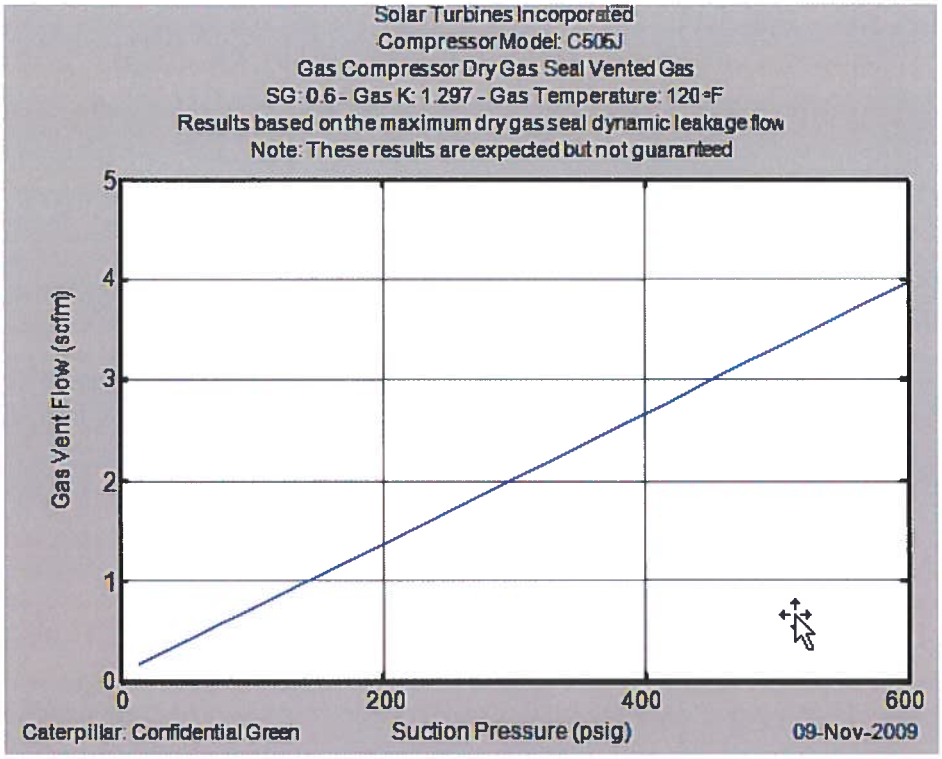

Figure 9 C505J

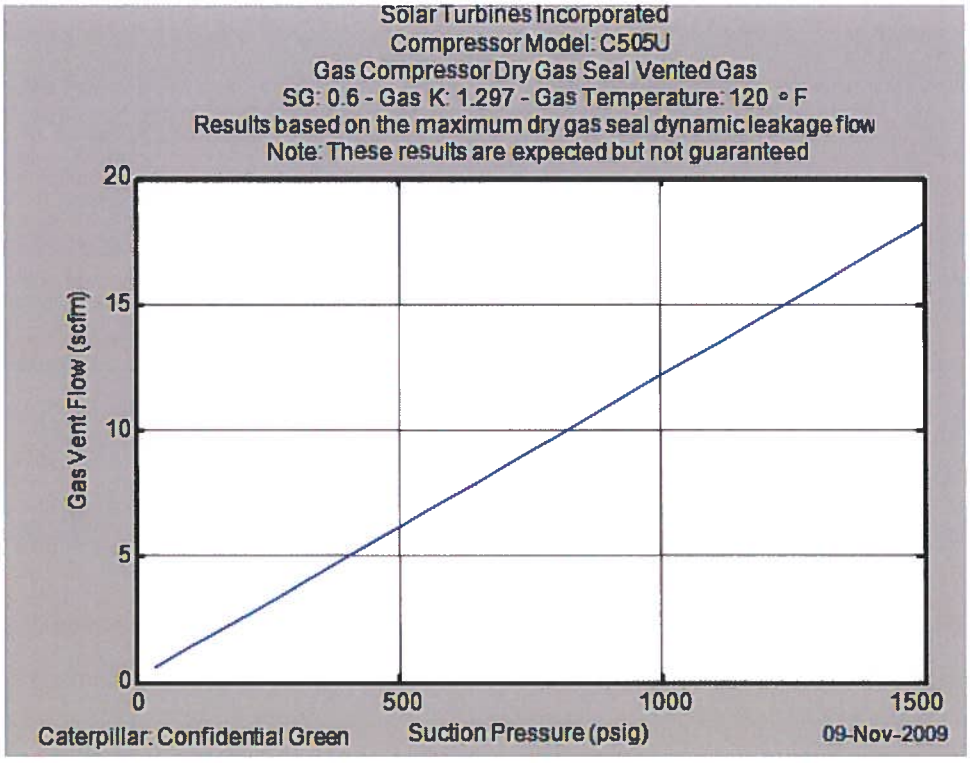

Figure 10 C505U

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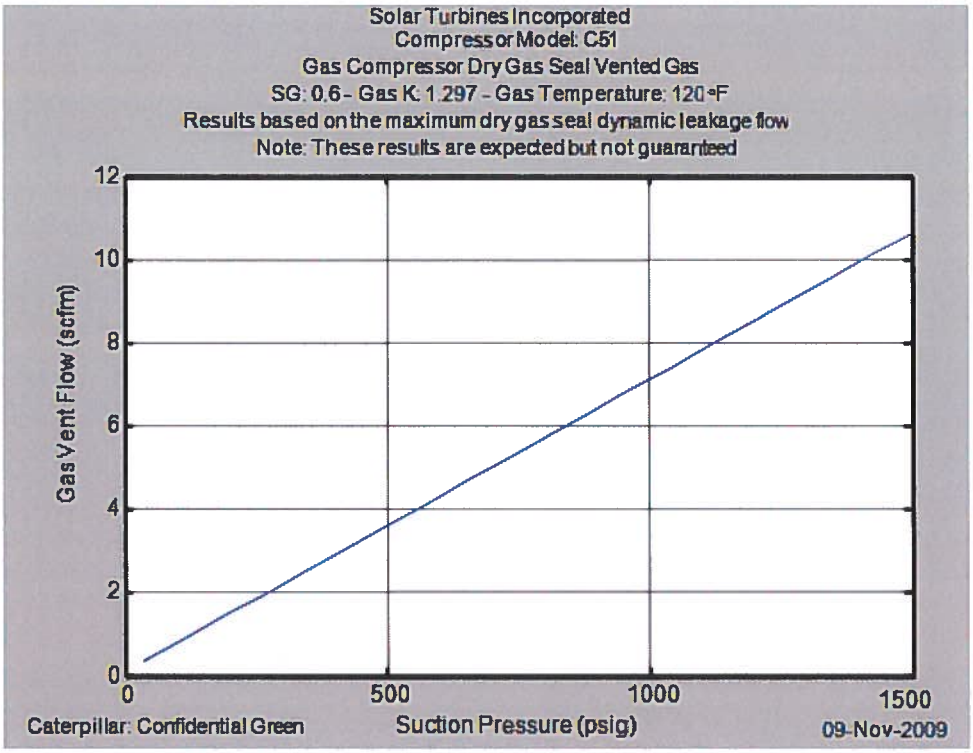

Figure 11 C51

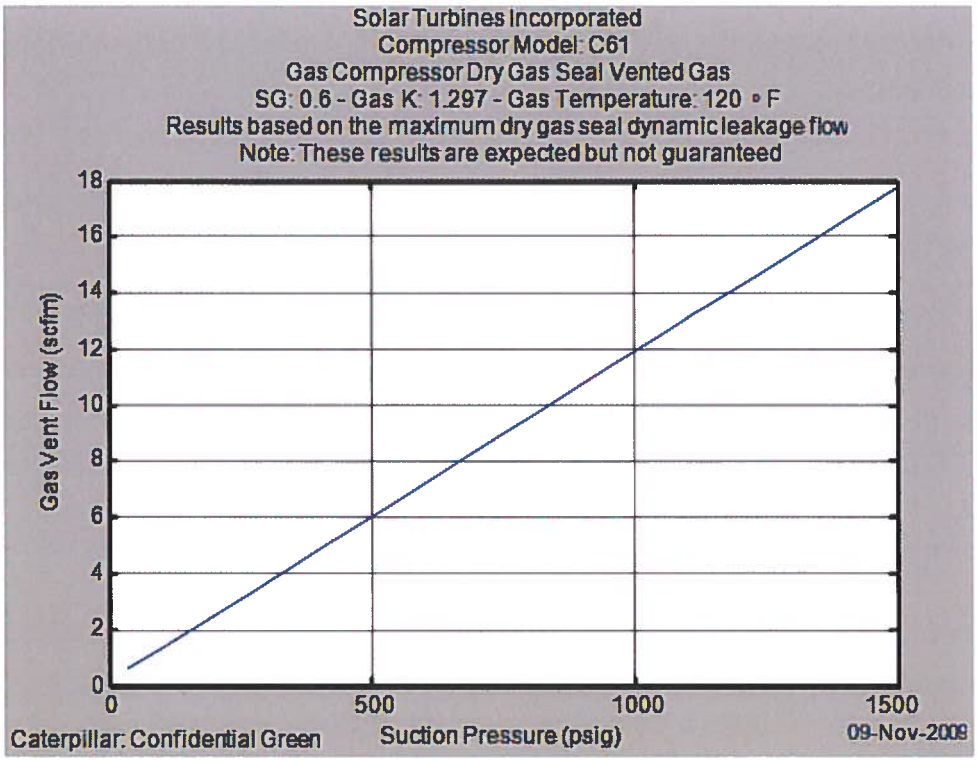

Figure 12 C61

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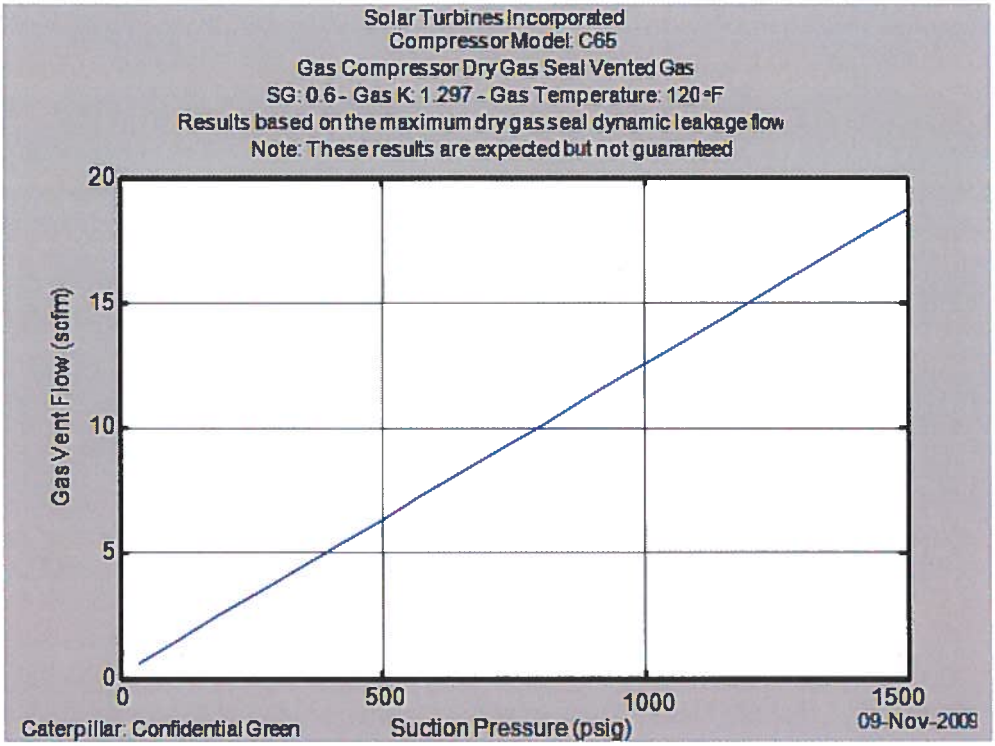

Figure 13 C65

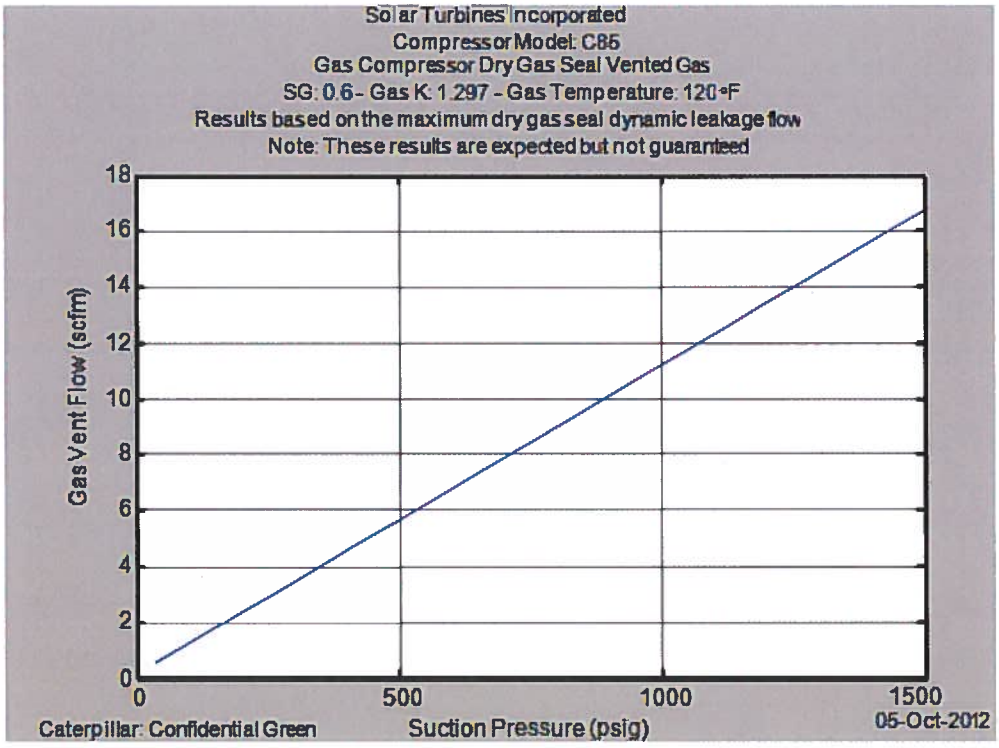

Figure 14 C85

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Particulate Matter Emission Estimates

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

This document summarizes Solar's recommended $PM_{10/2.5}$ emission levels for our combustion turbines. The recommended levels are based on an analysis of emissions tests collected from customer sites.

Particulate Matter Definition

National Ambient Air Quality Standards (NAAQS) for particulate matter were first set in 1971. Total suspended particulate (TSP) was the first indicator used to represent suspended particles in the ambient air. Since July 1, 1987, the Environmental Protection Agency (EPA) has used the indicator PM_{10}, which includes only the particles with aerodynamic diameter smaller than 10 micrometers. PM_{10} (coarse particles) come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads by vehicle traffic.

The EPA added a $PM_{2.5}$ ambient air standard in 1997. $PM_{2.5}$ includes particles with an aerodynamic diameter less than 2.5 micrometers. $PM_{2.5}$ (fine particles) are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds, emitted by combustion activities, are transformed by chemical reactions.

Nearly all particulate matter from gas turbine exhaust is less than one micrometer (micron) in diameter. Thus the emission rates of TSP, PM_{10}, and $PM_{2.5}$ from gas turbines are theoretically equivalent although source testing will show variation due to test method detection levels and processes.

TESTING FOR PARTICULATE MATTER

The turbine combustion process has little effect on the particulate matter generated and measured. The largest contributor to particulate matter emissions for gas and liquid fired combustion turbines is measurement technique and error. Other, minor contributing, sources of particulate matter emissions include carbon, ash, fuel-bound sulfur, artifact sulfate formation, compressor/lubricating oils, and inlet air.

Historical customer particulate matter source test data show that there is significant variability from test to test. The source test results support the common industry argument that particulate matter from natural gas fired combustion sources is difficult to measure accurately. The reference test methods for particulate matter were developed primarily for measuring emissions from coal-fired power plants and other major emitters of particulates. Particulate concentrations from gas turbine can be 100 to 10,000 times lower than the "traditional" particulate sources. The test methods were not developed or verified for low emission levels. There are interferences, insignificant at higher exhaust particulate matter concentrations that result in emissions greater than the actual emissions from gas turbines. New methods are being developed to address this problem.

Due to measurement and procedural errors, the measured results, in most cases, may not be representative of actual particulate matter emitted. There are many potential error sources in measuring particulate matter. Most of these have to do with contamination of the samples, material from the sampling apparatus getting into the samples, and general human error in samples and analysis.

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Recommended Particulate Matter Emission Factors

When necessary to support the air permitting process Solar recommends the following $PM_{10/2.5}$ emission factors:

- Natural Gas: 0.015 lb/MMBtu fuel input (HHV)
- Landfill Gas: 0.03 lb/MMBtu fuel input (HHV)
- Liquid Fuel: 0.06 lb/MMBtu fuel input (HHV). The liquid fuel emission factor assumes fuel sulfur content is <500 ppm and ash content is <0.005% by wt.

The emission levels cited above are only for engine operation with the fuels listed. Other fuels may not yield similar results.

Recent customer source testing has shown that AP-42 (EPA AP-42 "Compilation of Air Pollutant Emission Factors.") emission factors for natural gas are achievable in the field, when the test method recommendations shown below are followed. Historically, Solar did not recommend using AP-42 because while some source test firms have measured below AP-42 levels, others have measured higher. Because particulate matter emissions levels are highly dependent on the test firm and have very little to do with the turbine, Solar does not warrant AP-42 levels but does recognize they are achievable in the field. Customers generally choose a particulate matter emissions factor at or above the AP-42 level that works for their site permitting recognizing that the lower the emissions factor the higher the risk for source testing. Any Solar warranty on particulate matter would be at the recommended levels above, e.g. 0.015 lb/MMBtu (HHV) for natural gas.

Test Method Recommendation

Solar recommends that EPA Methods 201/201A[1] be used to measure the "front half". "Front half" represents filterable particulate matter.

EPA Method 202[2] (with nitrogen purge and field blanks) should be used to measure the "back half". "Back half" measurements represent the condensable portion of particulate matter.

EPA Method 5[3], which measures the front and back halves may be substituted (e.g. where exhaust temperatures do not allow the use of Method 202).

Testing should include three test runs of 4 hours each.

Solar recommends using the aforementioned test methods until more representative test methods are developed and made commercially available.

References

[1] EPA Method 201, Determination of PM10 Emissions, Exhaust Gas Recycle Procedure. EPA Method 201A, Determination of PM10 Emissions, Constant Sampling Rate Procedure, 40 CFR 60, Part 60, Appendix A.

[2] EPA Method 202, Determination of Condensible Particulate Emissions from Stationary Sources, 40 CFR 60, Part 60, Appendix A.

[3] EPA Method 5, Determination of Particulate Emissions from Stationary Sources, 40 CFR 60, Part 60, Appendix

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C200 MicroTurbine
High-pressure Natural Gas

World's largest air-bearing microturbine produces 200kW of clean, green, and reliable power.

- Ultra-low emissions
- One moving part – minimal maintenance and downtime
- Patented air bearing – no lubricating oil or coolant
- 5 and 9 year Factory Protection Plans available
- Remote monitoring and diagnostic capabilities
- Integrated utility synchronization and protection
- Small, modular design allows for easy, low-cost installation
- Proven technology with tens of millions of run hours and counting
- Internal fuel gas compressor available for low fuel pressure natural gas applications



C200 MicroTurbine

Electrical Performance[1]

Electrical Power Output	200kW
Voltage	400–480 VAC
Electrical Service	3-Phase, 4 wire
Frequency	50/60 Hz, grid connect operation
	10–60 Hz, stand alone operation
Maximum Output Current	290A RMS @ 400V, grid connect operation
	240A RMS @ 480V, grid connect operation
	310A RMS, stand alone operation[2]
Electrical Efficiency LHV	33%

Fuel/Engine Characteristics[1]

Natural Gas HHV	30.7–47.5 MJ/m^3 (825–1,275 BTU/scf)
Inlet Pressure[3]	517–552 kPa gauge (75–80 psig)
Fuel Flow HHV	2,400 MJ/hr (2,280,000 BTU/hr)
Net Heat Rate LHV	10.9 MJ/kWh (10,300 BTU/kWh)

Exhaust Characteristics[1]

NOx Emissions @ 15% O_2[4]	< 9 ppmvd (18 mg/m^3)
NOx / Electrical Output[4]	0.14 g/bhp-hr (0.4 lb/MWhe)
Exhaust Gas Flow	1.3 kg/s (2.9 lbm/s)
Exhaust Gas Temperature	280°C (535°F)
Exhaust Energy	1,420 MJ/hr (1,350,000 BTU/hr)

Reliable power when and where you need it. Clean and simple.

Dimensions & Weight[5]

Width x Depth x Height[6]	1.7 x 3.8 x 2.5 m (67 x 150 x 98 in)
Weight – Grid Connect Model	2776 kg (6,120 lb)
Weight – Dual Mode Model	3413 kg (7,525 lb)

Minimum Clearance Requirements[7]

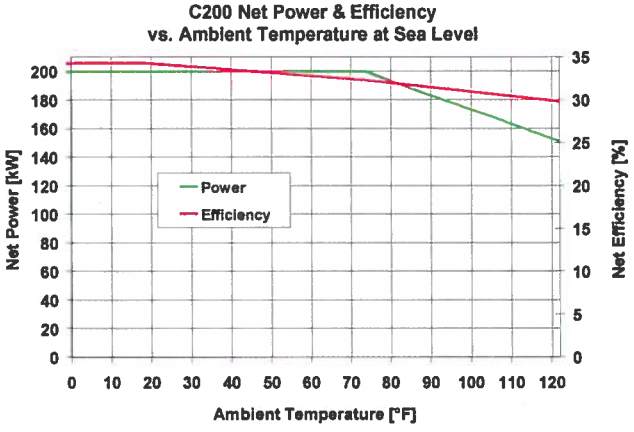
Vertical Clearance	0.6 m (24 in)
Horizontal Clearance	
Left & Right	1.1 m (42 in)
Front	1.1 m (42 in)
Rear	1.8 m (70 in)

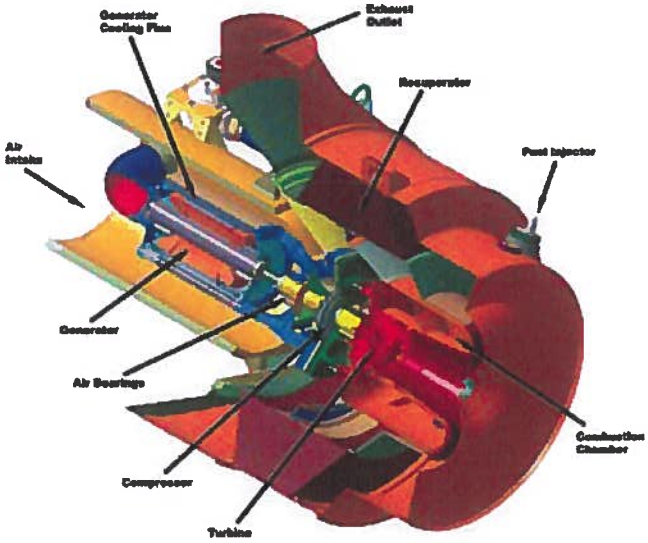
Sound Levels

Acoustic Emissions at Full Load Power	
Nominal at 10 m (33 ft)	65 dBA

Certifications

- UL 2200 and UL 1741 natural gas operation[8]
- Complies with IEEE 1547 and meets statewide utility interconnection requirements for California Rule 21 and the New York State Public Service Commission
- CE certified





(1) Nominal full power performance at ISO conditions: 59°F, 14.696 psia, 60% RH
(2) With linear load
(3) Inlet pressure for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(4) Emissions for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(5) Approximate dimensions and weight
(6) Height dimensions are to the roof line. Exhaust outlet extends at least 8 inches above the roof line
(7) Clearance requirements may increase due to local code considerations
(8) All natural gas models are planned to be UL Listed

Specifications are not warranted and are subject to change without notice.

21211 Nordhoff Street • Chatsworth • CA • 91311 • 866.422.7786 • 818.734.5300 • www.capstoneturbine.com
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Capstone Turbine Corporation • 21211 Nordhoff Street • Chatsworth • CA 91311 • USA
Phone: (818) 734-5300 • Fax: (818) 734-5320 • Web: www.microturbine.com

Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are "output based"; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	0.64	1.8	0.23
CR30 MBTU	Landfill Gas (2)	0.64	22.0	1.00
CR30 MBTU	Digester Gas (3)	0.64	11.0	1.00
C30 Liquid	Diesel #2 (4)	2.60	0.41	0.23
C65 NG Standard	Natural Gas (1)	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas (1)	0.17	1.30	0.10
C65 NG CARB	Natural Gas (1)	0.17	0.24	0.05
CR65 Landfill	Landfill Gas (2)	0.46	4.0	0.10
CR65 Digester	Digester Gas (3)	0.46	4.0	0.10
C200 NG	Natural Gas (1)	0.40	1.10	0.10
C200 NG CARB	Natural Gas (1)	0.14	0.20	0.04
CR200 Digester	Digester Gas (3)	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

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Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]

Model	Fuel	NOx	CO	VOC [5]
C30 NG	Natural Gas [1]	0.22	0.60	0.078
CR30 MBTU	Landfill Gas [2]	0.22	7.4	0.340
CR30 MBTU	Digester Gas [3]	0.22	3.7	0.340
C30 Liquid	Diesel #2 [4]	0.90	0.14	0.078
C65 NG Standard	Natural Gas [1]	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas [1]	0.06	0.44	0.034
C65 NG CARB	Natural Gas [1]	0.06	0.08	0.017
CR65 Landfill	Landfill Gas [2]	0.16	1.4	0.034
CR65 Digester	Digester Gas [3]	0.16	1.4	0.034
C200 NG	Natural Gas [1]	0.14	0.37	0.034
C200 NG CARB	Natural Gas [1]	0.05	0.07	0.014
CR200 Digester	Digester Gas [3]	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is "ppmvd" (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expresses as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New } O_2 = \frac{(20.9 - \text{New } O_2 \text{ Percent})}{(20.9 - \text{Current } O_2 \text{ Percent})} \text{ X Emissions at Current } O_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% } O_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \text{ X } 9 = 27 \text{ ppmvd}$$

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Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O2

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas (1)	9	40	9
CR30 MBTU	Landfill Gas (2)	9	500	40
CR30 MBTU	Digester Gas (3)	9	250	40
C30 Liquid	Diesel #2 (4)	35	9	9
C65 NG Standard	Natural Gas (1)	9	40	7
C65 NG Low NOx	Natural Gas (1)	4	40	7
C65 NG CARB	Natural Gas (1)	4	8	3
CR65 Landfill	Landfill Gas (2)	9	130	7
CR65 Digester	Digester Gas (3)	9	130	7
C200 NG	Natural Gas (1)	9	40	7
C200 NG CARB	Natural Gas (1)	4	8	3
CR200 Digester	Digester Gas (3)	9	130	7

Notes: same as Table 1

Table 4. Emission for Different Capstone Microturbine Models in [mg/m3] at 15% O2

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	18	50	6
CR30 MBTU	Landfill Gas (2)	18	620	30
CR30 MBTU	Digester Gas (3)	18	310	30
C30 Liquid	Diesel #2 (4)	72	11	6
C65 NG Standard	Natural Gas (1)	19	50	5
C65 NG Low NOx	Natural Gas (1)	8	50	5
C65 NG CARB	Natural Gas (1)	8	9	2
CR65 Landfill	Landfill Gas (2)	18	160	5
CR65 Digester	Digester Gas (3)	18	160	5
C200 NG	Natural Gas (1)	18	50	5
C200 NG CARB	Natural Gas (1)	8	9	2
CR200 Digester	Digester Gas (3)	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

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Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NOx). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWhe times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NOx emissions rate of:

NOx = .17 X (65/1000) X 24 = .27 pounds per day

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NOx output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

NOx = .17 X 28/70 = .068 pounds per MWh (based on total system output)

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NOx and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

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Greenhouse Gas Emissions

Many gasses are considered "greenhouse gasses", and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO_2), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NOx and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO_2, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO_2. Emission of CO_2 depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO_2 emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO_2 that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO_2 released is substantially less when useful thermal output is also considered in the measurement.

Table 5. CO_2 Emission for Capstone Microturbine Models in [lb/MWh]

Model	Fuel	CO_2	
		Electric Only	70% Total CHP
C30 NG	Natural Gas (1)	1,690	625
CR30 MBTU	Landfill Gas (1)	1,690	625
CR30 MBTU	Digester Gas (1)	1,690	625
C30 Liquid	Diesel #2 (2)	2,400	855
C65 NG Standard	Natural Gas (1)	1,520	625
C65 NG Low NOx	Natural Gas (1)	1,570	625
C65 NG CARB	Natural Gas (1)	1,570	625
CR65 Landfill	Landfill Gas (1)	1,520	625
CR65 Digester	Digester Gas (1)	1,520	625
C200 NG	Natural Gas (1)	1,330	625
C200 NG CARB	Natural Gas (1)	1,330	625
CR200 Digester	Digester Gas (1)	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO_2 content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO_2 content of 160 lb/MMBTU (HHV)

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Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

Table 6. Useful Unit Conversions

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW_{th}: Kilowatt (thermal)
- kW_e : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as "electric horsepower-hour")
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m3: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: applications@capstoneturbine.com

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ATTACHMENT O

Monitoring/Recordkeeping/Reporting/Testing Plans

ATTACHMENT O - MONITORING, RECORDING, REPORTING, AND TESTING PLANS

Plan Type	Emission unit	Pollutant	Requirements	Frequency	Method of Measurement	Regulatory Reference
Monitoring, Recordkeeping	Compressor Turbines S001, S002	NO_X	Performance test	Annual	EPA Test Methods	NSPS KKKK
Monitoring	Compressor Turbines S001, S002		Amount of natural gas consumed, hours of operation	Monthly	N/A	
Monitoring, Recordkeeping	Liquid Loading (S019)	VOC	Monitor throughput of loading	Monthly	Records	

See Attachment D for additional information.

ATTACHMENT P

Public Notice

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that Mountain Valley Pipeline, LLC (MVP) has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a construction permit (R-13) to construct a new natural gas transmission compressor station (Stallworth Station) located on Dawson-Springdale Rd about 5 miles east of Meadow Bridge in Fayette County, West Virginia. The site latitude and longitude coordinates are: 37.86801 N, -80. 75776 W.

The applicant estimates the potential increase in the following Regulated Air Pollutants associated with the project after the installation of the proposed equipment:

Particulate Matter (PM) = 20.30 tpy
Sulfur Dioxide (SO2) = 4.74 tpy
Volatile Organic Compounds (VOC) = 13.46 tpy
Carbon Monoxide (CO) = 91.28 tpy
Nitrogen Oxides (NOx) = 79.84 tpy
Hazardous Air Pollutants (HAPs) = 4.53 tpy
Carbon Dioxide Equivalents (CO_2e) = 169,866 tpy

Startup of operation will begin around the 4th quarter of 2017. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1250, during normal business hours.

Dated on October XX, 2015.

By: Mountain Valley Pipeline, LLC.
Shawn Posey, Senior Vice President – Engineering and Construction
625 Liberty Avenue Suite 1700
Pittsburgh, PA 15222

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-D
Bradshaw Compressor Station Air Quality Modeling Report

FEDERAL ENERGY REGULATORY COMMISSION
AIR QUALITY MODELING REPORT

Bradshaw Compressor Station

Mountain Valley PIPELINE LLC

Prepared By:

TRINITY CONSULTANTS

October 2015

TABLE OF CONTENTS

1. INTRODUCTION 1-1
1.1. Facility Background 1-1

2. MODELING PROCEDURES 2-1
2.1. NAAQS Analysis 2-1
2.2. Background Air Quality 2-1

3. MODELING METHODOLOGY 3-1
3.1. Dispersion Model Selection and Building Downwash Analysis 3-1
3.2. Meteorological Data 3-2
3.2.1. Site Location and Surface Characteristics 3-3
3.2.2. Topographic Setting 3-4
3.2.3. Data Quality 3-7
3.3. Treatment of Terrain 3-7
3.4. Receptor Grids 3-7
3.5. GEP Stack Height Analysis 3-9
3.6. Representation of Emission Sources 3-10
3.6.1. Coordinate System 3-10
3.6.2. Source Types 3-10
3.6.3. Source Parameters and Emission Rates 3-10

4. MODELING RESULTS 4-1

ATTACHMENT A. COMPARISON OF SURFACE CHARACTERISTICS A

ATTACHMENT B. MODEL FILES CD B

ATTACHMENT C. MODELED SOURCE INVENTORY C

ATTACHMENT D. LOAD ANALYSIS D

LIST OF FIGURES

Figure 1-1. Area Map 1-2

Figure 2-1. Background Monitor Locations 2-2

Figure 3-1. Location of Morgantown Municipal Airport Meteorological Tower 3-3

Figure 3-2. Morgantown Airport Wind Rose 3-5

Figure 3-3. Allegheny County Airport Wind Rose 3-6

Figure 3-4. Wheeling-Ohio County Airport Wind Rose 3-6

Figure 3-5. Receptor Grid 3-8

Figure 3-6. Receptor Grid (Zoomed In) 3-9

LIST OF TABLES

Table 2-1. Primary and Secondary NAAQS 2-1

Table 2-2. Selected Background Monitors 2-3

Table 2-3. Selected Background Concentrations 2-4

Table 3-1. Model Selection Options 3-2

Table 4-1. Modeling Results - PM_{10} 24-Hour NAAQS 4-2

Table 4-2. Modeling Results – $PM_{2.5}$ 24-Hour NAAQS 4-2

Table 4-3. Modeling Results – $PM_{2.5}$ Annual NAAQS 4-2

Table 4-4. Modeling Results – SO_2 1-Hour NAAQS 4-3

Table 4-5. Modeling Results – SO_2 3-Hour NAAQS 4-3

Table 4-6. Modeling Results – SO_2 24-Hour NAAQS 4-3

Table 4-7. Modeling Results – SO_2 Annual NAAQS 4-4

Table 4-8. Modeling Results – NO_2 1-Hour NAAQS 4-4

Table 4-9. Modeling Results – NO_2 Annual NAAQS 4-4

Table 4-10. Modeling Results – CO 1-Hour NAAQS 4-4

Table 4-11. Modeling Results – CO 8-Hour NAAQS 4-5

Table 4-12. Modeling Results – Lead 3-Month NAAQS 4-5

1. INTRODUCTION

Mountain Valley Pipeline, LLC (MVP), a subsidiary of EQT Corporation (EQT), is seeking authorization from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act (NGA) to construct and operate a new natural gas compressor station in Wetzel County, West Virginia (Bradshaw Compressor Station).

The Project will include the installation of the following combustion equipment at the Bradshaw Compressor Station:

- Four (4) Solar Titan 130 natural gas-fired turbines each rated at 23,536 horsepower (hp) at site-specific conditions (22,400 hp ISO);
- Fourteen (14) Capstone C200 natural gas-fired microturbines each rated at 200 kW; and
- Two (2) natural gas-fired fuel gas heaters, each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input).[1]

This modeling report outlines the methodologies used to conduct the air dispersion modeling analysis required by the FERC for the Project. Air dispersion modeling is utilized as a tool to demonstrate that the Project complies with the National Ambient Air Quality Standards (NAAQS).

The remainder of this modeling report is organized as follows:

- Section 2: Modeling Procedures;
- Section 3: Modeling Methodology; and
- Section 4: Modeling Results.

MVP has included, as Attachment B to this modeling report, a CD containing all the files associated with the FERC air dispersion modeling analysis of the Project. This CD includes those files associated with importing terrain elevations, analyzing building downwash, meteorological data, and AERMOD.

1.1. FACILITY BACKGROUND

The Bradshaw Compressor Station will be located in Wetzel County, West Virginia at approximately 540.1 kilometers east and 4,376.0 kilometers north, Universal Transverse Mercator (UTM) Zone 17. Figure 1-1 provides an area map which shows the location of the facility relative to surrounding terrain and other features, such as roads and rivers.

[1] The station will also include one (1) natural gas-fired office building heater with heat input of 0.12 MMBtu/hr, one (1) 240 barrel (bbl) storage tank for produced fluids and one (1) 100 bbl storage tank for used oil. The heater and tanks are insignificant emissions sources and were not included in the model.

Figure 1-1. Area Map



2.1. NAAQS ANALYSIS

Air quality dispersion modeling was conducted to evaluate the cumulative impact with regard to the NAAQS at the Bradshaw Compressor Station. Modeling was conducted for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and lead (Pb). The NAAQS evaluated in this modeling analysis are presented in Table 2-1.

Table 2-1. Primary and Secondary NAAQS

Pollutant	Averaging Period	Primary NAAQS (µg/m³)	Secondary NAAQS (µg/m³)	Form of Standard
PM_{10}	24-hour	150	150	Not to be exceeded more than once per year on average over 3 years
$PM_{2.5}$	24-hour	35	35	3-year average of the 98th percentile 24-hour average concentrations
	Annual	12.0	15.0	3-year average of the annual arithmetic mean
SO_2	1-hour	196 (75 ppb)	--	3-year average of the 99th percentile of daily maximum 1-hour concentrations
	3-hour	--	1,300 (500 ppb)	Not to be exceeded more than once per year
	24-hour	365 (140 ppb)[A]	--	Not to be exceeded more than once per year
	Annual	80 (30 ppb)[A]	--	Annual arithmetic mean
NO_2	1-hour	188 (100 ppb)	--	3-year average of the 98th percentile of daily maximum 1-hour concentrations
	Annual	100 (53 ppb)	100 (53 ppb)	Annual arithmetic mean
CO	1-hour	40,000 (35 ppm)	--	Not to be exceeded more than once per year
	8-hour	10,000 (9 ppm)	--	Not to be exceeded more than once per year
Pb	3-month[B]	0.15	0.15	Maximum arithmetic mean

[A] The annual and 24-hour SO_2 standards will be revoked one year after the effective date in areas with a designated status of the revised SO_2 NAAQS, per 40 CFR §50.4(e).

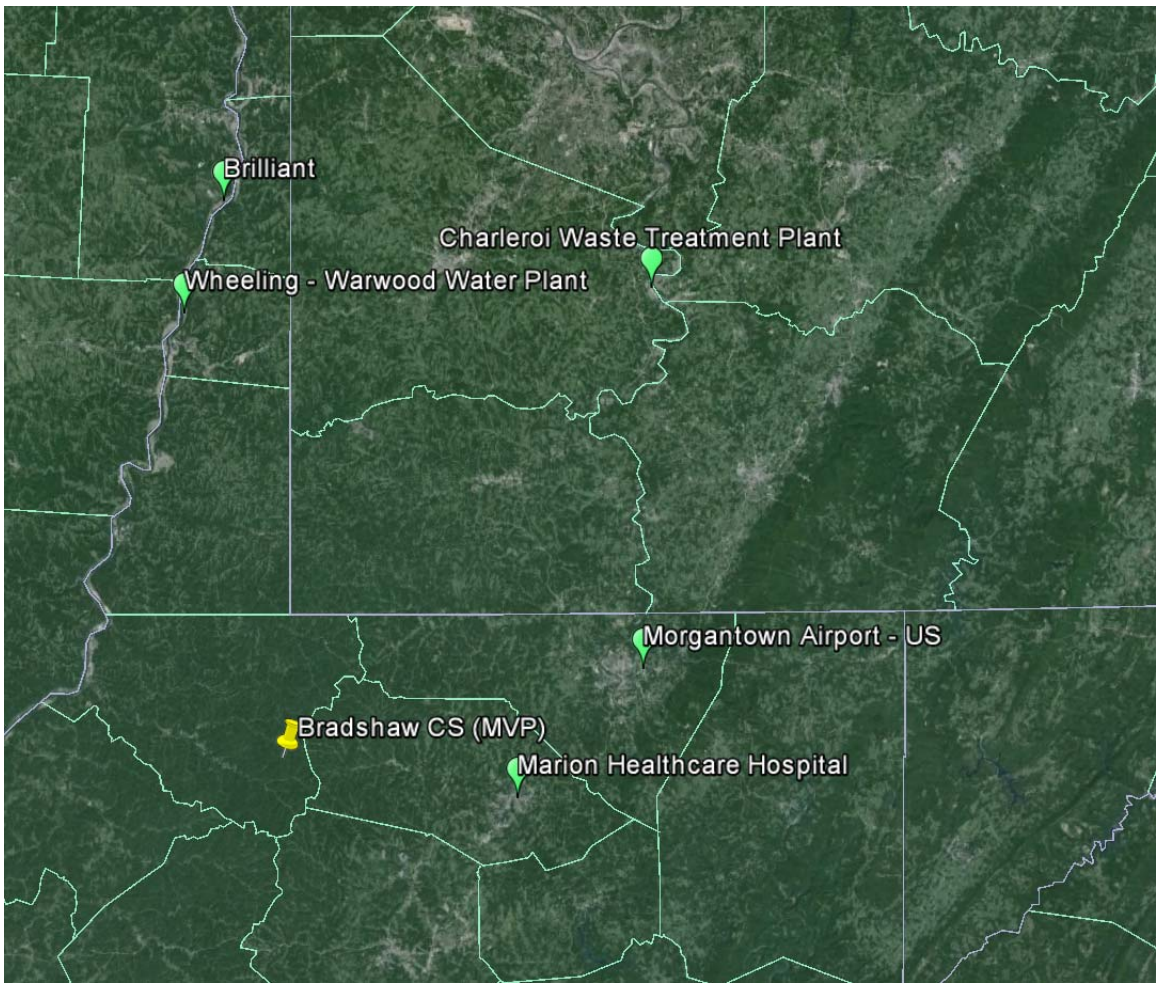
[B] The lead NAAQS is evaluated as a rolling 3-month average concentration.

2.2. BACKGROUND AIR QUALITY

In evaluating cumulative impacts with respect to the NAAQS, maximum modeled impacts were added to representative ambient background concentrations and compared to the applicable NAAQS. Selection of the existing monitoring station data that is "representative" of the ambient air quality in the area surrounding the Bradshaw Compressor Station is determined based on the following three criteria: 1) monitor location, 2) data quality, and 3) data currentness. Key considerations based on the monitor location criteria include proximity to the significant impact area of the facility, similarity of emission sources impacting the monitor to the emission sources impacting the airshed surrounding the Bradshaw Compressor Station, and the similarity of the land use and land cover (LULC) surrounding the monitor and facility. The data quality criteria refers to the monitor being an approved state and local air monitoring station (SLAM) or similar monitor type subject to the quality assurance requirements in 40 CFR Part 58 Appendix A. Data currentness refers to the fact that the most recent three complete years of quality assured data are generally preferred.

Figure 2-1 presents the location of the closest, most representative monitor locations which are proposed for use in the NAAQS analysis.

Figure 2-1. Background Monitor Locations



As is discussed in more detail, MVP selected monitors with the most currently available data (2012-2014), that are within the region, and that have reasonably similar topographic settings. The selected monitors are generally in more populated or industrialized areas than the Bradshaw Compressor Station and thus represent conservative estimates of ambient background.

Specifically with regards to NO_2 and CO monitoring data, MVP used a representative ambient monitor, AQS# 421250005, located at the Charleroi Waste Treatment Plant in Washington County, Pennsylvania. At approximately 87 kilometers (km), the Charleroi site is nearly equal distant to the other nearby monitoring site for these pollutants, the Marcellus site in Washington County, PA. However, the Charleroi site has superior data counts compared to the Marcellus site. Furthermore, the Charleroi site is located in a much more populated area than the Bradshaw Compressor Station thus the monitor provides conservative estimates of ambient background concentrations.

For $PM_{2.5}$, MVP used a representative ambient monitor, AQS# 540490006, located at Marion Health Care Hospital in Marion County, West Virginia. At approximately 32 km southeast of the facility, the Marion Hospital site is nearly equal distant to the next closest monitoring site for $PM_{2.5}$. In addition, $PM_{2.5}$ is a regional pollutant and due to the proximity of the monitor, the background concentration is expected to be similar to that of the Bradshaw Compressor Station. The Marion Hospital site is located in a much more populated area than the Bradshaw Compressor Station thus the monitor provides conservative estimates of ambient background concentrations.

For SO_2, MVP used a monitor located at the airport in Morgantown, Monongalia County, West Virginia (AQS# 540610003). There are three monitors closer than the Morgantown monitor. However, two of these monitors (one in Belmont County, Ohio and one in Moundsville, WV) are located along the Ohio River Valley and near significant historical SO_2 emissions sources (e.g., the Kammer Station near Moundsville) and are thus excluded from further consideration. The remaining alternate station is located in Greene County, PA. However, the Morgantown monitor has better data capture, particularly in 2012. Given this and the monitor's location in a more urban area than the proposed Bradshaw Compressor Station, the Morgantown monitor was utilized as a representative and reasonably conservative background concentration.

For PM_{10}, MVP used a monitor located in Brilliant, Jefferson County, Ohio (AQS# 390810001). The Brilliant monitor is located approximately 81 km north of the facility. The Brilliant monitor is the closest PM_{10} monitor to the proposed station and as such was selected for use in this analysis. Note that the Brilliant background concentration is also the highest, or equivalent, of the four closest monitors indicating that the use of this monitor is a conservative assumption.

For lead, MVP used a monitor located at the Warwood Water Plant located in Ohio County, West Virginia (AQS# 540690010). The Wheeling site is the closest monitoring site for lead (approximately 65 km northwest of the facility) that has high data counts for the 2011 through 2013 timeframe. The Wheeling site is located in a much more populated area than the Bradshaw Compressor Station and has several nearby industrial sources, thus the monitor provides conservative estimates of ambient background concentrations.

Table 2-2 presents a list of the selected monitor locations and measured pollutants.

Table 2-2. Selected Background Monitors

Site ID	Address	County	State	Pollutant Monitored
421250005	Charleroi Waste Treatment Plant, Charleroi, PA	Washington	PA	NO_2, CO
540490006	Marion Health Care Hospital, 401 Guffey Street, Fairmont, WV	Marion	WV	$PM_{2.5}$
540610003	Morgantown Airport, Morgantown, WV	Monongalia	WV	SO_2
390810001	Brilliant, OH	Jefferson	OH	PM_{10}
540690010	Warwood Water Plant, Wheeling, WV	Ohio	WV	Pb

Based on available, validated data, MVP proposes to utilize the ambient background concentrations shown in Table 2-3 in the modeling analyses.

Table 2-3. Selected Background Concentrations

Pollutant	Averaging Period	2012-2014 Monitor Background Concentration (µg/m³)	Metric	Monitor Location
PM_{10}	24-hour	47.0	3-year average Highest-second-high (H2H)	Brilliant
$PM_{2.5}$	24-hour	18.8	3-year average of 98th percentile	Marion Hospital
	Annual	9.7	3-year average	
SO_2	1-hour	39.3	3-year average of 99th percentile	Morgantown Airport
	3-hour	41.9	H2H (2012)	
	24-hour	16.8	H2H (2013)	
	Annual	5.2	Annual Average (2012)	
NO_2	1-hour	68.4	3-year average of 98th percentile	Charleroi
	Annual	16.1	Annual Average (2014)	
CO	1-hour	2,864	H2H (2014)	Charleroi
	8-hour	1,718	H2H (2012)	
Pb	3-month	0.04	Highest Month (2012)	Wheeling

3. MODELING METHODOLOGY

This section of the modeling report describes the procedures and data resources utilized in the air dispersion modeling analyses.

3.1. DISPERSION MODEL SELECTION AND BUILDING DOWNWASH ANALYSIS

Dispersion models predict ambient pollutant concentrations by simulating the evolution of the pollutant plume over time and space given data inputs including the quantity of emissions, stack exhaust parameters (e.g., velocity, flowrate, and temperature) and weather data. Building structures that obstruct wind flow near emission points may cause stack discharges to become caught in the turbulent wakes of these structures leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent. These effects generally cause higher ground-level pollutant concentrations since building downwash inhibits dispersion from elevated stack discharges. For this reason, building downwash algorithms are considered an integral component of the selected air dispersion model.

Version 15181 of the AERMOD model was used to estimate maximum ground-level concentrations in the air pollutant analyses conducted. AERMOD is a refined, steady-state, multiple source dispersion model that was promulgated in December 2005 as the Environmental Protection Agency (EPA)-preferred model to use for industrial sources in this type of air dispersion modeling analysis.[2] The AERMOD modeling was performed using regulatory default options except as otherwise noted in this report. The AERMOD model has the Plume Rise Modeling Enhancements (PRIME) incorporated in the regulatory version, so the direction-specific building downwash dimensions used as input were determined by the Building Profile Input Program, PRIME version (BPIP PRIME), version 04274.[3] BPIP PRIME is designed to incorporate the concepts and procedures expressed in the Good Engineering Practice (GEP) Technical Support document, the Building Downwash Guidance document, and other related documents,[4] while incorporating the PRIME enhancements to improve prediction of ambient impacts in building cavities and wake regions. Table 3-1 summarizes the model control options that were utilized in this analysis.

[2] 40 CFR 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).
[3] Earth Tech, Inc., *Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model*, Concord, MA.
[4] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

Table 3-1. Model Selection Options

Control Option	Option Selected	Justification
Pollutant ID	CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, Other (for lead)	--
Terrain	Elevated, Meters	The receptor grid covers varying terrain elevations; as such, the elevated option was selected.
Flagpole Receptors	N/A	--
Run or Not	Run	--
Averaging Times	1-hour, 3-hour, 8-hour, 24-hour, month, and annual	MVP selected the appropriate averaging periods for each pollutant.
Model	PRIME	The PRIME algorithms are default.
Dispersion	Concentration, Rural, Regulatory Default Option	This modeling analysis is assessing compliance with concentration standards. MVP is located in a predominantly rural area. The regulatory default option was selected.
NO_2 Model Options	N/A	MVP did not utilize any Tier 2 or 3 model options for NO_2 modeling.
Particulate Model Options	N/A	MVP did not utilize particle deposition or depletion options for particulate modeling.
Output Files	.aml	Model output file from Breeze User Interface (contained in zip files [.amz])

3.2. METEOROLOGICAL DATA

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, readily available data from the closest and most representative National Weather Service (NWS) station are commonly used. Regulatory air dispersion modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- Wind speed;
- Wind direction;
- Air temperature;
- Micrometeorological parameters (e.g., friction velocity, Monin-Obukhov length);
- Mechanical mixing height; and
- Convective mixing height.

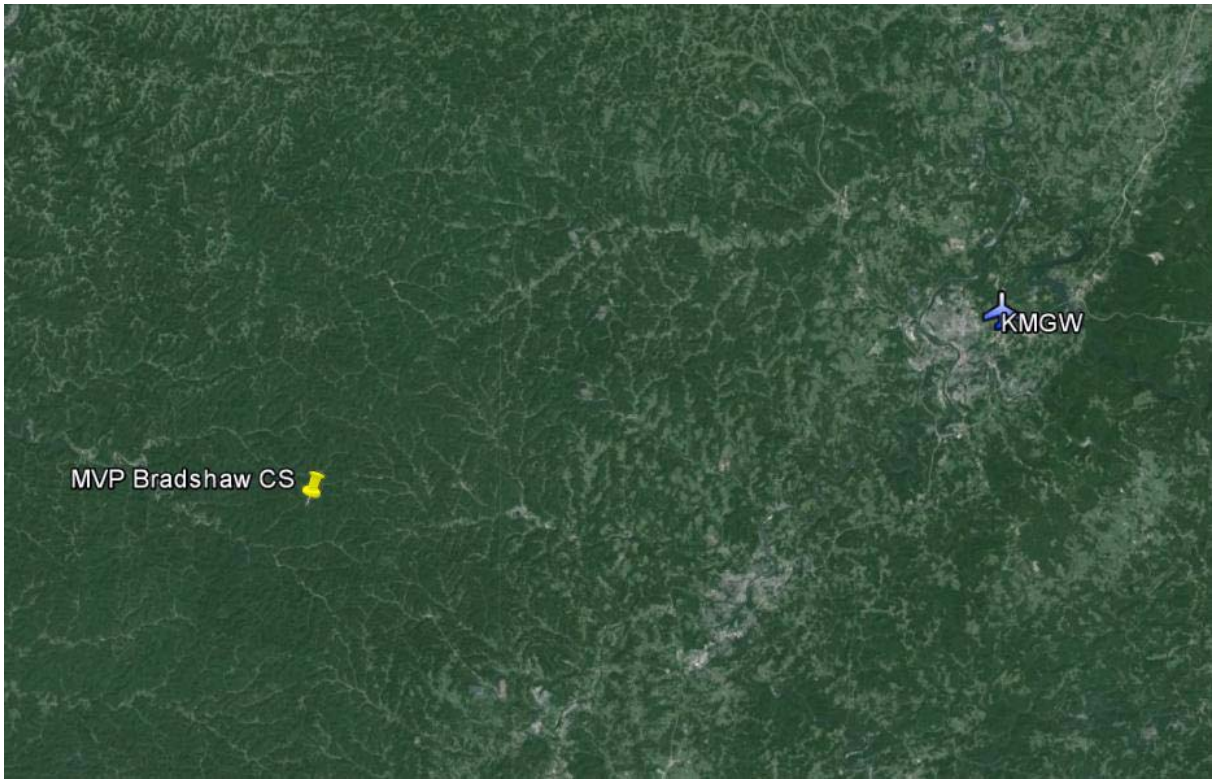
The first three of these parameters are directly measured by monitoring equipment located at typical surface observation stations. The friction velocity, Monin-Obukhov length, and mixing heights are derived from characteristic micrometeorological parameters and from observed and correlated values of cloud cover, solar insulation, time of day and year, and latitude of the surface observation station. Surface observation stations form a relatively dense network, are almost always found at airports, and are typically operated by the NWS.

Upper air stations are fewer in number than surface observing points since the upper atmosphere is less vulnerable to local effects caused by terrain or other land influences and is therefore less variable. The NWS operates virtually all available upper air measurement stations in the United States.

3.2.1. Site Location and Surface Characteristics

MVP utilized 2010 to 2014 meteorological data from the meteorological tower at Morgantown Municipal Airport (KMGW), located roughly 55 km northeast of the Bradshaw Compressor Station. Figure 3-1 shows the relative location of Morgantown Municipal Airport to the Bradshaw Compressor Station.

Figure 3-1. Location of Morgantown Municipal Airport Meteorological Tower



The meteorological tower at Morgantown Municipal Airport is not the closest tower to the Bradshaw Compressor Station. North Central West Virginia Airport (KCKB) is located approximately 37 km southeast of the facility. However, the terrain surrounding North Central West Virginia Airport is rather rough with significant features mostly to the south which is not true for the Bradshaw Compressor Station.

AERSURFACE (version 13016) was used as an objective method for evaluating landuse characteristics and their associated micrometeorological parameters for a given location. The AERSURFACE program was used in the evaluation of potential NWS stations in the area. AERSURFACE was used to create seasonal values of albedo, Bowen ratio and surface roughness, across 12 directional sectors (e.g. 0-30 degrees). The seasonal parameters correspond to the calendar months in which they occur (i.e. winter values for December-February). The albedo and Bowen ratio values were determined from taking the geometric mean over a 10 kilometer (km) area out from the location of interest. The surface roughness values assigned by AERSURFACE were based on a 1 km radius out from the site.

The figures in Attachment A illustrate the magnitude of the micrometeorological differences between the Morgantown Airport and Bradshaw Compressor Station sites, as determined by AERSURFACE.

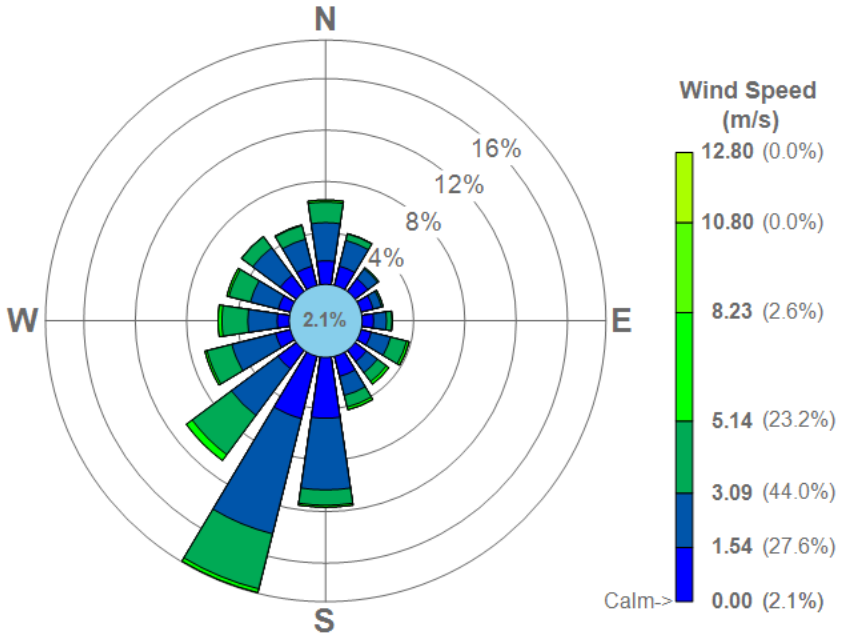
The albedo and Bowen ratio values show reasonable agreement across the directional sectors. However, there are variations in surface roughness across a couple of sectors. Accordingly, MVP performed a sensitivity analysis of the surface characteristics (most notably the surface roughness) to determine the impact of these differences. For this assessment a constant emission rate (1 lb/hr) was input for the turbine normal operating scenario (i.e., 100 percent load). The results of this analysis were compared for all receptors in the domain and for each metric used in this analysis (e.g., 1-hour H1H, H2H, H4H, and H8H, 3-hour H1H and H2H, etc.). AERMOD responded to the surface characteristics differences between the two sites with moderately varying output concentrations (30% on average).

3.2.2. Topographic Setting

The complexity of the terrain is another important consideration in determining data representativeness. In addition to the land use similarities shown above, the Morgantown Airport and the Bradshaw Compressor Station are at both at relatively high elevations (~449 meters for the station and ~375 meters for the tower) without significant terrain features between the sites or similar hills around the individual locations.

Figure 3-2 provides a wind rose for the Morgantown Airport for the data period of 2010 to 2014.

Figure 3-2. Morgantown Airport Wind Rose



As shown in Figure 3-2, wind is largely from the west and south at Morgantown Airport. This is the general wind pattern in this area and is also expected to be the wind pattern at the Bradshaw Compressor Station site. To demonstrate this, 5-year wind roses (2009 – 2013) for the Allegheny County Airport which is located 105 km northeast of the Bradshaw Compressor Station and Wheeling-Ohio County Airport which is located approximately 70 km north of the Bradshaw Compressor Station are provided as Figures 3-3 and 3-4, respectively. All wind roses show the same predominant wind directions from the west and south.

Figure 3-3. Allegheny County Airport Wind Rose

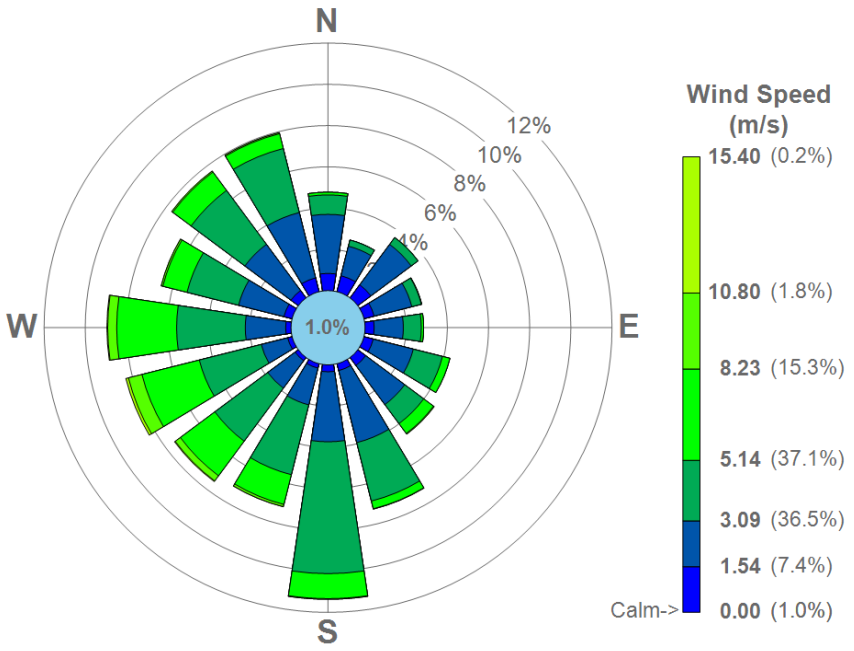
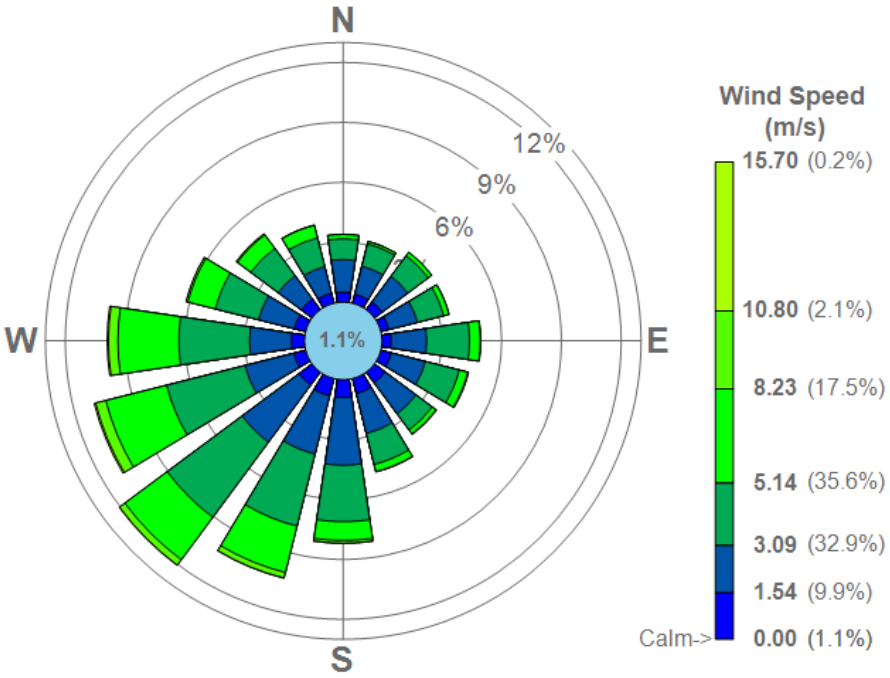


Figure 3-4. Wheeling-Ohio County Airport Wind Rose



3.2.3. Data Quality

The Morgantown Airport meteorological data was processed through the latest version of AERMET (version 15181) to include upper air measurements from the Pittsburgh International Airport site (KPIT). Per EPA guidance, 1-minute Automated Surface Observing System (ASOS) wind data was also incorporated in the processing, using the latest version of AERMINUTE (version 14337). A base elevation of 381.9 meters was used for the meteorological tower in the modeling analysis.

3.3. TREATMENT OF TERRAIN

Through the use of the AERMOD terrain preprocessor (AERMAP), AERMOD incorporates not only the receptor heights, but also an effective height (hill height scale) that represents the significant terrain features surrounding a given receptor that could lead to plume recirculation and other terrain interaction.[5]

Receptor terrain elevations input to the model were those interpolated from 1/3 arc second National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS). The array elevations and elevations for emission sources and buildings at the Bradshaw Compressor Station were based on site grade elevations.

3.4. RECEPTOR GRIDS

For this air dispersion modeling analysis, ground-level concentrations were calculated along the facility boundary and also within a Cartesian receptor grid outside the fenceline. The boundary receptors were spaced 50 meters apart starting at an arbitrary point on the boundary. The Cartesian grid generally consists of the following receptor spacing:

- 50 meter-spaced receptors from the boundary out to 2 kilometers;
- 100 meter-spaced receptors from 2 to 5 kilometers;
- 500 meter-spaced receptors from 5 to 10 kilometers; and
- 1,000 meter-spaced receptors from 10 to 25 kilometers.

In general, the receptors covered a region extending from all edges of the Bradshaw Compressor Station boundary to the point where impacts from the Project are no longer expected to be significant. For this modeling analysis, MVP considered all land outside of the facility's fenceline to be ambient air although MVP owns property beyond the fenceline.

Receptor elevations required by AERMOD were determined using the AERMAP terrain preprocessor (version 11103). Figures 3-5 and 3-6 show the full receptor grid and a closer view of the receptors at the facility, respectively.

[5] EPA, *Users Guide for the AERMOD Terrain Preprocessor (AERMAP)*, Research Triangle Park, NC, EPA-454/B-03-003, October 2004.

Figure 3-5. Receptor Grid

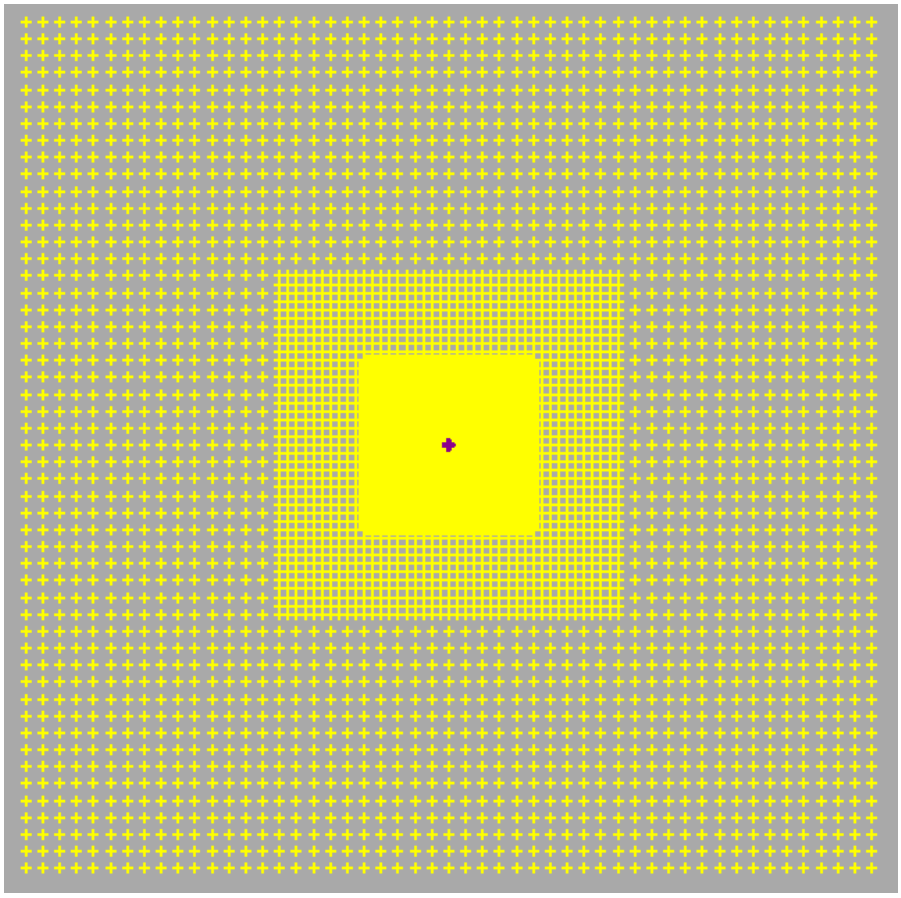
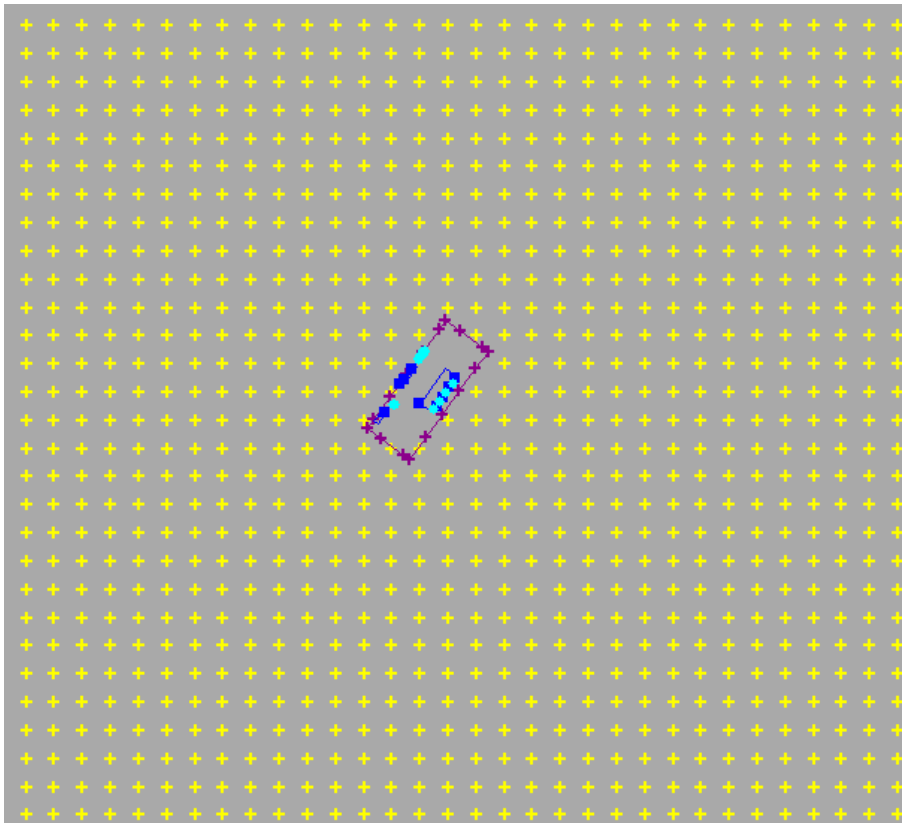


Figure 3-6. Receptor Grid (Zoomed In)



3.5. GEP STACK HEIGHT ANALYSIS

Stack height regulations restrict the use of stack heights in excess of GEP in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations. The minimum stack height not subject to the effects of downwash, called the GEP stack height, is defined by the following formula:

H_{GEP} = H + 1.5L, where:

H_{GEP} = minimum GEP stack height,
H = structure height, and
L = lesser dimension of the structure (height or projected width).

The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP PRIME. In general, the lowest GEP stack height for any source is 65 meters by default.[6] A source may construct a stack that exceeds GEP, but is limited to the GEP stack height in the air quality analysis demonstration. All proposed source stacks at the Bradshaw Compressor Station are less than 65 meters tall and therefore meet the requirements of GEP.

[6] 40 CFR §51.100(ii).

3.6. REPRESENTATION OF EMISSION SOURCES

3.6.1. Coordinate System

In all modeling analysis data files, the location of emission sources, structures, and receptors, are represented in the UTM coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). The datum for this modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 17.

3.6.2. Source Types

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. In these air dispersions modeling analyses, MVP utilized point sources for all emission sources. There were no area or volumes sources used in this modeling analysis.

For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses. The proposed turbines and heaters at the Bradshaw Compressor Station have an unobstructed vertical release and were therefore modeled as point sources. Stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) used in the modeling analyses were based on design values for the turbine for each operating load considered in the analysis.

The proposed microturbines at the Bradshaw Compressor Station are equipped with hinged rain caps. These rain caps are necessary to avoid rainwater build up when the units are not operating. However, during operation the rain caps are forced open by the exhaust plume and remain open during operation thereby not obstructing the plume. As such, these sources were also modeled as point sources with their design values for height, diameter, exhaust gas temperature, and gas exit velocity.[7]

3.6.3. Source Parameters and Emission Rates

In general, a dispersion modeling analysis should contain sufficient detail to determine the maximum ambient concentration of the pollutant under consideration, and in many cases this involves modeling several operating loads or production rates. As such, this modeling analysis considered the proposed combustion turbine operating at various expected load scenarios (100 percent, 75 percent, and 50 percent loads). These scenarios encompass the variations in flow potentially resulting from reduced operational loads, thus determining the worst-case modeled concentrations. For this load analysis, a unit emission rate (One (1) lb/hr) was input into the model and results were scaled based on the actual potential to emit (lb/hr) for each operating load. The worst-case load determined from this load analysis (as shown in Attachment D) and the 100 percent load scenario were utilized in the AERMOD modeling analyses.

MVP also evaluated the effect of startup and shutdown emissions from the proposed combustion turbines in this analysis. A startup or shutdown event of the turbine is expected to last 10 minutes. This is a much shorter time than the shortest NAAQS averaging period (i.e., 1-hour) and as such was not included in modeling. In addition, the only modeled pollutants for which startup and shutdown emissions are available are NO_2 and CO. For NO_2,

[7] The Vermont Department of Environmental Conservation and Northwest Clean Air Agency have both published guidance supporting the treatment of hinged rain caps as unobstructed, vertical releases (http://www.anr.state.vt.us/air/permitting/docs/Rain_Guard_Guidance.pdf and http://www.nwcleanair.org/pdf/forms/misc/Stack%20and%20Rain%20Guard%20Requirements1.pdf). The West Virginia Department of Environmental Protection does not have any state-specific air dispersion modeling guidance.

the startup and shutdown emissions, in lb/event, are much less than the normal operation hourly emission rate. For CO, emissions per event are higher than the normal operation hourly emission rate, however, the modeling results for the 1-hour CO standard are well below the NAAQS.

The source parameters and emissions utilized in this analysis are included in Attachment C.

4. MODELING RESULTS

Following the procedures and methods discussed in this report, the following tables summarize the results from the conducted modeling analyses. As shown in the tables below, the results of the analyses indicate that the predicted ambient impacts resulting from the operation of the Bradshaw Compressor Station plus the existing ambient background concentration are lower than each of the NAAQS.

Electronic input and output files for all AERMOD model runs are included in Attachment B.

Table 4-1. Modeling Results - PM_{10} 24-Hour NAAQS

Scenario/ Load	H6H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	10.4	47.0	57.4	150	Yes
Worst-Case Load	11.0		58.0		Yes

Table 4-2. Modeling Results – $PM_{2.5}$ 24-Hour NAAQS

Scenario/ Load	5-year Average H1H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	3.7	18.8	22.5	35	Yes
Worst-Case Load	3.8		22.6		Yes

Table 4-3. Modeling Results – $PM_{2.5}$ Annual NAAQS

Scenario/ Load	5-year Average Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	0.7	9.7	10.4	12	Yes
Worst-Case Load	0.8		10.5		Yes

Table 4-4. Modeling Results – SO_2 1-Hour NAAQS

Scenario/ Load	5-year Average H4H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load/Worst-Case Load	6.8	39.3	46.1	196	Yes

Table 4-5. Modeling Results – SO_2 3-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	5.5	7.3	4.3	8.3	7.7	8.3	41.9	50.3	1,300	Yes

Table 4-6. Modeling Results – SO_2 24-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	1.4	2.8	1.9	2.8	2.0	2.8	16.8	19.6	365	Yes
Worst-Case Load	1.4	2.8	1.9	2.9	2.0	2.9		19.6		Yes

Table 4-7. Modeling Results – SO_2 Annual NAAQS

Scenario/ Load	1st High Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	0.1	0.2	0.2	0.2	0.2	0.2	5.2	5.4	80	Yes
Worst-Case Load	0.2	0.2	0.2	0.2	0.2	0.2		5.4		Yes

Table 4-8. Modeling Results – NO_2 1-Hour NAAQS

Scenario/ Load	5-year Average H8H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load/Worst-Case Load	114.6	68.4	183.0	188	Yes

Table 4-9. Modeling Results – NO_2 Annual NAAQS

Scenario/ Load	1st High Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	5.9	6.9	6.3	7.5	7.8	7.8	16.1	23.9	100	Yes
Worst-Case Load	6.1	7.1	6.4	7.7	8.0	8.0		24.1		Yes

Table 4-10. Modeling Results – CO 1-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	145.7	147.6	152.2	166.8	171.9	171.9	2864.0	3036.0	40,000	Yes

Table 4-11. Modeling Results – CO 8-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	62.5	92.1	81.0	101.3	68.3	101.3	1718.4	1819.7	10,000	Yes

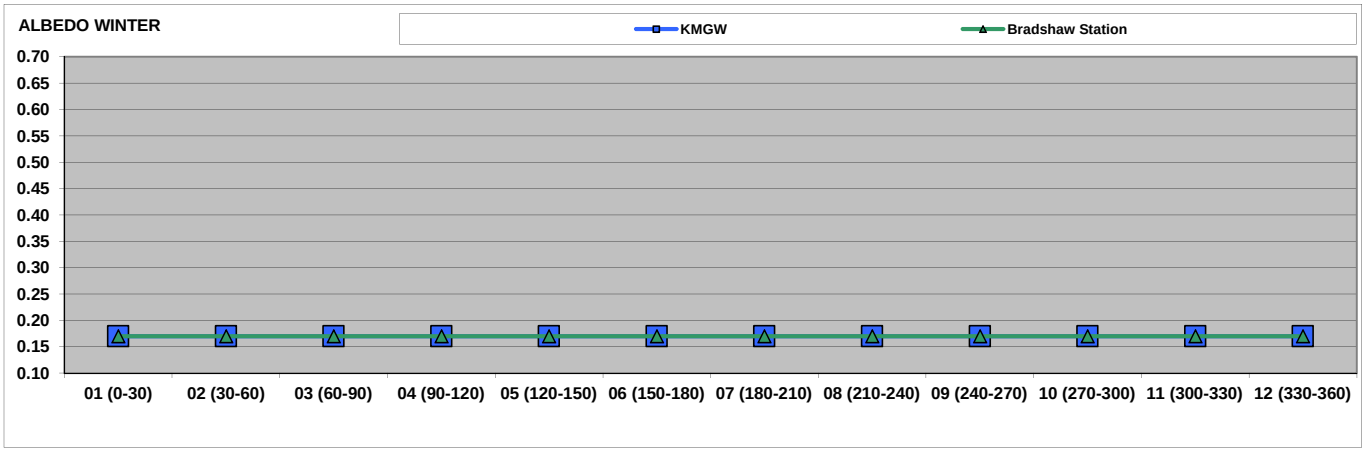
Table 4-12. Modeling Results – Lead 3-Month NAAQS

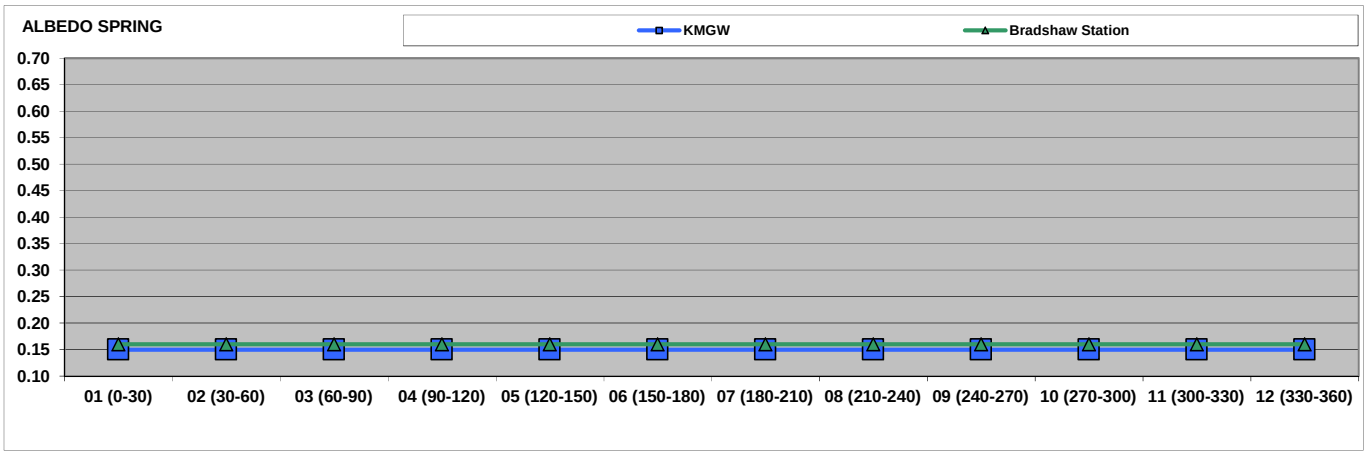
Scenario/ Load	H1H Modeled Concentration (µg/m³)[A]						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	0.00004	0.00004	0.00004	0.00004	0.00005	0.00005	0.04	0.04	0.15	Yes

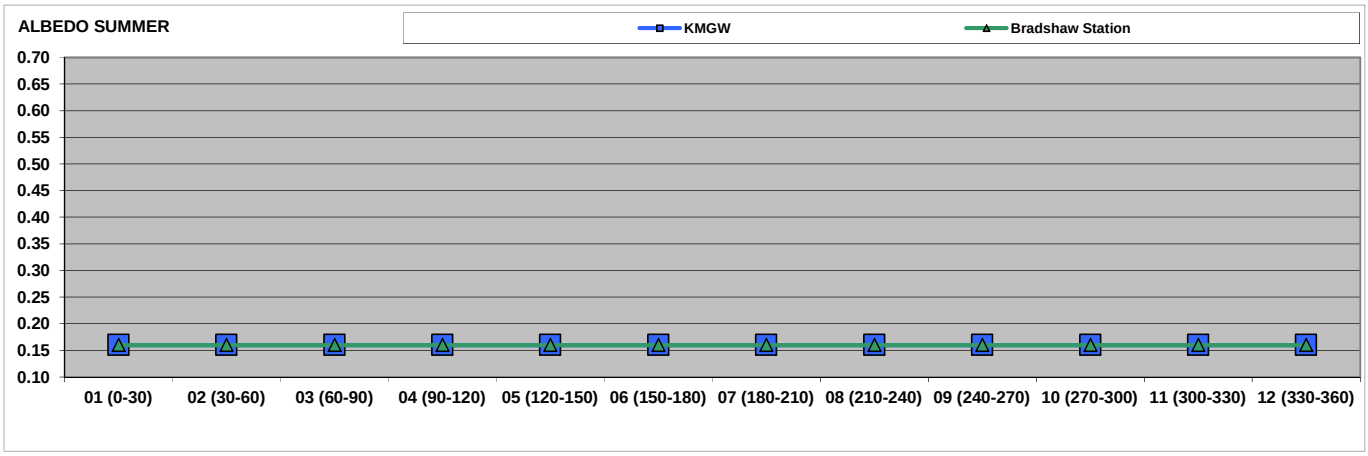
[A] Results shown are maximum monthly average concentration. This is a conservative assumption as the NAAQS is based on a rolling 3-month average.

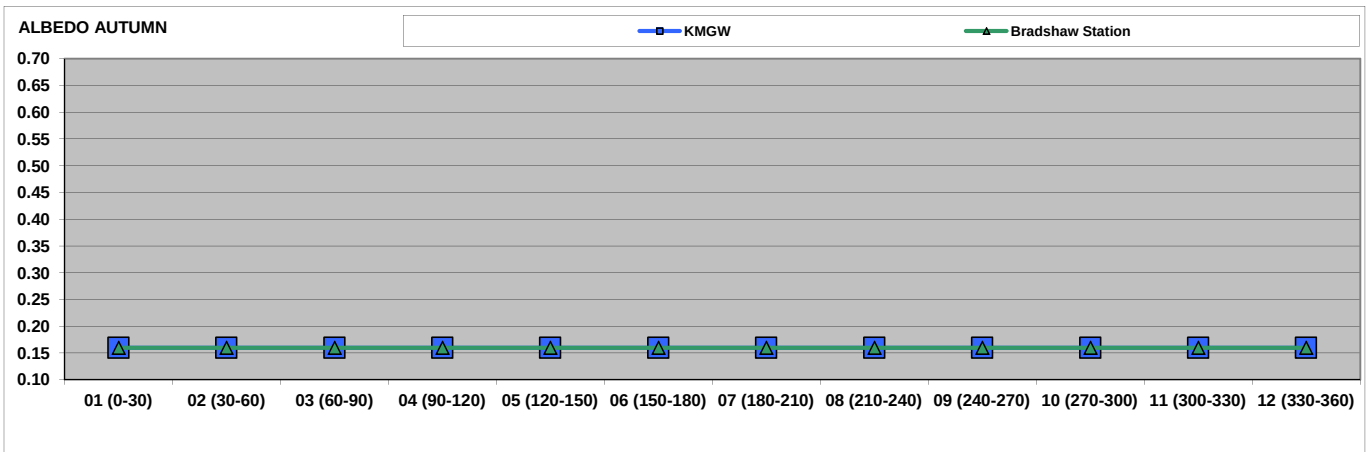
ATTACHMENT A. COMPARISON OF SURFACE CHARACTERISTICS

COMPARISON OF ALBEDO VALUES

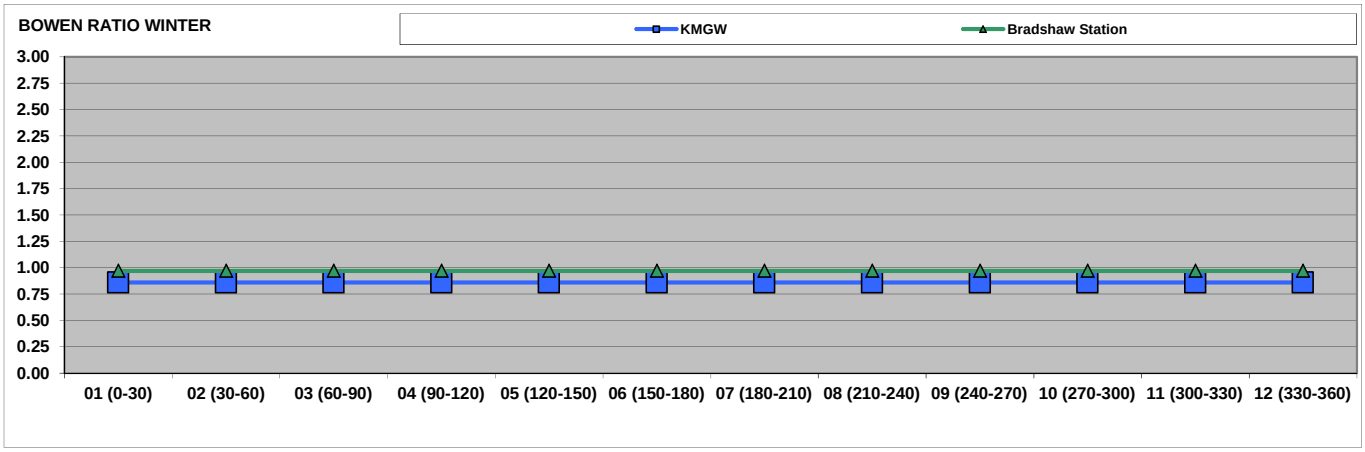


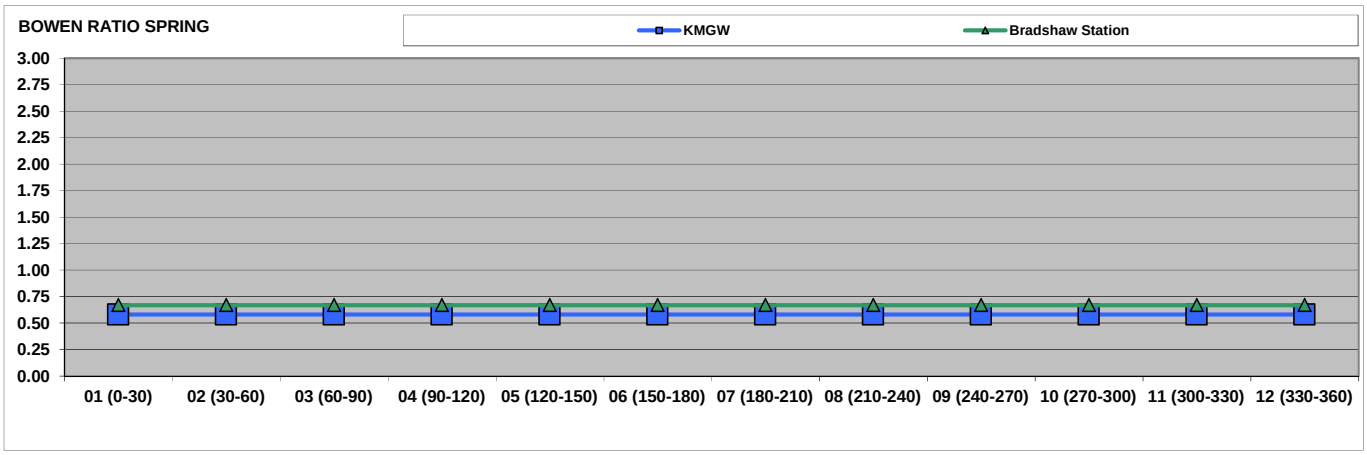


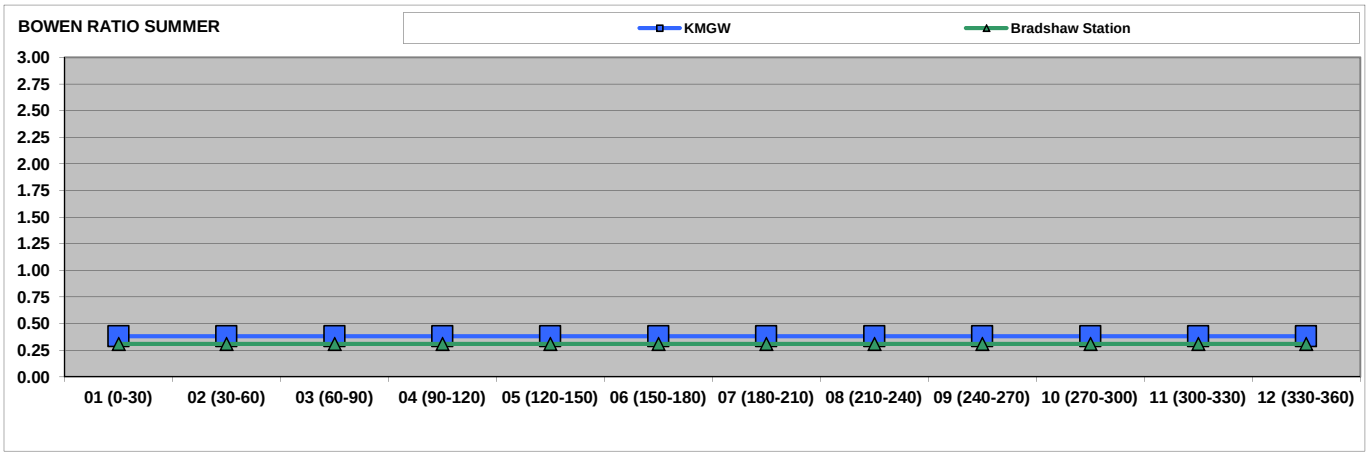


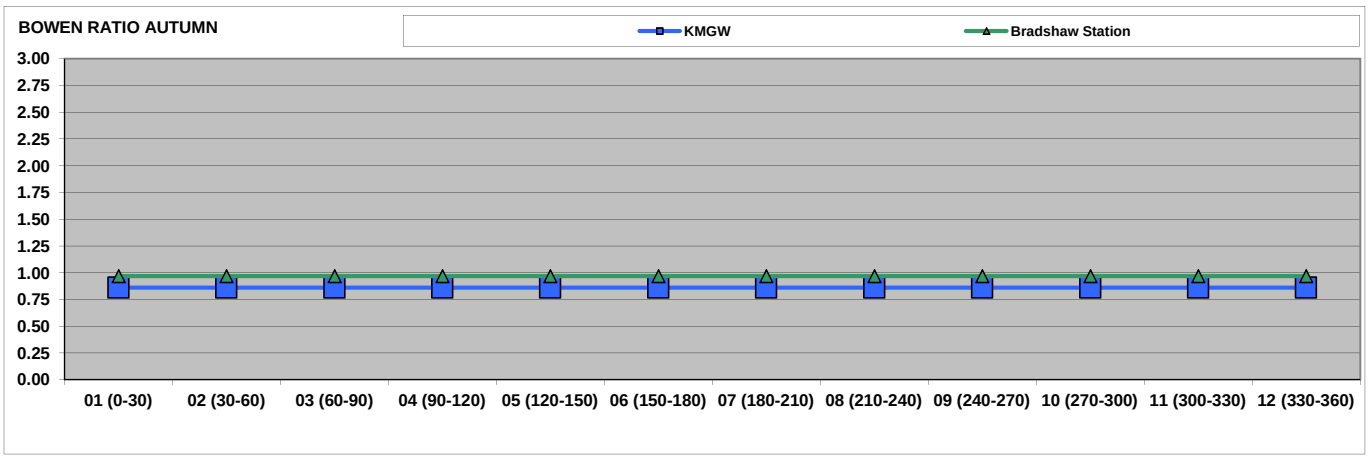


COMPARISON OF BOWEN RATIO VALUES

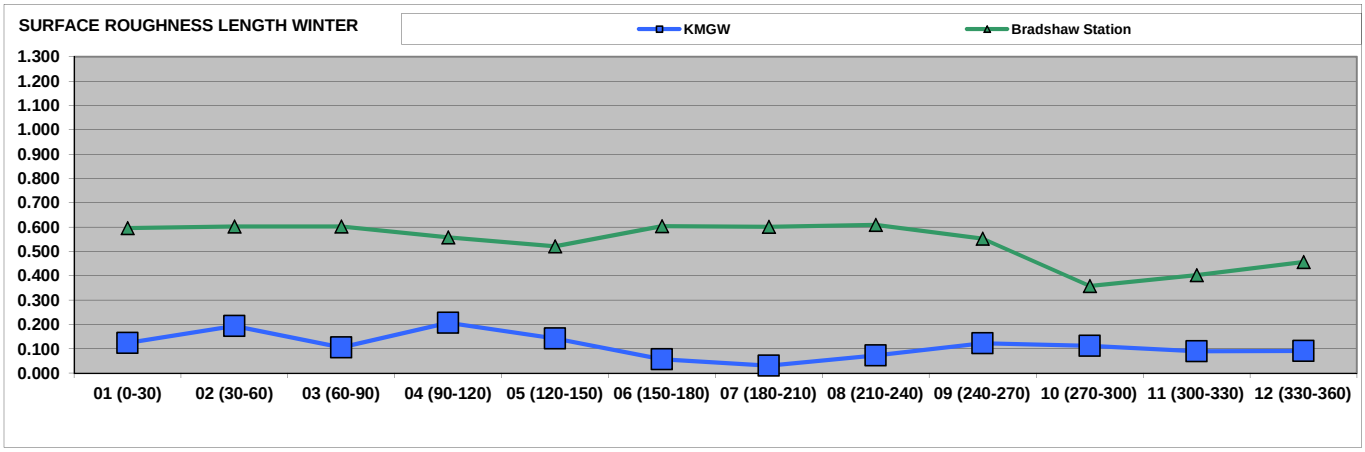


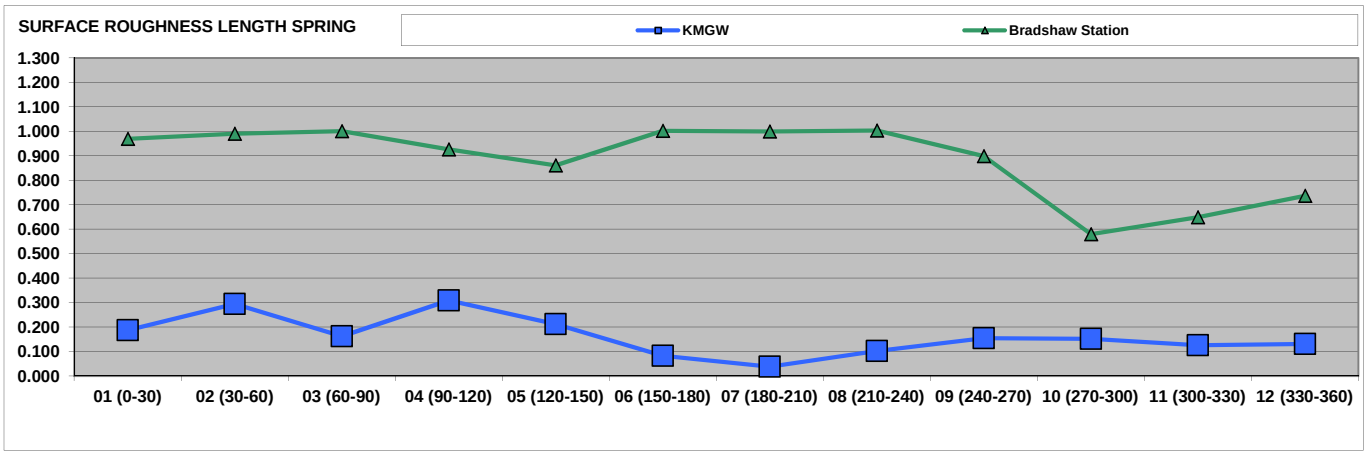


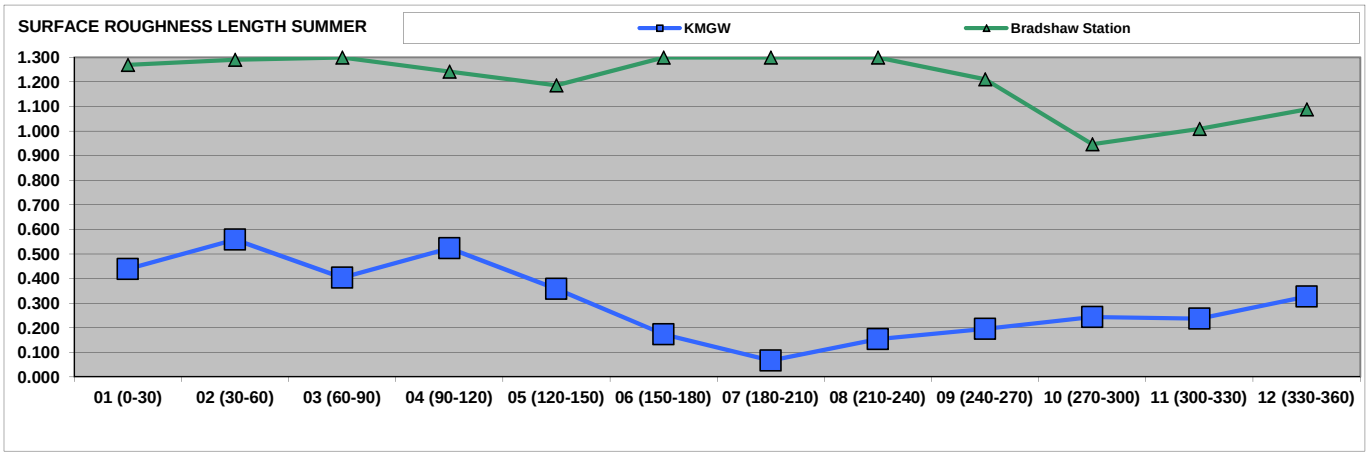


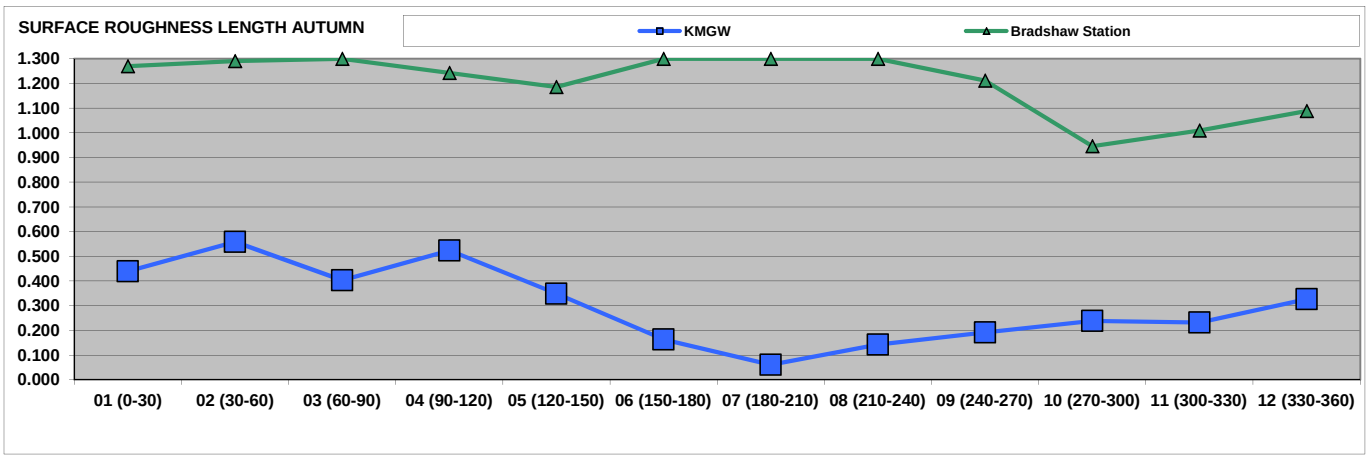


COMPARISON OF SURFACE ROUGHNESS LENGTH VALUES









ATTACHMENT B. MODEL FILES CD

ATTACHMENT C. MODELED SOURCE INVENTORY

Bradshaw Compressor Station - Modeled Source Inventory
1-Hour CO Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	CO Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.22
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.18
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.22
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	9.90
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	9.90
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	9.90
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	9.90
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.18

Bradshaw Compressor Station - Modeled Source Inventory
8-Hour CO Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	CO Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.22
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.18
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.22
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.22
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.22
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	9.90
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	9.90
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	9.90
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	9.90
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.18

Bradshaw Compressor Station - Modeled Source Inventory
Pb Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	Pb Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.00
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	1.07E-06
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.00
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.00
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.00
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.00
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.00
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.00
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.00
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	0.00
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	0.00
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	0.00
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	0.00
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	1.07E-06

* No load scenario was run for the turbines as there are no lead emissions from the turbines with which to determine worst-case load.

Bradshaw Compressor Station - Modeled Source Inventory
1-Hour NO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.08
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.21
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.08
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	9.80
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	9.80
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	9.80
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	9.80
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.21

Bradshaw Compressor Station - Modeled Source Inventory
Annual NO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.08
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.21
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.08
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.08
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.08
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	9.80
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	9.80
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	9.80
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	9.80
T1_75L	Turbine 1 Load, 75% Load	540177.3	4376034.7	448.7	15.24	741.9	14.70	2.75	7.80
T2_75L	Turbine 2 Load, 75% Load	540188.7	4376050.4	448.7	15.24	741.9	14.70	2.75	7.80
T3_75L	Turbine 3 Load, 75% Load	540200.0	4376066.0	448.7	15.24	741.9	14.70	2.75	7.80
T4_75L	Turbine 4 Load, 75% Load	540211.4	4376081.7	448.7	15.24	741.9	14.70	2.75	7.80
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.21

Bradshaw Compressor Station - Modeled Source Inventory
24-Hour $PM_{2.5}$ Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	$PM_{2.5}$ Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.02
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.02
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	2.64
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	2.64
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	2.64
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	2.64
T3_75L	Turbine 3 Load, 75% Load	540200.0	4376066.0	448.7	15.24	741.9	14.70	2.75	2.22
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.02

Bradshaw Compressor Station - Modeled Source Inventory
Annual $PM_{2.5}$ Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	$PM_{2.5}$ Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.02
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.02
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	2.64
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	2.64
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	2.64
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	2.64
T1_50L	Turbine 1 Load, 50% Load	540177.3	4376034.7	448.7	15.24	761.2	11.68	2.75	1.72
T3_50L	Turbine 3 Load, 50% Load	540200.0	4376066.0	448.7	15.24	761.2	11.68	2.75	1.72
T4_50L	Turbine 4 Load, 50% Load	540211.4	4376081.7	448.7	15.24	761.2	11.68	2.75	1.72
T2_50L	Turbine 2 Load, 50% Load	540188.7	4376050.4	448.7	15.24	761.2	11.68	2.75	1.72
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.02

Bradshaw Compressor Station - Modeled Source Inventory
24-Hour PM_{10} Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	PM_{10} Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.02
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.02
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.02
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	2.64
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	2.64
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	2.64
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	2.64
T3_75L	Turbine 3 Load, 75% Load	540200.0	4376066.0	448.7	15.24	741.9	14.70	2.75	2.22
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.02

Bradshaw Compressor Station - Modeled Source Inventory
1-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.001
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.01
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	0.60
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	0.60
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	0.60
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	0.60
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.001

Bradshaw Compressor Station - Modeled Source Inventory
3-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.001
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.01
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	0.60
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	0.60
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	0.60
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	0.60
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.001

Bradshaw Compressor Station - Modeled Source Inventory
24-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.001
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.01
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	0.60
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	0.60
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	0.60
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	0.60
T3_75L	Turbine 3 Load, 75% Load	540200.0	4376066.0	448.7	15.24	741.9	14.70	2.75	0.50
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.001

Bradshaw Compressor Station - Modeled Source Inventory
Annual SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
MICTURB1	CAPSTONE MICROTURBINE 1	540159.6	4376135.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	540160.5	4376136.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	540161.3	4376138.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	540162.3	4376139.5	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	540163.2	4376140.8	448.7	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	540107.3	4376044.7	448.7	4.57	727.6	0.60	0.51	0.001
MICTURB6	CAPSTONE MICROTURBINE 6	540154.9	4376129.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB7	CAPSTONE MICROTURBINE 7	540153.8	4376127.8	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	540152.9	4376126.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	540152.0	4376125.1	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR10	CAPSTONE MICROTURBINE 10	540150.9	4376123.9	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR11	CAPSTONE MICROTURBINE 11	540155.8	4376130.4	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR12	CAPSTONE MICROTURBINE 12	540158.6	4376134.3	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR13	CAPSTONE MICROTURBINE 13	540156.7	4376131.7	448.7	3.74	552.6	32.18	0.30	0.01
MICTUR14	CAPSTONE MICROTURBINE 14	540157.7	4376133.0	448.7	3.74	552.6	32.18	0.30	0.01
T1_100N	Turbine 1 Normal, 100% Load	540177.3	4376034.7	448.7	15.24	752.6	17.72	2.75	0.60
T2_100N	Turbine 2 Normal, 100% Load	540188.7	4376050.4	448.7	15.24	752.6	17.72	2.75	0.60
T3_100N	Turbine 3 Normal, 100% Load	540200.0	4376066.0	448.7	15.24	752.6	17.72	2.75	0.60
T4_100N	Turbine 4 Normal, 100% Load	540211.4	4376081.7	448.7	15.24	752.6	17.72	2.75	0.60
T1_50L	Turbine 1 Load, 50% Load	540177.3	4376034.7	448.7	15.24	761.2	11.68	2.75	0.39
T3_50L	Turbine 3 Load, 50% Load	540200.0	4376066.0	448.7	15.24	761.2	11.68	2.75	0.39
T4_50L	Turbine 4 Load, 50% Load	540211.4	4376081.7	448.7	15.24	761.2	11.68	2.75	0.39
T2_50L	Turbine 2 Load, 50% Load	540188.7	4376050.4	448.7	15.24	761.2	11.68	2.75	0.39
FGHEAT2	FUEL GAS HEATER 2	540109.6	4376042.7	448.7	4.57	727.6	0.60	0.51	0.001

Bradshaw Compressor Station - Modeled Source Inventory
Load Analysis for Turbines 1, 2, 3, and 4

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	Emission Rate Used for Scaling Results from 1 lb/hr Modeling Analysis (lb/hr)									
									1-hr CO	8-hr CO	1-hr NO_2	Annual NO_2	24-hr $PM_{2.5}$	Annual $PM_{2.5}$	24-hr PM_{10}	1-hr SO_2	3-hr SO_2	24-hr SO_2	Annual SO_2
T1_50N	TURBINE 1 AT 50% load	540177.3	4376034.7	448.7	15.24	761.23	11.68	2.75	5.20	5.20	5.10	5.10	1.72	1.72	1.72	0.39	0.39	0.39	0.39
T2_50N	TURBINE 2 AT 50% load	540188.7	4376050.4	448.7	15.24	761.23	11.68	2.75	5.20	5.20	5.10	5.10	1.72	1.72	1.72	0.39	0.39	0.39	0.39
T3_50N	TURBINE 3 AT 50% load	540200.0	4376066.0	448.7	15.24	761.23	11.68	2.75	5.20	5.20	5.10	5.10	1.72	1.72	1.72	0.39	0.39	0.39	0.39
T4_50N	TURBINE 4 AT 50% load	540211.4	4376081.7	448.7	15.24	761.23	11.68	2.75	5.20	5.20	5.10	5.10	1.72	1.72	1.72	0.39	0.39	0.39	0.39
T1_75N	TURBINE 1 AT 75% load	540177.3	4376034.7	448.7	15.24	741.89	14.7	2.75	7.90	7.90	7.80	7.80	2.22	2.22	2.22	0.50	0.50	0.50	0.50
T2_75N	TURBINE 2 AT 75% load	540188.7	4376050.4	448.7	15.24	741.89	14.7	2.75	7.90	7.90	7.80	7.80	2.22	2.22	2.22	0.50	0.50	0.50	0.50
T3_75N	TURBINE 3 AT 75% load	540200.0	4376066.0	448.7	15.24	741.89	14.7	2.75	7.90	7.90	7.80	7.80	2.22	2.22	2.22	0.50	0.50	0.50	0.50
T4_75N	TURBINE 4 AT 75% load	540211.4	4376081.7	448.7	15.24	741.89	14.7	2.75	7.90	7.90	7.80	7.80	2.22	2.22	2.22	0.50	0.50	0.50	0.50
T1_100N	TURBINE 1 AT 100% load	540177.3	4376034.7	448.7	15.24	752.63	17.72	2.75	9.90	9.90	9.80	9.80	2.64	2.64	2.64	0.60	0.60	0.60	0.60
T2_100N	TURBINE 2 AT 100% load	540188.7	4376050.4	448.7	15.24	752.63	17.72	2.75	9.90	9.90	9.80	9.80	2.64	2.64	2.64	0.60	0.60	0.60	0.60
T3_100N	TURBINE 3 AT 100% load	540200.0	4376066.0	448.7	15.24	752.63	17.72	2.75	9.90	9.90	9.80	9.80	2.64	2.64	2.64	0.60	0.60	0.60	0.60
T4_100N	TURBINE 4 AT 100% load	540211.4	4376081.7	448.7	15.24	752.63	17.72	2.75	9.90	9.90	9.80	9.80	2.64	2.64	2.64	0.60	0.60	0.60	0.60

ATTACHMENT D. LOAD ANALYSIS

Load Analysis Results for Bradshaw Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 1

		2010				2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 1	1-hr	H1H	7.43416	5.99502	5.23781	9.25833	8.18255	7.35075	7.60241	6.63774	5.86026	9.05489	8.05762	7.13185	8.92277	8.01217	7.30678
	3-hr	H1H	4.7402	3.86811	3.36028	8.74414	7.70856	6.81196	6.65163	5.83149	5.06074	8.26846	7.46162	6.70141	7.65318	6.09692	4.39215
	8-hr	H1H	4.23667	2.49021	2.15032	7.48991	6.48249	5.55344	4.47213	3.89183	2.9798	7.89115	7.10938	6.42886	4.68654	4.17127	3.71908
	24-hr	H1H	1.84456	1.16561	0.86789	3.25521	2.79374	2.38181	2.56264	2.06198	1.50501	3.71601	3.17774	2.8206	2.25733	1.89182	1.5523
	Monthly	H1H	0.1402	0.09824	0.06979	0.37082	0.29131	0.22762	0.23314	0.15848	0.10424	0.39973	0.29008	0.23608	0.19934	0.14597	0.11026
	Annual	1H	0.07362	0.04393	0.02809	0.08375	0.05552	0.03558	0.07786	0.05048	0.03463	0.0805	0.05648	0.03928	0.09427	0.06324	0.04188

		2010				2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	38.6576	47.3607	51.8543	48.1433	64.6421	72.7724	39.5325	52.4381	58.0166	47.0854	63.6552	70.6053	46.3984	63.2961	72.3371	*48.1433*	*64.6421*	***72.7724***
	8-hr	H1H	22.0307	19.6727	21.2882	38.9475	51.2117	54.9791	23.2551	30.7455	29.5000	41.0340	56.1641	63.6457	24.3700	32.9530	36.8189	*41.0340*	*56.1641*	***63.6457***
PM10	24-hr	H1H	3.1772	2.5850	2.2927	5.6069	6.1957	6.2921	4.4140	4.5728	3.9758	6.4006	7.0473	7.4513	3.8881	4.1955	4.1008	*6.4006*	*7.0473*	***7.4513***
PM2.5	24-hr	H1H	3.1772	2.5850	2.2927	5.6069	6.1957	6.2921	4.4140	4.5728	3.9758	6.4006	7.0473	7.4513	3.8881	4.1955	4.1008	*6.4006*	*7.0473*	***7.4513***
	Annual	1H	0.1268	0.0974	0.0742	0.1443	0.1231	0.0940	0.1341	0.1119	0.0915	0.1387	0.1253	0.1038	0.1624	0.1402	0.1106	***0.1624***	*0.1402*	*0.1106*
NO2	1-hr	H1H	37.9142	46.7612	51.3305	47.2175	63.8239	72.0374	38.7723	51.7744	57.4305	46.1799	62.8494	69.8921	45.5061	62.4949	71.6064	*47.2175*	*63.8239*	***72.0374***
	Annual	1H	0.3755	0.3427	0.2753	0.4271	0.4331	0.3487	0.3971	0.3937	0.3394	0.4106	0.4405	0.3849	0.4808	0.4933	0.4104	*0.4808*	***0.4933***	*0.4104*
SO2	1-hr	H1H	2.9025	3.0136	3.1364	3.6147	4.1132	4.4016	2.9682	3.3366	3.5091	3.5352	4.0504	4.2705	3.4836	4.0275	4.3752	*3.6147*	*4.1132*	***4.4016***
	3-hr	H1H	1.8507	1.9444	2.0121	3.4139	3.8749	4.0790	2.5969	2.9314	3.0303	3.2282	3.7508	4.0128	2.9880	3.0648	2.6300	*3.4139*	*3.8749*	***4.0790***
	24-hr	H1H	0.7202	0.5859	0.5197	1.2709	1.4043	1.4262	1.0005	1.0365	0.9012	1.4508	1.5974	1.6890	0.8813	0.9510	0.9295	*1.4508*	*1.5974*	***1.6890***
	Annual	1H	0.0287	0.0221	0.0168	0.0327	0.0279	0.0213	0.0304	0.0254	0.0207	0.0314	0.0284	0.0235	0.0368	0.0318	0.0251	***0.0368***	*0.0318*	*0.0251*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Load Analysis Results for Bradshaw Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 2

			2010			2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 2	1-hr	H1H	7.83272	6.88841	6.1165	9.4096	8.45326	7.56075	7.54026	6.68806	6.01918	9.39097	8.24071	7.26175	8.62232	7.80218	7.08027
	3-hr	H1H	5.62903	4.62902	3.88396	8.2022	7.32921	6.56262	5.56091	4.75256	4.03982	7.72271	6.84993	6.06137	6.91857	6.01274	5.19094
	8-hr	H1H	4.08631	3.44151	2.89171	6.73173	5.88445	5.19842	3.45986	2.96392	2.20528	6.91215	6.19792	5.60757	6.03963	5.34696	4.43237
	24-hr	H1H	2.69654	2.28766	1.82305	3.29383	2.84784	2.4807	2.23269	1.87605	1.63289	3.54993	3.02603	2.56352	3.12652	2.66457	2.24414
	Monthly	H1H	0.18629	0.14457	0.10893	0.35924	0.28808	0.23386	0.25561	0.18231	0.12613	0.52396	0.41258	0.31421	0.25323	0.18769	0.15472
	Annual	1H	0.06077	0.03944	0.02665	0.09369	0.0666	0.04527	0.07864	0.05356	0.03701	0.11266	0.08476	0.06353	0.09937	0.07283	0.05255

			2010			2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	40.7301	54.4184	60.5534	48.9299	66.7808	74.8514	39.2094	52.8357	59.5899	48.8330	65.1016	71.8913	44.8361	61.6372	70.0947	*48.9299*	*66.7808*	***74.8514***
	8-hr	H1H	21.2488	27.1879	28.6279	35.0050	46.4872	51.4644	17.9913	23.4150	21.8323	35.9432	48.9636	55.5149	31.4061	42.2410	43.8805	*35.9432*	*48.9636*	***55.5149***
PM10	24-hr	H1H	4.6447	5.0733	4.8160	5.6735	6.3156	6.5533	3.8457	4.1605	4.3137	6.1146	6.7108	6.7721	5.3853	5.9092	5.9284	*6.1146*	*6.7108*	***6.7721***
PM2.5	24-hr	H1H	4.6447	5.0733	4.8160	5.6735	6.3156	6.5533	3.8457	4.1605	4.3137	6.1146	6.7108	6.7721	5.3853	5.9092	5.9284	*6.1146*	*6.7108*	***6.7721***
	Annual	1H	0.1047	0.0875	0.0704	0.1614	0.1477	0.1196	0.1355	0.1188	0.0978	0.1941	0.1880	0.1678	0.1712	0.1615	0.1388	***0.1941***	*0.1880*	*0.1678*
NO2	1-hr	H1H	39.9469	53.7296	59.9417	47.9890	65.9354	74.0954	38.4553	52.1669	58.9880	47.8939	64.2775	71.1652	43.9738	60.8570	69.3866	*47.9890*	*65.9354*	***74.0954***
	Annual	1H	0.3099	0.3076	0.2612	0.4778	0.5195	0.4436	0.4011	0.4178	0.3627	0.5746	0.6611	0.6226	0.5068	0.5681	0.5150	*0.5746*	***0.6611***	*0.6226*
SO2	1-hr	H1H	3.0581	3.4626	3.6625	3.6737	4.2493	4.5273	2.9439	3.3619	3.6042	3.6664	4.1424	4.3483	3.3663	3.9220	4.2396	*3.6737*	*4.2493*	***4.5273***
	3-hr	H1H	2.1977	2.3269	2.3257	3.2023	3.6842	3.9296	2.1711	0.0000	2.4190	3.0151	3.4433	3.6295	2.7012	3.0225	3.1083	*3.2023*	*3.6842*	***3.9296***
	24-hr	H1H	1.0528	1.1500	1.0916	1.2860	1.4315	1.4854	0.8717	0.9430	0.9778	1.3860	1.5211	1.5350	1.2207	1.3394	1.3438	*1.3860*	*1.5211*	***1.5350***
	Annual	1H	0.0237	0.0198	0.0160	0.0366	0.0335	0.0271	0.0307	0.0269	0.0222	0.0440	0.0426	0.0380	0.0388	0.0366	0.0315	***0.0440***	*0.0426*	*0.0380*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Load Analysis Results for Bradshaw Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 3

			2010			2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 3	1-hr	H1H	6.6048	5.75607	5.09603	5.82438	5.29306	4.74107	6.68067	5.78382	4.95286	7.11671	6.2829	5.50442	7.50699	6.73945	6.11058
	3-hr	H1H	6.05358	5.12224	4.26197	4.97153	4.16854	3.58423	4.01519	3.43283	2.98585	5.8787	5.04739	4.16846	7.05142	6.29994	5.60938
	8-hr	H1H	3.60816	2.95292	2.31969	3.89396	3.43783	3.06313	2.66863	2.03849	1.69421	4.18762	3.40894	2.66737	4.12593	3.57165	3.0098
	24-hr	H1H	2.44922	1.95512	1.53006	1.65009	1.47021	1.31966	0.94229	0.69966	0.56644	2.64768	2.00627	1.41779	3.14366	2.52297	1.99383
	Monthly	H1H	0.12302	0.08908	0.06703	0.21726	0.17596	0.14286	0.11895	0.07968	0.05622	0.38069	0.27683	0.20608	0.32314	0.22876	0.15788
	Annual	1H	0.04263	0.02945	0.02117	0.0434	0.03127	0.02142	0.04594	0.02786	0.01987	0.07023	0.0488	0.03416	0.06063	0.03989	0.02618

			2010			2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	34.3450	45.4730	50.4507	30.2868	41.8152	46.9366	34.7395	45.6922	49.0333	37.0069	49.6349	54.4938	39.0363	53.2417	60.4947	*39.0363*	*53.2417*	***60.4947***
	8-hr	H1H	18.7624	23.3281	22.9649	20.2486	27.1589	30.3250	13.8769	16.1041	16.7727	21.7756	26.9306	26.4070	21.4548	28.2160	29.7970	*21.7756*	*28.2160*	***30.3250***
PM10	24-hr	H1H	4.2187	4.3359	4.0420	2.8422	3.2605	3.4862	1.6230	1.5516	1.4964	4.5605	4.4493	3.7454	5.4148	5.5952	5.2672	*5.4148*	***5.5952***	*5.2672*
PM2.5	24-hr	H1H	4.2187	4.3359	4.0420	2.8422	3.2605	3.4862	1.6230	1.5516	1.4964	4.5605	4.4493	3.7454	5.4148	5.5952	5.2672	*5.4148*	***5.5952***	*5.2672*
	Annual	1H	0.0734	0.0653	0.0559	0.0748	0.0693	0.0566	0.0791	0.0618	0.0525	0.1210	0.1082	0.0902	0.1044	0.0885	0.0692	***0.1210***	*0.1082*	*0.0902*
NO2	1-hr	H1H	33.6845	44.8973	49.9411	29.7043	41.2859	46.4625	34.0714	45.1138	48.5380	36.2952	49.0066	53.9433	38.2856	52.5677	59.8837	*38.2856*	*52.5677*	***59.8837***
	Annual	1H	0.2174	0.2297	0.2075	0.2213	0.2439	0.2099	0.2343	0.2173	0.1947	0.3582	0.3806	0.3348	0.3092	0.3111	0.2566	*0.3582*	***0.3806***	*0.3348*
SO2	1-hr	H1H	2.5787	2.8934	3.0515	2.2740	2.6607	2.8389	2.6083	2.9074	2.9657	2.7785	3.1583	3.2960	2.9309	3.3878	3.6590	*2.9309*	*3.3878*	***3.6590***
	3-hr	H1H	2.3635	2.5748	2.5520	1.9410	2.0954	2.1462	1.5676	0.0000	1.7879	2.2952	2.5372	2.4960	2.7530	3.1668	3.3589	*2.7530*	*3.1668*	***3.3589***
	24-hr	H1H	0.9562	0.9828	0.9162	0.6442	0.7390	0.7902	0.3679	0.3517	0.3392	1.0337	1.0085	0.8490	1.2274	1.2682	1.1939	*1.2274*	***1.2682***	*1.1939*
	Annual	1H	0.0166	0.0148	0.0127	0.0169	0.0157	0.0128	0.0179	0.0140	0.0119	0.0274	0.0245	0.0205	0.0237	0.0201	0.0157	***0.0274***	*0.0245*	*0.0205*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Load Analysis Results for Bradshaw Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 4

		2010				2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 4	1-hr	H1H	9.78651	8.49519	7.29085	9.45811	7.6484	5.73183	8.37612	6.48591	4.29586	9.78071	8.55544	7.63051	9.90861	8.50606	6.84473
	3-hr	H1H	8.91752	6.73472	5.14592	5.89992	4.72509	3.57276	5.21807	4.4259	2.09505	9.03905	8.06529	7.18958	7.47494	6.33034	5.1897
	8-hr	H1H	4.85343	3.91974	3.35675	3.60274	3.04477	2.56407	3.77269	1.85142	1.1678	7.07274	6.20365	5.53967	6.7065	5.58991	3.96172
	24-hr	H1H	2.5242	1.83202	1.28447	1.94796	1.56751	1.33703	1.70776	0.99235	0.46425	4.86922	4.07541	3.55033	3.7614	2.80609	2.00831
	Monthly	H1H	0.14155	0.10563	0.06942	0.16101	0.12682	0.10187	0.13048	0.08485	0.05541	0.5821	0.43335	0.27392	0.2792	0.16907	0.0984
	Annual	1H	0.04121	0.02741	0.01892	0.03483	0.02283	0.01647	0.04033	0.02637	0.01728	0.0894	0.06347	0.03995	0.05994	0.0407	0.02755

		2010				2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	50.8899	67.1120	72.1794	49.1822	60.4224	56.7451	43.5558	51.2387	42.5290	50.8597	67.5880	75.5420	51.5248	67.1979	67.7628	*51.5248*	*67.5880*	***75.5420***
	8-hr	H1H	25.2378	30.9659	33.2318	18.7342	24.0537	25.3843	19.6180	14.6262	11.5612	36.7782	49.0088	54.8427	34.8738	44.1603	39.2210	*36.7782*	*49.0088*	***54.8427***
PM10	24-hr	H1H	4.3478	4.0629	3.3932	3.3553	3.4763	3.5321	2.9415	2.2007	1.2264	8.3870	9.0380	9.3790	6.4788	6.2230	5.3054	*8.3870*	*9.0380*	***9.3790***
PM2.5	24-hr	H1H	4.3478	4.0629	3.3932	3.3553	3.4763	3.5321	2.9415	2.2007	1.2264	8.3870	9.0380	9.3790	6.4788	6.2230	5.3054	*8.3870*	*9.0380*	***9.3790***
	Annual	1H	0.0710	0.0608	0.0500	0.0600	0.0506	0.0435	0.0695	0.0585	0.0456	0.1540	0.1408	0.1055	0.1032	0.0903	0.0728	***0.1540***	*0.1408*	*0.1055*
NO2	1-hr	H1H	49.9112	66.2625	71.4503	48.2364	59.6575	56.1719	42.7182	50.5901	42.0994	49.8816	66.7324	74.7790	50.5339	66.3473	67.0784	*50.5339*	*66.7324*	***74.7790***
	Annual	1H	0.2102	0.2138	0.1854	0.1776	0.1781	0.1614	0.2057	0.2057	0.1693	0.4559	0.4951	0.3915	0.3057	0.3175	0.2700	*0.4559*	***0.4951***	*0.3915*
SO2	1-hr	H1H	3.8209	4.2703	4.3657	3.6927	3.8447	3.4322	3.2702	3.2603	2.5723	3.8186	4.3006	4.5691	3.8685	4.2758	4.0986	*3.8685*	*4.3006*	***4.5691***
	3-hr	H1H	3.4816	3.3854	3.0813	2.3035	2.3752	2.1393	2.0373	0.0000	1.2545	3.5290	4.0542	4.3051	2.9184	3.1821	3.1076	*3.5290*	*4.0542*	***4.3051***
	24-hr	H1H	0.9855	0.9209	0.7691	0.7605	0.7880	0.8006	0.6667	0.4988	0.2780	1.9011	2.0486	2.1259	1.4685	1.4106	1.2026	*1.9011*	*2.0486*	***2.1259***
	Annual	1H	0.0161	0.0138	0.0113	0.0136	0.0115	0.0099	0.0157	0.0133	0.0103	0.0349	0.0319	0.0239	0.0234	0.0205	0.0165	***0.0349***	*0.0319*	*0.0239*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-E
Harris Compressor Station Air Quality Modeling Report

FEDERAL ENERGY REGULATORY COMMISSION
AIR QUALITY MODELING REPORT

Harris Compressor Station

Mountain Valley PIPELINE LLC

Prepared By:

TRINITY CONSULTANTS

October 2015

TABLE OF CONTENTS

1. INTRODUCTION 1-1
1.1. Facility Background 1-1

2. MODELING PROCEDURES 2-1
2.1. NAAQS Analysis 2-1
2.2. Background Air Quality 2-1

3. MODELING METHODOLOGY 3-1
3.1. Dispersion Model Selection and Building Downwash Analysis 3-1
3.2. Meteorological Data 3-2
3.2.1. Site Location and Surface Characteristics 3-3
3.2.2. Topographic Setting 3-4
3.2.3. Data Quality 3-5
3.3. Treatment of Terrain 3-5
3.4. Receptor Grids 3-6
3.5. GEP Stack Height Analysis 3-7
3.6. Representation of Emission Sources 3-8
3.6.1. Coordinate System 3-8
3.6.2. Source Types 3-8
3.6.3. Source Parameters and Emission Rates 3-8

4. MODELING RESULTS 4-1

ATTACHMENT A. COMPARISON OF SURFACE CHARACTERISTICS A

ATTACHMENT B. MODEL FILES CD B

ATTACHMENT C. MODELED SOURCE INVENTORY C

ATTACHMENT D. LOAD ANALYSIS D

LIST OF FIGURES

Figure 1-1. Area Map 1-2

Figure 2-1. Background Monitor Locations 2-2

Figure 3-1. Location of North Central West Virginia Meteorological Tower 3-3

Figure 3-2. North Central West Virginia Airport Wind Rose 3-4

Figure 3-3. Morgantown Airport Wind Rose 3-5

Figure 3-4. Receptor Grid 3-6

Figure 3-5. Receptor Grid (Zoomed In) 3-7

LIST OF TABLES

Table 2-1. Primary and Secondary NAAQS 2-1

Table 2-2. Selected Background Monitors 2-3

Table 2-3. Selected Background Concentrations 2-4

Table 3-1. Model Selection Options 3-2

Table 4-1. Modeling Results - PM_{10} 24-Hour NAAQS 4-2

Table 4-2. Modeling Results – $PM_{2.5}$ 24-Hour NAAQS 4-2

Table 4-3. Modeling Results – $PM_{2.5}$ Annual NAAQS 4-2

Table 4-4. Modeling Results – SO_2 1-Hour NAAQS 4-3

Table 4-5. Modeling Results – SO_2 3-Hour NAAQS 4-3

Table 4-6. Modeling Results – SO_2 24-Hour NAAQS 4-3

Table 4-7. Modeling Results – SO_2 Annual NAAQS 4-4

Table 4-8. Modeling Results – NO_2 1-Hour NAAQS 4-4

Table 4-9. Modeling Results – NO_2 Annual NAAQS 4-4

Table 4-10. Modeling Results – CO 1-Hour NAAQS 4-4

Table 4-11. Modeling Results – CO 8-Hour NAAQS 4-5

Table 4-12. Modeling Results – Lead 3-Month NAAQS 4-5

1. INTRODUCTION

Mountain Valley Pipeline, LLC (MVP), a subsidiary of EQT Corporation (EQT), is seeking authorization from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act (NGA) to construct and operate a new natural gas compressor station in Braxton County, West Virginia (the Harris Compressor Station).

The Project will include the installation of the following combustion equipment at the Harris Compressor Station:

- Two (2) Solar Titan 130 natural gas-fired turbines, each rated at 20,455 horsepower (hp) at site-specific conditions (20,500 hp ISO);
- Nine (9) Capstone C200 microturbines, each rated at 200 kW; and
- Two (2) natural gas-fired fuel gas heaters, each rated at 2.31 million British thermal units per hour (MMBtu/hr). [1]

The proposed WB Interconnect will be located approximately 0.2 kilometers (km) from the Harris Compressor Station. The only combustion equipment at the Interconnect is a line heater rated at 9.0 MMBtu/hr. This heater was included in the modeling analysis due to its proximity to the Harris station.

This modeling report outlines the methodologies used to conduct the air dispersion modeling analysis required by the FERC for the project. Air dispersion modeling is utilized as a tool to demonstrate that the project complies with the National Ambient Air Quality Standards (NAAQS).

The remainder of this modeling report is organized as follows:

- Section 2: Modeling Procedures;
- Section 3: Modeling Methodology ; and
- Section 4: Modeling Results.

MVP has included, as Attachment B to this modeling report, a CD containing all the files associated with the FERC air dispersion modeling analysis of the Project. This CD includes those files associated with importing terrain elevations, analyzing building downwash, meteorological data, and AERMOD.

1.1. FACILITY BACKGROUND

The Harris Compressor Station will be located in Braxton County, West Virginia at approximately 543.2 kilometers east and 4,286.1 kilometers north, Universal Transverse Mercator (UTM) Zone 17. Figure 1-1 provides an area map which shows the location of the facility relative to surrounding terrain and other features, such as roads and rivers.

[1] The station will also include one (1) natural gas-fired office building heater with heat input of 0.12 MMBtu/hr, one (1) 240 barrel (bbl) storage tank for produced fluids and one (1) 100 bbl storage tank for used oil. The heater and tanks are insignificant emissions sources and were not included in the model.

Figure 1-1. Area Map



2.1. NAAQS ANALYSIS

Air quality dispersion modeling was conducted to evaluate the cumulative impact with regard to the NAAQS at the Harris Compressor Station. Modeling was conducted for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and lead (Pb). The NAAQS evaluated in this modeling analysis are presented in Table 2-1.

Table 2-1. Primary and Secondary NAAQS

Pollutant	Averaging Period	Primary NAAQS ($\mu g/m^3$)	Secondary NAAQS ($\mu g/m^3$)	Form of Standard
PM_{10}	24-hour	150	150	Not to be exceeded more than once per year on average over 3 years
$PM_{2.5}$	24-hour	35	35	3-year average of the 98th percentile 24-hour average concentrations
	Annual	12.0	15.0	3-year average of the annual arithmetic mean
SO_2	1-hour	196 (75 ppb)	--	3-year average of the 99th percentile of daily maximum 1-hour concentrations
	3-hour	--	1,300 (500 ppb)	Not to be exceeded more than once per year
	24-hour	365 (140 ppb)[A]	--	Not to be exceeded more than once per year
	Annual	80 (30 ppb)[A]	--	Annual arithmetic mean
NO_2	1-hour	188 (100 ppb)	--	3-year average of the 98th percentile of daily maximum 1-hour concentrations
	Annual	100 (53 ppb)	100 (53 ppb)	Annual arithmetic mean
CO	1-hour	40,000 (35 ppm)	--	Not to be exceeded more than once per year
	8-hour	10,000 (9 ppm)	--	Not to be exceeded more than once per year
Pb	3-month[B]	0.15	0.15	Maximum arithmetic mean

[A] The annual and 24-hour SO_2 standards will be revoked one year after the effective date in areas with a designated status of the revised SO_2 NAAQS, per 40 CFR §50.4(e).

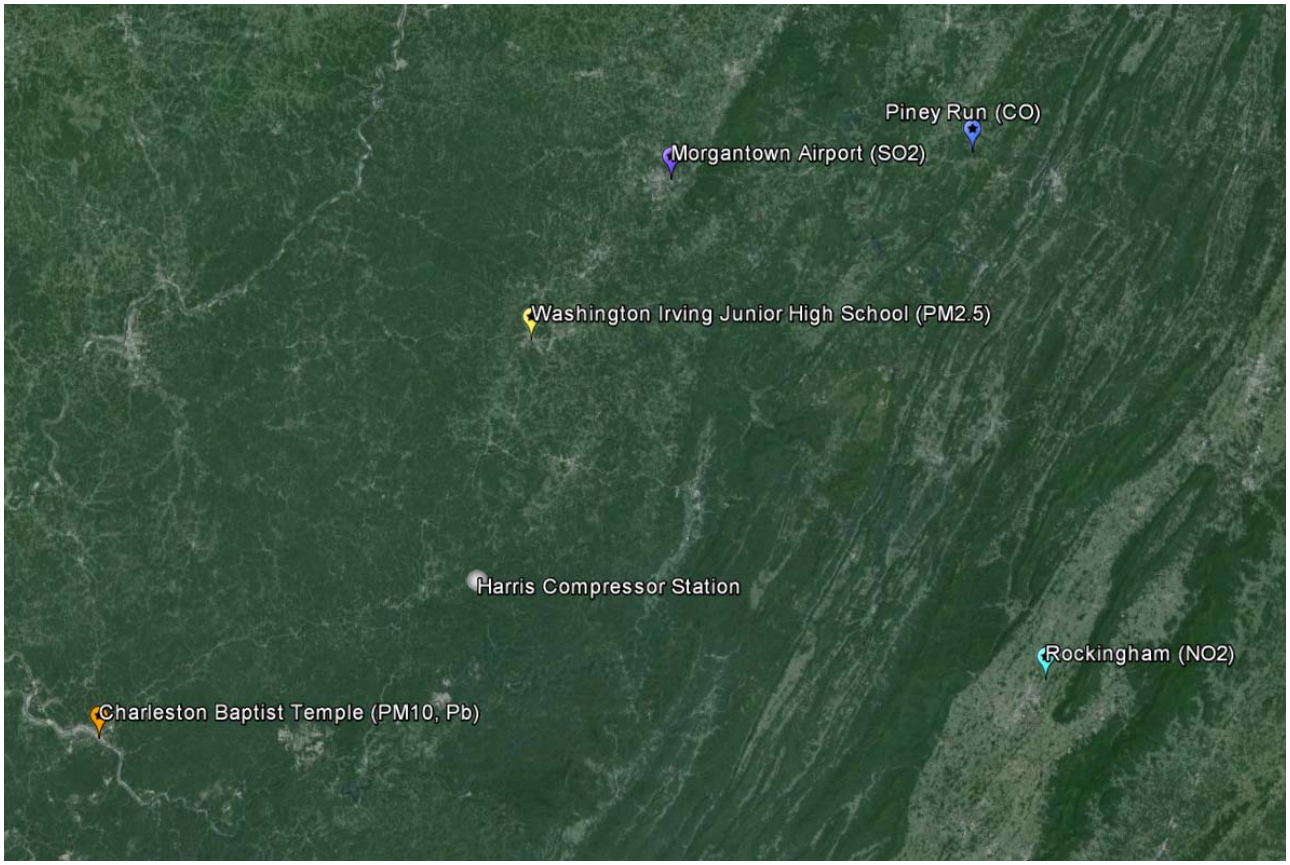
[B] The lead NAAQS is evaluated as a rolling 3-month average concentration.

2.2. BACKGROUND AIR QUALITY

In evaluating cumulative impacts with respect to the NAAQS, maximum modeled impacts were added to representative ambient background concentrations and compared to the applicable NAAQS. Selection of the existing monitoring station data that is "representative" of the ambient air quality in the area surrounding the Harris Compressor Station is determined based on the following three criteria: 1) monitor location, 2) data quality, and 3) data currentness. Key considerations based on the monitor location criteria include proximity to the significant impact area of the facility, similarity of emission sources impacting the monitor to the emission sources impacting the airshed surrounding the Harris Compressor Station, and the similarity of the land use and land cover (LULC) surrounding the monitor and facility. The data quality criteria refers to the monitor being an approved state and local air monitoring station (SLAM) or similar monitor type subject to the quality assurance requirements in 40 CFR Part 58 Appendix A. Data currentness refers to the fact that the most recent three complete years of quality assured data are generally preferred.

Figure 2-1 presents the location of the closest, most representative monitor locations which are proposed for use in the NAAQS analysis.

Figure 2-1. Background Monitor Locations



As is discussed in more detail, MVP selected monitors with the most currently available data (2012-2014), that are within the region, and that have reasonably similar topographic settings. The selected monitors are generally in more populated or industrialized areas than the Harris Compressor Station and thus represent conservative estimates of ambient background.

With regard to NO_2 monitoring data, MVP used a representative ambient monitor, AQS# 51-165-0003, located at the Rockingham Virginia Department of Transportation (VDOT) in Rockingham County, Virginia. The Rockingham site is the closest monitoring site for this pollutant [approximately 149 km east of the facility] and has high data counts for the most recent three years (2012-2014). The Rockingham site is located within half a kilometer from a heavily traveled interstate (Interstate 81). Thus, the monitor provides conservative estimates of ambient background concentrations.

For CO, MVP used a representative ambient monitor, AQS# 24-023-0002, located at the Piney Run monitoring station in Garrett County, Maryland. The Piney Run monitoring station is located approximately 167 km northeast of the facility and is the closest CO monitoring site to the Harris Compressor Station. Piney Run also has similar LULC to the Harris Compressor Station and has high data counts for the most recent three years (2012-2014).

For $PM_{2.5}$, MVP used a representative ambient monitor, AQS# 54-033-0003, located at Washington Irving Junior High School in Harrison County, West Virginia. The Washington Irving site is the closest monitoring site for $PM_{2.5}$ (approximately 64 km northeast of the facility). In addition, $PM_{2.5}$ is a regional pollutant and due to the proximity of the monitor, the background concentration is expected to be similar to that of the Harris Compressor Station. The Washington Irving site is also located in a much more populated area than the Harris Compressor Station, thus the monitor provides conservative estimates of ambient background concentrations.

For SO_2, MVP used a monitor located at the Morgantown Airport in Monongalia County, West Virginia (AQS# 54-061-0003). This monitor is located approximately 114 km northeast of the station. There are two other monitoring sites located nearly equidistant to the Morgantown Airport. However, these two sites are directly situated in more populated areas, Vienna/Parkersburg, West Virginia and Charleston, West Virginia than the Harris Compressor Station or the Morgantown monitor. Notwithstanding its more similar LULC, the Morgantown site is located in a more populated area than the Harris Compressor Station and thus provides a conservative estimate of background concentrations.

For PM_{10}, MVP used a monitor located at Charleston Baptist Temple in Kanawha County, West Virginia (AQS# 54-039-0010). The Charleston Baptist Temple monitor is the closest PM_{10} monitor to the Harris Compressor Station, and it located approximately 107 km southwest of the facility. This monitoring site also has much higher data counts in the most recent three years (2012-2014) than the two next-nearest monitoring sites. Given its location in Charleston, West Virginia, this monitor provides a conservative estimate of background concentration.

For lead, MVP used a monitor located at the Charleston Baptist Temple in Kanawha County, West Virginia (AQS# 54-039-0010). At about 107 km upwind of the facility, the Charleston site is the closest monitoring site for lead and is located in a much more populated area than the Compressor Station. Thus the monitor provides conservative estimates of ambient background concentrations.

Table 2-2 presents a list of the selected monitor locations and measured pollutants.

Table 2-2. Selected Background Monitors

Site ID	Address	County	State	Pollutant Monitored
51-165-0003	Rockingham VDOT, North Valley Pike, Harrisonburg, VA	Rockingham	VA	NO_2
24-023-0002	Piney Run, Frostburg Reservoir, Finzel, MD	Garrett	MD	CO
54-033-0003	Washington Irving Junior High School, Clarksburg, WV	Harrison	WV	$PM_{2.5}$
54-061-0003	Morgantown US Airport, Morgantown, WV	Monongalia	WV	SO_2
54-039-0010	Charleston Baptist Temple, Charleston, WV	Kanawha	WV	PM_{10}, Pb

Based on available, validated data, MVP proposes to utilize the ambient background concentrations shown in Table 2-3 in the modeling analyses.

Table 2-3. Selected Background Concentrations

Pollutant	Averaging Period	2012-2014 Monitor Background Concentration (µg/m³)	Metric	Monitor Location
PM_{10}	24-hour	30.0	3-year maximum Highest-second-high (H2H)	Charleston Baptist Temple
$PM_{2.5}$	24-hour	19.0	3-year average of 98th percentile	Washing Irving Junior High School
	Annual	9.1	3-year average	
SO_2	1-hour	39.3	3-year average of 99th percentile	Morgantown US Airport
	3-hour	41.9	H2H (2012)	
	24-hour	16.8	H2H (2013)	
	Annual	5.2	Annual Average (2014)	
NO_2	1-hour	73.4	3-year average of 98th percentile	Rockingham VDOT
	Annual	17.0	Annual Average (2012)	
CO	1-hour	953.1	H2H (2012)	Piney Run
	8-hour	458.2	H2H (2012)	
Pb	3-month	0.012	Highest Month (2012)	Charleston Baptist Temple

3. MODELING METHODOLOGY

This section of the modeling report describes the procedures and data resources utilized in the air dispersion modeling analyses.

3.1. DISPERSION MODEL SELECTION AND BUILDING DOWNWASH ANALYSIS

Dispersion models predict ambient pollutant concentrations by simulating the evolution of the pollutant plume over time and space given data inputs including the quantity of emissions, stack exhaust parameters (e.g., velocity, flowrate, and temperature) and weather data. Building structures that obstruct wind flow near emission points may cause stack discharges to become caught in the turbulent wakes of these structures leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent. These effects generally cause higher ground-level pollutant concentrations since building downwash inhibits dispersion from elevated stack discharges. For this reason, building downwash algorithms are considered an integral component of the selected air dispersion model.

Version 15181 of the AERMOD model was used to estimate maximum ground-level concentrations in the air pollutant analyses conducted. AERMOD is a refined, steady-state, multiple source dispersion model that was promulgated in December 2005 as the Environmental Protection Agency (EPA)-preferred model to use for industrial sources in this type of air dispersion modeling analysis.[2] The AERMOD modeling was performed using regulatory default options except as otherwise noted in this report. The AERMOD model has the Plume Rise Modeling Enhancements (PRIME) incorporated in the regulatory version, so the direction-specific building downwash dimensions used as input were determined by the Building Profile Input Program, PRIME version (BPIP PRIME), version 04274.[3] BPIP PRIME is designed to incorporate the concepts and procedures expressed in the Good Engineering Practice (GEP) Technical Support document, the Building Downwash Guidance document, and other related documents,[4] while incorporating the PRIME enhancements to improve prediction of ambient impacts in building cavities and wake regions. Table 3-1 summarizes the model control options that were utilized in this analysis.

[2] 40 CFR 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).
[3] Earth Tech, Inc., *Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model*, Concord, MA.
[4] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

Table 3-1. Model Selection Options

Control Option	Option Selected	Justification
Pollutant ID	CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, Other (for lead)	--
Terrain	Elevated, Meters	The receptor grid covers varying terrain elevations; as such, the elevated option was selected.
Flagpole Receptors	N/A	--
Run or Not	Run	--
Averaging Times	1-hour, 3-hour, 8-hour, 24-hour, month, and annual	MVP selected the appropriate averaging periods for each pollutant.
Model	PRIME	The PRIME algorithms are default.
Dispersion	Concentration, Rural, Regulatory Default Option	This modeling analysis is assessing compliance with concentration standards. Harris is located in a predominantly rural area. The regulatory default option was selected.
NO_2 Model Options	N/A	MVP did not utilize any Tier 2 or 3 model options for NO_2 modeling.
Particulate Model Options	N/A	MVP did not utilize particle deposition or depletion options for particulate modeling.
Output Files	.aml	Model output file from Breeze User Interface (contained in zip files [.amz])

3.2. METEOROLOGICAL DATA

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, readily available data from the closest and most representative National Weather Service (NWS) station are commonly used. Regulatory air dispersion modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- Wind speed;
- Wind direction;
- Air temperature;
- Micrometeorological parameters (e.g., friction velocity, Monin-Obukhov length);
- Mechanical mixing height; and
- Convective mixing height.

The first three of these parameters are directly measured by monitoring equipment located at typical surface observation stations. The friction velocity, Monin-Obukhov length, and mixing heights are derived from characteristic micrometeorological parameters and from observed and correlated values of cloud cover, solar insulation, time of day and year, and latitude of the surface observation station. Surface observation stations form a relatively dense network, are almost always found at airports, and are typically operated by the NWS.

Upper air stations are fewer in number than surface observing points since the upper atmosphere is less vulnerable to local effects caused by terrain or other land influences and is therefore less variable. The NWS operates virtually all available upper air measurement stations in the United States.

3.2.1. Site Location and Surface Characteristics

MVP utilized 2010 to 2014 meteorological data from the meteorological tower at North Central West Virginia Airport (KCKB), located roughly 69 km north of the Harris Compressor Station. Figure 3-1 shows the relative location of North Central West Virginia airport to the Harris Compressor Station.

Figure 3-1. Location of North Central West Virginia Meteorological Tower



The meteorological tower at North Central West Virginia airport is not the closest tower to the Harris Compressor Station. Elkins-Randolph County Airport (KEKN) is located approximately 60 km from the station. However, KEKN is situated in a north-south valley terrain system, which is not true of the Harris Compressor Station, and sits at a 160 m higher elevation than the Harris site. Given these considerations, North Central West Virginia airport was determined to be the most representative meteorological station based on site location.

AERSURFACE (version 13016) was used as an objective method for evaluating land use characteristics and their associated micrometeorological parameters for a given location. The AERSURFACE program was used in the evaluation of potential NWS stations in the area. AERSURFACE was used to create seasonal values of albedo, Bowen ratio and surface roughness, across 12 directional sectors (e.g. 0-30 degrees). The seasonal parameters correspond to the calendar months in which they occur (i.e. winter values for December-February). The albedo

and Bowen ratio values were determined from taking the geometric mean over a 10 kilometer (km) area out from the location of interest. The surface roughness values assigned by AERSURFACE were based on a 1 km radius out from the site.

The figures in Attachment A illustrate the magnitude of the micrometeorological differences between North Central West Virginia airport and Harris Compressor Station sites, as determined by AERSURFACE.

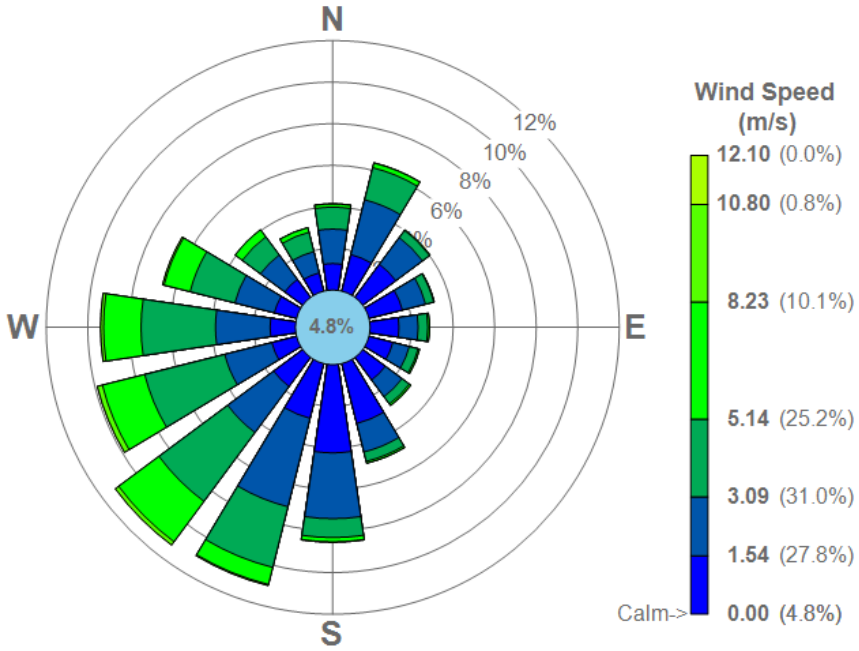
The albedo and Bowen ratio values show reasonable agreement across the directional sectors. However, there are variations in surface roughness across a couple of sectors. Accordingly, MVP performed a sensitivity analysis of the surface characteristics (most notably the surface roughness) to determine the impact of these differences. For this assessment a constant emission rate (1 lb/hr) was input for the turbine normal operating scenario (i.e., 100 percent load). The results of this analysis were compared for all receptors in the domain and for each metric used in this analysis (e.g., 1-hour H1H, H2H, H4H, and H8H, 3-hour H1H and H2H, etc.). AERMOD responded to the surface characteristics differences between the two sites with moderately varying output concentrations (33% on average).

3.2.2. Topographic Setting

The complexity of the terrain is another important consideration in determining data representativeness. In addition to the land use similarities shown above, North Central West Virginia airport and the Harris Compressor Station are at both at relatively high elevations (~442 meters for the station and ~367 for the tower) without significant terrain features between the sites or similar hills around the individual locations.

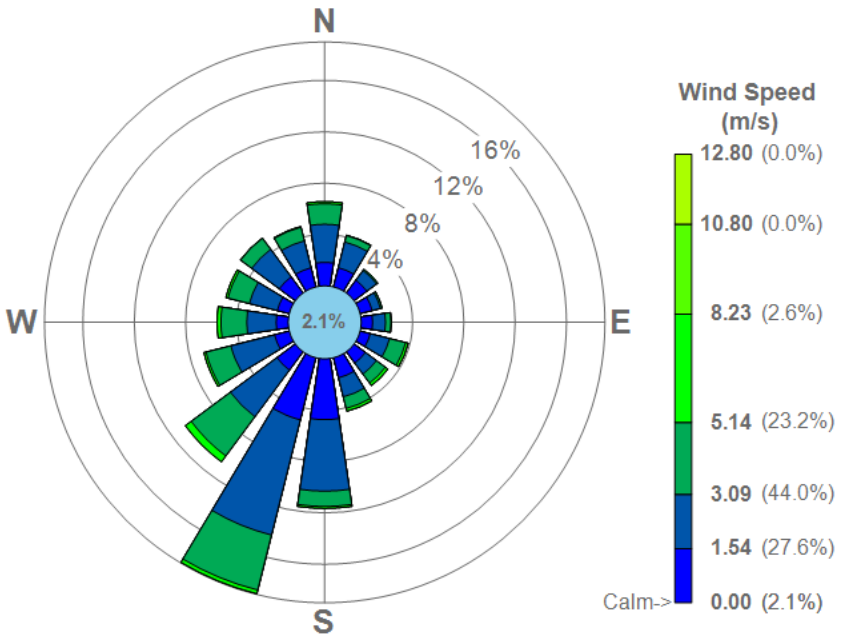
Figure 3-2 provides a wind rose for North Central West Virginia airport for the data period of 2010 to 2014.

Figure 3-2. North Central West Virginia Airport Wind Rose



As shown in Figure 3-2, wind is largely from the southwest at North Central West Virginia airport. This is the general wind pattern in this area and is also expected to be the wind pattern at the Harris Compressor Station site. To demonstrate this, a 5-year wind rose (2010 – 2014) for the Morgantown Airport which is located 115 km northeast of the Harris Compressor Station is provided as Figure 3-3. All wind roses show the same predominant wind directions from the west and south.

Figure 3-3. Morgantown Airport Wind Rose



3.2.3. Data Quality

The North Central West Virginia Airport meteorological data was processed through the latest version of AERMET (version 15181) to include upper air measurements from the Roanoke Airport site (KRNK). Per EPA guidance, 1-minute Automated Surface Observing System (ASOS) wind data was also incorporated in the processing, using the latest version of AERMINUTE (version 14337).[5] A base elevation of 366.7 meters was used for the meteorological tower in the modeling analysis.

3.3. TREATMENT OF TERRAIN

Through the use of the AERMOD terrain preprocessor (AERMAP), AERMOD incorporates not only the receptor heights, but also an effective height (hill height scale) that represents the significant terrain features surrounding a given receptor that could lead to plume recirculation and other terrain interaction.[6]

Receptor terrain elevations input to the model were those interpolated from 1/3 arc second National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS). The array elevations and elevations for emission sources and buildings at the Harris Compressor Station were based on site grade elevations.

[5] Version 14237 of AERMINUTE was released after the modeling for this project was initiated. The results of this modeling analysis are not expected to change based on the version of AERMINUTE.
[6] EPA, *Users Guide for the AERMOD Terrain Preprocessor (AERMAP)*, Research Triangle Park, NC, EPA-454/B-03-003, October 2004.

3.4. RECEPTOR GRIDS

For this air dispersion modeling analysis, ground-level concentrations were calculated along the facility boundary and also within a Cartesian receptor grid outside the fenceline. The boundary receptors were spaced 50 meters apart starting at an arbitrary point on the boundary. The Cartesian grid generally consists of the following receptor spacing:

- 50 meter-spaced receptors from the boundary out to 2 kilometers;
- 100 meter-spaced receptors from 2 to 5 kilometers;
- 500 meter-spaced receptors from 5 to 10 kilometers; and
- 1,000 meter-spaced receptors from 10 to 25 kilometers.

In general, the receptors covered a region extending from all edges of the Harris Compressor Station boundary to the point where impacts from the Project are no longer expected to be significant. For this modeling analysis, MVP considered all land outside of the facility's fenceline to be ambient air although MVP owns property beyond the fenceline.

As noted previously, receptor elevations required by AERMOD were determined using the AERMAP terrain preprocessor (version 11103). Figures 3-5 and 3-6 show the full receptor grid and a closer view of the receptors are the facility, respectively.

Figure 3-4. Receptor Grid

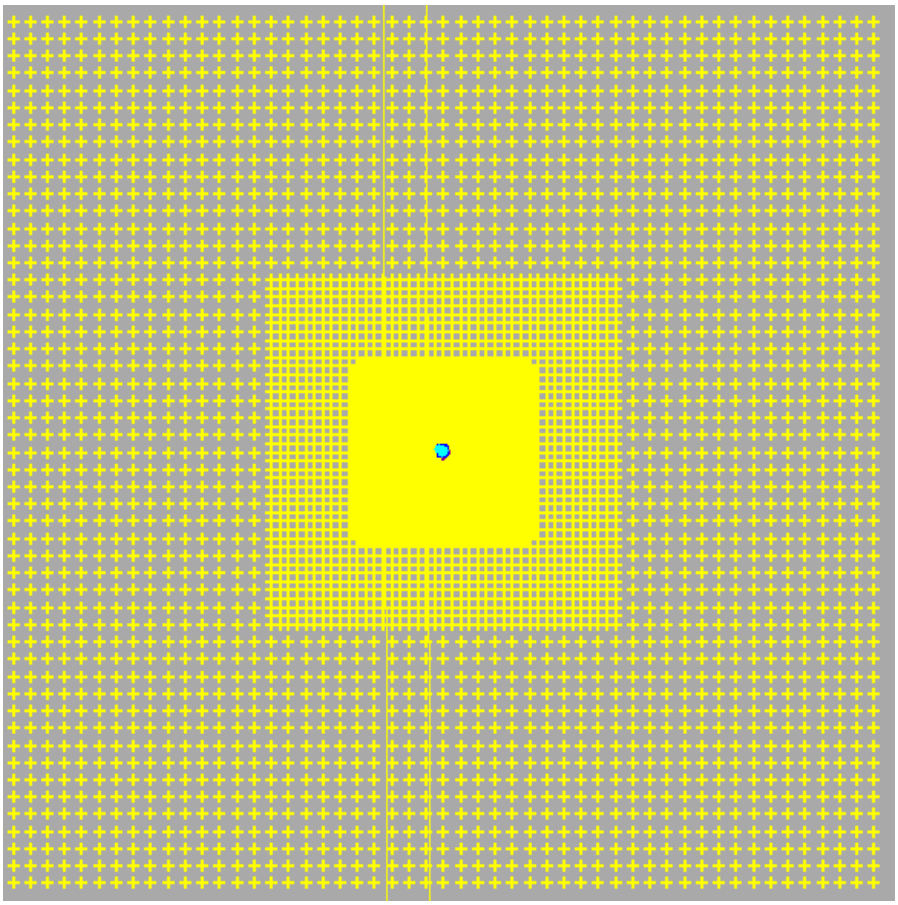
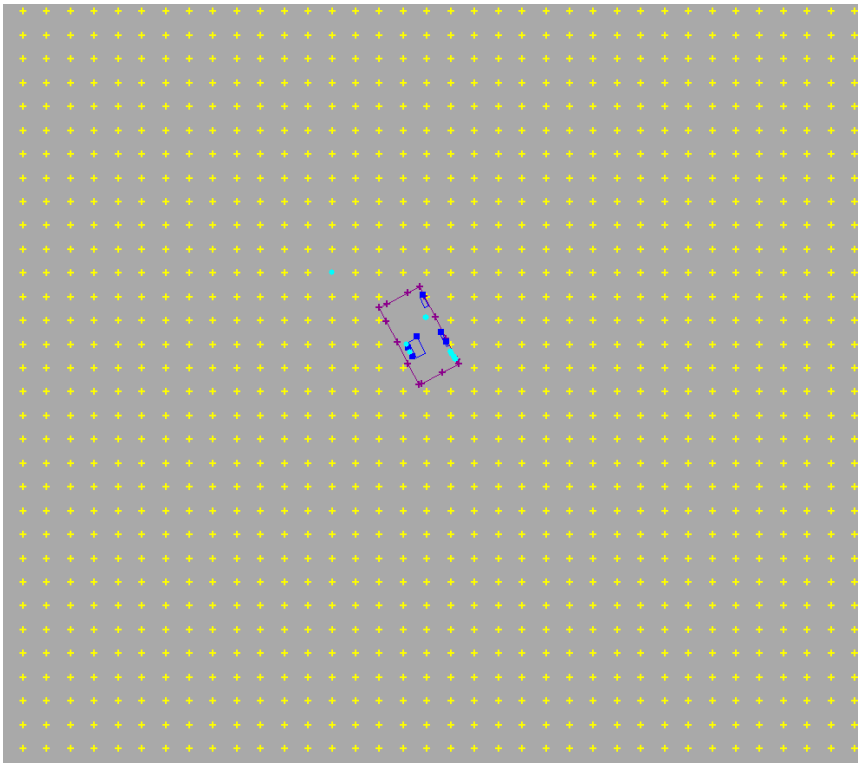


Figure 3-5. Receptor Grid (Zoomed In)



3.5. GEP STACK HEIGHT ANALYSIS

Stack height regulations restrict the use of stack heights in excess of GEP in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations. The minimum stack height not subject to the effects of downwash, called the GEP stack height, is defined by the following formula:

H_{GEP} = H + 1.5L, where:

H_{GEP} = minimum GEP stack height,
H = structure height, and
L = lesser dimension of the structure (height or projected width).

The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP PRIME. In general, the lowest GEP stack height for any source is 65 meters by default.[7] A source may construct a stack that exceeds GEP, but is limited to the GEP stack height in the air quality analysis demonstration. All proposed source stacks at the Harris Compressor Station are less than 65 meters tall and therefore meet the requirements of GEP.

[7] 40 CFR §51.100(ii).

3.6. REPRESENTATION OF EMISSION SOURCES

3.6.1. Coordinate System

In all modeling analysis data files, the location of emission sources, structures, and receptors, are represented in the UTM coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). The datum for this modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 17.

3.6.2. Source Types

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. In these air dispersions modeling analyses, MVP utilized point sources for all emission sources. There were no area or volumes sources used in this modeling analysis.

For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses. The proposed turbines and heaters at the Harris Compressor Station and WB Interconnect have an unobstructed vertical release and were therefore modeled as point sources. Stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) used in the modeling analyses were based on design values for the turbine for each operating load considered in the analysis.

The proposed microturbines at the Harris Compressor Station are equipped with hinged rain caps. These rain caps are necessary to avoid rainwater build up when the units are not operating. However, during operation the rain caps are forced open by the exhaust plume and remain open during operation thereby not obstructing the plume. As such, these sources were also modeled as point sources with their design values for height, diameter, exhaust gas temperature, and gas exit velocity.[8]

3.6.3. Source Parameters and Emission Rates

In general, a dispersion modeling analysis should contain sufficient detail to determine the maximum ambient concentration of the pollutant under consideration, and in many cases this involves modeling several operating loads or production rates. As such, this modeling analysis considered the proposed combustion turbine operating at various expected load scenarios (100 percent, 75 percent, and 50 percent loads). These scenarios encompass the variations in flow potentially resulting from reduced operational loads, thus determining the worst-case modeled concentrations. For this load analysis, a unit emission rate (one lb/hr) was input into the model and results were scaled based on the actual potential to emit (lb/hr) for each operating load. The worst-case load determined from this load analysis (as shown in Attachment D) and the 100 percent load scenario were utilized in the AERMOD modeling analyses.

MVP also evaluated the effect of startup and shutdown emissions from the proposed combustion turbines in this analysis. A startup or shutdown event of the turbine is expected to last 10 minutes. This is a much shorter time than the shortest NAAQS averaging period (i.e., 1-hour) and as such was not included in modeling. In addition, the only modeled pollutants for which startup and shutdown emissions are available are NO_2 and CO. For NO_2,

[8] The Vermont Department of Environmental Conservation and Northwest Clean Air Agency have both published guidance supporting the treatment of hinged rain caps as unobstructed, vertical releases (http://www.anr.state.vt.us/air/permitting/docs/Rain_Guard_Guidance.pdf and http://www.nwcleanair.org/pdf/forms/misc/Stack%20and%20Rain%20Guard%20Requirements1.pdf). The West Virginia Department of Environmental Protection does not have any state-specific air dispersion modeling guidance.

the startup and shutdown emissions, in lb/event, are much less than the normal operation hourly emission rate. For CO, emissions per event are higher than the normal operation hourly emission rate, however, the modeling results for the 1-hour CO standard are well below the NAAQS.

The source parameters and emissions utilized in this analysis are included in Attachment C.

4. MODELING RESULTS

Following the procedures and methods discussed in this report, the following tables summarize the results from the conducted modeling analyses. As shown in the tables below, the results of the analyses indicate that the predicted ambient impacts resulting from the operation of the Harris Compressor Station plus the existing ambient background concentration are lower than each of the NAAQS.

Electronic input and output files for all AERMOD model runs are included in Attachment B.

Table 4-1. Modeling Results - PM_{10} 24-Hour NAAQS

Scenario/ Load	H6H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	8.0	30.0	38.0	150	Yes
Worst-Case Load	8.5		38.5		Yes

Table 4-2. Modeling Results – $PM_{2.5}$ 24-Hour NAAQS

Scenario/ Load	5-year Average H1H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	4.2	19.0	23.2	35	Yes
Worst-Case Load	4.6		23.6		Yes

Table 4-3. Modeling Results – $PM_{2.5}$ Annual NAAQS

Scenario/ Load	5-year Average Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	0.9	9.1	10.0	12	Yes
Worst-Case Load	1.2		10.3		Yes

Table 4-4. Modeling Results – SO_2 1-Hour NAAQS

Scenario/ Load	5-year Average H4H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	3.8	39.3	43.1	196	Yes
Worst-Case Load	3.8		43.1		Yes

Table 4-5. Modeling Results – SO_2 3-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	3.1	3.9	3.6	3.6	3.8	3.9	41.9	45.8	1,300	Yes

Table 4-6. Modeling Results – SO_2 24-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	1.3	2.6	1.6	1.8	1.9	2.6	16.8	19.4	365	Yes
Worst-Case Load	1.6	2.7	1.8	1.9	1.9	2.7		19.4		Yes

Table 4-7. Modeling Results – SO_2 Annual NAAQS

Scenario/ Load	1st High Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	0.1	0.2	0.1	0.1	0.2	0.2	5.2	5.4	80	Yes
Worst-Case Load	0.2	0.2	0.2	0.2	0.2	0.2		5.4		Yes

Table 4-8. Modeling Results – NO_2 1-Hour NAAQS

Scenario/ Load	5-year Average H8H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	90.8	73.4	164.2	188	Yes
Worst-Case Load	90.8		164.2		Yes

Table 4-9. Modeling Results – NO_2 Annual NAAQS

Scenario/ Load	1st High Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	9.9	8.6	8.3	7.8	9.8	9.9	17.0	26.9	100	Yes
Worst-Case Load	10.8	9.6	9.4	8.8	11.0	11.0		28.1		Yes

Table 4-10. Modeling Results – CO 1-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	97.8	92.4	90.3	91.7	100.4	100.4	953.1	1053.5	40,000	Yes
Worst-Case Load	97.8	93.1	90.8	96.4	100.8	100.8		1053.9		Yes

Table 4-11. Modeling Results – CO 8-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	57.6	65.3	62.8	55.1	61.6	65.3	458.2	523.6	10,000	Yes

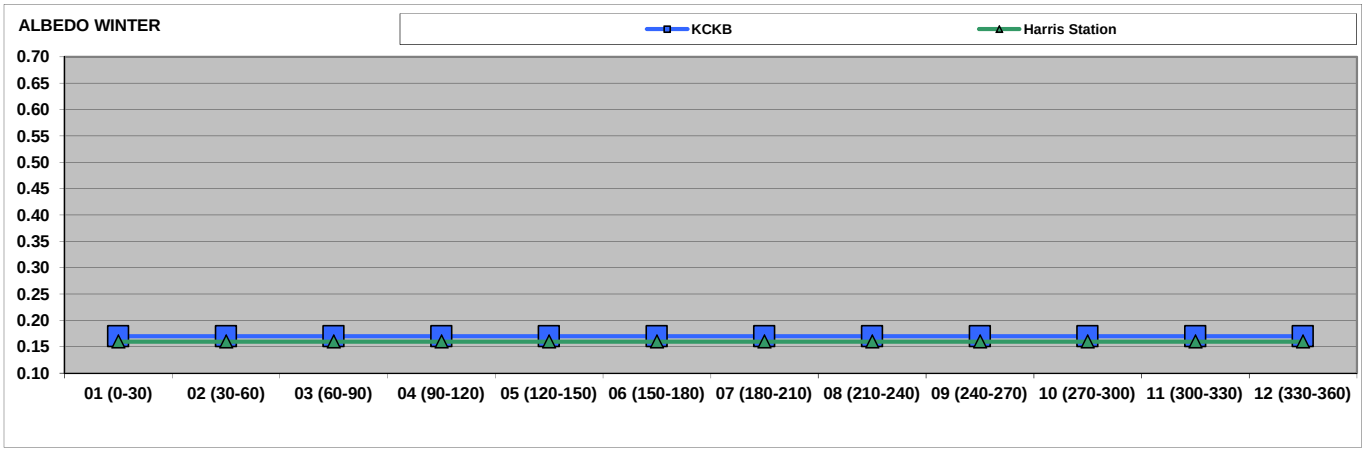
Table 4-12. Modeling Results – Lead 3-Month NAAQS

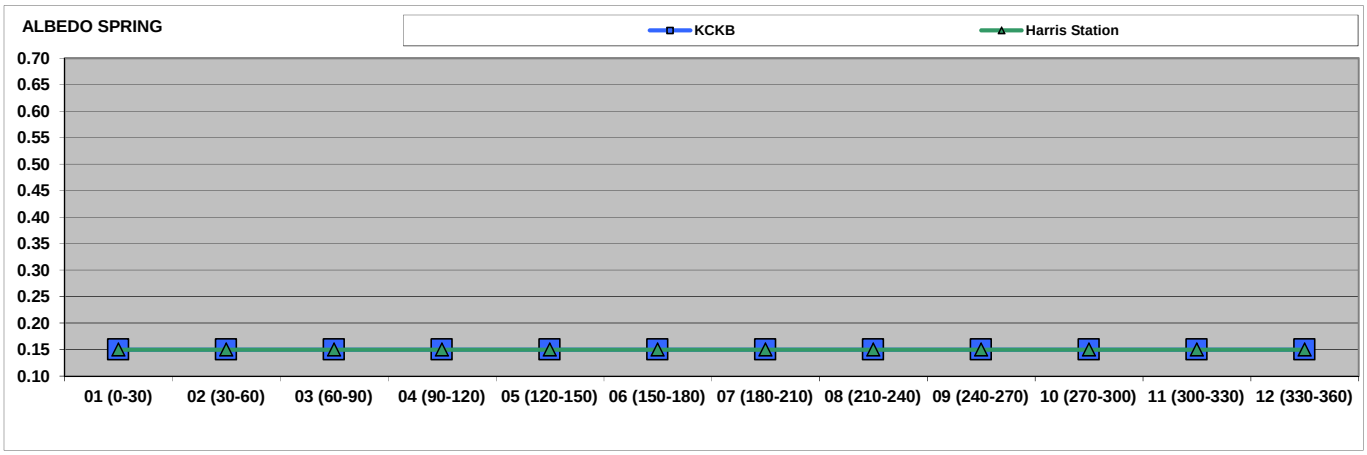
Scenario/ Load	H1H Modeled Concentration (µg/m³)[A]						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	0.00006	0.00005	0.00005	0.00006	0.00008	0.00008	0.012	0.01	0.15	Yes

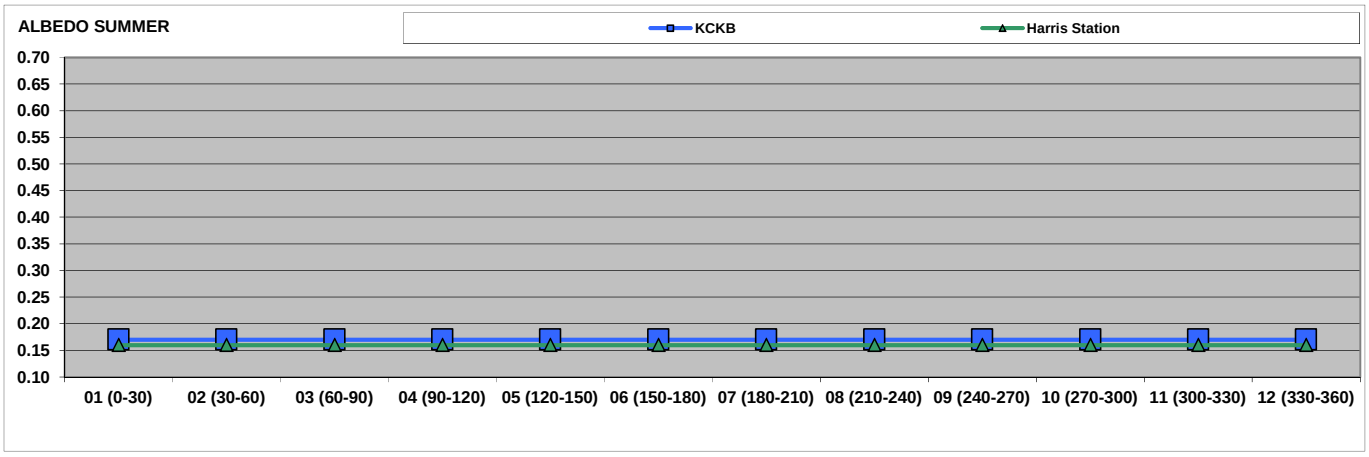
[A] Results shown are maximum monthly average concentration. This is a conservative assumption as the NAAQS is based on a rolling 3-month average.

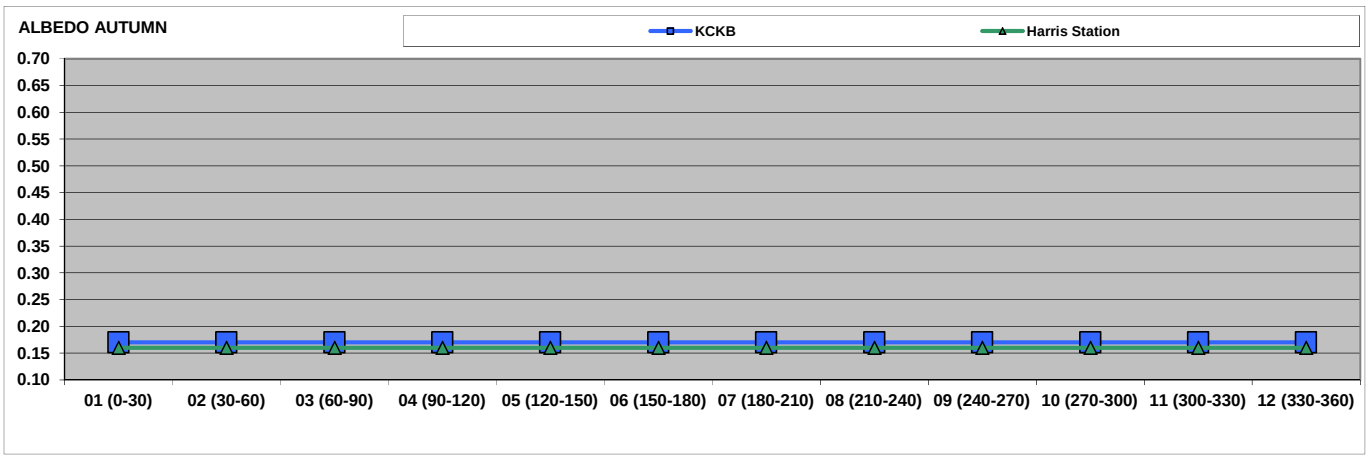
ATTACHMENT A. COMPARISON OF SURFACE CHARACTERISTICS

COMPARISON OF ALBEDO VALUES

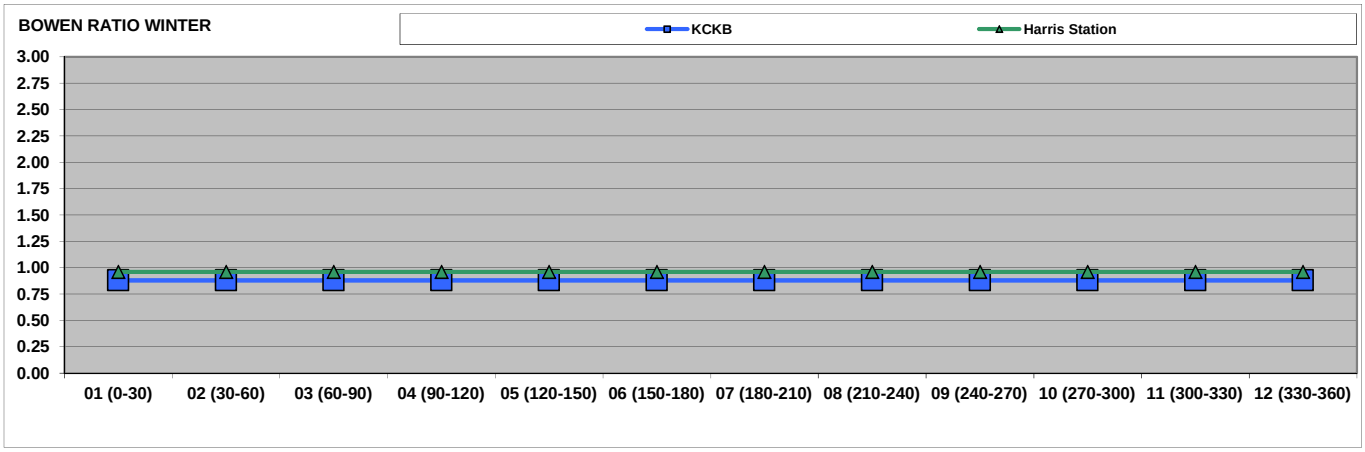


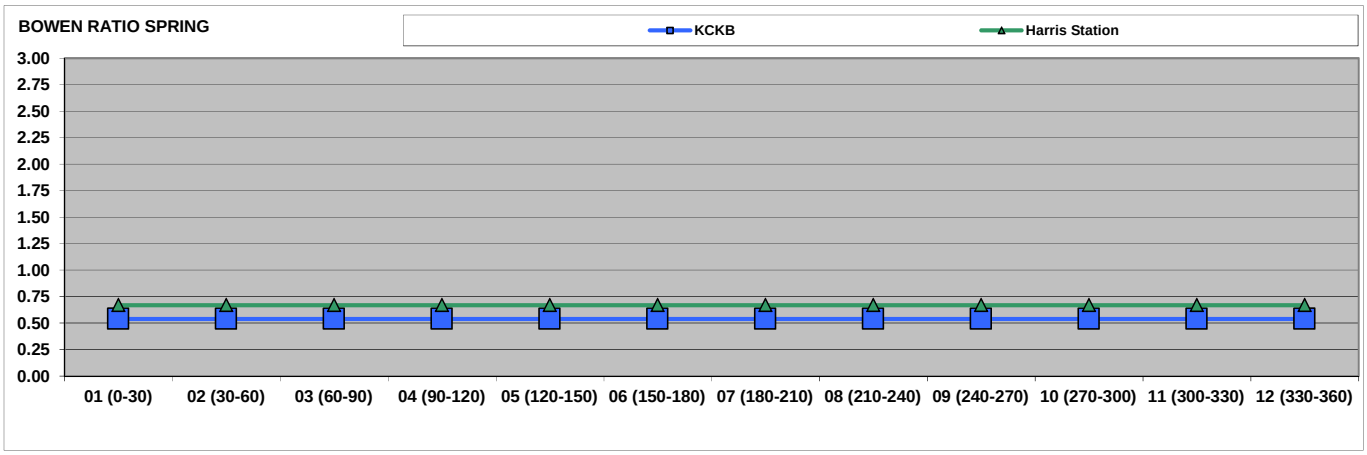


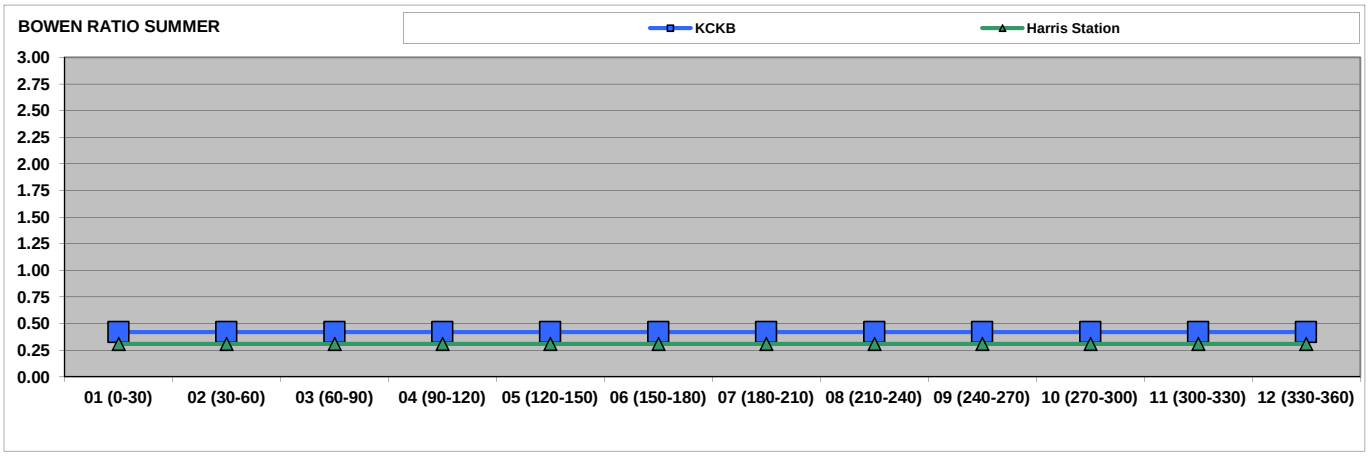


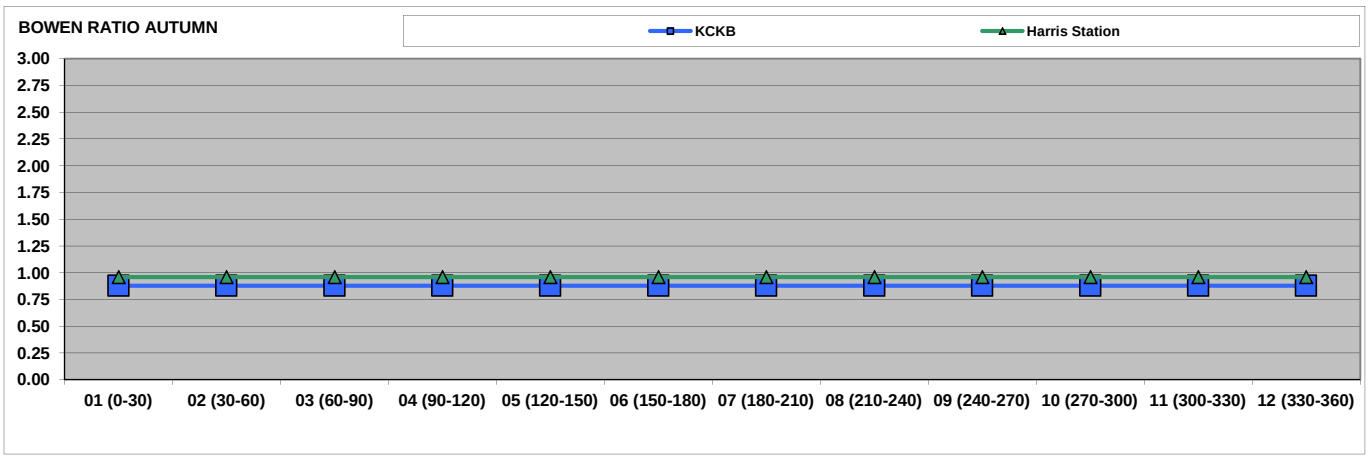


COMPARISON OF BOWEN RATIO VALUES

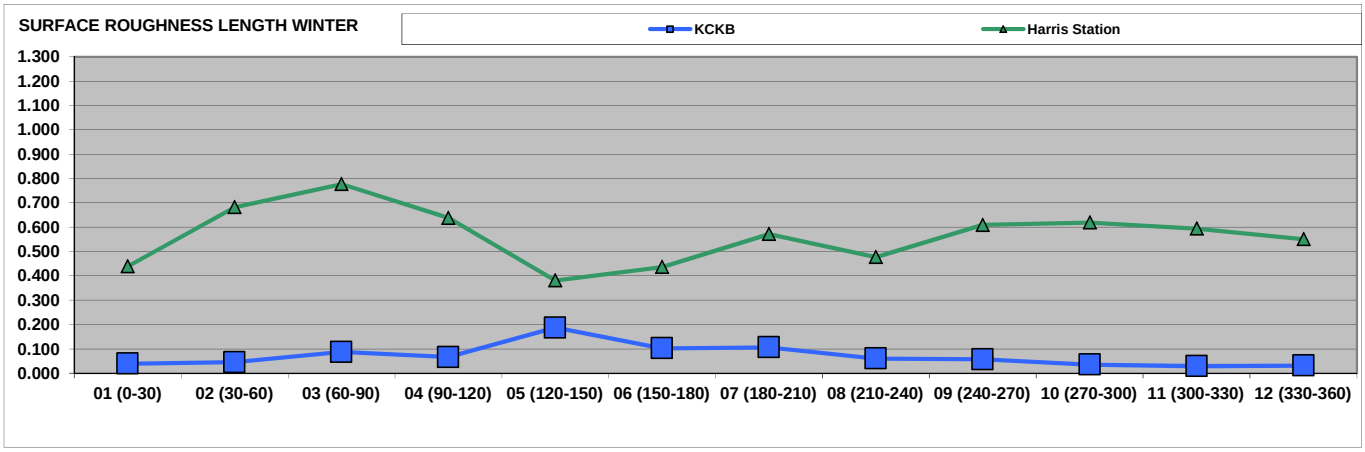


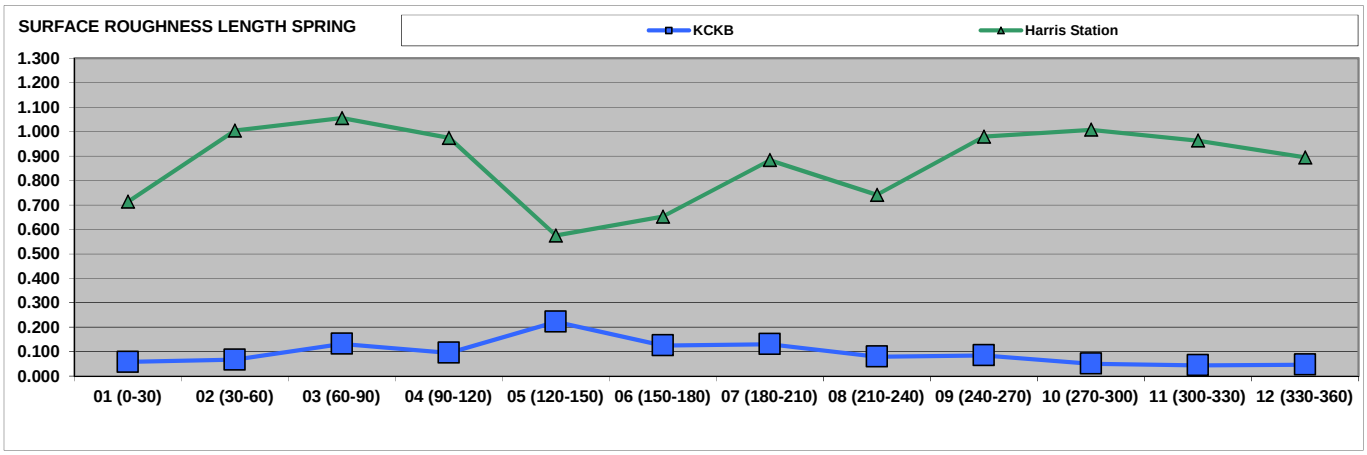


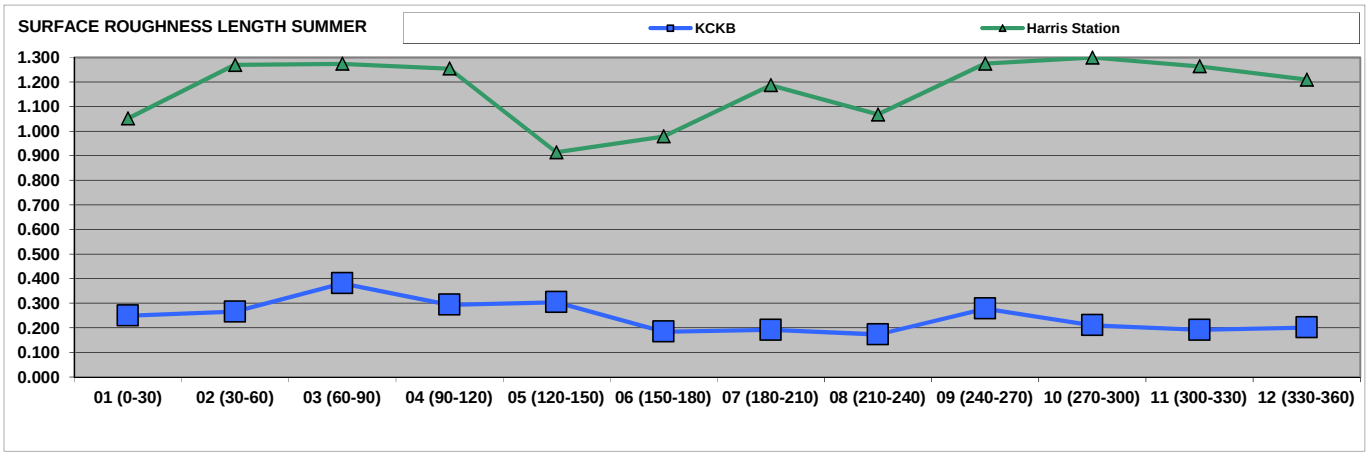


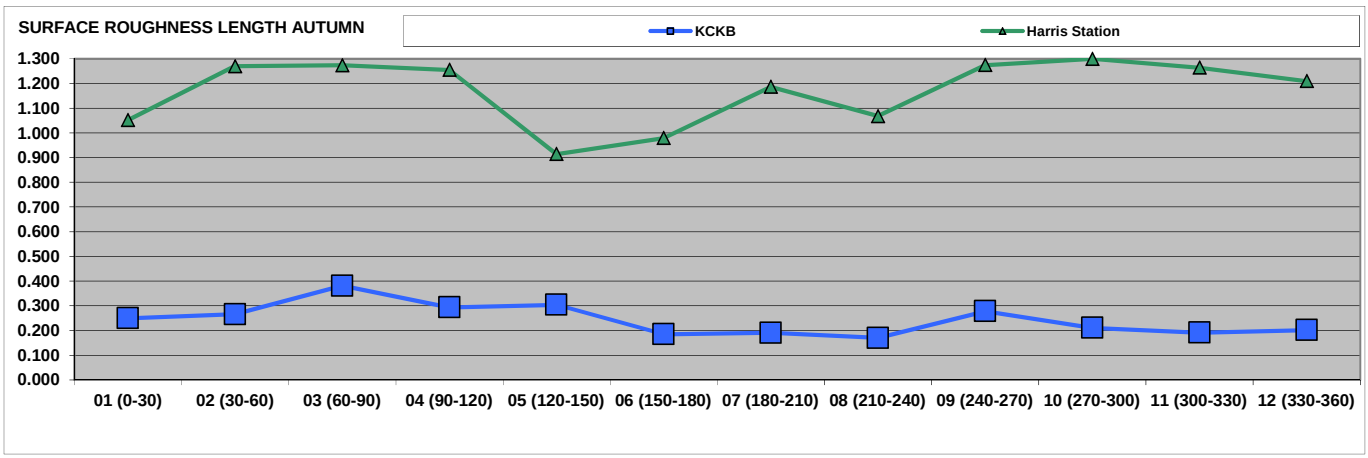


COMPARISON OF SURFACE ROUGHNESS LENGTH VALUES









ATTACHMENT B. MODEL FILES CD

ATTACHMENT C. MODELED SOURCE INVENTORY

Harris Compressor Station - Modeled Source Inventory
1-Hour CO Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	CO Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.18
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.22
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	9.03
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	9.03
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	5.20
T2_50L	TURBINE 2 Load, 50% Load	543203.1	4286044.8	441.7	15.24	648.2	6.91	2.92	5.20
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.70
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.18

Harris Compressor Station - Modeled Source Inventory
8-hour CO Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	CO Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.18
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.22
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.22
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	9.03
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	9.03
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.70
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.18

Harris Compressor Station - Modeled Source Inventory
Pb Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	Pb Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	1.07E-06
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.0E+00
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.0E+00
T1_100N	TURBINE 1 Normal and worst case load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	0.0E+00
T2_100N	TURBINE 2 Normal and worst case load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	0.0E+00
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	4.2E-06
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	1.07E-06

* No load scenario was run for the turbines as there are no lead emissions from the turbines with which to determine worst-case load.

Harris Compressor Station - Modeled Source Inventory
1-Hour NO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.21
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.08
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	8.90
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	8.90
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	5.13
T2_50L	TURBINE 2 Load, 50% Load	543203.1	4286044.8	441.7	15.24	648.2	6.91	2.92	5.13
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.83
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.21

Harris Compressor Station - Modeled Source Inventory
Annual NO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.21
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.08
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.08
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	8.90
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	8.90
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	5.13
T2_50L	TURBINE 2 Load, 50% Load	543203.1	4286044.8	441.7	15.24	648.2	6.91	2.92	5.13
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.83
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.21

Harris Compressor Station - Modeled Source Inventory
24-Hour $PM_{2.5}$ Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	$PM_{2.5}$ Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.02
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.02
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	2.32
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	1.34
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	2.32
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.06
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.02

Harris Compressor Station - Modeled Source Inventory
Annual $PM_{2.5}$ Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	$PM_{2.5}$ Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.02
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.02
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	2.32
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	2.32
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	1.34
T2_50L	TURBINE 2 Load, 50% Load	543203.1	4286044.8	441.7	15.24	648.2	6.91	2.92	1.34
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.06
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.02

Harris Compressor Station - Modeled Source Inventory
24-Hour PM_{10} Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	PM_{10} Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	0.02
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	0.02
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	2.32
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	2.32
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	1.34
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	0.06
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	0.02

Harris Compressor Station - Modeled Source Inventory
1-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	1.3E-03
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	7.8E-03
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	5.3E-01
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	5.3E-01
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	3.0E-01
T2_50L	TURBINE 2 Load, 50% Load	543203.1	4286044.8	441.7	15.24	648.2	6.91	2.92	3.0E-01
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	5.0E-03
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	1.3E-03

Harris Compressor Station - Modeled Source Inventory
3-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	1.3E-03
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	7.8E-03
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	5.3E-01
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	5.3E-01
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	5.0E-03
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	1.3E-03

Harris Compressor Station - Modeled Source Inventory
24-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	1.3E-03
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	7.8E-03
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	5.3E-01
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	5.3E-01
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	3.0E-01
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	5.0E-03
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	1.3E-03

Harris Compressor Station - Modeled Source Inventory
Annual SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
FGHEAT1	FUEL GAS HEATER 1	543234.6	4286117.1	441.7	4.57	727.6	0.60	0.51	1.3E-03
MICTURB1	CAPSTONE MICROTURBINE 1	543294.6	4286035.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB2	CAPSTONE MICROTURBINE 2	543295.5	4286033.9	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB3	CAPSTONE MICROTURBINE 3	543296.3	4286032.5	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB4	CAPSTONE MICROTURBINE 4	543297.3	4286031.1	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB5	CAPSTONE MICROTURBINE 5	543298.1	4286029.7	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB6	CAPSTONE MICROTURBINE 6	543290.1	4286042.2	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB7	CAPSTONE MICROTURBINE 7	543289.3	4286043.6	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB8	CAPSTONE MICROTURBINE 8	543288.5	4286045	441.7	3.74	552.6	32.18	0.30	7.8E-03
MICTURB9	CAPSTONE MICROTURBINE 9	543287.5	4286046.4	441.7	3.74	552.6	32.18	0.30	7.8E-03
T1_100N	TURBINE 1 Normal, 100% Load	543194.1	4286062.4	441.7	15.24	756.5	13.88	2.92	5.3E-01
T2_100N	TURBINE 2 Normal, 100% Load	543203.1	4286044.8	441.7	15.24	756.5	13.88	2.92	5.3E-01
T1_50L	TURBINE 1 Load, 50% Load	543194.1	4286062.4	441.7	15.24	648.2	6.91	2.92	3.0E-01
T2_50L	TURBINE 2 Load, 50% Load	543203.1	4286044.8	441.7	15.24	648.2	6.91	2.92	3.0E-01
WBHTR	WB INTERCONNECT LINE HEATER	543037.5	4286212.2	475.5	4.27	727.6	31.24	0.46	5.0E-03
FGHEAT2	FUEL GAS HEATER 2	543237.5	4286118.4	441.7	4.57	727.6	0.60	0.51	1.3E-03

Harris Compressor Station - Modeled Source Inventory
Load Analysis for Turbine 1 and Turbine 2

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	Emission Rate Used for Scaling Results from 1 lb/hr Modeling Analysis (lb/hr)									
									1-hr CO	8-hr CO	1-hr NO_2	Annual NO_2	24-hr $PM_{2.5}$	Annual $PM_{2.5}$	24-hr PM_{10}	1-hr SO_2	3-hr SO_2	24-hr SO_2	Annual SO_2
T1_50N	TURBINE 1 at 50% load	543194.1	4286062.4	441.7	15.24	648.15	6.91	2.92	5.20	5.20	5.13	5.13	1.34	1.34	1.34	0.304	0.304	0.304	0.304
T1_75N	TURBINE 1 at 75% load	543194.1	4286062.4	441.7	15.24	755.93	12.19	2.92	7.91	7.91	7.79	7.79	2.03	2.03	2.03	0.461	0.461	0.461	0.461
T1_100N	TURBINE 1 at 100% load	543194.1	4286062.4	441.7	15.24	756.48	13.88	2.92	9.03	9.03	8.90	8.90	2.32	2.32	2.32	0.526	0.526	0.526	0.526
T2_50N	TURBINE 2 at 50% load	543203.1	4286044.8	441.7	15.24	648.15	6.91	2.92	5.20	5.20	5.13	5.13	1.34	1.34	1.34	0.304	0.304	0.304	0.304
T2_75N	TURBINE 2 at 75% load	543203.1	4286044.8	441.7	15.24	755.93	12.19	2.92	7.91	7.91	7.79	7.79	2.03	2.03	2.03	0.461	0.461	0.461	0.461
T2_100N	TURBINE 2 at 100% load	543203.1	4286044.8	441.7	15.24	756.48	13.88	2.92	9.03	9.03	8.90	8.90	2.32	2.32	2.32	0.526	0.526	0.526	0.526

ATTACHMENT D. LOAD ANALYSIS

Load Analysis Results for Harris Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 1

		2010				2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 1	1-hr	H1H	5.93214	4.75158	4.75482	8.49658	5.12591	4.59739	8.55443	4.85562	4.76319	9.36941	4.83291	4.41672	8.66907	4.61134	4.55211
	3-hr	H1H	5.03676	3.77424	3.43238	6.11817	4.48978	4.18809	5.62534	3.98293	3.59819	5.97563	4.38574	4.02545	5.90818	4.30131	3.96202
	8-hr	H1H	4.4754	2.96526	2.64784	5.31686	3.7346	3.44073	5.22081	3.9229	3.56703	4.78975	3.41925	3.05299	4.98962	3.31709	3.00303
	24-hr	H1H	3.52136	1.98542	1.60077	4.09386	2.50106	2.21045	3.3267	1.78117	1.57241	2.90626	1.70973	1.45728	3.41747	2.15822	1.90812
	Monthly	H1H	0.33589	0.13266	0.10719	0.56795	0.29235	0.24832	0.4692	0.20774	0.17393	0.38133	0.14129	0.11735	0.45489	0.19887	0.16635
	Annual	1H	0.15821	0.04863	0.03848	0.22503	0.10138	0.08539	0.18388	0.07087	0.05786	0.168	0.06059	0.04786	0.23973	0.0981	0.0808

		2010				2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	30.8471	37.5850	42.9360	44.1822	40.5459	41.5144	44.4830	38.4080	43.0116	48.7209	38.2283	39.8830	45.0792	36.4757	41.1056	***48.7209***	*40.5459*	*43.0116*
	8-hr	H1H	23.2721	23.4552	23.9100	27.6477	29.5407	31.0698	27.1482	31.0301	32.2103	24.9067	27.0463	27.5685	25.9460	26.2382	27.1174	*27.6477*	*31.0301*	***32.2103***
PM10	24-hr	H1H	4.7212	4.0367	3.7160	5.4887	5.0851	5.1314	4.4602	3.6215	3.6502	3.8965	3.4762	3.3829	4.5819	4.3881	4.4295	***5.4887***	*5.0851*	*5.1314*
PM2.5	24-hr	H1H	4.7212	4.0367	3.7160	5.4887	5.0851	5.1314	4.4602	3.6215	3.6502	3.8965	3.4762	3.3829	4.5819	4.3881	4.4295	***5.4887***	*5.0851*	*5.1314*
	Annual	1H	0.2121	0.0989	0.0893	0.3017	0.2061	0.1982	0.2465	0.1441	0.1343	0.2252	0.1232	0.1111	0.3214	0.1995	0.1876	***0.3214***	*0.2061*	*0.1982*
NO2	1-hr	H1H	30.4319	37.0148	42.3179	43.5875	39.9308	40.9168	43.8842	37.8253	42.3924	48.0651	37.6484	39.3088	44.4723	35.9223	40.5138	***48.0651***	*39.9308*	*42.3924*
	Annual	1H	0.8116	0.3788	0.3425	1.1544	0.7898	0.7600	0.9433	0.5521	0.5150	0.8618	0.4720	0.4260	1.2298	0.7642	0.7191	***1.2298***	*0.7898*	*0.7600*
SO2	1-hr	H1H	1.8028	2.1898	2.5019	2.5821	2.3623	2.4191	2.5997	2.2377	2.5063	2.8473	2.2273	2.3240	2.6345	2.1252	2.3953	***2.8473***	*2.3623*	*2.5063*
	3-hr	H1H	1.5307	1.7394	1.8061	1.8593	2.0691	2.2037	1.7095	1.8356	1.8933	1.8160	2.0212	2.1181	1.7955	1.9823	2.0848	*1.8593*	*2.0691*	***2.2037***
	24-hr	H1H	1.0701	0.9150	0.8423	1.2441	1.1526	1.1631	1.0110	0.8209	0.8274	0.8832	0.7879	0.7668	1.0386	0.9946	1.0040	***1.2441***	*1.1526*	*1.1631*
	Annual	1H	0.0481	0.0224	0.0202	0.0684	0.0467	0.0449	0.0559	0.0327	0.0304	0.0511	0.0279	0.0252	0.0729	0.0452	0.0425	***0.0729***	*0.0467*	*0.0449*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Load Analysis Results for Harris Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 2

			2010			2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 2	1-hr	H1H	6.53383	4.92331	4.95465	9.93243	5.18427	4.92203	9.80793	4.78908	4.4597	10.04276	4.85831	4.55966	9.2836	5.33126	4.87552
	3-hr	H1H	6.24394	4.52418	4.18095	6.16983	4.69293	4.38378	6.20076	4.48469	4.13179	6.21674	4.83417	4.46534	6.30947	4.76968	4.48673
	8-hr	H1H	5.05857	3.41312	3.16013	6.08212	4.56336	4.25528	5.1628	3.77018	3.54732	5.11543	3.46101	3.14185	5.28739	3.48382	3.1955
	24-hr	H1H	3.61312	2.32416	2.11503	5.18208	3.50927	3.2214	4.4741	2.32655	2.06099	3.43581	2.2888	2.05	4.77166	3.10372	2.74082
	Monthly	H1H	0.56795	0.19099	0.15464	0.63192	0.33107	0.29042	0.69523	0.29776	0.24742	0.55888	0.22	0.18274	0.62612	0.28399	0.23544
	Annual	1H	0.25989	0.08804	0.06718	0.27991	0.12091	0.09954	0.25536	0.10031	0.07966	0.22523	0.08986	0.07328	0.34057	0.1388	0.11214

			2010			2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	33.9759	38.9434	44.7405	51.6486	41.0076	44.4459	51.0012	37.8816	40.2711	52.2224	38.4292	41.1737	48.2747	42.1703	44.0259	***52.2224***	*42.1703*	*44.7405*
	8-hr	H1H	26.3046	26.9978	28.5360	31.6270	36.0962	38.4252	26.8466	29.8221	32.0323	26.6002	27.3766	28.3709	27.4944	27.5570	28.8554	*31.6270*	*36.0962*	***38.4252***
PM10	24-hr	H1H	4.8442	4.7255	4.9098	6.9477	7.1350	7.4782	5.9985	4.7303	4.7844	4.6065	4.6536	4.7589	6.3975	6.3105	6.3626	*6.9477*	*7.1350*	***7.4782***
PM2.5	24-hr	H1H	4.8442	4.7255	4.9098	6.9477	7.1350	7.4782	5.9985	4.7303	4.7844	4.6065	4.6536	4.7589	6.3975	6.3105	6.3626	*6.9477*	*7.1350*	***7.4782***
	Annual	1H	0.3484	0.1790	0.1560	0.3753	0.2458	0.2311	0.3424	0.2039	0.1849	0.3020	0.1827	0.1701	0.4566	0.2822	0.2603	***0.4566***	*0.2822*	*0.2603*
NO2	1-hr	H1H	33.5185	38.3526	44.0964	50.9534	40.3855	43.8061	50.3147	37.3069	39.6913	51.5194	37.8462	40.5810	47.6249	41.5305	43.3921	***51.5194***	*41.5305*	*44.0964*
	Annual	1H	1.3332	0.6858	0.5979	1.4359	0.9419	0.8859	1.3100	0.7814	0.7090	1.1554	0.7000	0.6522	1.7471	1.0813	0.9980	***1.7471***	*1.0813*	*0.9980*
SO2	1-hr	H1H	1.9856	2.2689	2.6071	3.0184	2.3892	2.5899	2.9806	2.2071	2.3466	3.0520	2.2390	2.3992	2.8213	2.4570	2.5654	***3.0520***	*2.4570*	*2.6071*
	3-hr	H1H	1.8975	2.0850	2.2000	1.8750	2.1628	2.3067	1.8844	0.0000	2.1741	1.8892	2.2279	2.3496	1.9174	2.1981	2.3609	*1.9174*	*2.2279*	***2.3609***
	24-hr	H1H	1.0980	1.0711	1.1129	1.5748	1.6173	1.6951	1.3597	1.0722	1.0845	1.0441	1.0548	1.0787	1.4501	1.4304	1.4422	*1.5748*	*1.6173*	***1.6951***
	Annual	1H	0.0790	0.0406	0.0353	0.0851	0.0557	0.0524	0.0776	0.0462	0.0419	0.0684	0.0414	0.0386	0.1035	0.0640	0.0590	***0.1035***	*0.0640*	*0.0590*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-F
Stallworth Compressor Station Air Quality Modeling Report

FEDERAL ENERGY REGULATORY COMMISSION
AIR QUALITY MODELING REPORT

Stallworth Compressor Station

Mountain Valley PIPELINE LLC

Prepared By:

TRINITY CONSULTANTS

October 2015

TABLE OF CONTENTS

1. INTRODUCTION 1-1
1.1. Facility Background 1-1

2. MODELING PROCEDURES 2-1
2.1. NAAQS Analysis 2-1
2.2. Background Air Quality 2-1

3. MODELING METHODOLOGY 3-1
3.1. Dispersion Model Selection and Building Downwash Analysis 3-1
3.2. Meteorological Data 3-2
3.2.1. Site Location and Surface Characteristics 3-3
3.2.2. Topographic Setting 3-4
3.2.3. Data Quality 3-5
3.3. Treatment of Terrain 3-5
3.4. Receptor Grids 3-6
3.5. GEP Stack Height Analysis 3-7
3.6. Representation of Emission Sources 3-8
3.6.1. Coordinate System 3-8
3.6.2. Source Types 3-8
3.6.3. Source Parameters and Emission Rates 3-8

4. MODELING RESULTS 4-1

ATTACHMENT A. COMPARISON OF SURFACE CHARACTERISTICS A

ATTACHMENT B. MODEL FILES CD B

ATTACHMENT C. MODELED SOURCE INVENTORY C

ATTACHMENT D. LOAD ANALYSIS D

LIST OF FIGURES

Figure 1-1. Area Map 1-2

Figure 2-1. Background Monitor Locations 2-2

Figure 3-1. Location of Raleigh County Memorial Airport Meteorological Tower 3-3

Figure 3-2. Raleigh County Memorial Airport Wind Rose 3-5

Figure 3-3. Receptor Grid 3-6

Figure 3-4. Receptor Grid (Zoomed In) 3-7

LIST OF TABLES

Table 2-1. Primary and Secondary NAAQS 2-1

Table 2-2. Selected Background Monitors 2-3

Table 2-3. Selected Background Concentrations 2-4

Table 3-1. Model Selection Options 3-2

Table 4-1. Modeling Results - PM_{10} 24-Hour NAAQS 4-2

Table 4-2. Modeling Results – $PM_{2.5}$ 24-Hour NAAQS 4-2

Table 4-3. Modeling Results – $PM_{2.5}$ Annual NAAQS 4-2

Table 4-4. Modeling Results – SO_2 1-Hour NAAQS 4-3

Table 4-5. Modeling Results – SO_2 3-Hour NAAQS 4-3

Table 4-6. Modeling Results – SO_2 24-Hour NAAQS 4-3

Table 4-7. Modeling Results – SO_2 Annual NAAQS 4-4

Table 4-8. Modeling Results – NO_2 1-Hour NAAQS 4-4

Table 4-9. Modeling Results – NO_2 Annual NAAQS 4-4

Table 4-10. Modeling Results – CO 1-Hour NAAQS 4-4

Table 4-11. Modeling Results – CO 8-Hour NAAQS 4-5

Table 4-12. Modeling Results – Lead 3-Month NAAQS 4-5

1. INTRODUCTION

Mountain Valley Pipeline, LLC (MVP), a subsidiary of EQT Corporation (EQT), is seeking authorization from the Federal Energy Regulatory Commission (FERC) pursuant to Section 7(c) of the Natural Gas Act (NGA) to construct and operate a new natural gas compressor station in Fayette County, West Virginia (Stallworth Compressor Station).

The Project will include the installation of the following combustion equipment at the Stallworth Compressor Station:

- Two (2) Solar Titan 130 natural gas-fired turbines each rated at 19,483 horsepower (hp) at site-specific conditions (20,500 hp ISO);
- Ten (10) Capstone C200 natural gas-fired microturbines each rated at 200 kW; and
- Two (2) natural gas-fired, fuel gas heaters, each rated at 2.31 million British thermal units per hour (MMBtu/hr, heat input).[1]

This modeling report outlines the methodologies used to conduct the air dispersion modeling analysis required by the FERC for the Project. Air dispersion modeling is utilized as a tool to demonstrate that the Project complies with the National Ambient Air Quality Standards (NAAQS).

The remainder of this modeling report is organized as follows:

- Section 2: Modeling Procedures;
- Section 3: Modeling Methodology; and
- Section 4: Modeling Results.

MVP has included, as Attachment B to this modeling report, a CD containing all the files associated with the FERC air dispersion modeling analysis of the Project. This CD includes those files associated with importing terrain elevations, analyzing building downwash, meteorological data, and AERMOD.

1.1. FACILITY BACKGROUND

The Stallworth Compressor Station will be located in Fayette County, West Virginia at approximately 521.3 kilometers east and 4,191.2 kilometers north, Universal Transverse Mercator (UTM) Zone 17. Figure 1-1 provides an area map which shows the location of the facility relative to surrounding terrain and other features, such as roads and rivers.

[1] The station will also include one (1) natural gas-fired office building heater with heat input of 0.12 MMBtu/hr, one (1) 240 barrel (bbl) storage tank for produced fluids and one (1) 100 bbl storage tank for used oil. The heater and tanks are insignificant emissions sources and were not included in the model.

Figure 1-1. Area Map



2.1. NAAQS ANALYSIS

Air quality dispersion modeling was conducted to evaluate the cumulative impact with regard to the NAAQS at the Stallworth Compressor Station. Modeling was conducted for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and lead (Pb). The NAAQS evaluated in this modeling analysis are presented in Table 2-1.

Table 2-1. Primary and Secondary NAAQS

Pollutant	Averaging Period	Primary NAAQS (µg/m³)	Secondary NAAQS (µg/m³)	Form of Standard
PM_{10}	24-hour	150	150	Not to be exceeded more than once per year on average over 3 years
$PM_{2.5}$	24-hour	35	35	3-year average of the 98th percentile 24-hour average concentrations
	Annual	12.0	15.0	3-year average of the annual arithmetic mean
SO_2	1-hour	196 (75 ppb)	--	3-year average of the 99th percentile of daily maximum 1-hour concentrations
	3-hour	--	1,300 (500 ppb)	Not to be exceeded more than once per year
	24-hour	365 (140 ppb)[A]	--	Not to be exceeded more than once per year
	Annual	80 (30 ppb)[A]	--	Annual arithmetic mean
NO_2	1-hour	188 (100 ppb)	--	3-year average of the 98th percentile of daily maximum 1-hour concentrations
	Annual	100 (53 ppb)	100 (53 ppb)	Annual arithmetic mean
CO	1-hour	40,000 (35 ppm)	--	Not to be exceeded more than once per year
	8-hour	10,000 (9 ppm)	--	Not to be exceeded more than once per year
Pb	3-month[B]	0.15	0.15	Maximum arithmetic mean

[A] The annual and 24-hour SO_2 standards will be revoked one year after the effective date in areas with a designated status of the revised SO_2 NAAQS, per 40 CFR §50.4(e).

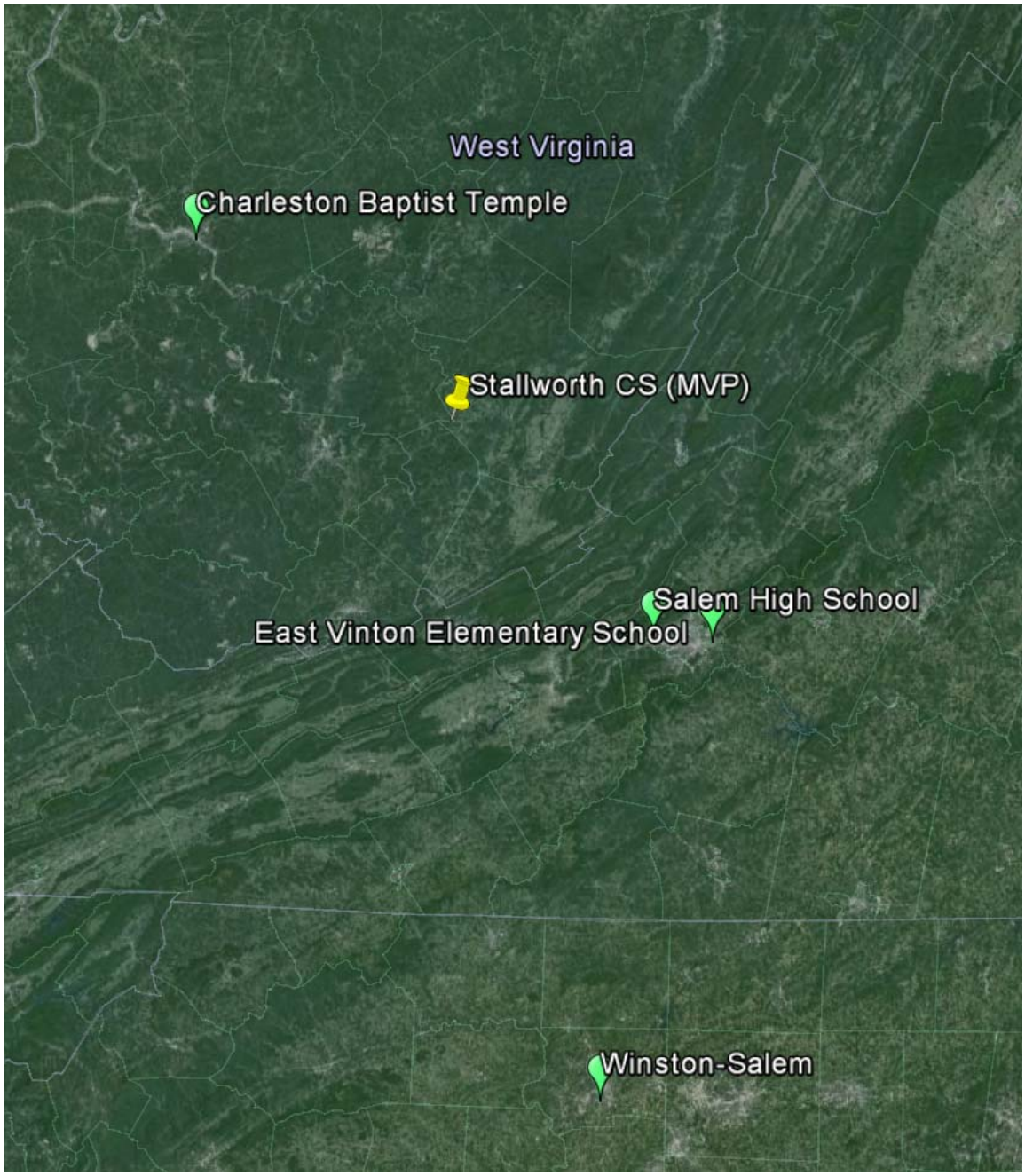
[B] The lead NAAQS is evaluated as a rolling 3-month average concentration.

2.2. BACKGROUND AIR QUALITY

In evaluating cumulative impacts with respect to the NAAQS, maximum modeled impacts were added to representative ambient background concentrations and compared to the applicable NAAQS. Selection of the existing monitoring station data that is "representative" of the ambient air quality in the area surrounding the Stallworth Compressor Station is determined based on the following three criteria: 1) monitor location, 2) data quality, and 3) data currentness. Key considerations based on the monitor location criteria include proximity to the significant impact area of the facility, similarity of emission sources impacting the monitor to the emission sources impacting the airshed surrounding the Stallworth Compressor Station, and the similarity of the land use and land cover (LULC) surrounding the monitor and facility. The data quality criteria refers to the monitor being an approved state and local air monitoring station (SLAM) or similar monitor type subject to the quality assurance requirements in 40 CFR Part 58 Appendix A. Data currentness refers to the fact that the most recent three complete years of quality assured data are generally preferred.

Figure 2-1 presents the location of the closest, most representative monitor locations which are proposed for use in the NAAQS analysis.

Figure 2-1. Background Monitor Locations



As is discussed in more detail, MVP selected monitors with the most currently available data (2012-2014), that are within the region, and that have reasonably similar topographic settings. The selected monitors are generally in more populated or industrialized areas than the Stallworth Compressor Station and thus represent conservative estimates of ambient background.

For NO_2 monitoring data, MVP used a representative ambient monitor, AQS# 511611004, located at the East Vinton Elementary School in Roanoke County, Virginia. At approximately 101 kilometers (km) southeast of the facility, the East Vinton site is the closest monitoring site for NO_2. Furthermore, the East Vinton site has high data counts and is located in a much more populated area than the Stallworth Compressor Station. Thus the monitor provides conservative estimates of ambient background concentrations.

For $PM_{2.5}$, MVP used a representative ambient monitor, AQS# 517750011, located at Salem High School in Salem City, Virginia. At approximately 87 km southeast of the facility, the Salem site is the second closest monitoring site for $PM_{2.5}$. The Maxwell Hill Elementary School is closer, but this site had very few data counts in 2014, therefore the Salem High School site gives a more accurate representation of background. Also, the Salem High School site is located in a much more populated area than the Stallworth Compressor Station thus the monitor provides conservative estimates of ambient background concentrations.

For CO monitoring data, MVP used a representative ambient monitor, AQS# 370670023, located at Winston-Salem in Forsyth County, North Carolina. At approximately 204 km southeast of the facility, the Winston-Salem site is the second closest monitoring site for CO. East Vinton Elementary School is the closest CO monitor, but the site does not have any CO data for 2012, therefore it was not used. The Winston-Salem site has high data counts and is located in a much more populated area than the Stallworth Compressor Station thus the monitor provides conservative estimates of ambient background concentrations.

For lead (Pb), SO_2 and PM_{10} monitoring data, MVP used a representative ambient monitor, AQS# 540390010, located at the Charleston Baptist Temple in Kanawha County, West Virginia. At approximately 93 km northwest of the facility, the Charleston site is the closest monitoring site for these pollutants. Furthermore, for all pollutants the Charleston site has relatively high data counts, is located in a much more populated area than the Stallworth Compressor Station, and has the highest background values in the area. Thus, the monitor provides conservative estimates of ambient background concentrations.

Table 2-2 presents a list of the selected monitor locations and measured pollutants.

Table 2-2. Selected Background Monitors

Site ID	Address	County	State	Pollutant Monitored
511611004	East Vinton Elementary School, Vinton, VA	Roanoke	VA	NO_2
517750011	Salem High School, Salem, VA	Salem City	VA	$PM_{2.5}$
370670023	Winston-Salem, NC	Forsyth	NC	CO
540390010	Charleston Baptist Temple, Charleston, WV	Kanawha	WV	SO_2, PM_{10}, & Pb

Based on available, validated data, MVP proposes to utilize the ambient background concentrations shown in Table 2-3 in the modeling analyses.

Table 2-3. Selected Background Concentrations

Pollutant	Averaging Period	2012-2014 Monitor Background Concentration (µg/m³)	Metric	Monitor Location
PM_{10}	24-hour	30.0	3-year average Highest-second-high (H2H)	Charleston Baptist Temple
$PM_{2.5}$	24-hour	17.3	3-year average of 98th percentile	Salem High School
	Annual	8.7	3-year average	
SO_2	1-hour	110.9	3-year average of 99th percentile	Charleston Baptist Temple
	3-hour	120.5	H2H (2014)	
	24-hour	46.9	H2H (2013)	
	Annual	10.8	Annual Average (2012)	
NO_2	1-hour	69.2	3-year average of 98th percentile	East Vinton Elementary School
	Annual	12.6	Annual Average (2012)	
CO	1-hour	2,750	H2H (2013)	Winston-Salem
	8-hour	1,948	H2H (2013)	
Pb	3-month	0.012	Highest Month (2012)	Charleston Baptist Temple

This section of the modeling report describes the procedures and data resources utilized in the air dispersion modeling analyses.

3.1. DISPERSION MODEL SELECTION AND BUILDING DOWNWASH ANALYSIS

Dispersion models predict ambient pollutant concentrations by simulating the evolution of the pollutant plume over time and space given data inputs including the quantity of emissions, stack exhaust parameters (e.g., velocity, flowrate, and temperature) and weather data. Building structures that obstruct wind flow near emission points may cause stack discharges to become caught in the turbulent wakes of these structures leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent. These effects generally cause higher ground-level pollutant concentrations since building downwash inhibits dispersion from elevated stack discharges. For this reason, building downwash algorithms are considered an integral component of the selected air dispersion model.

Version 15181 of the AERMOD model was used to estimate maximum ground-level concentrations in the air pollutant analyses conducted. AERMOD is a refined, steady-state, multiple source dispersion model that was promulgated in December 2005 as the Environmental Protection Agency (EPA)-preferred model to use for industrial sources in this type of air dispersion modeling analysis.[2] The AERMOD modeling was performed using regulatory default options except as otherwise noted in this report. The AERMOD model has the Plume Rise Modeling Enhancements (PRIME) incorporated in the regulatory version, so the direction-specific building downwash dimensions used as input were determined by the Building Profile Input Program, PRIME version (BPIP PRIME), version 04274.[3] BPIP PRIME is designed to incorporate the concepts and procedures expressed in the Good Engineering Practice (GEP) Technical Support document, the Building Downwash Guidance document, and other related documents,[4] while incorporating the PRIME enhancements to improve prediction of ambient impacts in building cavities and wake regions. Table 3-1 summarizes the model control options that were utilized in this analysis.

[2] 40 CFR 51, Appendix W–*Guideline on Air Quality Models*, Appendix A.1– AMS/EPA Regulatory Model (AERMOD).
[3] Earth Tech, Inc., *Addendum to the ISC3 User's Guide, The PRIME Plume Rise and Building Downwash Model*, Concord, MA.
[4] U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised),* Research Triangle Park, North Carolina, EPA 450/4-80-023R, June 1985.

Table 3-1. Model Selection Options

Control Option	Option Selected	Justification
Pollutant ID	CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2, Other (for lead)	--
Terrain	Elevated, Meters	The receptor grid covers varying terrain elevations; as such, the elevated option was selected.
Flagpole Receptors	N/A	--
Run or Not	Run	--
Averaging Times	1-hour, 3-hour, 8-hour, 24-hour, month, and annual	MVP selected the appropriate averaging periods for each pollutant.
Model	PRIME	The PRIME algorithms are default.
Dispersion	Concentration, Rural, Regulatory Default Option	This modeling analysis is assessing compliance with concentration standards. MVP is located in a predominantly rural area. The regulatory default option was selected.
NO_2 Model Options	N/A	MVP did not utilize any Tier 2 or 3 model options for NO_2 modeling.
Particulate Model Options	N/A	MVP did not utilize particle deposition or depletion options for particulate modeling.
Output Files	.aml	Model output file from Breeze User Interface (contained in zip files [.amz])

3.2. METEOROLOGICAL DATA

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, readily available data from the closest and most representative National Weather Service (NWS) station are commonly used. Regulatory air dispersion modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- Wind speed;
- Wind direction;
- Air temperature;
- Micrometeorological parameters (e.g., friction velocity, Monin-Obukhov length);
- Mechanical mixing height; and
- Convective mixing height.

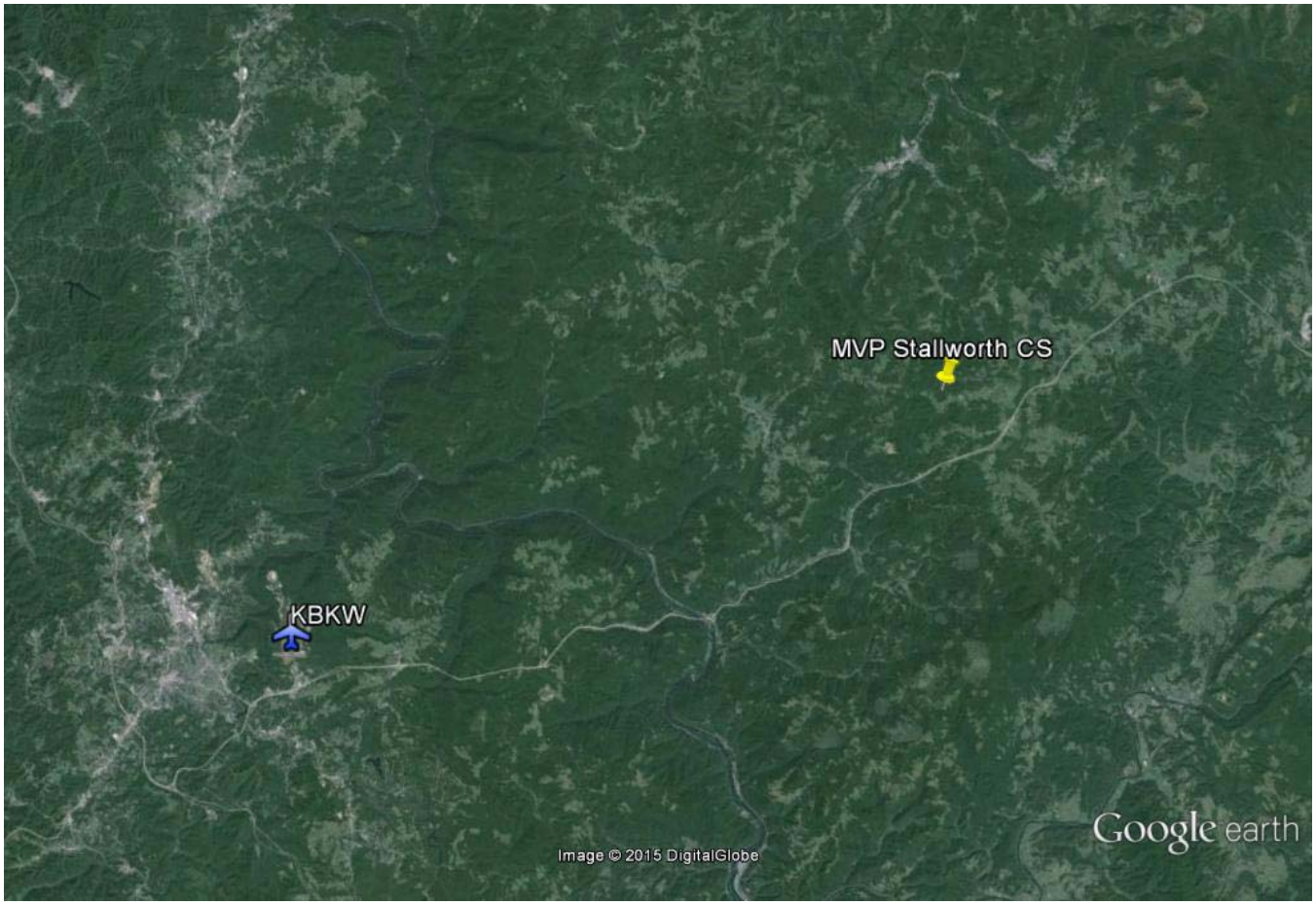
The first three of these parameters are directly measured by monitoring equipment located at typical surface observation stations. The friction velocity, Monin-Obukhov length, and mixing heights are derived from characteristic micrometeorological parameters and from observed and correlated values of cloud cover, solar insulation, time of day and year, and latitude of the surface observation station. Surface observation stations form a relatively dense network, are almost always found at airports, and are typically operated by the NWS.

Upper air stations are fewer in number than surface observing points since the upper atmosphere is less vulnerable to local effects caused by terrain or other land influences and is therefore less variable. The NWS operates virtually all available upper air measurement stations in the United States.

3.2.1. Site Location and Surface Characteristics

MVP utilized 2010 to 2014 meteorological data from the meteorological tower at Raleigh County Memorial Airport (KBKW), located roughly 33 km east of the Stallworth Compressor Station. Figure 3-1 shows the relative location of Raleigh County Memorial airport to the Stallworth Compressor Station.

Figure 3-1. Location of Raleigh County Memorial Airport Meteorological Tower



The meteorological tower at Raleigh County Memorial airport is the closest tower to the Stallworth Compressor Station with the next closest being nearly 75 km distant. Given its close proximity to the station, the Raleigh County Memorial airport is ideally situated for use in this analysis.

AERSURFACE (version 13016) was used as an objective method for evaluating landuse characteristics and their associated micrometeorological parameters for a given location. The AERSURFACE program was used in the evaluation of potential NWS stations in the area. AERSURFACE was used to create seasonal values of albedo, Bowen ratio and surface roughness, across 12 directional sectors (e.g. 0-30 degrees). The seasonal parameters correspond to the calendar months in which they occur (i.e. winter values for December-February). The albedo

and Bowen ratio values were determined from taking the geometric mean over a 10 kilometer (km) area out from the location of interest. The surface roughness values assigned by AERSURFACE were based on a 1 km radius out from the site.

The figures in Attachment A illustrate the magnitude of the micrometeorological differences between Raleigh County Memorial airport and Stallworth Compressor Station sites, as determined by AERSURFACE.

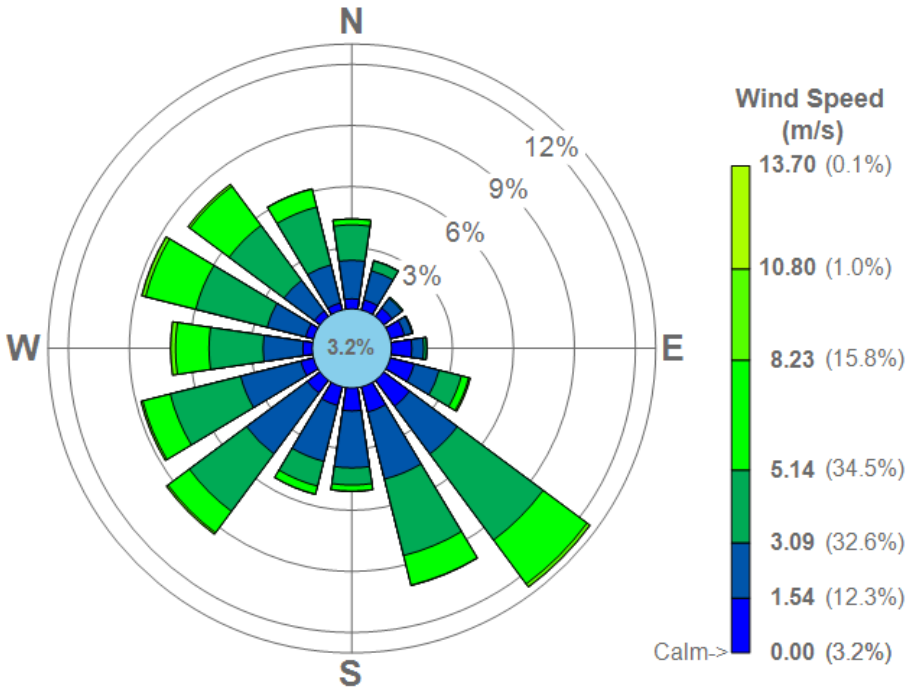
The albedo and Bowen ratio values show reasonable agreement across the directional sectors. However, there are variations in surface roughness across a couple of sectors. Accordingly, MVP performed a sensitivity analysis of the surface characteristics (most notably the surface roughness) to determine the impact of these differences. For this assessment a constant emission rate (1 lb/hr) was input for the turbine normal operating scenario (i.e., 100 percent load). The results of this analysis were compared for all receptors in the domain and for each metric used in this analysis (e.g., 1-hour H1H, H2H, H4H, and H8H, 3-hour H1H and H2H, etc.). AERMOD responded to the surface characteristics differences between the two sites with moderately varying output concentrations (19% on average).

3.2.2. Topographic Setting

The complexity of the terrain is another important consideration in determining data representativeness. In addition to the land use similarities shown above, Raleigh County Memorial airport and the Stallworth Compressor Station are at both at relatively high elevations (~845 for the station and ~762 for the tower) in the southern portion of West Virginia. While there are some terrain features surrounding the Raleigh County Memorial airport (as evident in the wind from the southeast shown in Figure 3-2), the wind is largely from the west at Raleigh County Memorial airport, which is indicative of the regional wind patterns.

Figure 3-2 provides a wind rose for Raleigh County Memorial airport for the data period of 2010 to 2014.

Figure 3-2. Raleigh County Memorial Airport Wind Rose



3.2.3. Data Quality

The Raleigh County Memorial airport meteorological data was processed through the latest version of AERMET (version 15181) to include upper air measurements from the Roanoke Airport site (KRNK). Per EPA guidance, 1-minute Automated Surface Observing System (ASOS) wind data was also incorporated in the processing, using the latest version of AERMINUTE (version 14337).[5] A base elevation of 762 meters was used for the meteorological tower in the modeling analysis.

3.3. TREATMENT OF TERRAIN

Through the use of the AERMOD terrain preprocessor (AERMAP), AERMOD incorporates not only the receptor heights, but also an effective height (hill height scale) that represents the significant terrain features surrounding a given receptor that could lead to plume recirculation and other terrain interaction.[6]

Receptor terrain elevations input to the model were those interpolated from 1/3 arc second National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS). The array elevations and elevations for emission sources and buildings at the Stallworth Compressor Station were based on site grade elevations.

[5] Version 14237 of AERMINUTE was released after the modeling for this project was initiated. The results of this modeling analysis are not expected to change based on the version of AERMINUTE.

[6] EPA, *Users Guide for the AERMOD Terrain Preprocessor (AERMAP)*, Research Triangle Park, NC, EPA-454/B-03-003, October 2004.

3.4. RECEPTOR GRIDS

For this air dispersion modeling analysis, ground-level concentrations were calculated along the facility boundary and also within a Cartesian receptor grid outside the fenceline. The boundary receptors were spaced 50 meters apart starting at an arbitrary point on the boundary. The Cartesian grid generally consists of the following receptor spacing:

- 50 meter-spaced receptors from the boundary out to 2 kilometers;
- 100 meter-spaced receptors from 2 to 5 kilometers;
- 500 meter-spaced receptors from 5 to 10 kilometers; and
- 1,000 meter-spaced receptors from 10 to 25 kilometers.

In general, the receptors covered a region extending from all edges of the Stallworth Compressor Station boundary to the point where impacts from the Project are no longer expected to be significant. For this modeling analysis, MVP considered all land outside of the facility's fenceline to be ambient air although MVP owns property beyond the fenceline.

Receptor elevations required by AERMOD were determined using the AERMAP terrain preprocessor (version 11103). Figures 3-5 and 3-6 show the full receptor grid and a closer view of the receptors at the facility, respectively.

Figure 3-3. Receptor Grid

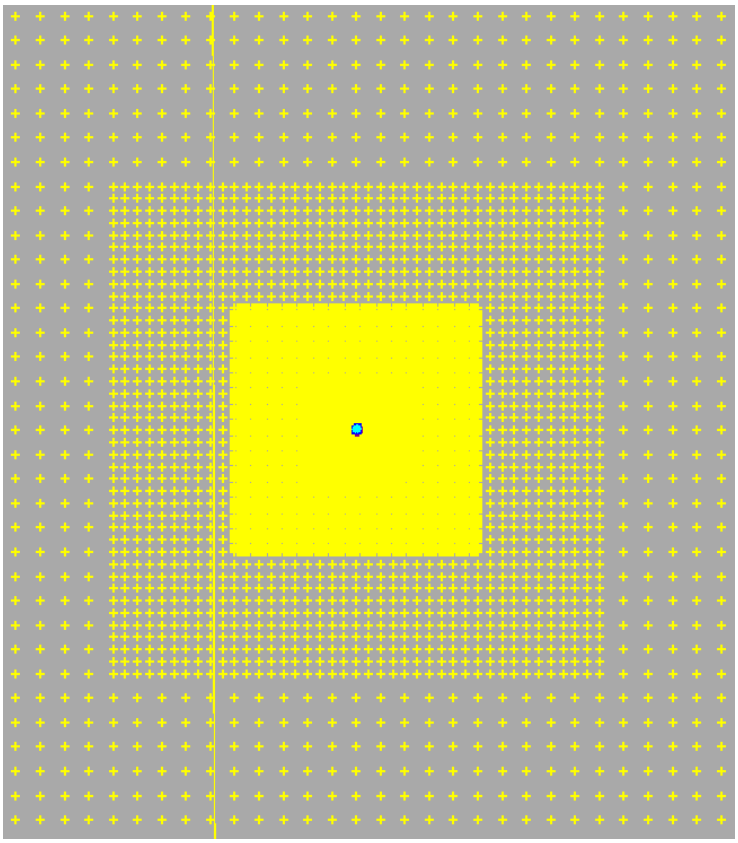
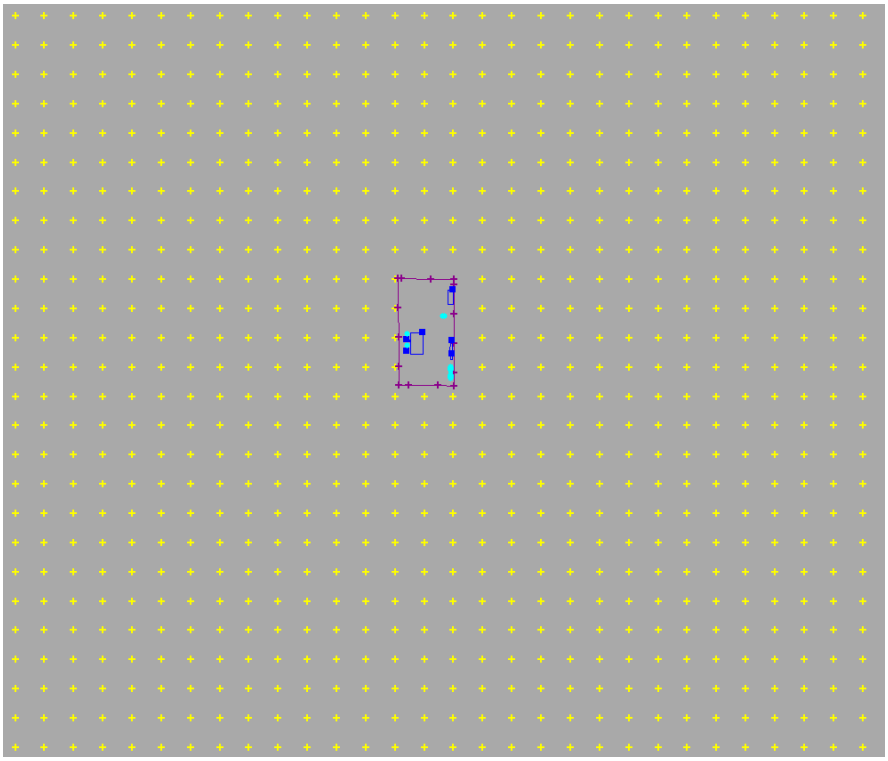


Figure 3-4. Receptor Grid (Zoomed In)



3.5. GEP STACK HEIGHT ANALYSIS

Stack height regulations restrict the use of stack heights in excess of GEP in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations. The minimum stack height not subject to the effects of downwash, called the GEP stack height, is defined by the following formula:

H_{GEP} = H + 1.5L, where:

H_{GEP} = minimum GEP stack height,
H = structure height, and
L = lesser dimension of the structure (height or projected width).

The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP PRIME. In general, the lowest GEP stack height for any source is 65 meters by default.[7] A source may construct a stack that exceeds GEP, but is limited to the GEP stack height in the air quality analysis demonstration. All proposed source stacks at the Stallworth Compressor Station are less than 65 meters tall and therefore meet the requirements of GEP.

[7] 40 CFR §51.100(ii).

3.6. REPRESENTATION OF EMISSION SOURCES

3.6.1. Coordinate System

In all modeling analysis data files, the location of emission sources, structures, and receptors, are represented in the UTM coordinate system. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). The datum for this modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 17.

3.6.2. Source Types

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. In these air dispersions modeling analyses, MVP utilized point sources for all emission sources. There were no area or volumes sources used in this modeling analysis.

For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses. The proposed turbines and heaters at the Stallworth Compressor Station have an unobstructed vertical release and were therefore modeled as point sources. Stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) used in the modeling analyses were based on design values for the turbine for each operating load considered in the analysis.

The proposed microturbines at the Stallworth Compressor Station are equipped with hinged rain caps. These rain caps are necessary to avoid rainwater build up when the units are not operating. However, during operation the rain caps are forced open by the exhaust plume and remain open during operation thereby not obstructing the plume. As such, these sources were also modeled as point sources with their design values for height, diameter, exhaust gas temperature, and gas exit velocity.[8]

3.6.3. Source Parameters and Emission Rates

In general, a dispersion modeling analysis should contain sufficient detail to determine the maximum ambient concentration of the pollutant under consideration, and in many cases this involves modeling several operating loads or production rates. As such, this modeling analysis considered the proposed combustion turbine operating at various expected load scenarios (100 percent, 75 percent, and 50 percent loads). These scenarios encompass the variations in flow potentially resulting from reduced operational loads, thus determining the worst-case modeled concentrations. For this load analysis, a unit emission rate (one lb/hr) was input into the model and results were scaled based on the actual potential to emit (lb/hr) for each operating load. The worst-case load determined from this load analysis (as shown in Attachment D) and the 100 percent load scenario were utilized in the AERMOD modeling analyses.

MVP also evaluated the effect of startup and shutdown emissions from the proposed combustion turbines in this analysis. A startup or shutdown event of the turbine is expected to last 10 minutes. This is a much shorter time than the shortest NAAQS averaging period (i.e., 1-hour) and as such was not included in modeling. In addition, the only modeled pollutants for which startup and shutdown emissions are available are NO_2 and CO. For NO_2,

[8] The Vermont Department of Environmental Conservation and Northwest Clean Air Agency have both published guidance supporting the treatment of hinged rain caps as unobstructed, vertical releases (http://www.anr.state.vt.us/air/permitting/docs/Rain_Guard_Guidance.pdf and http://www.nwcleanair.org/pdf/forms/misc/Stack%20and%20Rain%20Guard%20Requirements1.pdf). The West Virginia Department of Environmental Protection does not have any state-specific air dispersion modeling guidance.

the startup and shutdown emissions, in lb/event, are much less than the normal operation hourly emission rate. For CO, emissions per event are higher than the normal operation hourly emission rate, however, the modeling results for the 1-hour CO standard are well below the NAAQS.

The source parameters and emissions utilized in this analysis are included in Attachment C.

4. MODELING RESULTS

Following the procedures and methods discussed in this report, the following tables summarize the results from the conducted modeling analyses. As shown in the tables below, the results of the analyses indicate that the predicted ambient impacts resulting from the operation of the Stallworth Compressor Station plus the existing ambient background concentration are lower than each of the NAAQS.

Electronic input and output files for all AERMOD model runs are included in Attachment B.

Table 4-1. Modeling Results - PM_{10} 24-Hour NAAQS

Scenario/ Load	H6H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	7.4	30.0	37.4	150	Yes
Worst-Case Load	7.9		37.9		Yes

Table 4-2. Modeling Results – $PM_{2.5}$ 24-Hour NAAQS

Scenario/ Load	5-year Average H1H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	3.7	17.3	21.0	35	Yes
Worst-Case Load	4.8		22.1		Yes

Table 4-3. Modeling Results – $PM_{2.5}$ Annual NAAQS

Scenario/ Load	5-year Average Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load	0.8	8.7	9.4	12	Yes
Worst-Case Load	1.0		9.7		Yes

Table 4-4. Modeling Results – SO_2 1-Hour NAAQS

Scenario/ Load	5-year Average H4H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load/Worst-Case Load	3.7	110.9	114.6	196	Yes

Table 4-5. Modeling Results – SO_2 3-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	3.5	3.4	3.5	3.4	3.6	3.6	120.5	124.1	1,300	Yes

Table 4-6. Modeling Results – SO_2 24-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	2.0	1.7	1.7	1.3	1.5	2.0	46.9	48.9	365	Yes
Worst-Case Load	2.0	1.8	1.8	1.4	1.7	2.0		48.9		Yes

Table 4-7. Modeling Results – SO_2 Annual NAAQS

Scenario/ Load	1st High Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	0.1	0.1	0.1	0.1	0.1	0.1	10.8	11.0	80	Yes
Worst-Case Load	0.2	0.2	0.1	0.2	0.2	0.2		11.1		Yes

Table 4-8. Modeling Results – NO_2 1-Hour NAAQS

Scenario/ Load	5-year Average H8H Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
100% Load/Worst-Case Load	91.0	69.2	160.3	188	Yes

Table 4-9. Modeling Results – NO_2 Annual NAAQS

Scenario/ Load	1st High Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	7.2	8.8	7.1	8.2	8.8	8.8	12.6	21.5	100	Yes
Worst-Case Load	7.8	9.7	7.8	9.0	9.9	9.9		22.6		Yes

Table 4-10. Modeling Results – CO 1-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	92.6	89.8	93.3	90.1	86.9	93.3	2749.5	2842.7	40,000	Yes

Table 4-11. Modeling Results – CO 8-Hour NAAQS

Scenario/ Load	H2H Modeled Concentration (µg/m³)						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load/Worst-Case Load	68.4	58.5	55.2	50.6	58.1	68.4	1947.5	2015.9	10,000	Yes

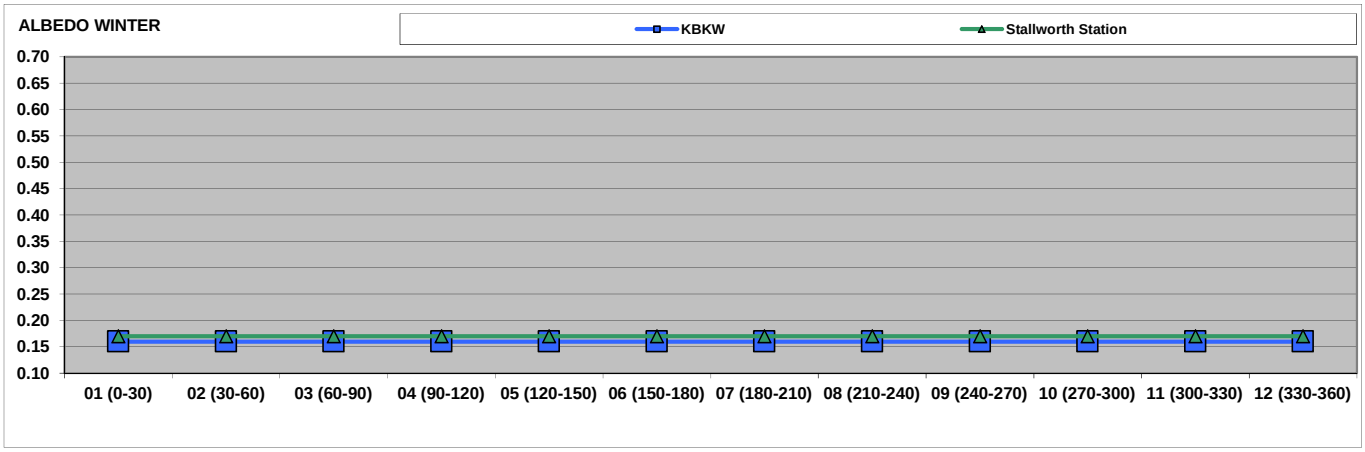
Table 4-12. Modeling Results – Lead 3-Month NAAQS

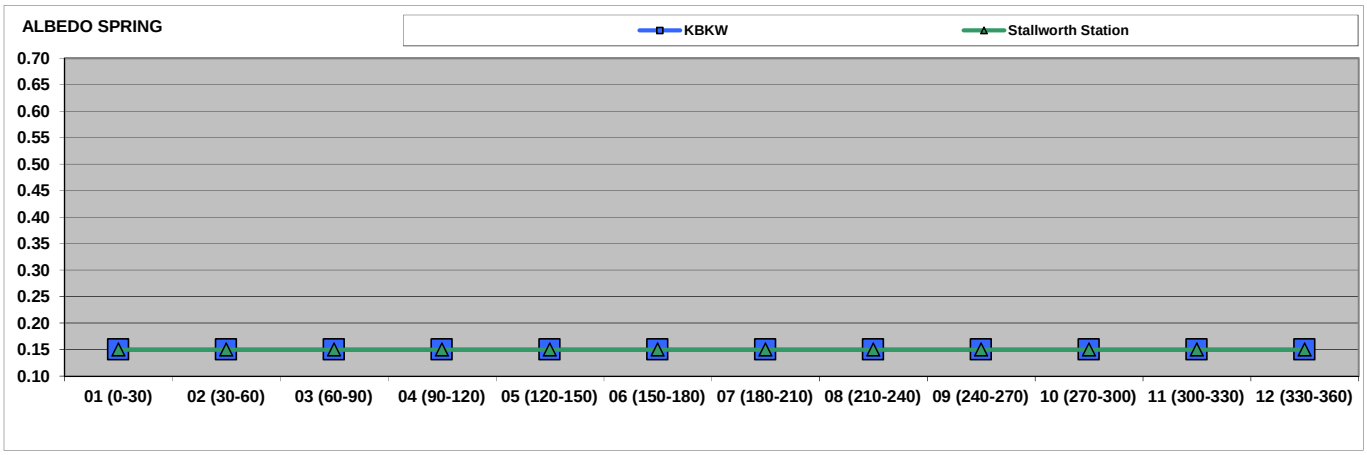
Scenario/ Load	H1H Modeled Concentration (µg/m³)[A]						Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Below NAAQS?
	2010	2011	2012	2013	2014	Maximum				
100% Load	0.00005	0.00005	0.00005	0.00006	0.00005	0.00006	0.01	0.01	0.15	Yes

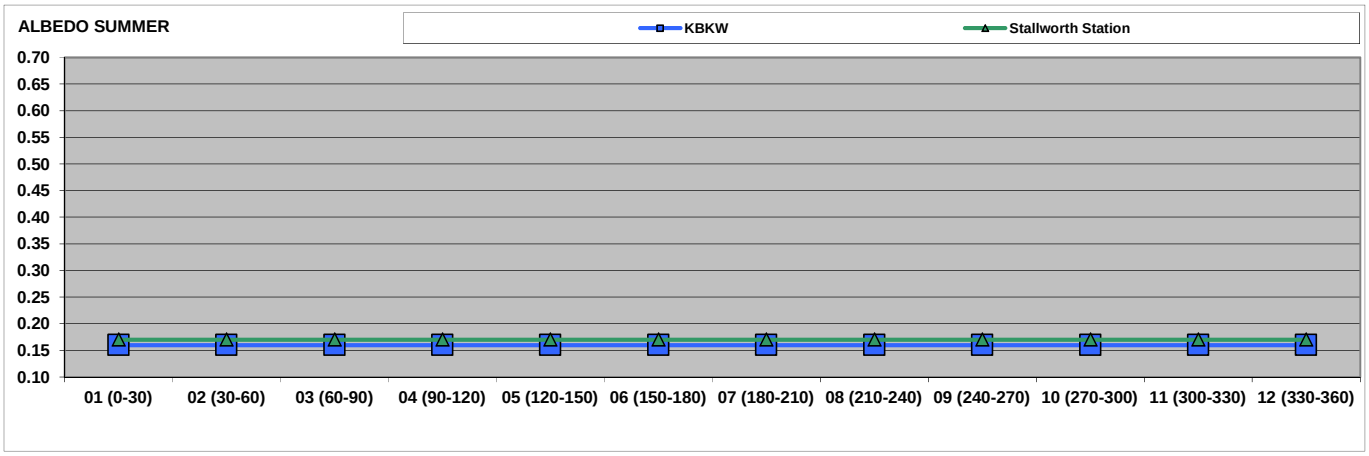
[A] Results shown are maximum monthly average concentration. This is a conservative assumption as the NAAQS is based on a rolling 3-month average.

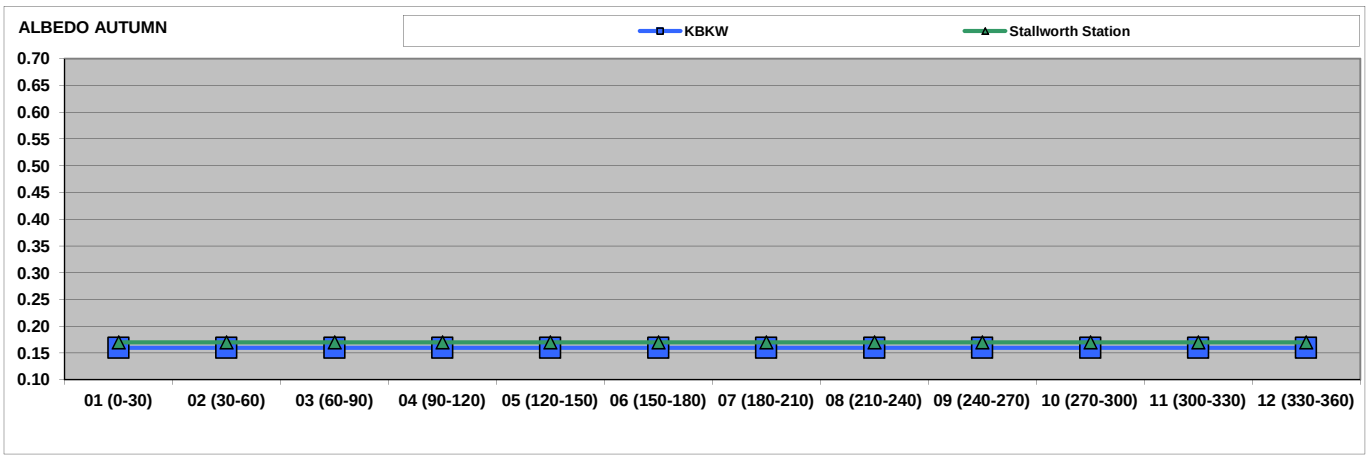
ATTACHMENT A. COMPARISON OF SURFACE CHARACTERISTICS

COMPARISON OF ALBEDO VALUES

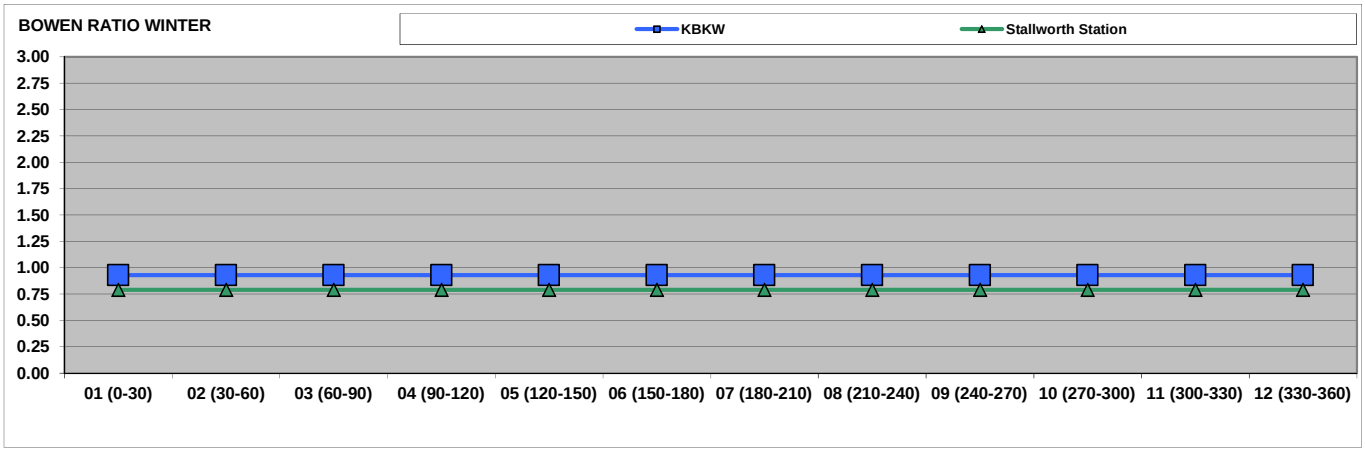


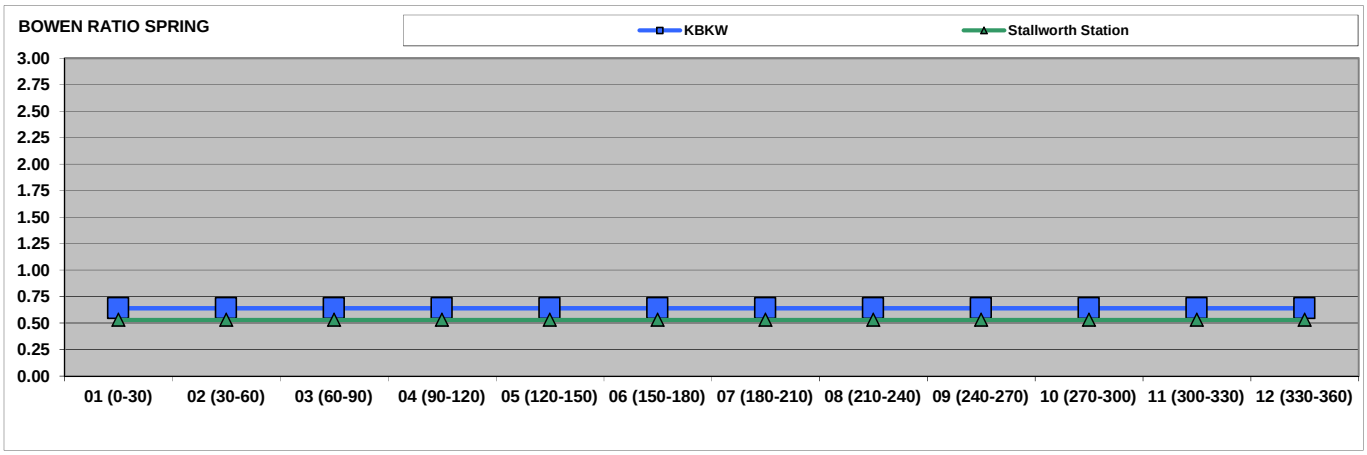


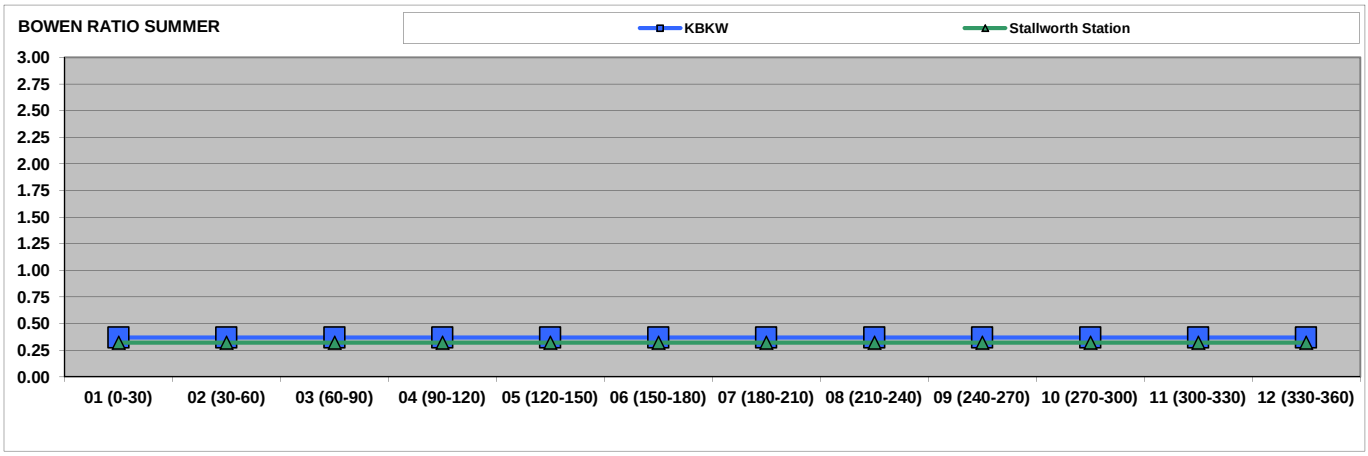


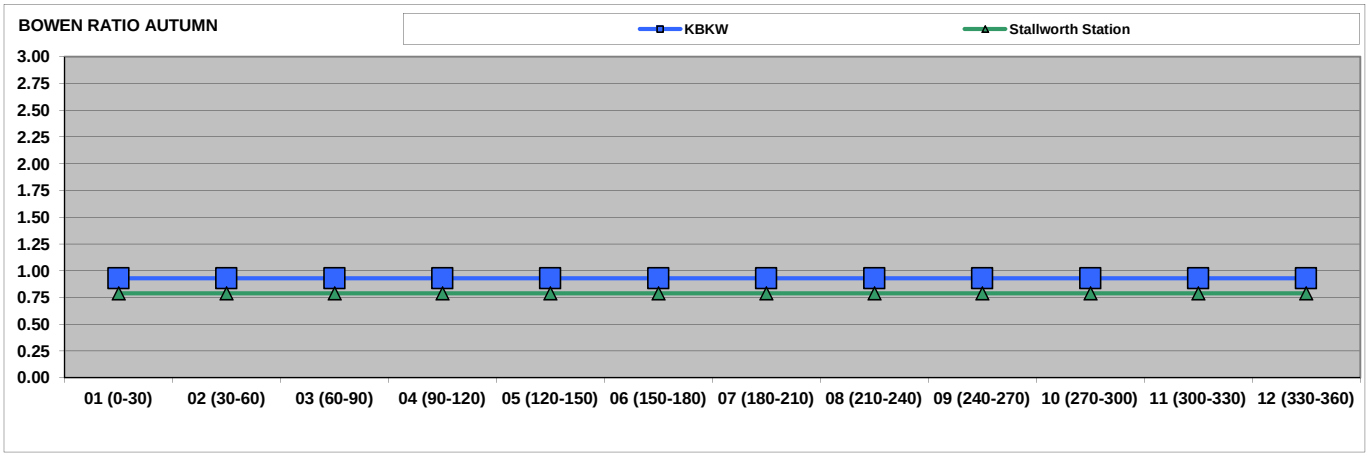


COMPARISON OF BOWEN RATIO VALUES

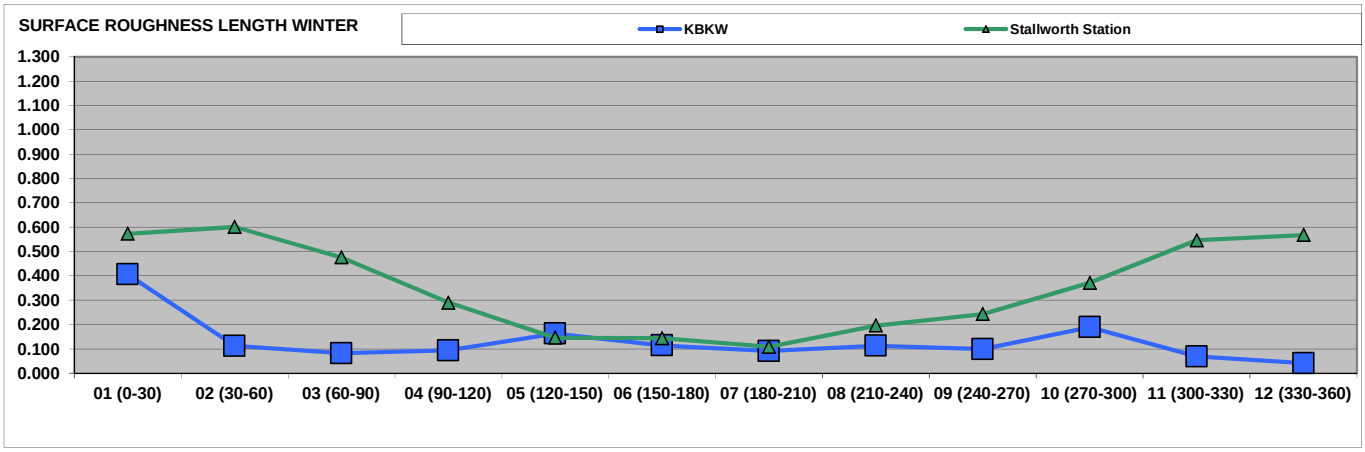


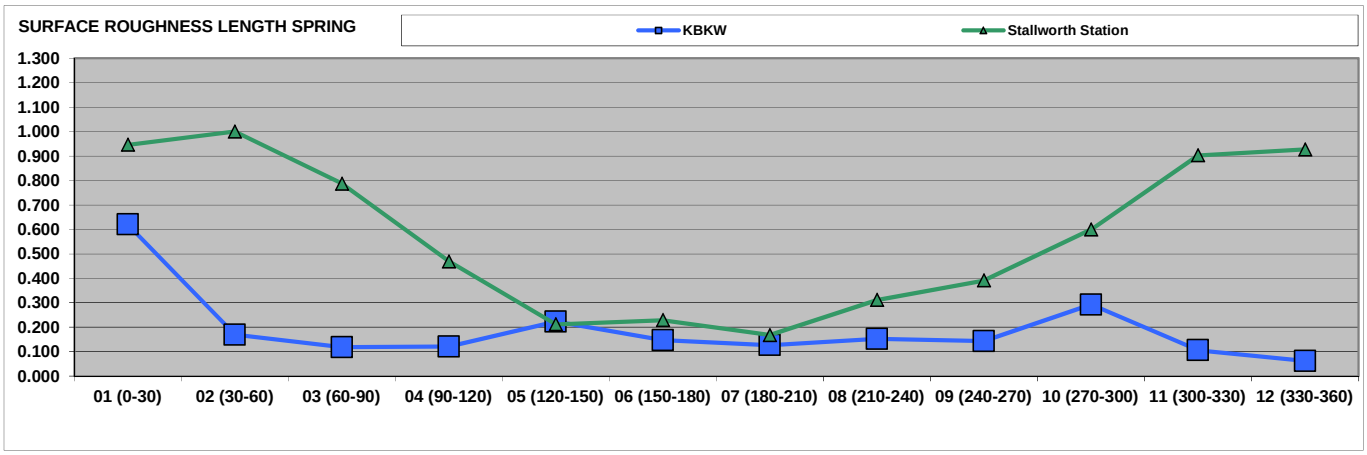


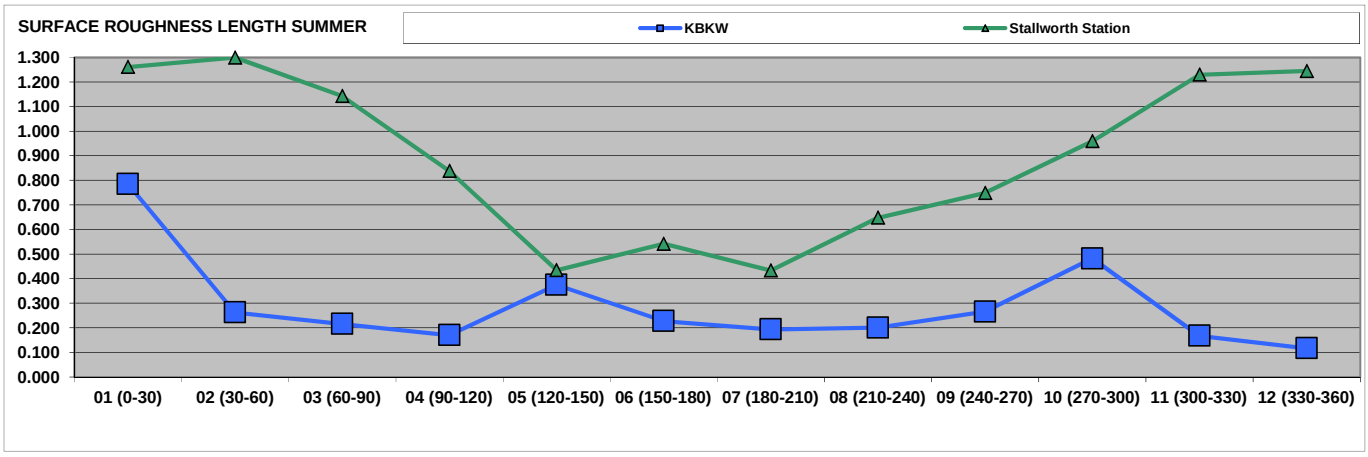


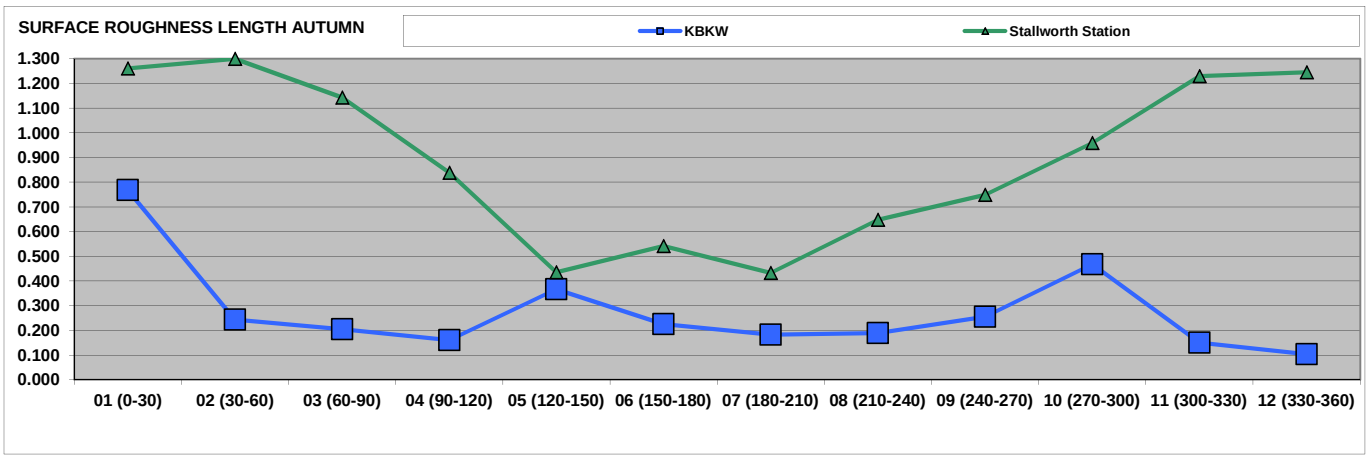


COMPARISON OF SURFACE ROUGHNESS LENGTH VALUES









ATTACHMENT B. MODEL FILES CD

ATTACHMENT C. MODELED SOURCE INVENTORY

Stallworth Compressor Station - Modeled Source Inventory
1-Hour & 8-Hour CO Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	CO Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	8.61
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	8.61
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.22
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.18
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.22
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.22
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.22
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.18

Stallworth Compressor Station - Modeled Source Inventory
Pb Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	Pb Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	0.0E+00
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	0.0E+00
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.0E+00
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	1.07E-06
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.0E+00
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.0E+00
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	1.07E-06

* No load scenario was run for the turbines as there are no lead emissions from the turbines with which to determine worst-case load.

Stallworth Compressor Station - Modeled Source Inventory
1-Hour NO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	8.49
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	8.49
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.08
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.21
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.08
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.08
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.21

Stallworth Compressor Station - Modeled Source Inventory
Annual NO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	NO_2 Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	8.49
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	8.49
T1_50L	Turbine 1 Load, 50% Load	521287.3	4191164.6	844.6	15.24	648.7	7.39	2.75	4.89
T2_50L	Turbine 2 Load, 50% Load	521287	4191144.9	844.6	15.24	648.7	7.39	2.75	4.89
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.08
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.21
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.08
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.08
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.08
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.21

Stallworth Compressor Station - Modeled Source Inventory
24-Hour $PM_{2.5}$ Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	$PM_{2.5}$ Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	2.21
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	2.21
T1_50L	Turbine 1 Load, 50% Load	521287.3	4191164.6	844.6	15.24	648.7	7.39	2.75	1.28
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.02
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.02
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.02

Stallworth Compressor Station - Modeled Source Inventory
Annual $PM_{2.5}$ Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	$PM_{2.5}$ Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	2.21
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	2.21
T1_50L	Turbine 1 Load, 50% Load	521287.3	4191164.6	844.6	15.24	648.7	7.39	2.75	1.28
T2_50L	Turbine 2 Load, 50% Load	521287	4191144.9	844.6	15.24	648.7	7.39	2.75	1.28
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.02
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.02
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.02

Stallworth Compressor Station - Modeled Source Inventory
24-Hour PM_{10} Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	PM_{10} Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	2.21
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	2.21
T1_50L	Turbine 1 Load, 50% Load	521287.3	4191164.6	844.6	15.24	648.7	7.39	2.75	1.28
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.02
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.02
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.02
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.02
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.02
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.02

Stallworth Compressor Station - Modeled Source Inventory
1-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	0.50
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	0.50
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.001
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.001

Stallworth Compressor Station - Modeled Source Inventory
3-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	0.50
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	0.50
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.001
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.001

Stallworth Compressor Station - Modeled Source Inventory
24-Hour SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	0.50
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	0.50
T1_50L	Turbine 1 Load, 50% Load	521287.3	4191164.6	844.6	15.24	648.7	7.39	2.75	0.29
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.001
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.001

Stallworth Compressor Station - Modeled Source Inventory
Annual SO_2 Modeling Analysis

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	SO_2 Emission Rate (lb/hr)
T1_100N	Turbine 1 Normal, 100% Load	521287.3	4191164.6	844.6	15.24	757.0	14.94	2.75	0.50
T2_100N	Turbine 2 Normal, 100% Load	521287	4191144.9	844.6	15.24	757.0	14.94	2.75	0.50
T1_50L	Turbine 1 Load, 50% Load	521287.3	4191164.6	844.6	15.24	648.7	7.39	2.75	0.29
T2_50L	Turbine 2 Load, 50% Load	521287	4191144.9	844.6	15.24	648.7	7.39	2.75	0.29
MICTURB1	CAPSTONE MICROTURBINE 1	521362.4	4191094.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB2	CAPSTONE MICROTURBINE 2	521362.5	4191092.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB3	CAPSTONE MICROTURBINE 3	521362.4	4191091.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB4	CAPSTONE MICROTURBINE 4	521362.4	4191089.4	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB5	CAPSTONE MICROTURBINE 5	521362.4	4191087.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB6	CAPSTONE MICROTURBINE 6	521362.5	4191101.9	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT1	FUEL GAS HEATER 1	521348.3	4191194.7	844.6	4.57	727.6	0.60	0.51	0.001
MICTURB7	CAPSTONE MICROTURBINE 7	521362.5	4191103.6	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB8	CAPSTONE MICROTURBINE 8	521362.5	4191105.1	844.6	3.74	552.6	32.18	0.30	0.01
MICTURB9	CAPSTONE MICROTURBINE 9	521362.5	4191106.8	844.6	3.74	552.6	32.18	0.30	0.01
MICTRB10	CAPSTONE MICROTURBINE 10	521362.5	4191108.40	844.6	3.74	552.6	32.18	0.30	0.01
FGHEAT2	FUEL GAS HEATER 2	521351.2	4191194.80	844.6	4.57	727.6	0.60	0.51	0.001

Stallworth Compressor Station - Modeled Source Inventory
Load Analysis for Turbine 1 and Turbine 2

Model ID	Description	X-Coordinate (m)	Y-Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)	Emission Rate Used for Scaling Results from 1 lb/hr Modeling Analysis (lb/hr)									
									1-hr CO	8-hr CO	1-hr NO_2	Annual NO_2	24-hr $PM_{2.5}$	Annual $PM_{2.5}$	24-hr PM_{10}	1-hr SO_2	3-hr SO_2	24-hr SO_2	Annual SO_2
T1_50N	TURBINE 1 AT 50% load	521287.3	4191164.6	844.6	15.24	648.71	7.39	2.75	4.96	4.96	4.89	4.89	1.28	1.28	1.28	0.29	0.29	0.29	0.29
T2_50N	TURBINE 2 at 50% load	521287	4191144.9	844.6	15.24	648.71	7.39	2.75	4.96	4.96	4.89	4.89	1.28	1.28	1.28	0.29	0.29	0.29	0.29
T1_75N	TURBINE 1 AT 75% load	521287.3	4191164.6	844.6	15.24	756.48	13.11	2.75	7.54	7.54	7.43	7.43	1.94	1.94	1.94	0.44	0.44	0.44	0.44
T2_75N	TURBINE 2 at 75% load	521287	4191144.9	844.6	15.24	756.48	13.11	2.75	7.54	7.54	7.43	7.43	1.94	1.94	1.94	0.44	0.44	0.44	0.44
T1_100N	TURBINE 1 AT 100% load	521287.3	4191164.6	844.6	15.24	757.04	14.94	2.75	8.61	8.61	8.49	8.49	2.21	2.21	2.21	0.50	0.50	0.50	0.50
T2_100N	TURBINE 2 at 100% load	521287	4191144.9	844.6	15.24	757.04	14.94	2.75	8.61	8.61	8.49	8.49	2.21	2.21	2.21	0.50	0.50	0.50	0.50

ATTACHMENT D. LOAD ANALYSIS

Load Analysis Results for Stallworth Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 1

		2010				2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 1	1-hr	H1H	6.0366	4.37114	4.07663	6.2027	4.35112	4.11397	6.33035	4.26122	4.01486	6.1496	4.62428	4.43845	5.98693	4.39397	4.1556
	3-hr	H1H	5.48752	3.76141	3.42625	5.55666	4.10208	3.83673	5.64603	4.17992	3.88628	5.33559	3.73372	3.44109	5.7217	4.23552	3.97122
	8-hr	H1H	5.04242	3.41284	3.03156	5.05652	2.96399	2.37829	4.81299	3.23471	2.88647	5.18508	3.29875	2.95524	5.60609	3.73027	3.31933
	24-hr	H1H	3.97635	2.42463	2.07737	3.6289	1.44293	1.22236	4.09876	2.12172	1.84453	3.29035	1.60585	1.444	3.85712	2.11724	1.71939
	Monthly	H1H	0.66694	0.22138	0.16384	0.47659	0.18469	0.14311	0.41947	0.14872	0.11859	0.54504	0.2374	0.18641	0.57096	0.26705	0.21241
	Annual	1H	0.25521	0.07559	0.0539	0.17489	0.05168	0.04146	0.17823	0.06031	0.0455	0.22129	0.06159	0.04465	0.231	0.07545	0.05577

		2010				2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	29.9415	32.9584	35.0998	30.7654	32.8074	35.4213	31.3985	32.1296	34.5679	30.5020	34.8671	38.2151	29.6952	33.1305	35.7797	*31.3985*	*34.8671*	***38.2151***
	8-hr	H1H	25.0104	25.7328	26.1017	25.0803	22.3485	20.4771	23.8724	24.3897	24.8525	25.7180	24.8726	25.4446	27.8062	28.1262	28.5794	*27.8062*	*28.1262*	***28.5794***
PM10	24-hr	H1H	5.0838	4.6997	4.5964	4.6396	2.7968	2.7046	5.2403	4.1125	4.0812	4.2067	3.1126	3.1950	4.9314	4.1039	3.8044	***5.2403***	*4.6997*	*4.5964*
PM2.5	24-hr	H1H	5.0838	4.6997	4.5964	4.6396	2.7968	2.7046	5.2403	4.1125	4.0812	4.2067	3.1126	3.1950	4.9314	4.1039	3.8044	***5.2403***	*4.6997*	*4.5964*
	Annual	1H	0.3263	0.1465	0.1193	0.2236	0.1002	0.0917	0.2279	0.1169	0.1007	0.2829	0.1194	0.0988	0.2953	0.1462	0.1234	***0.3263***	*0.1465*	*0.1234*
NO2	1-hr	H1H	29.5190	32.4776	34.6106	30.3312	32.3288	34.9276	30.9554	31.6609	34.0862	30.0715	34.3584	37.6824	29.2761	32.6472	35.2810	*30.9554*	*34.3584*	***37.6824***
	Annual	1H	1.2480	0.5616	0.4576	0.8552	0.3840	0.3520	0.8715	0.4481	0.3863	1.0821	0.4576	0.3791	1.1296	0.5606	0.4735	***1.2480***	*0.5616*	*0.4735*
SO2	1-hr	H1H	1.7494	1.9205	2.0445	1.7975	1.9117	2.0633	1.8345	1.8722	2.0136	1.7821	2.0317	2.2260	1.7350	1.9305	2.0841	*1.8345*	*2.0317*	***2.2260***
	3-hr	H1H	1.5903	1.6526	1.7184	1.6103	1.8022	1.9242	1.6362	1.8364	1.9491	1.5462	1.6404	1.7258	1.6581	1.8609	1.9917	*1.6581*	*1.8609*	***1.9917***
	24-hr	H1H	1.1523	1.0653	1.0419	1.0516	0.6340	0.6130	1.1878	0.9322	0.9251	0.9535	0.7055	0.7242	1.1178	0.9302	0.8623	***1.1878***	*1.0653*	*1.0419*
	Annual	1H	0.0740	0.0332	0.0270	0.0507	0.0227	0.0208	0.0517	0.0265	0.0228	0.0641	0.0271	0.0224	0.0669	0.0331	0.0280	***0.0740***	*0.0332*	*0.0280*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Load Analysis Results for Stallworth Compressor Station - AERMOD Concentrations (ug/m3) Resulting from 1 lb/hr Emission Rate

Turbine 2

		2010				2011			2012			2013			2014		
Emission Unit	**Avg. Period**	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
T-130 Turbine 2	1-hr	H1H	6.40318	4.96888	4.61821	6.58739	5.10743	4.81917	6.27506	4.81114	4.49761	6.38715	4.85362	4.55216	6.57455	4.97306	4.72596
	3-hr	H1H	6.09283	4.41391	4.13841	6.36695	4.89435	4.60472	6.03093	4.53837	4.29755	6.03644	4.22906	3.91175	6.37939	4.727	4.45012
	8-hr	H1H	5.41621	3.72496	3.40911	6.18215	4.5735	4.25055	5.83803	4.4161	4.12751	4.76514	3.11837	2.80205	5.29571	3.74483	3.48885
	24-hr	H1H	3.84876	2.54363	2.3013	4.42618	3.18831	2.98315	4.15786	2.57703	2.40689	3.11145	1.63544	1.4689	3.79851	2.09884	1.85733
	Monthly	H1H	0.83659	0.36629	0.29728	0.83823	0.4553	0.39062	0.62747	0.28345	0.23458	0.77865	0.279	0.22544	0.6131	0.31802	0.27808
	Annual	1H	0.34668	0.14283	0.11589	0.29593	0.12762	0.10351	0.24255	0.11486	0.09743	0.30992	0.12424	0.09984	0.30015	0.12783	0.10537

		2010				2011			2012			2013			2014			MAX		
	Avg. Period	**Metric**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**	**50N**	**75N**	**100N**
CO	1-hr	H1H	31.7598	37.4654	39.7628	32.6735	38.5100	41.4931	31.1243	36.2760	38.7244	31.6803	36.5963	39.1941	32.6098	37.4969	40.6905	*32.6735*	*38.5100*	***41.4931***
	8-hr	H1H	26.8644	28.0862	29.3524	30.6635	34.4842	36.5972	28.9566	33.2974	35.5379	23.6351	23.5125	24.1257	26.2667	28.2360	30.0390	*30.6635*	*34.4842*	***36.5972***
PM10	24-hr	H1H	4.9207	4.9303	5.0919	5.6589	6.1799	6.6006	5.3159	4.9951	5.3255	3.9780	3.1700	3.2501	4.8564	4.0682	4.1096	*5.6589*	*6.1799*	***6.6006***
PM2.5	24-hr	H1H	4.9207	4.9303	5.0919	5.6589	6.1799	6.6006	5.3159	4.9951	5.3255	3.9780	3.1700	3.2501	4.8564	4.0682	4.1096	*5.6589*	*6.1799*	***6.6006***
	Annual	1H	0.4432	0.2768	0.2564	0.3783	0.2474	0.2290	0.3101	0.2226	0.2156	0.3962	0.2408	0.2209	0.3837	0.2478	0.2331	***0.4432***	*0.2768*	*0.2564*
NO2	1-hr	H1H	31.3116	36.9188	39.2086	32.2123	37.9482	40.9148	30.6850	35.7468	38.1847	31.2332	36.0624	38.6478	32.1495	36.9498	40.1234	*32.2123*	*37.9482*	***40.9148***
	Annual	1H	1.6953	1.0612	0.9839	1.4471	0.9482	0.8788	1.1861	0.8534	0.8272	1.5155	0.9231	0.8476	1.4677	0.9498	0.8946	***1.6953***	*1.0612*	*0.9839*
SO2	1-hr	H1H	1.8556	2.1831	2.3162	1.9090	2.2439	2.4169	1.8185	2.1138	2.2557	1.8510	2.1324	2.2830	1.9053	2.1849	2.3702	*1.9090*	*2.2439*	***2.4169***
	3-hr	H1H	1.7657	1.9393	2.0755	1.8451	2.1503	2.3094	1.7477	0.0000	2.1553	1.7493	1.8580	1.9618	1.8487	2.0768	2.2319	*1.8487*	*2.1503*	***2.3094***
	24-hr	H1H	1.1154	1.1175	1.1542	1.2827	1.4008	1.4961	1.2049	1.1322	1.2071	0.9017	0.7185	0.7367	1.1008	0.9221	0.9315	*1.2827*	*1.4008*	***1.4961***
	Annual	1H	0.1005	0.0628	0.0581	0.0858	0.0561	0.0519	0.0703	0.0505	0.0489	0.0898	0.0546	0.0501	0.0870	0.0562	0.0528	***0.1005***	*0.0628*	*0.0581*
Pb	Monthly	H1H	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	***0.0000***	***0.0000***	***0.0000***

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-G
Bradshaw Compressor Station Pre-Construction Noise Study

global environmental solutions

Mountain Valley Pipeline, LLC

Bradshaw Compressor Station

Pre-Construction Noise Study

SLR Ref: 119.01204.00010, 0001, Revision 2

October 14, 2015

Mountain Valley PIPELINE LLC

Pre-Construction Noise Study

Prepared for:

Mountain Valley Pipeline, LLC
675 Liberty Ave., Suite 1700
Pittsburgh, PA 15222

This document has been prepared by SLR International Corp. The material and data in this report were prepared under the supervision and direction of the undersigned.

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CONTENTS

ACRONYMS ..... **iii**

SUMMARY **1**

1. Introduction and Purpose **2**

2. Environmental Sound Level Criteria **2**

3. Description of Site and Proposed Compressor Station **2**

3.1 Description of Site 2
3.2 Description of the Station Equipment 2

4. Sound Level Survey **3**

4.1 Measurement Equipment 3
4.2 Weather Conditions 3
4.3 Monitoring Locations 3
4.4 Measured Sound Level Data 4

5. Proposed Equipment Noise Impact Evaluation **4**

5.1 Significant Sound Sources 4
5.2 Noise Model Development 5
5.2.1 Data and Assumptions 5
5.2.2 Noise Model Results – Typical Operation Scenario 6
5.2.3 Noise Model Results – Unit Blowdown Scenario 7
5.2.4 Noise Model Results – Emergency Shutdown Scenario 8
5.2.5 Noise Model Results – Construction 8

6. Noise Control Treatments **9**

6.1 Compressor Building Walls and Roof 9
6.2 Compressor Building Doors 9
6.3 Compressor Building Ventilation 10
6.4 Turbine Exhausts 10
6.4.1 Silencer Performance 10
6.4.2 Exhaust Duct and Shell Noise 10
6.5 Turbine Intake 11
6.5.1 Silencer Performance 11
6.5.2 Intake Breakout 11
6.6 Lube Oil / Auxiliary Coolers 11
6.7 Gas Cooler Fans 11
6.8 Station Piping 11
6.8.1 Acoustical Pipe Lagging Materials 11
6.8.2 Piping Isolation 12
6.9 Compressor Blowdown 12

7. Summary **12**

CONTENTS (CONTINUED)

FIGURES

Figure 1: NSA and Sound Level Measurement Locations
Figure 2: Predicted Station Sound Levels dBA L_{dn}

TABLES

Table 4-1: Weather Conditions During Sound Level Survey
Table 4-2: Summary of Monitoring Locations
Table 4-3: Existing Sound Level Measurement Results at Monitoring Locations
Table 5-1: Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment
Table 5-2: Compressor Station Sound Level Predictions
Table 5-3: Compressor Unit Blowdown Sound Level Predictions
Table 5-4: Station ESD Blowdown Sound Level Predictions
Table 6-1: Recommended Noise Mitigation Treatments

APPENDICES

Appendix A Glossary of Common Acoustical Terminology
Appendix B Detailed Calculation Table For Construction Noise Model

ACRONYMS

dB	Decibel
dBA	A-weighted Decibel
EDT	Eastern Daylight Time
FERC	Federal Energy Regulatory Commission
Hz	Hertz
IL	Insertion loss
ISO	International Organization for Standardization
lb/cf	Pounds per cubic foot
lb/sf	Pounds per square foot
L_{dn}	24-hour average day-night sound level
L_{eq}	Equivalent continuous sound level
L_w	Sound power level
L_p	Sound pressure level
SLM	Sound level meter
TL	Transmission loss

SUMMARY

SLR International Corporation (SLR) has prepared a pre-construction noise study at the request of Mountain Valley Pipeline, LLC (MVP) for the proposed Bradshaw Compressor Station (Station) near Smithfield in Wetzel County, West Virginia. The project is a greenfield compressor station. This report presents the results from SLR's sound level survey of the existing ambient conditions, the noise model development, the recommendations for equipment sound power levels, and the recommended noise control treatments for the planned station equipment. The three main goals of this report are as follows:

- Document the existing ambient acoustic environment around the proposed site, and to locate the nearest noise-sensitive areas (NSAs) surrounding the proposed Station.
- Calculate the sound level contribution of the Station at the NSAs surrounding the proposed Station after construction.
- Determine noise control treatments and noise specifications for the Station equipment to ensure that the facility meets the Federal Energy Regulatory Commission (FERC) sound level limit of 55 dBA L_{dn}.

A pre-construction sound survey of the Station was conducted by SLR on May 20 and 21, 2015. Sound levels were measured continuously for more than 20 hours at three locations surrounding the proposed Station site. The measured existing sound levels at the closest NSAs ranged from 42.6 to 45.8 dBA L_{dn}.

A noise model was developed for the station using manufacturer noise data along with sound level data from other similar compressor stations. The noise model was used to predict the Station sound level contribution at the closest NSAs and to develop recommended noise control treatments for the Station equipment.

Table A, below, summarizes the predicted sound levels and noise impact analyses for the proposed Station at the closest NSAs. Computer noise modeling predicts that the Station contributions at the NSAs will be in compliance with the FERC limit of 55 dBA L_{dn} after the construction of the proposed compressor station equipment with the noise control treatments described in this report.

Table A: Compressor Station Sound Level Predictions

NSA	Distance from Compressor Building	Direction	Measured Existing Background	Estimated Contribution of Station Equipment	Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	1,335	NW	42.6	40.2	44.6	2.0
2	2,135	WNW	42.6	29.2	42.8	0.2
3	3,105	WSW	42.6	24.3	42.7	0.1
4	3,030	SE	44.1	43.5	46.8	2.7
5	2,380	NE	45.8	44.1	48.0	2.3

1. INTRODUCTION AND PURPOSE

SLR International Corporation (SLR) has constructed a computer noise model and noise control treatment design study at the request of Mountain Valley Pipeline, LLC (MVP) for the proposed Bradshaw Compressor Station (Station) near Smithfield in Wetzel County, West Virginia. The proposed Station will have four new Titan 130E turbine/compressor units, each rated at 22,400 horsepower (hp). Also presented are the results of a pre-construction noise survey conducted by SLR and the requirements for equipment sound power levels and noise control treatments that are necessary for the planned equipment to meet the FERC sound level limit of 55 dBA day-night average (L_{dn}).

2. ENVIRONMENTAL SOUND LEVEL CRITERIA

The environmental sound level contributions from the proposed equipment at this compressor station are subject to the FERC noise regulation governing interstate gas transmission compressor stations. The FERC noise regulation is receptor based, and limits compressor station noise contributions to no more than 55 dBA L_{dn} or, equivalently, no more than a continuous 48.6 dBA at the surrounding noise sensitive areas (NSAs). NSAs are typically residences, schools, churches, or hospitals. There are no other known state, county, or local regulations that would apply to this compressor station site.

3. DESCRIPTION OF SITE AND PROPOSED COMPRESSOR STATION

3.1 DESCRIPTION OF SITE

The Station site is located off of Bear Run Road approximately 2.8 miles northeast of Smithfield, West Virginia. The area surrounding the proposed Station is rural and sparsely populated, consisting primarily of cleared fields and forest.

3.2 DESCRIPTION OF THE STATION EQUIPMENT

The proposed Station will have four new Solar Titan 130E 22,400 hp gas powered turbines driving centrifugal compressors in a new acoustically-insulated compressor building. Associated equipment is as follows:

- Gas aftercoolers
- Turbine lube oil coolers
- Turbine intake and exhaust openings
- Station suction and discharge piping and suction separators

4. SOUND LEVEL SURVEY

Roy Judy of SLR conducted the sound level survey between 12:00 PM May 20, 2015 and 11:30 AM May 21, 2015 Eastern Daylight Time (EDT). Three measurement locations were selected that were determined to be representative of the closest NSAs.

4.1 MEASUREMENT EQUIPMENT

Sound level equipment used during the site survey:

- Larson Davis Model 824 Type 1 Sound Level Meters: s/n A0335, A0424, A0975
- Larson Davis Cal200 s/n 7078

4.2 WEATHER CONDITIONS

Weather conditions were appropriate for an environmental sound level survey as summarized in **Table 4-1**. There was a period of rain during the survey that lasted from about 1:00 AM to 9:00 AM on May 21. Sound level data collected during that time period were excluded from the analysis.

Table 4-1: Weather Conditions During Sound Level Survey

Dates	May 20 – 21, 2015
Temperature Range	49°F – 58ºF
Relative Humidity Range	55% – 59%
Wind Speed	0 – 5 mph
Wind From	WSW
Precipitation	Intermittent rain at night

4.3 MONITORING LOCATIONS

Five NSAs were identified by SLR using aerial imagery. They consisted of the five closest residential areas to the compressor building. These are shown in **Figure 1** along with the monitoring locations selected by SLR. The monitoring locations selected are summarized in **Table 4-2**. The distance and direction from the site to the monitoring locations and ambient noise sources present during data collection are described therein. The distances reference the nearest compressor building perimeter.

Table 4-2: Summary of Monitoring Locations

Monitoring Location	Distance from Compressor Building (feet)	Direction to Monitoring Location	Noise Sources Present
NSA 1 - 3	2,335	WNW	Birds, occasional traffic
NSA 4	3,290	SE	Birds, nearby stream
NSA 5	2,575	NE	Birds, ATV trails nearby

4.4 MEASURED SOUND LEVEL DATA

The sound level measurement results are summarized in **Table 4-3**, below. The measured sound levels for daytime (L_{eq} (d), dBA), nighttime (L_{eq} (n), dBA), and the equivalent day-night sound level (L_{dn}, dBA) are shown.

Data were collected at locations near NSA 2, NSA 4, and NSA 5 over a period of about 23 hours. The ambient sound levels at NSA 2 were assumed to be representative of the levels at NSA 1 and NSA 3, which are both located nearby. The NSA and measurement locations are shown in **Figure 1**.

Sound levels were measured using the slow meter response and A-weighting and were measured in 1/3- and 1/1-octave bands. Sound levels were recorded in 10-second sampling periods averaged over 15-minute intervals.

Table 4-3: Existing Sound Level Measurement Results at Monitoring Locations

Monitoring Location	Measurement Duration[1]	Measured Day Average	Measured Night Average	Measured Day-Night Average
	HH:MM	**L_{eq} dBA**	**L_{eq} dBA**	**L_{dn} dBA**
NSA 1	23:00	43.6	30.2	**42.6**
NSA 2				
NSA 3				
NSA 4	22:15	44.0	34.2	**44.1**
NSA 5	22:45	46.4	34.6	**45.8**

[1]Total measurement duration is shown. Data collected between 1:00 am and 9:00 am were excluded due to rain noise.

5. PROPOSED EQUIPMENT NOISE IMPACT EVALUATION

5.1 SIGNIFICANT SOUND SOURCES

The following sound sources are considered significant:

- Noise from the turbine exhaust, including the exhaust outlet and noise radiated from the exhaust ductwork, expansion joints, and silencer shell.
- Noise from the turbine intake air system, including the inlet opening and noise radiated from the silencer/ductwork shell and any duct joints.
- Turbine/Compressor casing noise that penetrates the building and building ventilation openings.
- Noise from the lube oil and gas aftercoolers.
- Noise radiated by aboveground station piping.

5.2 NOISE MODEL DEVELOPMENT

A three-dimensional computer noise model was constructed to analyze the noise contributions expected from the proposed compressor station configuration. The model was developed using CadnaA, version 4.5.151, a commercial noise modeling package developed by DataKustik GmbH. The software takes into account spreading losses, ground and atmospheric effects, shielding from barriers and buildings, reflections from surfaces and other sound propagation properties. The software is based on published engineering standards. The ISO 9613 standard was used for air absorption and other noise propagation calculations.

5.2.1 DATA AND ASSUMPTIONS

The proposed compressor building dimensions were used in the computer model. The equipment was arranged as per the latest available plot plan, with the unit suction and discharge piping on the northwest side of the compressor building, and the turbine intakes, exhausts, and lube oil coolers on the southeast side. The turbine exhaust was modeled at a height of 50 feet above grade, as specified in the most recent plot plan.

The turbine and valve building layout and ventilation design have not been finalized, so the ventilation opening size and distribution has been based on the latest compressor building plans provided by MVP. The compressor building includes ten wall intakes, each sized at 48 inches square, and a throat ridge ventilator.

Table 5-1 shows the interior sound levels and the sound power levels used in the model for the Station equipment. Manufacturer data (as available) and measurements of similar units in operation at other compressor stations were used to determine sound pressure and sound power levels for the equipment.

The sound pressure level in the compressor/valve building was taken from measurements at a comparable station with similar turbine-driven compressors. Those levels were then adjusted based on the horsepower of the Titan 130E turbine. The noise generated by the intake ductwork and exhaust system ductwork were included in the exhaust and intake levels warranted by Solar. The sound levels due to suction and discharge piping were based on sound level measurements of a Mars 100 turbine-driven compressor at a similar station with 1.5 dB added to account for the Titan 130E turbine's greater horsepower. The lube oil cooler sound power

levels were taken from sound level specifications provided by Solar to MVP for a 90 dBA lube oil cooler. The turbine intake levels were based on data provided by Solar for Titan 130 turbines. The turbine exhaust levels were based on data provided by Solar for a Titan 130E with a Universal silencer.

Table 5-1: Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Solar Titan 130E Exhaust and Ductwork, Sound Pressure Level with Silencer at 50 ft., L_p[1]	90	87	70	63	62	54	53	44	46	65
Solar Titan 130 Intake and Ductwork, Sound Pressure Level at 50 ft., L_p[1]	82	86	76	68	42	9	8	35	26	65
Solar 90 dBA Lube Oil Cooler, Sound Pressure Level at 50 ft., L_p[1]	64	71	68	61	56	53	49	45	39	60
Total Sound Power Level of Gas Aftercooler, L_w[2]	103	103	102	99	94	92	86	80	74	97
Sound Level in Compressor Building at Inner Wall Surface, L_p[3]	84	84	95	99	97	96	98	106	97	109
Suction Piping, Total L_w[3]	94	96	95	90	91	96	111	100	90	113
Discharge Piping, Total L_w[3]	96	92	92	98	103	96	108	100	89	110
42” Building Wall Panel Fan, L_w	97	97	101	97	96	96	93	88	81	100
Throat Ridge Ventilator, L_w	111	106	103	98	97	94	93	96	92	102

[1] From Solar.
[2] From Moore Fan Datasheet for MVP, adjusted to a total sound power level of 97 dBA.
[3] Based on measurements of similar installed equipment, adjusted for horsepower increase.

Foliage in the area of the Station ranges from grass and crops to areas of dense woods. To be conservative, no foliage was included in the noise model. The model presents a worst-case prediction without any influence of trees or vegetation.

The terrain was modeled based on the latest available USGS topographical data at a resolution of 10 by 10 meters. A temperature of 20 degrees Celcius and 70 percent relative humidity were used for the atmospheric absorption calculations. The ground absorption coefficient for the station site was set as 0.1 and at 0.5 for the mixed ground for all other areas.

5.2.2 NOISE MODEL RESULTS – TYPICAL OPERATION SCENARIO

Table 5-2 shows a summary of the predicted sound level contribution of the station equipment at each NSA, along with a prediction of the overall NSA sound levels including the Station and ambient environmental sources. This table indicates that with the proposed noise control treatments discussed below, the compressor station noise contributions at all of the nearest NSAs will be below the FERC criterion of 55 dBA L_{dn}.

Table 5-2: Compressor Station Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background	Estimated Contribution of Station Equipment		Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{eq} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	1,335	NW	42.6	33.8	**40.2**	44.6	2.0
2	2,135	WNW	42.6	22.8	**29.2**	42.8	0.2
3	3,105	WSW	42.6	17.9	**24.3**	42.7	0.1
4	3,030	SE	44.1	37.1	**43.5**	46.8	2.7
5	2,380	NE	45.8	37.7	**44.1**	48.0	2.3

5.2.3 NOISE MODEL RESULTS – UNIT BLOWDOWN SCENARIO

Under certain circumstances, the pressure in the compressor casing and unit piping must be released in a controlled manner. These events are commonly called “blowdowns” and occur when the unit is shut down for an extended period. During the blowdown, the high pressure gas in the system is released in a controlled fashion through a blowdown silencer. Blowdown events may cause a temporary increase in sound level that usually lasts for about five minutes.

A compressor blowdown scenario was modeled using a blowdown silencer specified to limit the blowdown sound levels to a maximum of **75 dBA at 50 feet**. Two silencers will be employed at the Station, each with the specified sound level contribution. **Table 5-3** shows the predicted short-term sound pressure levels at the NSAs during a blowdown event. The unit blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term sound level impact of the Station. The predicted blowdown sound levels are quite low, with the highest predicted sound level of 42.7 dBA L_{eq} at NSA 5.

Table 5-3: Compressor Unit Blowdown Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
	(feet)		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	dB
1	1,335	NW	30.2	31.9	34.1	3.9
2	2,135	WNW	30.2	24.8	31.3	1.1
3	3,105	WSW	30.2	20.5	30.6	0.4
4	3,030	SE	34.2	31.7	36.1	1.9
5	2,380	NE	34.6	42.7	43.3	8.7

5.2.4 NOISE MODEL RESULTS – EMERGENCY SHUTDOWN SCENARIO

The station has an emergency shutdown (ESD) system that automatically halts operation of the station in the event of an irregularity. This results in a full station blowdown during which the gas from all station piping is released in a controlled manner. These events are extremely rare and take place only in the event of an emergency or when the system is tested once every few years. The station ESD system will include a series of silencers that are designed to limit the maximum sound level due to each silencer to **85 dBA at 50 feet**. Three silencers are planned for the Station, each individually meeting the sound level target.

Table 5-4 shows the predicted short-term sound levels at the NSAs due to an ESD blowdown. The station ESD blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term nighttime sound level impact of the Station. The predicted sound levels are all below 55 dBA, with the highest predicted sound level of 54.7 dBA at NSA 5. This is a reasonable sound level for an event that will only occur in emergency situations or during testing periods that are scheduled ahead of time and with limited frequency and duration.

Table 5-4: Station ESD Blowdown Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
	(feet)		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	dB
1	1,335	NW	30.2	44.9	45.0	14.8
2	2,135	WNW	30.2	37.1	37.9	7.7
3	3,105	WSW	30.2	32.9	34.8	4.6
4	3,030	SE	34.2	43.7	44.2	10.0
5	2,380	NE	34.6	54.7	54.7	20.1

5.2.5 NOISE MODEL RESULTS – CONSTRUCTION

Only standard construction equipment will be used in the construction of the station, with no dynamic compaction or pile driving expected. Most construction will take place during daytime working hours of 7:00 a.m. until 7:00 p.m. Emergencies or other unusual circumstances may necessitate nighttime work, but the bulk of activity will take place during daylight hours.

The highest sound levels during construction are expected during the early earthmoving phase. Equipment that may be operating during this phase would include bulldozers, front end loaders, dump trucks, generators, etc. Based on the equipment usage predictions from MVP, a sound level calculation was performed using the Federal Highway Administration's Roadway Construction Noise Model (RCNM) version 1.0. Two bulldozers, two dump trucks, one generator, one front end loader, two excavators, one light plant, and a drill rig were included in the calculation. NSA 5 has the least shielding from the Station site, and the predicted sound levels at this NSA are the highest, even though it is not the closest NSA. Based on this

collection of equipment, the predicted maximum short-term sound level during construction is 50.1 dBA L_{eq} at NSA 5. The RCNM calculation is included in Appendix B.

6. NOISE CONTROL TREATMENTS

A summary of the modeled performance of one possible set of noise control treatments is shown in **Table 6-1**, below. The following subsections describe the treatments.

The noise mitigation measures shown are based on the most current station design, and represent one potential set of possible mitigation measures. There are many different combinations of noise control mitigation measures that will provide similar noise control. As the station design, including noise mitigation treatments, is finalized, the mitigation design will be modified to account for these design changes while maintaining compliance with the FERC sound level requirements.

Table 6-1: Recommended Noise Mitigation Treatments

Recommended Insertion Loss (IL) or Transmission Loss (TL)										
Source	**Treatment Description**	**Recommended Treatment Performance**								
		31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Compressor/Valve Building	STC-39 Wall and Roof System, TL	10	16	17	24	44	49	55	55	58
Equipment Door	STC-21 Insulated Roll-up Door, TL	2	7	12	17	18	19	22	30	35
Building Ventilation	Three foot silencers and lined hoods, IL **66 dBA at 12 feet**	1	5	10	18	22	26	30	35	25
Comp. Suction and Discharge Piping	Lagging (ISO Type B2), IL	0	0	0	0	6	15	24	33	42

6.1 COMPRESSOR BUILDING WALLS AND ROOF

The compressor building should have an STC-39 wall and roof system with the transmission loss performance shown in **Table 6-1**. The compressor building should have no windows, skylights, or translucent panels.

The interior surface of the compressor building walls should be acoustically absorptive, having a noise reduction coefficient of at least 0.8. The inside of the compressor building can be lined with perforated metal of at least 23% open area for insulation protection, if so desired. The building should be well sealed with no cracks or gaps. All piping penetrations through the building walls should be well insulated, flashed, and caulked.

6.2 COMPRESSOR BUILDING DOORS

The compressor building will have three 14 foot by 14 foot steel roll-up equipment doors. Standard insulated overhead doors will be sufficient for the equipment doors. The performance shown in **Table 6-1** is the recommended transmission loss performance of the STC-21 roll-up door.

The personnel doors should be STC-32 or better industrial metal doors with good perimeter seals. Small glass windows in the man doors are acceptable as long as the door STC rating is achieved.

6.3 COMPRESSOR BUILDING VENTILATION

All building ventilation openings should include standard acoustical louvers or silencers such that the total sound pressure level contribution of each opening does not exceed **66 dBA at 12 feet** from the opening. The sound pressure level calculated for the interior of the building due to the turbine and compressor equipment is shown in **Table 5-1**. The sound level target for each ventilation opening includes the sound level contribution of both the mechanical equipment inside the building along with the sound levels due to the ventilation fans. The ventilation system supplier should submit the sound power level of the proposed building ventilation fans during the bidding process for review.

The approximate ventilation silencer performance is shown in **Table 6-1**. The final performance requirements of these silencers will depend on the size, number, and type of ventilation fans used in the design. The sound pressure level target should be the primary design criterion, as it can be field-tested after installation.

The throat ridge ventilator should have acoustic insulation applied to the damper and an acoustic baffle suspended beneath it along the center of the building.

6.4 TURBINE EXHAUSTS

6.4.1 SILENCER PERFORMANCE

The turbine will include an exhaust silencer system that results in the sound pressure level spectrum shown in **Table 5-1** at a distance of 50 feet. Because of the complexities involved with the field verification of silencer insertion loss, the vendor should bid to meet a sound pressure level target of **65 dBA at 50 feet** from the exhaust opening, measured horizontally from the edge of the stack top with turbine in any steady-state operational condition, including partial load and full load. Solar Turbines has provided a warranty to meet this sound level requirement.

6.4.2 EXHAUST DUCT AND SHELL NOISE

In large turbine-powered installations it is common for a significant amount of sound energy to radiate from the exhaust system ductwork, expansion joints, and exhaust silencer shell. This sound energy is often termed “shell-radiated” noise. Shell-radiated noise is not necessarily calculated by exhaust system manufacturers but can be a dominant noise source for NSAs close to the Station. Solar Turbines included shell-radiated noise in the acoustical warranty provided for the turbine exhaust. The warranted level of 65 dBA at 50 feet quoted above for the turbine exhaust silencer includes shell-radiated noise.

6.5 TURBINE INTAKE

6.5.1 SILENCER PERFORMANCE

The modeled turbine inlet silencing is shown in **Table 6-1**. This is the performance of the entire intake system, including any filter insertion loss. This data was provided by Solar as the silencer design criterion. Solar has warranted a sound pressure level no more than **65 dBA at 50 feet** from the turbine air intake face.

6.5.2 INTAKE BREAKOUT

Sound radiating from the intake ductwork on the turbine side of the inlet silencer can be a significant noise source. If possible, the inlet silencer should be located inside of the compressor building. If the inlet silencer is not located inside a compressor building, then the inlet ductwork between the silencer and the building wall should be acoustically lagged with the ISO Type B2 lagging listed in **Table 6-1**. Solar has warranted a sound pressure level no more than **65 dBA at 50 feet** from the turbine air intake including any breakout noise.

6.6 LUBE OIL / AUXILIARY COOLERS

The sound power level of the lube oil cooler should not exceed the sound power levels given in **Table 5-1**. This is the total sound power level for the entire cooler (i.e. not just a single fan). The sound power level in **Table 5-1** is equivalent to the Solar 90 dBA lube oil cooler.

6.7 GAS COOLER FANS

Table 5-1 shows the total radiated sound power level for the gas aftercooler fans at the Station. This is the total sound power, and is the sum of the sound power of each fan, along with any radiated sound due to the motors and drive assemblies. This was modeled using the sound power level spectrum supplied by the equipment manufacturer adjusted to a total sound power level of 97 dBA. The predicted sound pressure level is approximately **57 dBA at 100 feet** from the cooler.

6.8 STATION PIPING

Noise from centrifugal compressors will cause significant noise radiation from connected piping. To the extent practical, all suction and discharge piping should be run underground. All outdoor aboveground piping between the compressor and the separators on the suction side, and the compressor and the gas cooler on the discharge side, will need to be acoustically lagged.

6.8.1 ACOUSTICAL PIPE LAGGING MATERIALS

All aboveground unit piping from the compressor side of the separators / gas aftercooler to the point at which the piping enters the building should be treated with acoustical lagging or blankets with the performance shown in **Table 6-1** for Type B2 lagging. This is generally equivalent to (listed from pipe surface outwards):

- 3 inches of 6 to 8 lb/cf mineral wool or fiberglass pipe insulation,

- a layer of 1 lb/sf mass-loaded vinyl,
- and a layer of 0.016″ aluminum jacketing or silicon-coated fiberglass cloth.

Other lagging systems are available that will offer similar acoustical performance, and the lagging system performance shown in **Table 6-1** should be used as the performance goal rather than the listed material requirements.

6.8.2 PIPING ISOLATION

To limit noise radiation from structural supports, the compressor piping should be isolated from pipe supports and other structural contacts using at least 1/4 inch neoprene bearing pads. The stiffness of the neoprene should be chosen so that the static deflection of the pads under the piping loads is about 1/16 inch. Secondary steel elements such as cable trays, pipe racks, walkways, and conduit supports should not be connected to the pipe supports and/or piping.

6.9 COMPRESSOR BLOWDOWN

The compressor blowdown silencer has been designed to meet a sound limit of no more than **75 dBA at 50 feet** from the base of the silencer. Any silencer that can meet this performance or better would be expected to produce sound pressure levels no greater than those shown in **Table 5-3** at the NSAs.

7. SUMMARY

MVP is proposing to construct the Bradshaw Compressor Station, a new greenfield compressor station, near Smithfield in Wetzel County, West Virginia. Measurements at the closest NSAs to the proposed station site show that the current ambient sound levels in the area range from 42.6 to 45.8 dBA L_{dn}. A noise model has been developed of the proposed station equipment. The model predicts that the Station sound level contribution at the NSAs will range from 24.3 to 44.1 dBA $L_{dn.}$ The Station is expected to be in compliance with the FERC sound level limit of 55 dBA L_{dn} after installation of the proposed compressor station equipment with the noise control treatments outlined in this report.

LIMITATIONS

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FIGURES



Mountain Valley Pipeline Project

N

NAD

0 900 1800 3600

Mountain Valley PIPELINE

Figure 1
NSA and Sound Level
Measurement Locations
Bradshaw Compressor Station

September, 2015

Data Sources: Google Earth

LEGEND

- HOUSE OR MOBILE HOME (RESIDENCE)
- NONRESIDENTIAL BUILDING
- NSA NOISE SENSITIVE AREA
- MEASUREMENT LOCATION

Mountain Valley Pipeline Project

Mountain Valley PIPELINE

Figure 2
Predicted Station Sound Levels
dBA Ldn
Bradshaw Compressor Station

September, 2015

NSA 1
33.8 dBA Leq
40.2 dBA Ldn

NSA 2
22.8 dBA Leq
29.2 dBA Ldn

NSA 3
17.9 dBA Leq
24.3 dBA Ldn

NSA 4
37.1 dBA Leq
43.5 dBA Ldn

NSA 5
37.7 dBA Leq
44.1 dBA Ldn

Site Pad

Scale, feet
0 250 500 1000

Legend

Sound Pressure Level, dBA Ldn

- >= 25.0
- >= 30.0
- >= 35.0
- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0

Noise Sensitive Area

Data Sources: Google Earth, CadnaA

N

SCALE: AS SHOWN

APPENDIX A

GLOSSARY OF COMMON ACOUSTICAL TERMINOLOGY

Pre-Construction Noise Study

Mountain Valley Pipeline, LLC
675 Liberty Ave., Suite 1700
Pittsburgh, PA 15222

October 14, 2015

A-weighting: a weighting scale in which sound pressure levels in individual frequency bands are adjusted to match the response of the human ear. The reference adjustment is 0 dB at 1000 Hz. The human ear is much less responsive at low frequencies. An A-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBA.

C-weighting: a weighting scale that is relatively flat from 31.5 Hz to 8000 Hz with a roll-off higher and lower than those frequencies. The adjustment is 0 dB from 200 Hz to 1250 Hz. A C-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBC.

Insertion Loss (IL): the decrease (in decibels, dB) in sound power level measured at the location of the receiver when a sound attenuator (e.g., muffler), barrier, or other sound reduction element is inserted in the transmission path between the source and the receiver.

L_d: the daytime average sound level. The L_{eq} averaged over daytime hours. Daytime hours may be defined differently by various ordinances and regulations. The hours between 7:00 a.m. and 10:00 p.m. is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{dn} (also DNL): the day-night average sound level, a metric used by many regulatory bodies (including FERC and HUD) as an overall representation of the sound at a measurement location. The L_{dn} is calculated by averaging the sound measured over a 24-hour period, with 10 decibels added to sound levels measured during nighttime hours.

L_{eq}: the equivalent-continuous sound level is a time-average sound level for a specified time period. It is the most commonly used form of sound level averaging. Specifically, the L_{eq} is the level of a steady sound that has the same sound energy as a time-varying sound during a stated time period and at a stated location.

L_n: the nightime average sound level. The L_{eq} averaged over nighttime hours. Nighttime hours may be defined differently by various ordinances and regulations. The hours between 10:00 p.m. and 7:00 a.m. is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{90}: a statistical parameter (percentile) that describes the sound level that is exceeded 90% of the time during a stated time period. For example, for a stated hourly L_{90} of 45 dBA, the sound level at the measurement location has a 90% chance of being greater than 45 dBA and a 10% chance of being less than or equal to 45 dBA. The L_{90} is often used as the “background” or “ambient” sound level for a given measurement period. Other percentile values are defined similarly, (e.g., L_{50}, L_{10}, etc.).

Sound Power Level (PWL or L_w): a logarithmic parameter that describes the power characteristics of a noise source, relative to a reference power value, expressed in decibels, dB or dBA. The sound power level should not be confused with the sound pressure level. The sound power level is a characteristic of a noise source analogous to the wattage rating of a light bulb, and it is independent of the surroundings. It is calculated from measurements of the sound pressure level. *A 75 watt light bulb will look much brighter in a white, reflective room than in a black, absorptive one. A noise source rated with a sound power level of 95 dBA will produce a much higher sound pressure level (will be much louder) in a small hard box than outside in a soft grassy meadow.*

Sound Pressure Level (SPL or L_p): a logarithmic parameter that describes the quantity of sound relative to a reference pressure value, expressed in decibels, dB or dBA. The SPL is the quantity that is measured with a sound level meter, and it is dependent upon the surroundings of a noise source.

Transmission Loss (TL): The difference (in decibels) between sound power incident upon a sound reduction element (wall or muffler) to that transmitted. The less sound energy is transmitted, the higher the TL value.

APPENDIX B

DETAILED CALCULATION TABLE FOR CONSTRUCTION NOISE MODEL

Pre-Construction Noise Study

Mountain Valley Pipeline, LLC
675 Liberty Ave., Suite 1700
Pittsburgh, PA 15222

October 14, 2015

Appendix B: Construction Noise Calculation Output

Roadway Construction Noise Model (RCNM),Version 1.0

Report date:	9/16/2015
Case Description:	Bradshaw - Earthmoving Phase

Description	**Land Use**
NSA 5	Residential

Description		**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Dozer		No	40		81.7	2380	2
Dozer		No	40		81.7	2380	2
Dump Truck		No	40		76.5	2380	2
Dump Truck		No	40		76.5	2380	2
Front End Loader		No	40		79.1	2380	2
Generator		No	50		80.6	2380	2
Excavator		No	40		80.7	2380	2
Excavator		No	40		80.7	2380	2
Generator (<25KVA, VMS signs)		No	50		72.8	2380	2
Drill Rig Truck		No	20		79.1	2380	2

Equipment		**Calculated (dBA)**	
		***Lmax**	**Leq**
Dozer		46.1	42.1
Dozer		46.1	42.1
Dump Truck		40.9	36.9
Dump Truck		40.9	36.9
Front End Loader		43.6	39.6
Generator		45.1	42.1
Excavator		45.2	41.2
Excavator		45.2	41.2
Generator (<25KVA, VMS signs)		37.3	34.2
Drill Rig Truck		43.6	36.6
	Total	**46.1**	**50.1**

*Calculated Lmax is the loudest single equipment contribution.

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-H
Harris Compressor Station Pre-Construction Noise Study

global environmental solutions

Mountain Valley Pipeline, LLC

Harris Compressor Station

Pre-Construction Noise Study

SLR Ref: 119.01204.00010, 0002, Revision 1

October 14, 2015

Mountain Valley PIPELINE LLC

Pre-Construction Noise Study

Prepared for:

Mountain Valley Pipeline, LLC
675 Liberty Ave., Suite 1700
Pittsburgh, PA 15222

This document has been prepared by SLR International Corp. The material and data in this report were prepared under the supervision and direction of the undersigned.

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Project Scientist

10/14/2015

CONTENTS

Acronyms ..... **iii**

Summary **1**

1. Introduction and Purpose **2**

2. Environmental Sound Level Criteria **2**

3. Description of Site and Proposed Station **2**

3.1 Description of Site 2
3.2 Description of the Station Equipment 2

4. Sound Level Survey **3**

4.1 Measurement Equipment 3
4.2 Weather Conditions 3
4.3 Monitoring Locations 3
4.4 Measured Sound Level Data 4

5. Proposed Equipment Noise Impact Evaluation **4**

5.1 Significant Sound Sources 4
5.2 Noise Model Development 5
5.2.1 Data and Assumptions 5
5.2.2 Noise Model Results – Typical Operation Scenario 6
5.2.3 Noise Model Results – Unit Blowdown Scenario 7
5.2.4 Noise Model Results – Emergency Shutdown Scenario 7
5.2.5 Noise Model Results – Construction 8

6. Noise Control Treatments **8**

6.1 Compressor Building Walls and Roof 9
6.2 Compressor Building Doors 9
6.3 Compressor Ventilation 9
6.4 Turbine Exhausts 10
6.4.1 Silencer Performance 10
6.4.2 Exhaust Duct and Shell Noise 10
6.5 Turbine Intake 10
6.5.1 Silencer Performance 10
6.5.2 Intake Breakout 10
6.6 Lube Oil / Auxiliary Coolers 11
6.7 Gas Cooler Fans 11
6.8 Station Piping 11
6.8.1 Acoustical Pipe Lagging Materials 11
6.8.2 Piping Isolation 11
6.8.3 Compressor Blowdown 12

7. Summary **12**

CONTENTS (CONTINUED)

FIGURES

Figure 1: NSA and Sound Level Measurement Locations
Figure 2: Predicted Station Sound Levels dBA L_{dn}

TABLES

Table 4-1: Weather Conditions During Sound Level Survey
Table 4-2: Summary of Monitoring Location
Table 4-3: Existing Sound Level Measurement Results at Monitoring Locations
Table 5-1: Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment
Table 5-2: Compressor Station Sound Level Predictions
Table 5-3: Compressor Unit Blowdown Sound Level Predictions
Table 5-4: Station ESD Blowdown Sound Level Predictions
Table 6-1: Recommended Noise Control Treatments

APPENDICES

Appendix A Glossary of Common Acoustical Terminology
Appendix B Detailed Calculation Table For Construction Noise Model

ACRONYMS

dB	Decibel
dBA	A-weighted Decibel
EDT	Eastern Daylight Time
FERC	Federal Energy Regulatory Commission
Hz	Hertz
IL	Insertion loss
ISO	International Organization for Standardization
lb/cf	Pounds per cubic foot
lb/sf	Pounds per square foot
L_{dn}	24-hour average day-night sound level
L_{eq}	Equivalent continuous sound level
L_w	Sound power level
L_p	Sound pressure level
SLM	Sound level meter
TL	Transmission loss

SUMMARY

SLR International Corporation (SLR) has prepared a pre-construction noise study at the request of Mountain Valley Pipeline, LLC (MVP) for the proposed Harris Compressor Station (Station) near Flatwoods in Braxton County, West Virginia. The project is a greenfield compressor station. This report presents the results from SLR's sound level survey of the existing ambient conditions, the noise model development, the recommendations for equipment sound power levels, and the recommended noise control treatments for the planned Station equipment. The three main goals of this report are as follows:

- Document the existing ambient acoustic environment around the proposed site, and to locate the nearest noise-sensitive areas (NSAs) surrounding the proposed Station.
- Calculate the sound level contribution of the Station at the NSAs surrounding the proposed Station after construction.
- Determine noise control treatments and noise specifications for the Station equipment to ensure that the facility meets the Federal Energy Regulatory Commission (FERC) sound level limit of 55 dBA L_{dn}.

A pre-construction sound survey of the Station was conducted by SLR on May 18 through 23, 2015. Sound levels were measured continuously for more than 27 hours at three locations surrounding the proposed Station site. The measured existing sound levels at the closest NSAs ranged from 45.1 to 55.3 dBA L_{dn}.

A noise model was developed for the station using manufacturer noise data along with sound level data from other similar compressor stations. The noise model was used to predict the Station sound level contribution at the closest NSAs and to develop recommended noise control treatments for the Station equipment.

Table A, below, summarizes the predicted sound levels and noise impact analyses for the proposed Station at the closest NSAs. Computer noise modeling predicts that the Station contributions at the NSAs will be in compliance with the FERC limit of 55 dBA L_{dn} after the construction of the proposed compressor station equipment with the noise control treatments described in this report.

Table A: Compressor Station Sound Level Predictions

NSA	Distance from Compressor Building	Direction	Measured Existing Background	Estimated Contribution of Station Equipment	Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	1,445	N	47.9	39.9	48.5	0.6
2	1,825	SW	48.5	46.9	50.8	2.3
3	1,965	SSE	48.5	48.5	51.5	3.0
4	3,340	WSW	55.3	43.0	55.5	0.2

1. INTRODUCTION AND PURPOSE

SLR International Corporation (SLR) has prepared a pre-construction noise study at the request of Mountain Valley Pipeline, LLC (MVP) for the proposed Harris Compressor Station (Station) near Flatwoods in Braxton County, West Virginia. The proposed Station will have two new Solar Titan 130 turbine/compressor units, each rated at 20,500 horsepower (hp). This report presents the results of a pre-construction noise survey conducted by SLR and the requirements for equipment sound power levels and noise control treatments that are necessary in order for the planned equipment to meet the FERC sound level limit of 55 dBA day-night average (L_{dn}).

2. ENVIRONMENTAL SOUND LEVEL CRITERIA

The environmental sound level contributions from the proposed equipment at this compressor station are subject to the FERC noise regulation governing interstate gas transmission compressor stations. The FERC noise regulation is receptor based, and limits compressor station noise contributions to no more than 55 dBA L_{dn} or, equivalently, no more than a continuous 48.6 dBA at the surrounding noise sensitive areas (NSAs). NSAs are typically residences, schools, churches, or hospitals. There are no other known state, county, or local regulations that would apply to this compressor station site.

3. DESCRIPTION OF SITE AND PROPOSED STATION

3.1 DESCRIPTION OF SITE

The Station site is located off of Milroy Road approximately eight miles east of Flatwoods, West Virginia. The area surrounding the proposed Station is rural and sparsely populated, consisting primarily of deciduous forests.

3.2 DESCRIPTION OF THE STATION EQUIPMENT

The proposed Station will have two new Solar Titan 130 20,500 hp turbines driving centrifugal compressors in a new acoustically-insulated compressor building. Associated equipment is as follows:

- Gas aftercoolers
- Turbine lube oil coolers
- Turbine intake and exhaust openings
- Station suction and discharge piping and suction separators

4. SOUND LEVEL SURVEY

Roy Judy of SLR conducted the sound level survey between 1:15 PM May 18, 2015 and 3:30 PM May 23, 2015 Eastern Daylight Time (EDT). Day and night data were collected at three locations near the NSAs. The NSA and measurement locations are shown in **Figure 1**.

4.1 MEASUREMENT EQUIPMENT

Sound level equipment used during the site survey:

- Larson Davis Model 824 Type 1 Sound Level Meters: s/n A0424, A0975
- Larson Davis Cal200 s/n 7078

4.2 WEATHER CONDITIONS

Weather conditions were appropriate for an environmental sound level survey as summarized in **Table 4-1**.

Table 4-1: Weather Conditions During Sound Level Survey

Dates	May 18 – 23, 2015
Temperature Range	54°F – 78ºF
Relative Humidity Range	46% – 60%
Wind Speed	5 mph
Wind From	West and South
Precipitation	Intermittent rain at night

4.3 MONITORING LOCATIONS

Four NSAs were identified by SLR using aerial imagery. They consisted of the four closest residential areas to the compressor building. These are shown in **Figure 1** along with the monitoring locations selected by SLR. The monitoring locations selected are summarized in **Table 4-2.** The distance and direction from the site to the monitoring locations and ambient noise sources present during data collection are described therein. The distances reference the nearest compressor building perimeter.

Table 4-2: Summary of Monitoring Location

Monitoring Location	Distance from Compressor Building (feet)	Direction to Monitoring Location	Noise Sources Present
NSA 1	1,755	N	Birds
NSA 2 & 3	2,050	SSE	Distant aircraft
NSA 4	3,490	WSW	Light traffic

4.4 MEASURED SOUND LEVEL DATA

The sound level measurement results are summarized in **Table 4-3**, below. The measured sound levels for daytime (L_{eq} (d), dBA), nighttime (L_{eq} (n), dBA), and the equivalent day-night sound level (L_{dn}, dBA) are shown.

Data were collected at locations near NSA 1, NSA 3, and NSA 4 over a period of more than 27 hours. The ambient sound levels at NSA 3 were assumed to be representative of the levels at NSA 2, which is located nearby. The NSA and measurement locations are shown in **Figure 1**.

Sound levels were measured using the slow meter response and A-weighting and were measured in 1/3- and 1/1-octave bands. Sound levels were recorded in 10-second sampling periods averaged over 15-minute intervals.

Table 4-3: Existing Sound Level Measurement Results at Monitoring Locations

Monitoring Location	Measurement Duration	Measured Day Average	Measured Night Average	Measured 24-Hour Day-Night Average
	HH:MM	L_{eq} dBA	L_{eq} dBA	L_{dn} dBA
NSA 1	30:30	47.9	38.0	**47.9**
NSA 2	27:45	48.7	38.2	**48.5**
NSA 3				
NSA 4	30:00	53.1	47.4	**55.3**

5. PROPOSED EQUIPMENT NOISE IMPACT EVALUATION

5.1 SIGNIFICANT SOUND SOURCES

The following sound sources are considered significant:

- Noise from the turbine exhaust, including the exhaust outlet and noise radiated from the exhaust ductwork, expansion joints, and silencer shell.
- Noise from the turbine intake air system, including the inlet opening and noise radiated from the silencer/ductwork shell and any duct joints.
- Turbine/Compressor casing noise that penetrates the building and building ventilation openings.
- Noise from the lube oil / auxiliary cooler and gas aftercooler,
- Noise radiated by aboveground station piping.

5.2 NOISE MODEL DEVELOPMENT

A three-dimensional computer noise model was constructed to analyze the noise contributions expected from the proposed compressor station configuration. The model was developed using CadnaA, version 4.5.151, a commercial noise modeling package developed by DataKustik GmbH. The software takes into account spreading losses, ground and atmospheric effects, shielding from barriers and buildings, reflections from surfaces and other sound propagation properties. The software is based on published engineering standards. The ISO 9613 standard was used for air absorption and other noise propagation calculations.

5.2.1 DATA AND ASSUMPTIONS

The proposed compressor building dimensions were used in the computer model. The equipment was arranged as per the latest available plot plan, with the unit suction and discharge piping on the northeast side, the turbine intakes, exhausts, and lube oil coolers on the southwest side of the compressor building. The turbine exhaust was modeled at a height of 50 feet above grade, as specified in the most recent plot plan.

The turbine and valve building layout and ventilation design have not been finalized, so the ventilation opening size and distribution has been based on the latest compressor building plans provided by MVP. The compressor building includes six wall intakes, each sized at about 48 inches square, and a throat ridge ventilator.

Table 5-1 shows the interior sound levels and the sound power levels used in the model for the Station equipment. Manufacturer data (as available) and measurements of similar units in operation at other compressor stations were used to determine sound pressure and sound power levels for the equipment.

Table 5-1: Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Solar Titan 130 Exhaust and Ductwork, Sound Pressure Level with Silencer at 50 ft., L_p[1]	84	86	72	63	63	54	46	32	21	65
Solar Titan 130 Intake and Ductwork, Sound Pressure Level at 50 ft., L_p[1]	82	86	76	68	42	9	8	35	26	65
Solar 90 dBA Lube Oil Cooler, Sound Pressure Level at 50 ft., L_p[1]	64	71	68	61	56	53	49	45	39	60
Total Sound Power Level of Gas Aftercooler, L_w[2]	103	103	102	99	94	92	86	80	74	97
Sound Level in Compressor Building at Inner Wall Surface, L_p[3]	84	84	95	98	97	96	98	106	97	108
Suction Piping, Total L_w[3]	94	96	95	90	91	96	111	100	90	112
Discharge Piping, Total L_w[3]	95	91	91	97	102	95	107	99	88	110
42” Building Wall Panel Fan, L_w	97	97	101	97	96	96	93	88	81	100
Throat Ridge Ventilator, Total L_w	111	106	103	98	97	94	93	96	92	102

[1] From Solar.
[2] From Moore Fan Datasheet for MVP, adjusted to a total sound power level of 97 dBA.
[3] Based on measurements of similar installed equipment, adjusted for horsepower increase.

The sound pressure level in the compressor/valve building was taken from measurements at a comparable station with similar turbine-driven compressors. Those levels were then adjusted based on the horsepower of the Titan 130 turbine. The noise generated by the intake ductwork and exhaust system ductwork were included in the exhaust and intake levels warranted by Solar. The sound levels due to suction and discharge piping were based on sound level measurements of a Mars 100 turbine-driven compressor at a similar station with 1.1 dB added to account for the Titan 130 turbine's greater horsepower. The lube oil cooler sound power levels were taken from sound level specifications provided by Solar to MVP for a 90 dBA lube oil cooler. The turbine intake and exhaust levels were also based on data provided Solar for this project.

Foliage in the area of the Station ranges from grass and crops to areas of dense woods. To be conservative, no foliage was included in the noise model. The model presents a worst-case prediction without any influence of trees or vegetation.

The terrain was modeled based on the latest available USGS topographical data at a resolution of 10 by 10 meters. A temperature of 20 degrees Celsius and 70 percent relative humidity were used for the atmospheric absorption calculations. The ground absorption coefficient for the station site was set as 0.1 and at 0.5 for the mixed ground for all other areas.

5.2.2 NOISE MODEL RESULTS – TYPICAL OPERATION SCENARIO

Table 5-2 shows a summary of the predicted sound level contribution of the Station equipment at each NSA along with a prediction of the overall NSA sound levels including the Station and ambient environmental sources. This table indicates that with the proposed noise control treatments discussed below, the compressor station noise contributions at all of the nearest NSAs will be below the FERC criterion of 55 dBA L_{dn}. The FERC sound level limits apply only to the sound level contribution of the compressor station equipment, and do not include the influence of the existing ambient sound levels. For instance, at NSA 4, the combined Station equipment and ambient sound levels are greater than 55 dBA L_{dn} due to the 55.3 dBA L_{dn} existing background. However, the 43.0 dBA L_{dn} sound level contribution of the Station equipment at this NSA is well below the FERC sound level limit of 55 dBA L_{dn}.

Table 5-2: Compressor Station Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background	Estimated Contribution of Station Equipment		Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{eq} dBA	L_{dn} dBA	L_{dn} dBA	(dB)
1	1,445	N	47.9	33.5	39.9	48.5	0.6
2	1,825	SW	48.5	40.5	46.9	50.8	2.3
3	1,965	SSE	48.5	42.1	48.5	51.5	3.0
4	3,340	WSW	55.3	36.6	43.0	55.5	0.2

5.2.3 NOISE MODEL RESULTS – UNIT BLOWDOWN SCENARIO

Under certain circumstances, the pressure in the compressor casing and unit piping must be released in a controlled manner. These events are commonly called "blowdowns" and occur when the unit is shut-down for an extended period. During the blowdown, the high pressure gas in the system is released in a controlled fashion through a blowdown silencer. Blowdown events cause a temporary increase in sound level that usually lasts for about five minutes.

A compressor blowdown scenario was modeled using a single blowdown silencer specified to limit the blowdown sound levels to a maximum of **75 dBA at 50 feet**. **Table 5-3** shows the predicted short-term sound pressure levels at the NSAs during a blowdown event. The unit blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term sound level impact of the Station. The predicted blowdown sound levels are quite low, with the highest predicted sound level of 42.1 dBA L_{eq} at NSA 3.

Table 5-3: Compressor Unit Blowdown Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
	(feet)		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	(dB)
1	1,445	N	38.0	33.4	39.3	1.3
2	1,825	SW	38.2	41.6	43.2	5.0
3	1,965	SSE	38.2	42.1	43.6	5.4
4	3,340	WSW	47.4	36.1	47.7	0.3

5.2.4 NOISE MODEL RESULTS – EMERGENCY SHUTDOWN SCENARIO

The station has an emergency shutdown (ESD) system that automatically halts operation of the station in the event of an irregularity. This results in a full station blowdown during which the gas from all station piping is released in a controlled manner. These events are extremely rare and take place only in the event of an emergency or when the system is tested every few years. The station ESD system will include two silencers that are each designed to limit the maximum sound level due to the blowdown to **85 dBA at 50 feet** per silencer.

Table 5-4 shows the predicted short-term sound levels at the NSAs due to an ESD blowdown. The station ESD blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term nighttime sound level impact of the Station. The predicted sound levels are all below 56 dBA, with the highest predicted sound level of 55.3 dBA at NSA 3. This is a reasonable sound level for an event that will only occur in emergency situations or during testing periods that are scheduled ahead of time and with limited frequency and duration.

Table 5-4: Station ESD Blowdown Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
	(feet)		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	(dB)
1	1,445	N	38.0	46.7	47.2	9.2
2	1,825	SW	38.2	54.8	54.9	16.7
3	1,965	SSE	38.2	55.3	55.4	17.2
4	3,340	WSW	47.4	49.3	51.5	4.1

5.2.5 NOISE MODEL RESULTS – CONSTRUCTION

Only standard construction equipment will be used in the construction of the station, with no dynamic compaction or pile driving expected. Most construction will take place during daytime working hours of 7:00 a.m. until 7:00 p.m. Emergencies or other unusual circumstances may necessitate nighttime work, but the bulk of activity will take place during daylight hours.

The highest sound levels during construction are expected during the early earthmoving phase. Equipment that may be operating during this phase would include bulldozers, front end loaders, dump trucks, generators, etc. Based on the equipment usage predictions from MVP, a sound level calculation was performed using the Federal Highway Administration's Roadway Construction Noise Model (RCNM) version 1.0. Two bulldozers, two dump trucks, one generator, one front end loader, two excavators, one light plant, and a drill rig were included in the calculation. Based on this collection of equipment, the predicted maximum short-term sound level during construction is 53.7 dBA L_{eq} at NSA 3. NSA 3 has the least shielding from the Station site, and the predicted sound levels at this NSA are the highest, even though it is not the closest NSA. The RCNM calculation is included in Appendix B.

6. NOISE CONTROL TREATMENTS

A summary of the modeled performance of one possible set of noise control treatments is shown in **Table 6-1**, below. The following subsections describe the treatments.

The noise mitigation measures shown are based on the most current station design, and represent one potential set of possible mitigation measures. There are many different combinations of noise control mitigation measures that will provide similar noise control. As the station design, including noise mitigation treatments, is finalized, the mitigation design will be modified to account for these design changes while maintaining compliance with the FERC sound level requirements.

Table 6-1: Recommended Noise Control Treatments

Recommended Insertion Loss (IL) or Transmission Loss (TL)										
Source	**Treatment Description**	**Recommended Treatment Performance**								
		31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Compressor/Valve Building	STC-39 Wall and Roof System, TL	10	16	17	24	44	49	55	55	58
Equipment Door	STC-21 Insulated Roll-up Door, TL	2	7	12	17	18	19	22	30	35
Building Ventilation	Three foot silencers and lined hoods, IL **66 dBA at 12 feet**	1	5	10	18	22	26	30	35	25
Comp. Suction and Discharge Piping	Lagging (ISO Type B2), IL	0	0	0	0	6	15	24	33	42

6.1 COMPRESSOR BUILDING WALLS AND ROOF

The compressor building should have an STC-39 wall and roof system with the transmission loss performance shown in **Table 6-1**. The compressor building should have no windows, skylights, or translucent panels.

The interior surface of the compressor building walls should be acoustically absorptive, having a noise reduction coefficient of at least 0.8. The inside of the compressor building can be lined with perforated metal of at least 23% open area for insulation protection, if so desired. The building should be well sealed with no cracks or gaps. All piping penetrations through the building walls should be well insulated, flashed, and caulked.

6.2 COMPRESSOR BUILDING DOORS

The compressor building will have a 14 foot by 14 foot steel roll-up equipment door. Standard insulated over-head door will be sufficient for the equipment doors. The performance shown in **Table 6-1** is the recommended transmission loss performance of the STC-21 roll-up door.

The personnel doors should be STC-32 or better industrial metal doors with good perimeter seals. Small glass windows in the man doors are acceptable as long as the door STC rating is achieved.

6.3 COMPRESSOR VENTILATION

All building ventilation openings should include standard acoustical louvers or silencers such that the total sound pressure level contribution of each opening does not exceed **66 dBA at 12 feet** from the opening. The sound pressure level calculated for the interior of the building due to the turbine and compressor equipment is shown in **Table 5-1**. The sound level target for each ventilation opening includes the sound level contribution of both the mechanical equipment inside the building along with the sound levels due to the ventilation fans. The ventilation system supplier should submit the sound power level of the proposed building ventilation fans during the bidding process for review.

The approximate ventilation silencer performance is shown in **Table 6-1**. The final performance requirements of these silencers will depend on the size, number, and type of ventilation fans used in the design. The sound pressure level target should be the primary design criterion, as it can be field-tested after installation.

The throat ridge ventilator should have acoustic insulation applied to the damper and an acoustic baffle suspended beneath it along the center of the building.

6.4 TURBINE EXHAUSTS

6.4.1 SILENCER PERFORMANCE

The turbine will include an exhaust silencer system that results in the sound pressure level spectrum shown in **Table 5-1** at a distance of 50 feet. Because of the complexities involved with the field verification of silencer insertion loss, the vendor should bid to meet a sound pressure level target of **65 dBA at 50 feet** from the exhaust opening, measured horizontally from the edge of the stack top with the turbine in any steady-state operational condition, including partial load and full load. Solar Turbines has provided a warranty to meet this sound level requirement.

6.4.2 EXHAUST DUCT AND SHELL NOISE

In large turbine-powered installations it is common for a significant amount of sound energy to radiate from the exhaust system ductwork, expansion joints, and exhaust silencer shell. This sound energy is often termed “shell-radiated” noise. Shell-radiated noise is not necessarily calculated by exhaust system manufacturers but can be a dominant noise source for NSAs close to the Station. Solar Turbines included shell-radiated noise in the acoustical warranty provided for the turbine exhaust. The warranted level of 65 dBA at 50 feet quoted above for the turbine exhaust silencer includes shell-radiated noise.

6.5 TURBINE INTAKE

6.5.1 SILENCER PERFORMANCE

The modeled turbine inlet silencing is shown in **Table 6-1**. This is the performance of the entire intake system, including any filter insertion loss. This data was provided by Solar as the silencer design criterion. Solar has warranted a sound pressure level no more than **65 dBA at 50 feet** from the turbine air intake face.

6.5.2 INTAKE BREAKOUT

Sound radiating from the intake ductwork on the turbine side of the inlet silencer can be a significant noise source. If possible, the inlet silencer should be located inside of the compressor building. If the inlet silencer is not located inside a compressor building, then the inlet ductwork between the silencer and the building wall should be acoustically lagged with the ISO Type B2 lagging listed in **Table 6-1**. Solar has warranted a sound pressure level no more than **65 dBA at 50 feet** from the turbine air intake including any breakout noise.

6.6 LUBE OIL / AUXILIARY COOLERS

The sound power level of the lube oil cooler should not exceed the sound power levels given in **Table 5-1**. This is the total sound power level for the entire cooler (i.e. not just a single fan). The sound power level in **Table 5-1** is equivalent to the Solar 90 dBA lube oil cooler.

6.7 GAS COOLER FANS

Table 5-1 shows the total radiated sound power level for the gas aftercooler fans at the Station. This is the total sound power, and is the sum of the sound power of each fan, along with any radiated sound due to the motors and drive assemblies. This was modeled using the sound power level spectrum supplied by the equipment manufacturer adjusted to a total sound power level of 97 dBA. The predicted sound pressure level is approximately **57 dBA at 100 feet** from the cooler.

6.8 STATION PIPING

Noise from centrifugal compressors will cause significant noise radiation from connected piping. To the extent practical, all suction and discharge piping should be run underground. All outdoor aboveground piping between the compressor and the separators on the suction side, and the compressor and the gas cooler on the discharge side, will need to be acoustically lagged.

6.8.1 ACOUSTICAL PIPE LAGGING MATERIALS

All aboveground unit piping from the compressor side of the separators / gas aftercooler to the point at which the piping enters the building should be treated with acoustical lagging or blankets with the performance shown in **Table 6-1** for Type B2 lagging. This is generally equivalent to (listed from pipe surface outwards):

- 3 inches of 6 to 8 lb/cf mineral wool or fiberglass pipe insulation,
- a layer of 1 lb/sf mass-loaded vinyl,
- and a layer of 0.016″ aluminum jacketing or silicon-coated fiberglass cloth.

Other lagging systems are available that will offer similar acoustical performance, and the lagging system performance shown in **Table 6-1** should be used as the performance goal rather than the listed material requirements.

6.8.2 PIPING ISOLATION

To limit noise radiation from structural supports, the compressor piping should be isolated from pipe supports and other structural contacts using at least 1/4 inch neoprene bearing pads. The stiffness of the neoprene should be chosen so that the static deflection of the pads under the piping loads is about 1/16 inch. Secondary steel elements such as cable trays, pipe racks, walkways, and conduit supports should not be connected to the pipe supports and/or piping.

6.8.3 COMPRESSOR BLOWDOWN

The compressor blowdown silencer has been designed to meet a sound limit of no more than **75 dBA at 50 feet** from the base of the silencer. Any silencer that can meet this performance or better would be expected to produce sound pressure levels no greater than those shown in **Table 5-3** at the NSAs.

7. SUMMARY

MVP is proposing to construct the Harris Compressor Station, a new greenfield compressor station, near Flatwoods in Braxton County, West Virginia. Measurements at the closest NSAs to the proposed station site show that the current ambient sound levels in the area range from 45.1 to 55.3 dBA L_{dn}. A noise model has been developed of the proposed station equipment. The model predicts that the station sound level contribution at the NSAs will range from 39.9 to 48.5 dBA $L_{dn.}$ The sound level contributions from the Station are expected to be in compliance with the FERC sound level limit of 55 dBA L_{dn} after installation of the proposed compressor station equipment with the noise control treatments outlined in this report.

LIMITATIONS

The services described in this work product were performed in accordance with generally accepted professional consulting principles and practices. No other representations or warranties, expressed or implied, are made. These services were performed consistent with our agreement with our client. This work product is intended solely for the use and information of our client unless otherwise noted. Any reliance on this work product by a third party is at such party's sole risk.

Opinions and recommendations contained in this work product are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, positions, time frames, and project parameters indicated. The data reported and the findings, observations, and conclusions expressed are limited by the scope of work. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this work product.

This work product presents professional opinions and findings of a scientific and technical nature. The work product shall not be construed to offer legal opinion or representations as to the requirements of, nor the compliance with, environmental laws rules, regulations, or policies of federal, state or local governmental agencies.

FIGURES



Mountain Valley Pipeline Project

N

0 900 1800 3600

Mountain Valley PIPELINE

Figure 1
NSA and Sound Level
Measurement Locations
Harris Compressor Station

September, 2015

Data Sources: Google Earth

LEGEND

- HOUSE OR MOBILE HOME (RESIDENCE)
- NONRESIDENTIAL BUILDING
- NSA NOISE SENSITIVE AREA
- MEASUREMENT LOCATION

Mountain Valley Pipeline Project

Mountain Valley PIPELINE

Figure 2
Predicted Station Sound Levels
dBA Ldn
Harris Compressor Station

September, 2015

NSA 1
33.5 dBA Leq
39.9 dBA Ldn

NSA 2
40.5 dBA Leq
46.9 dBA Ldn

NSA 3
42.1 dBA Leq
48.5 dBA Ldn

NSA 4
36.6 dBA Leq
43.0 dBA Ldn

Site Pad

Scale, feet
0 250 500 1000

Legend

Sound Pressure Level, dBA Ldn

- >= 25.0
- >= 30.0
- >= 35.0
- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0

Noise Sensitive Area

Data Sources: Google Earth, CadnaA

N

SCALE: AS SHOWN

APPENDIX A

GLOSSARY OF COMMON ACOUSTICAL TERMINOLOGY

Pre-Construction Noise Study

Mountain Valley **Pipeline, LLC**
675 Liberty Ave., Suite 1700
Pittsburgh, PA 15222

October 14, 2015

A-weighting: a weighting scale in which sound pressure levels in individual frequency bands are adjusted to match the response of the human ear. The reference adjustment is 0 dB at 1000 Hz. The human ear is much less responsive at low frequencies. An A-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBA.

C-weighting: a weighting scale that is relatively flat from 31.5 Hz to 8000 Hz with a roll-off higher and lower than those frequencies. The adjustment is 0 dB from 200 Hz to 1250 Hz. A C-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBC.

Insertion Loss (IL): the decrease (in decibels, dB) in sound power level measured at the location of the receiver when a sound attenuator (e.g., muffler), barrier, or other sound reduction element is inserted in the transmission path between the source and the receiver.

L_d: the daytime average sound level. The L_{eq} averaged over daytime hours. Daytime hours may be defined differently by various ordinances and regulations. The hours between 7:00 a.m. and 10:00 p.m. is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{dn} (also DNL): the day-night average sound level, a metric used by many regulatory bodies (including FERC and HUD) as an overall representation of the sound at a measurement location. The L_{dn} is calculated by averaging the sound measured over a 24-hour period, with 10 decibels added to sound levels measured during nighttime hours.

L_{eq}: the equivalent-continuous sound level is a time-average sound level for a specified time period. It is the most commonly used form of sound level averaging. Specifically, the L_{eq} is the level of a steady sound that has the same sound energy as a time-varying sound during a stated time period and at a stated location.

L_n: the nightime average sound level. The L_{eq} averaged over nighttime hours. Nighttime hours may be defined differently by various ordinances and regulations. The hours between 10:00 p.m. and 7:00 a.m. is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{90}: a statistical parameter (percentile) that describes the sound level that is exceeded 90% of the time during a stated time period. For example, for a stated hourly L_{90} of 45 dBA, the sound level at the measurement location has a 90% chance of being greater than 45 dBA and a 10% chance of being less than or equal to 45 dBA. The L_{90} is often used as the “background” or “ambient” sound level for a given measurement period. Other percentile values are defined similarly, (e.g., L_{50}, L_{10}, etc.).

Sound Power Level (PWL or L_w): a logarithmic parameter that describes the power characteristics of a noise source, relative to a reference power value, expressed in decibels, dB or dBA. The sound power level should not be confused with the sound pressure level. The sound power level is a characteristic of a noise source analogous to the wattage rating of a light bulb, and it is independent of the surroundings. It is calculated from measurements of the sound pressure level. *A 75 watt light bulb will look much brighter in a white, reflective room than in a black, absorptive one. A noise source rated with a sound power level of 95 dBA will produce a much higher sound pressure level (will be much louder) in a small hard box than outside in a soft grassy meadow.*

Sound Pressure Level (SPL or L_p): a logarithmic parameter that describes the quantity of sound relative to a reference pressure value, expressed in decibels, dB or dBA. The SPL is the quantity that is measured with a sound level meter, and it is dependent upon the surroundings of a noise source.

Transmission Loss (TL): The difference (in decibels) between sound power incident upon a sound reduction element (wall or muffler) to that transmitted. The less sound energy is transmitted, the higher the TL value.

APPENDIX B

DETAILED CALCULATION TABLE FOR CONSTRUCTION NOISE MODEL

Pre-Construction Noise Study

Mountain Valley Pipeline, LLC
675 Liberty Ave., Suite 1700
Pittsburgh, PA 15222

October 14, 2015

Appendix B: Construction Noise Calculation Output

Roadway Construction Noise Model (RCNM),Version 1.0

Report date:	9/16/2015
Case Description:	Harris- Earthmoving Phase

Description	**Land Use**
NSA 3	Residential

Description		**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Dozer		No	40		81.7	1965	0
Dozer		No	40		81.7	1965	0
Dump Truck		No	40		76.5	1965	0
Dump Truck		No	40		76.5	1965	0
Front End Loader		No	40		79.1	1965	0
Generator		No	50		80.6	1965	0
Excavator		No	40		80.7	1965	0
Excavator		No	40		80.7	1965	0
Generator (<25KVA, VMS signs)		No	50		72.8	1965	0
Drill Rig Truck		No	20		79.1	1965	0

Equipment		**Calculated (dBA)**	
		***Lmax**	**Leq**
Dozer		49.8	45.8
Dozer		49.8	45.8
Dump Truck		44.6	40.6
Dump Truck		44.6	40.6
Front End Loader		47.2	43.2
Generator		48.7	45.7
Excavator		48.8	44.8
Excavator		48.8	44.8
Generator (<25KVA, VMS signs)		40.9	37.9
Drill Rig Truck		47.3	40.3
	Total	**49.8**	**53.7**

*Calculated Lmax is the loudest single equipment contribution.

Mountain Valley Pipeline Project

Docket No. CP16-__-000

Resource Report 9

Appendix 9-I
Stallworth Compressor Station Pre-Construction Noise Study

global environmental solutions

Mountain Valley Pipeline, LLC

Stallworth Compressor Station

Pre-Construction Noise Study

SLR Ref: 119.01204.00010, 0003, Revision 0

October 14, 2015

Mountain Valley PIPELINE LLC

Pre-Construction Noise Study

Prepared for:

Mountain Valley Pipeline, LLC
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Pittsburgh, PA 15222

This document has been prepared by SLR International Corp. The material and data in this report were prepared under the supervision and direction of the undersigned.

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10/14/2015

CONTENTS

Acronyms ..... **iii**

Summary **1**

1. Introduction and Purpose **2**

2. Environmental Sound Level Criteria **2**

3. Description of Site and Proposed Station **2**

3.1 Description of Site 2
3.2 Description of the Station Equipment 2

4. Sound Level Survey **3**

4.1 Measurement Equipment 3
4.2 Weather Conditions 3
4.3 Monitoring Locations 3
4.4 Measured Sound Level Data 4

5. Proposed Equipment Noise Impact Evaluation **5**

5.1 Significant Sound Sources 5
5.2 Noise Model Development 5
5.2.1 Data and Assumptions 5
5.2.2 Noise Model Results – Typical Operation Scenario 6
5.2.3 Noise Model Results – Unit Blowdown Scenario 7
5.2.4 Noise Model Results – Emergency Shutdown Scenario 8
5.2.5 Noise Model Results – Construction 9

6. Noise Control Treatments **9**

6.1 Compressor Building Walls and Roof 10
6.2 Compressor Building Doors 10
6.3 Compressor Ventilation 10
6.4 Turbine Exhausts 10
6.4.1 Silencer Performance 10
6.4.2 Exhaust Duct and Shell Noise 11
6.5 Turbine Intake 11
6.5.1 Silencer Performance 11
6.5.2 Intake Breakout 11
6.6 Lube Oil / Auxiliary Coolers 11
6.7 Gas Cooler Fans 11
6.8 Station Piping 12
6.8.1 Acoustical Pipe Lagging Materials 12
6.8.2 Piping Isolation 12
6.8.3 Compressor Blowdown 12

7. Summary **13**

CONTENTS (CONTINUED)

FIGURES

Figure 1: NSA and Sound Level Measurement Locations
Figure 2: Predicted Station Sound Levels dBA L_{dn}

TABLES

Table 4-1: Weather Conditions During Sound Level Survey
Table 4-2: Summary of Monitoring Location
Table 4-3: Existing Sound Level Measurement Results at Monitoring Locations
Table 5-1: Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment
Table 5-2: Compressor Station Sound Level Predictions
Table 5-3: Compressor Blowdown Sound Level Predictions
Table 5-4: Station ESD Blowdown Sound Level Predictions
Table 6-1: Recommended Noise Control Treatments

APPENDICES

Appendix A Glossary of Common Acoustical Terminology
Appendix B Detailed Calculation Table For Construction Noise Model

ACRONYMS

dB	Decibel
dBA	A-weighted Decibel
EDT	Eastern Daylight Time
FERC	Federal Energy Regulatory Commission
Hz	Hertz
IL	Insertion loss
ISO	International Organization for Standardization
lb/cf	Pounds per cubic foot
lb/sf	Pounds per square foot
L_{dn}	24-hour average day-night sound level
L_{eq}	Equivalent continuous sound level
L_w	Sound power level
L_p	Sound pressure level
SLM	Sound level meter
TL	Transmission loss

SUMMARY

SLR International Corporation (SLR) has prepared a pre-construction noise study at the request of Mountain Valley Pipeline, LLC (MVP) for the proposed Stallworth Compressor Station (Station) near Meadow Bridge in Fayette County, West Virginia. The project is a greenfield compressor station. This report presents the results from SLR's sound level survey of the existing ambient conditions, the noise model development, the recommendations for equipment sound power levels, and the recommended noise control treatments for the planned Station equipment. The three main goals of this report are as follows:

- Document the existing ambient acoustic environment around the proposed site, and to locate the nearest noise-sensitive areas (NSAs) surrounding the proposed Station.
- Calculate the sound level contribution of the Station at the NSAs surrounding the proposed Station after construction.
- Determine noise control treatments and noise specifications for the Station equipment to ensure that the facility meets the Federal Energy Regulatory Commission (FERC) sound level limit of 55 dBA L_{dn}.

A pre-construction sound survey of the Station was conducted by SLR on April 28 through May 4, 2015. Sound levels were measured continuously for approximately 70 hours at three locations surrounding the proposed Station site. The measured existing sound levels at the closest NSAs ranged from 35.8 to 54.9 dBA L_{dn}.

A noise model was developed for the station using manufacturer noise data along with sound level data from other similar compressor stations. The noise model was used to predict the Station sound level contribution at the closest NSAs and to develop recommended noise control treatments for the Station equipment.

Table A, below, summarizes the predicted sound levels and noise impact analyses for the proposed Station at the closest NSAs. Computer noise modeling predicts that the Station contributions at the NSAs will be in compliance with the FERC limit of 55 dBA L_{dn} after the construction of the proposed compressor station equipment with the noise control treatments described in this report.

Table A: Compressor Station Sound Level Predictions

NSA	Distance to Compressor Building	Direction	Measured Existing Background	Estimated Contribution of Station Equipment	Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{dn} dBA	L_{dn} dBA	dB
1	2,835	WNW	54.9	36.8	55.0	0.1
2	1,985	West	39.6	40.4	43.0	3.4
3	2,085	SW	44.9	40.4	46.2	1.3
4	1,465	SSW	35.8	33.6	37.8	2.0
5	1,340	SE	54.1	39.4	54.2	0.1
6	2,755	ESE	54.1	36.1	54.2	0.1

1. INTRODUCTION AND PURPOSE

SLR International Corporation (SLR) has constructed a computer noise model and noise control treatment design study at the request of Mountain Valley Pipeline, LLC (MVP) for the proposed Stallworth Compressor Station (Station) near Meadow Bridge in Fayette County, West Virginia. The proposed Station will have two new Solar Titan 130 turbine/compressor units, each rated at 20,500 horsepower (hp). This report presents the results of a pre-construction noise survey conducted by SLR and the requirements for equipment sound power levels and noise control treatments that are necessary in order for the planned equipment to meet the FERC sound level limit of 55 dBA day-night average (L_{dn}).

2. ENVIRONMENTAL SOUND LEVEL CRITERIA

The environmental sound level contributions from the proposed equipment at this compressor station are subject to the FERC noise regulation governing interstate gas transmission compressor stations. The FERC noise regulation is receptor based, and limits compressor station noise contributions to no more than 55 dBA L_{dn} or, equivalently, no more than a continuous 48.6 dBA at the surrounding noise sensitive areas (NSAs). NSAs are typically residences, schools, churches, or hospitals.

The Station is also subject to the Fayette County noise ordinance, which limits noise at the receiving residential property lines to 65 dBA between 7 a.m. and 6 p.m. and 55 dBA between 6 p.m. and 7 a.m.

There are no other known state, county, or local regulations that would apply to this compressor station site.

3. DESCRIPTION OF SITE AND PROPOSED STATION

3.1 DESCRIPTION OF SITE

The Station site is located off of County Route 29 approximately 5 miles east of Meadow Bridge, West Virginia. The area surrounding the proposed Station is rural and sparsely populated, consisting primarily of cleared fields and deciduous hardwood forest.

3.2 DESCRIPTION OF THE STATION EQUIPMENT

The proposed Station will have two new Solar Titan 130 20,500 hp turbines driving centrifugal compressors in a new acoustically-insulated compressor building. Associated equipment is as follows:

- Gas aftercoolers
- Turbine lube oil coolers
- Turbine intake and exhaust openings

- Station suction and discharge piping and suction separators

4. SOUND LEVEL SURVEY

Roy Judy of SLR conducted the sound level survey between 4:00 PM April 28, 2015 and 2:00 PM May 4, 2015 Eastern Daylight Time (EDT). Day and night data were collected at three locations near the NSAs. The NSA and measurement locations are shown in **Figure 1**.

4.1 MEASUREMENT EQUIPMENT

Sound level equipment used during the site survey:

- Larson Davis Model 824 Type 1 Sound Level Meters: s/n A0335, A0424, A0975
- Larson Davis Cal200 s/n 7078

4.2 WEATHER CONDITIONS

Weather conditions were appropriate for an environmental sound level survey as summarized in **Table 4-1**.

Table 4-1: Weather Conditions During Sound Level Survey

Dates	April 28 – May 4, 2015
Temperature Range	47 – 61 °F
Relative Humidity Range	45 – 64%
Wind Speed	0 – 5 mph, gusting to 10 mph
Wind From	NE, NW
Precipitation	None

4.3 MONITORING LOCATIONS

Six NSAs were identified by SLR using aerial imagery. They consisted of the six closest residential areas to the compressor building. These are shown in **Figure 1** along with the monitoring locations selected by SLR. The monitoring locations selected are summarized in **Table 4-2.** The distance and direction from the site to the monitoring locations and ambient noise sources present during data collection are described therein. The distances reference the nearest compressor building perimeter.

Table 4-2: Summary of Monitoring Location

Monitoring Location	Distance from Compressor Building (feet)	Direction to Monitoring Location	Noise Sources Present
NSA 1	2,835	WNW	Constant distant aircraft
NSA 2	1,985	West	Birds, distant aircraft
NSA 3	2,085	SW	Road work at about 1000 ft. away
NSA 4	1,465	SSW	Birds, distant traffic
NSA 5 & 6	1,340	SE	Constant distant aircraft

4.4 MEASURED SOUND LEVEL DATA

The sound level measurement results are summarized in **Table 4-3**, below. The measured sound levels for daytime (L_{eq} (d), dBA), nighttime (L_{eq} (n), dBA), and the equivalent day-night sound level (L_{dn}, dBA) are shown.

Data were collected at locations near NSA 1, NSA 3, and NSA 5 over a period of 63 to 71 hours. The ambient sound levels at NSA 5 were assumed to be representative of the levels at NSA 6, which is located nearby. Shorter duration handheld measurements were taken during the day near NSA 2 and NSA 4. The average nighttime level for these locations was estimated by subtracting the average day-night difference measured at the other NSAs from the measured daytime level. The NSA and measurement locations are shown in **Figure 1**.

Sound levels were measured using the slow meter response and A-weighting and were measured in 1/3- and 1/1-octave bands. Long duration sound levels were recorded in 1-minute sampling periods averaged over 1-hour intervals. Short duration sound levels were recorded in 1-second sampling periods averaged over 5-minute intervals.

Table 4-3: Existing Sound Level Measurement Results at Monitoring Locations

Monitoring Location	Measurement Duration	Measured Day Average	Measured Night Average[1]	Measured 24-Hour Day-Night Average
	HH:MM	L_{eq} dBA	L_{eq} dBA	L_{dn} dBA
NSA 1	71:00	54.2	45.9	**54.9**
NSA 2	00:15	37.8	31.6	**39.6**
NSA 3	63:00	42.2	37.3	**44.9**
NSA 4	00:17	34.7	27.8	**35.8**
NSA 5	65:00	51.9	46.3	**54.1**
NSA 6				

[1] Night averages for short duration measurements were estimated by subtracting 6.2 dB from the measured day average. This is the average difference between day and night levels at the other three NSAs.

5. PROPOSED EQUIPMENT NOISE IMPACT EVALUATION

5.1 SIGNIFICANT SOUND SOURCES

The following sound sources are considered significant:

- Noise from the turbine exhaust, including the exhaust outlet and noise radiated from the exhaust ductwork, expansion joints, and silencer shell.
- Noise from the turbine intake air system, including the inlet opening and noise radiated from the silencer/ductwork shell and any duct joints.
- Turbine/Compressor casing noise that penetrates the building and building ventilation openings.
- Noise from the lube oil / auxiliary cooler and gas aftercoolers.
- Noise radiated by aboveground station piping.

5.2 NOISE MODEL DEVELOPMENT

A three-dimensional computer noise model was constructed to analyze the noise contributions expected from the proposed compressor station configuration. The model was developed using CadnaA, version 4.5.151, a commercial noise modeling package developed by DataKustik GmbH. The software takes into account spreading losses, ground and atmospheric effects, shielding from barriers and buildings, reflections from surfaces and other sound propagation properties. The software is based on published engineering standards. The ISO 9613 standard was used for air absorption and other noise propagation calculations.

5.2.1 DATA AND ASSUMPTIONS

The proposed compressor building dimensions were used in the computer model. The equipment was arranged as per the latest available plot plan, with the unit suction and discharge piping on the east side, and the turbine intakes, exhausts, and lube oil coolers on the west side of the compressor building. The turbine exhaust was modeled at a height of 50 feet above grade, as specified in the most recent plot plan.

The turbine and valve building layout and ventilation design have not been finalized, so the ventilation opening size and distribution has been based on the latest compressor building plans provided by MVP. The compressor building includes six wall intakes, each sized at 48 inches square, and a throat ridge ventilator.

Table 5-1 shows the interior sound levels and the sound power levels used in the model for the Station equipment. Manufacturer data (as available) and measurements of similar units in operation at other compressor stations were used to determine sound pressure and sound power levels for the equipment.

The sound pressure level in the compressor/valve building was taken from measurements at a comparable station with similar turbine-driven compressors. Those levels were then adjusted based on the horsepower of the Titan 130 turbine. The noise generated by the intake ductwork and exhaust system ductwork were included in the exhaust and intake levels warranted by Solar. The sound levels due to suction and discharge piping were based on sound level measurements of a Mars 100 turbine-driven compressor at a similar station with 1.1 dB added to account for the Titan 130 turbine's greater horsepower. The lube oil cooler sound power levels were taken from sound level specifications provided by Solar to MVP for a 90 dBA lube oil cooler. The turbine intake and exhaust levels were also based on data provided Solar for this project.

Table 5-1: Sound Pressure Levels (L_p) and Sound Power Levels (L_w) for Station Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Solar Titan 130 Exhaust and Ductwork, Sound Pressure Level with Silencer at 50 ft., L_p[1]	84	86	72	63	63	54	46	32	21	65
Solar Titan 130 Intake and Ductwork, Sound Pressure Level at 50 ft., L_p[1]	82	86	76	68	42	9	8	35	26	65
Solar 90 dBA Lube Oil Cooler, Sound Pressure Level at 50 ft., L_p[1]	64	71	68	61	56	53	49	45	39	60
Total Sound Power Level of Gas Aftercooler, L_w[2]	103	103	102	99	94	92	86	80	74	97
Sound Level in Compressor Building at Inner Wall Surface, L_p[3]	84	84	95	98	97	96	98	106	97	108
Suction Piping, Total L_w[3]	94	96	95	90	91	96	111	100	90	112
Discharge Piping, Total L_w[3]	95	91	91	97	102	95	107	99	88	110
42" Building Wall Panel Fan, L_w	97	97	101	97	96	96	93	88	81	100
Throat Ridge Ventilator, Total L_w	111	106	103	98	97	94	93	96	92	102

[1] From Solar.
[2] From Moore Fan Datasheet for MVP, adjusted to a total sound power level of 97 dBA.
[3] Based on measurements of similar installed equipment, adjusted for horsepower increase.

Foliage in the area of the Station ranges from grass and crops to areas of dense woods. To be conservative, no foliage was included in the noise model. The model presents a worst-case prediction without any influence of trees or vegetation.

The terrain was modeled based on the latest available USGS topographical data at a resolution of 10 by 10 meters. A temperature of 20 degrees Celcius and 70 percent relative humidity were used for the atmospheric absorption calculations. The ground absorption coefficient for the station site was set as 0.1 and at 0.5 for the mixed ground for all other areas.

5.2.2 NOISE MODEL RESULTS – TYPICAL OPERATION SCENARIO

Table 5-2 shows a summary of the predicted sound level contribution of the Station equipment at each NSA along with a prediction of the overall NSA sound levels including the Station and ambient environmental sources. This table indicates that with the proposed noise control treatments discussed below, the compressor station noise contributions at all of the nearest NSAs will be below the FERC criterion of 55 dBA L_{dn}.

Table 5-2: Compressor Station Sound Level Predictions

NSA	Distance from NSA to Compressor Building	Direction	Measured Existing Background	Estimated Contribution of Station Equipment		Combined, All Sources Including Ambient	Increase Above Existing Condition
	(feet)		L_{dn} dBA	L_{eq} dBA	L_{dn} dBA	L_{dn} dBA	(dB)
1	2,835	WNW	54.9	30.4	**36.8**	55.0	0.1
2	1,985	West	39.9	34.0	**40.4**	43.0	3.4
3	2,085	SW	44.9	34.0	**40.4**	46.2	1.3
4	1,465	SSW	36.8	27.2	**33.6**	37.8	2.0
5	1,340	SE	54.1	33.0	**39.4**	54.2	0.1
6	2,755	ESE	54.1	29.7	**36.1**	54.2	0.1

The worst-case facility property line location is northeast of the compressor building. This locations is shown in **Figure 1**. As shown in **Figure 1**, the maximum predicted sound level due to the station at the station property line is 50.2 dBA $L_{eq.}$ This is well below Fayette County's nighttime limit of 55 dBA. Therefore, the station is expected to operate in compliance with the county ordinance.

5.2.3 NOISE MODEL RESULTS – UNIT BLOWDOWN SCENARIO

Under certain circumstances, the pressure in the compressor casing and unit piping must be released in a controlled manner. These events are commonly called "blowdowns" and occur when the unit is shut-down for an extended period. During the blowdown, the high pressure gas in the system is released in a controlled fashion through a blowdown silencer. Blowdown events cause a temporary increase in sound level that usually lasts for about five minutes.

A compressor blowdown scenario was modeled using a blowdown silencer specified to limit the blowdown sound levels to a maximum of **75 dBA at 50 feet**. **Table 5-3** shows the predicted short-term sound pressure levels at the NSAs during a blowdown event. The unit blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term sound level impact at each Station. The predicted blowdown sound levels are quite low, with the highest predicted sound level of 37.0 dBA L_{eq} at NSA 5.

Table 5-3: Compressor Blowdown Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
	(feet)		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	(dB)
1	2,835	WNW	45.9	28.7	46	0.1
2	1,985	West	31.6	32.3	35	3.4
3	2,085	SW	37.3	32.6	38.6	1.3
4	1,465	SSW	27.8	30.8	32.6	4.8
5	1,340	SE	46.3	37.0	46.8	0.5
6	2,755	ESE	46.3	29.9	46.4	0.1

5.2.4 NOISE MODEL RESULTS – EMERGENCY SHUTDOWN SCENARIO

The station has an emergency shutdown (ESD) system that automatically halts operation of the station in the event of an irregularity. This results in a full station blowdown during which the gas from all station piping is released in a controlled manner. These events are extremely rare and take place only in the event of an emergency or when the system is tested every few years. The station ESD system will include two silencers that are each designed to limit the maximum sound level due to the blowdown to **85 dBA at 50 feet** per silencer.

Table 5-4 shows the predicted short-term sound levels at the NSAs due to an ESD blowdown. The station ESD blowdown event sound levels are compared to the nighttime average levels at each NSA to show the potential short-term nighttime sound level impact of the Station. The predicted sound levels are all below 50 dBA, with the highest predicted sound level of 49.4 dBA at NSA 5. This is a reasonable sound level for an event that will only occur in emergency situations or during testing periods that are scheduled ahead of time and with limited frequency and duration.

Table 5-4: Station ESD Blowdown Sound Level Predictions

NSA	Distance from Compressor Building to NSA	Direction	Measured Existing Background, Night Average	Estimated Contribution of Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
	(feet)		L_{eq} dBA	L_{eq} dBA	L_{eq} dBA	(dB)
1	2,835	WNW	45.9	42.0	47.4	1.5
2	1,985	West	31.6	45.6	45.8	14.2
3	2,085	SW	37.3	46.0	46.5	9.2
4	1,465	SSW	27.8	44.1	44.2	16.4
5	1,340	SE	46.3	49.4	51.1	4.8
6	2,755	ESE	46.3	43.1	48.0	1.7

5.2.5 NOISE MODEL RESULTS – CONSTRUCTION

Only standard construction equipment will be used in the construction of the station, with no dynamic compaction or pile driving expected. Most construction will take place during daytime working hours of 7:00 a.m. until 7:00 p.m. Emergencies or other unusual circumstances may necessitate nighttime work, but the bulk of activity will take place during daylight hours.

The highest sound levels during construction are expected during the early earthmoving phase. Equipment that may be operating during this phase would include bulldozers, front end loaders, dump trucks, generators, etc. Based on the equipment usage predictions from MVP, a sound level calculation was performed using the Federal Highway Administration's Roadway Construction Noise Model (RCNM) version 1.0. Two bulldozers, two dump trucks, one generator, one front end loader, two excavators, one light plant, and a drill rig were included in the calculation. Based on this collection of equipment, the predicted maximum short-term sound level during construction is 42.0 dBA L_{eq} at NSA 5, the NSA closest to the Station. The RCNM calculation is included in Appendix B.

6. NOISE CONTROL TREATMENTS

A summary of the modeled performance of one possible set of noise control treatments is shown in **Table 6-1**, below. The following subsections describe the treatments.

The noise mitigation measures shown are based on the most current station design, and represent one potential set of possible mitigation measures. There are many different combinations of noise control mitigation measures that will provide similar noise control. As the station design, including noise mitigation treatments, is finalized, the mitigation design will be modified to account for these design changes while maintaining compliance with the FERC sound level requirements.

Table 6-1: Recommended Noise Control Treatments

Recommended Insertion Loss (IL) or Transmission Loss (TL)										
Source	**Treatment Description**	**Recommended Treatment Performance**								
		31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Compressor/Valve Building	STC-39 Wall and Roof System, TL	10	16	17	24	44	49	55	55	58
Equipment Door	STC-21 Insulated Roll-up Door, TL	2	7	12	17	18	19	22	30	35
Building Ventilation	Three foot silencers and lined hoods, IL **66 dBA at 12 feet**	1	5	10	18	22	26	30	35	25
Comp. Suction and Discharge Piping	Lagging (ISO Type B2), IL	0	0	0	0	6	15	24	33	42

6.1 COMPRESSOR BUILDING WALLS AND ROOF

The compressor building should have an STC-39 wall and roof system with the transmission loss performance shown in **Table 6-1**. The compressor building should have no windows, skylights, or translucent panels.

The interior surface of the compressor building walls should be acoustically absorptive, having a noise reduction coefficient of at least 0.8. The inside of the compressor building can be lined with perforated metal of at least 23% open area for insulation protection, if so desired. The building should be well sealed with no cracks or gaps. All piping penetrations through the building walls should be well insulated, flashed, and caulked.

6.2 COMPRESSOR BUILDING DOORS

The compressor building will have a 14 foot by 14 foot steel roll-up equipment door. A standard insulated over-head door will be sufficient for the equipment door. The performance shown in **Table 6-1** is the recommended transmission loss performance of the STC-21 roll-up door.

The personnel doors should be STC-32 or better industrial metal doors with good perimeter seals. Small glass windows in the man doors are acceptable as long as the door STC rating is achieved.

6.3 COMPRESSOR VENTILATION

All building ventilation openings should include standard acoustical louvers or silencers such that the total sound pressure level contribution of each opening does not exceed **66 dBA at 12 feet** from the opening. The sound pressure level calculated for the interior of the building due to the turbine and compressor equipment is shown in **Table 5-1**. The sound level target for each ventilation opening includes the sound level contribution of both the mechanical equipment inside the building along with the sound levels due to the ventilation fans. The ventilation system supplier should submit the sound power level of the proposed building ventilation fans during the bidding process for review.

The approximate ventilation silencer performance is shown in **Table 6-1**. The final performance requirements of these silencers will depend on the size, number, and type of ventilation fans used in the design. The sound pressure level target should be the primary design criterion, as it can be field-tested after installation.

The throat ridge ventilator should have acoustic insulation applied to the damper and an acoustic baffle suspended beneath it along the center of the building.

6.4 TURBINE EXHAUSTS

6.4.1 SILENCER PERFORMANCE

The turbine will include an exhaust silencer system that results in the sound pressure level spectrum shown in **Table 5-1** at a distance of 50 feet. Because of the complexities involved with the field verification of silencer insertion loss, the vendor should bid to meet a sound pressure

level target of **65 dBA at 50 feet** from the exhaust opening, measured horizontally from the edge of the stack top with the turbine in any steady-state operational condition, including partial load and full load. Solar Turbines has provided a warranty to meet this sound level requirement.

6.4.2 EXHAUST DUCT AND SHELL NOISE

In large turbine-powered installations it is common for a significant amount of sound energy to radiate from the exhaust system ductwork, expansion joints, and exhaust silencer shell. This sound energy is often termed “shell-radiated” noise. Shell-radiated noise is not necessarily calculated by exhaust system manufacturers but can be a dominant noise source for NSAs close to the Station. Solar Turbines included shell-radiated noise in the acoustical warranty provided for the turbine exhaust. The warranted level of 65 dBA at 50 feet quoted above for the turbine exhaust silencer includes shell-radiated noise.

6.5 TURBINE INTAKE

6.5.1 SILENCER PERFORMANCE

The modeled turbine inlet silencing is shown in **Table 6-1**. This is the performance of the entire intake system, including any filter insertion loss. This data was provided by Solar as the silencer design criterion. Solar has warranted a sound pressure level no more than **65 dBA at 50 feet** from the turbine air intake face.

6.5.2 INTAKE BREAKOUT

Sound radiating from the intake ductwork on the turbine side of the inlet silencer can be a significant noise source. If possible, the inlet silencer should be located inside of the compressor building. If the inlet silencer is not located inside a compressor building, then the inlet ductwork between the silencer and the building wall should be acoustically lagged with the ISO Type B2 lagging listed in **Table 6-1**. Solar has warranted a sound pressure level no more than **65 dBA at 50 feet** from the turbine air intake including any breakout noise.

6.6 LUBE OIL / AUXILIARY COOLERS

The sound power level of each lube oil cooler should not exceed the sound power levels given in **Table 5-1**. This is the total sound power level for the entire cooler (i.e. not just a single fan). The sound power level in **Table 5-1** is equivalent to the Solar 90 dBA lube oil cooler.

6.7 GAS COOLER FANS

Table 5-1 shows the total radiated sound power level for the gas aftercooler fans at the Station. This is the total sound power, and is the sum of the sound power of each fan, along with any radiated sound due to the motors and drive assemblies. This was modeled using the sound power level spectrum supplied by the equipment manufacturer adjusted to a total sound power level of 97 dBA. The predicted sound pressure level is approximately **57 dBA at 100 feet** from the cooler.

6.8 STATION PIPING

Noise from centrifugal compressors will cause significant noise radiation from connected piping. To the extent practical, all suction and discharge piping should be run underground. All outdoor aboveground piping between the compressor and the separators on the suction side, and the compressor and the gas cooler on the discharge side, will need to be acoustically lagged.

6.8.1 ACOUSTICAL PIPE LAGGING MATERIALS

All aboveground unit piping from the compressor side of the separators / gas aftercooler to the point at which the piping enters the building should be treated with acoustical lagging or blankets with the performance shown in **Table 6-1** for Type B2 lagging. This is generally equivalent to (listed from pipe surface outwards):

- 3 inches of 6 to 8 lb/cf mineral wool or fiberglass pipe insulation,
- a layer of 1 lb/sf mass-loaded vinyl,
- and a layer of 0.016″ aluminum jacketing or silicon-coated fiberglass cloth.

Other lagging systems are available that will offer similar acoustical performance, and the lagging system performance shown in **Table 6-1** should be used as the performance goal rather than the listed material requirements.

6.8.2 PIPING ISOLATION

To limit noise radiation from structural supports, the compressor piping should be isolated from pipe supports and other structural contacts using at least 1/4 inch neoprene bearing pads. The stiffness of the neoprene should be chosen so that the static deflection of the pads under the piping loads is about 1/16 inch. Secondary steel elements such as cable trays, pipe racks, walkways, and conduit supports should not be connected to the pipe supports and/or piping.

6.8.3 COMPRESSOR BLOWDOWN

The compressor blowdown silencer has been designed to meet a sound limit of no more than **75 dBA at 50 feet** from the base of the silencer. Any silencer that can meet this performance or better would be expected to produce sound pressure levels no greater than those shown in **Table 5-3** at the NSAs.

7. SUMMARY

MVP is proposing to construct the Stallworth Compressor Station, a new greenfield compressor station, near Meadow Bridge in Fayette County, West Virginia. Measurements at the closest NSAs to the proposed station site show that the current ambient sound levels in the area range from 36.8 to 54.9 dBA L_{dn}. A noise model has been developed of the proposed station equipment. The model predicts that the station sound level contribution at the NSAs will range from 33.6 to 40.4 dBA $L_{dn.}$ The Station is expected to be in compliance with the FERC sound level limit of 55 dBA L_{dn} after installation of the proposed compressor station equipment with the noise control treatments outlined in this report.

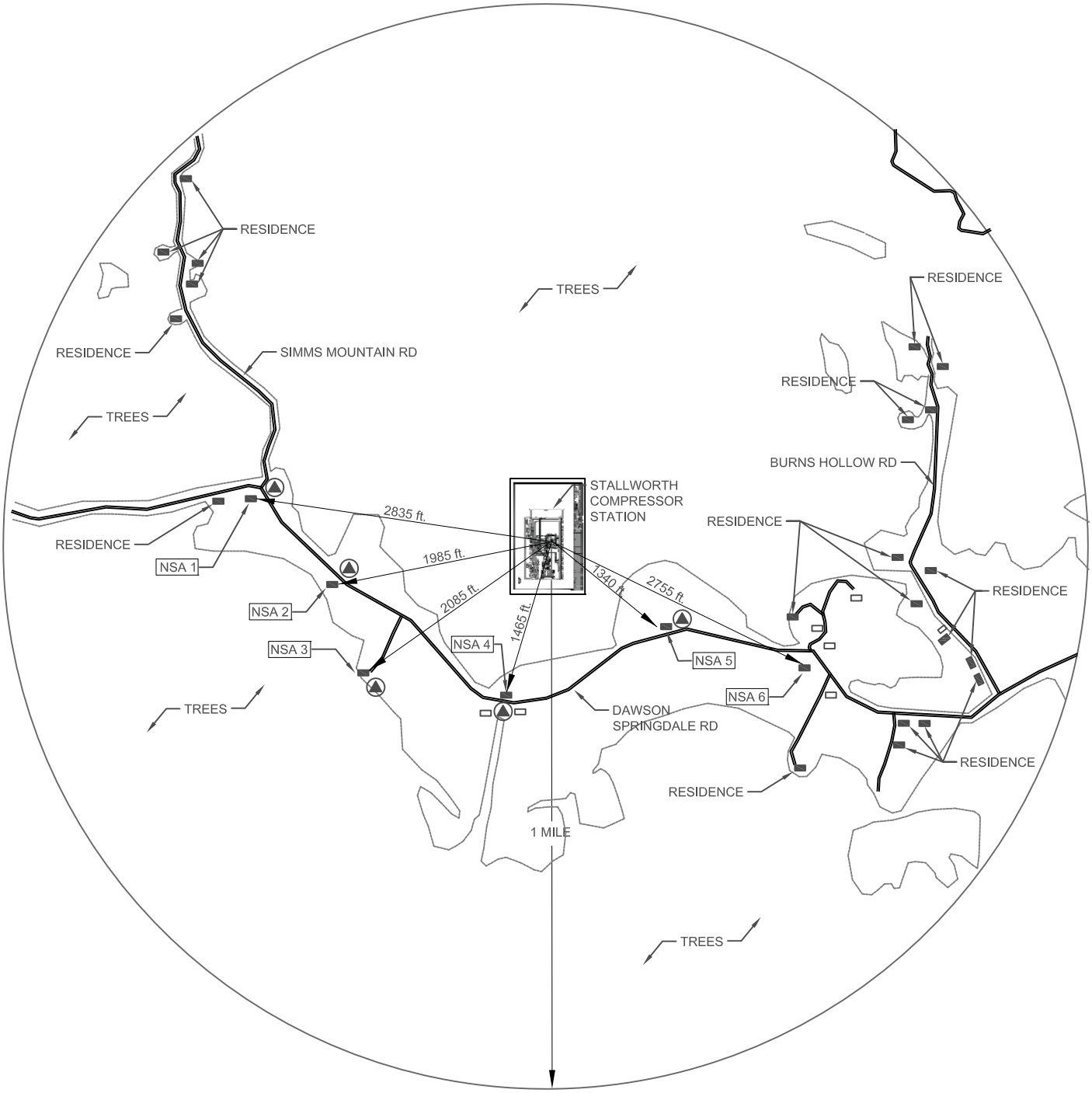
LIMITATIONS

The services described in this work product were performed in accordance with generally accepted professional consulting principles and practices. No other representations or warranties, expressed or implied, are made. These services were performed consistent with our agreement with our client. This work product is intended solely for the use and information of our client unless otherwise noted. Any reliance on this work product by a third party is at such party's sole risk.

Opinions and recommendations contained in this work product are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, positions, time frames, and project parameters indicated. The data reported and the findings, observations, and conclusions expressed are limited by the scope of work. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this work product.

This work product presents professional opinions and findings of a scientific and technical nature. The work product shall not be construed to offer legal opinion or representations as to the requirements of, nor the compliance with, environmental laws rules, regulations, or policies of federal, state or local governmental agencies.

FIGURES



Mountain Valley Pipeline Project

N

0 900 1800 3600

Mountain Valley PIPELINE

Figure 1
NSA and Sound Level
Measurement Locations
Stallworth Compressor Station

September, 2015

Data Sources: Google Earth

LEGEND

- HOUSE OR MOBILE HOME (RESIDENCE)
- NONRESIDENTIAL BUILDING
- NSA NOISE SENSITIVE AREA
- MEASUREMENT LOCATION

Mountain Valley Pipeline Project

Mountain Valley PIPELINE

Figure 2
Predicted Station Sound Levels
dBA Ldn
Stallworth Compressor Station

September, 2015

Worst-Case
Property Line
50.2 dBA Leq

NSA 1
30.4 dBA Leq
36.8 dBA Ldn

NSA 2
34.0 dBA Leq
40.4 dBA Ldn

NSA 3
34.0 dBA Leq
40.4 dBA Ldn

NSA 4
27.2 dBA Leq
33.6 dBA Ldn

NSA 5
33.0 dBA Leq
39.4 dBA Ldn

NSA 6
29.7 dBA Leq
36.1 dBA Ldn

Site Pad

Property Line

Property Line

Legend

Sound Pressure Level,
dBA Ldn

- >= 25.0
- >= 30.0
- >= 35.0
- >= 40.0
- >= 45.0
- >= 50.0
- >= 55.0
- >= 60.0
- >= 65.0
- >= 70.0

Noise Sensitive Area

Scale, feet
0 250 500 1000

N

SCALE: AS SHOWN

Data Sources: Google Earth, CadnaA

APPENDIX A

GLOSSARY OF COMMON ACOUSTICAL TERMINOLOGY

Pre-Construction Noise Study

Mountain Valley Pipeline, LLC
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Pittsburgh, PA 15222

October 14, 2015

A-weighting: a weighting scale in which sound pressure levels in individual frequency bands are adjusted to match the response of the human ear. The reference adjustment is 0 dB at 1000 Hz. The human ear is much less responsive at low frequencies. An A-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBA.

C-weighting: a weighting scale that is relatively flat from 31.5 Hz to 8000 Hz with a roll-off higher and lower than those frequencies. The adjustment is 0 dB from 200 Hz to 1250 Hz. A C-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBC.

Insertion Loss (IL): the decrease (in decibels, dB) in sound power level measured at the location of the receiver when a sound attenuator (e.g., muffler), barrier, or other sound reduction element is inserted in the transmission path between the source and the receiver.

L_d: the daytime average sound level. The L_{eq} averaged over daytime hours. Daytime hours may be defined differently by various ordinances and regulations. The hours between 7:00 a.m. and 10:00 p.m. is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{dn} (also DNL): the day-night average sound level, a metric used by many regulatory bodies (including FERC and HUD) as an overall representation of the sound at a measurement location. The L_{dn} is calculated by averaging the sound measured over a 24-hour period, with 10 decibels added to sound levels measured during nighttime hours.

L_{eq}: the equivalent-continuous sound level is a time-average sound level for a specified time period. It is the most commonly used form of sound level averaging. Specifically, the L_{eq} is the level of a steady sound that has the same sound energy as a time-varying sound during a stated time period and at a stated location.

L_n: the nightime average sound level. The L_{eq} averaged over nighttime hours. Nighttime hours may be defined differently by various ordinances and regulations. The hours between 10:00 p.m. and 7:00 a.m. is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{90}: a statistical parameter (percentile) that describes the sound level that is exceeded 90% of the time during a stated time period. For example, for a stated hourly L_{90} of 45 dBA, the sound level at the measurement location has a 90% chance of being greater than 45 dBA and a 10% chance of being less than or equal to 45 dBA. The L_{90} is often used as the “background” or “ambient” sound level for a given measurement period. Other percentile values are defined similarly, (e.g., L_{50}, L_{10}, etc.).

Sound Power Level (PWL or L_w): a logarithmic parameter that describes the power characteristics of a noise source, relative to a reference power value, expressed in decibels, dB or dBA. The sound power level should not be confused with the sound pressure level. The sound power level is a characteristic of a noise source analogous to the wattage rating of a light bulb, and it is independent of the surroundings. It is calculated from measurements of the sound pressure level. *A 75 watt light bulb will look much brighter in a white, reflective room than in a black, absorptive one. A noise source rated with a sound power level of 95 dBA will produce a much higher sound pressure level (will be much louder) in a small hard box than outside in a soft grassy meadow.*

Sound Pressure Level (SPL or L_p): a logarithmic parameter that describes the quantity of sound relative to a reference pressure value, expressed in decibels, dB or dBA. The SPL is the quantity that is measured with a sound level meter, and it is dependent upon the surroundings of a noise source.

Transmission Loss (TL): The difference (in decibels) between sound power incident upon a sound reduction element (wall or muffler) to that transmitted. The less sound energy is transmitted, the higher the TL value.

APPENDIX B

DETAILED CALCULATION TABLE FOR CONSTRUCTION NOISE MODEL

Pre-Construction Noise Study

Mountain Valley Pipeline, LLC
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Pittsburgh, PA 15222

October 14, 2015

Appendix B: Construction Noise Calculation Output

Roadway Construction Noise Model (RCNM),Version 1.0

Report date:	9/16/2015
Case Description:	Stallworth - Earthmoving Phase

Description	**Land Use**
NSA 1	Residential

Description		**Impact Device**	**Usage(%)**	**Equipment Spec Lmax (dBA)**	**Actual Lmax (dBA)**	**Receptor Distance (feet)**	**Estimated Shielding (dBA)**
Dozer		No	40		81.7	1340	15
Dozer		No	40		81.7	1340	15
Dump Truck		No	40		76.5	1340	15
Dump Truck		No	40		76.5	1340	15
Front End Loader		No	40		79.1	1340	15
Generator		No	50		80.6	1340	15
Excavator		No	40		80.7	1340	15
Excavator		No	40		80.7	1340	15
Generator (<25KVA, VMS signs)		No	50		72.8	1340	15
Drill Rig Truck		No	20		79.1	1340	15

Equipment		**Calculated (dBA)**	
		***Lmax**	**Leq**
Dozer		38.1	34.1
Dozer		38.1	34.1
Dump Truck		32.9	28.9
Dump Truck		32.9	28.9
Front End Loader		35.5	31.6
Generator		37.1	34.1
Excavator		37.1	33.2
Excavator		37.1	33.2
Generator (<25KVA, VMS signs)		29.2	26.2
Drill Rig Truck		35.6	28.6
	Total	**38.1**	**42.0**

*Calculated Lmax is the loudest single equipment contribution.