

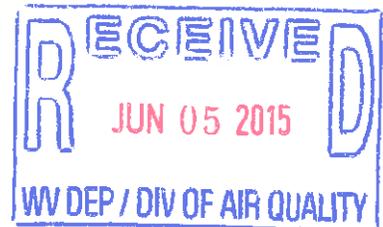
Columbia Pipeline GroupSM

Jim Alexander
Air Permitting
NiSource
801 E. 86th Avenue
Merrillville, IN 46410
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June 3, 2015

Mr. William F. Durham, Director
WVDEP - Division of Air Quality
601 57th Street SE
Charleston, West Virginia 25304

Columbia Gas
Trans LLC
Lone Oak Station
R13-3251
051-00216
Ed Andrews



RE: Construction Application (45CSR13)
Columbia Gas Transmission LLC
Lone Oak Compressor Station

Dear Mr. Durham,

Attached is an initial application for construction of Columbia Gas Transmission's (Columbia) proposed Lone Oak Compressor Station, which will be located in Marshall County, West Virginia. This package contains Columbia's application to install the following equipment:

- Four (4) Solar Mars 100 natural gas-fired compressor turbines;
- One (1) Waukesha natural gas-fired emergency generator;
- One (1) small natural gas-fired process heater;
- Forty (40) natural gas-fired catalytic space heaters; and
- Various small, insignificant tanks (condensate, waste liquid, lube oil).

The Station's potential to emit (PTE) exceeds the Title V applicability threshold for nitrogen oxide and carbon monoxide; therefore, the Station will be considered a Title V source for permitting purposes. After the construction permit has been approved by WVDEP and the equipment installed, a Title V Operating Permit application will be submitted. The Station's PTE will not exceed Prevention of Significant Deterioration (PSD) applicability thresholds; therefore, the Station will not be considered a major PSD source.

This application package includes all required forms and attachment for a minor NSR construction permit application. A check in the amount of \$2,000 is included for application fees.

Should you have any questions or need additional information, please feel free to contact the undersigned at (219) 647-5924 or via email at jamesalexander@nisource.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Jim Alexander".

Jim Alexander
Air Permitting

Attachments

APPLICATION FOR 45 CSR 13
CONSTRUCTION PERMIT

Columbia Gas Transmission LLC
Lone Oak Compressor Station
Marshall County, West Virginia

June 2015

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NSR Application Form

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Attachment I: Emission Units Table

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Attachment L: Emissions Unit Data Sheets

Attachment N: Supporting Emissions Calculations

Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans

Attachment P: Public Notice

Attachment R: Delegation of Authority



WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF AIR QUALITY
 601 57th Street, SE
 Charleston, WV 25304
 (304) 926-0475
www.dep.wv.gov/dag

**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): Columbia Gas		2. Federal Employer ID No. (FEIN): 310802435	
3. Name of facility (if different from above): Lone Oak Compressor Station		4. The applicant is the: <input type="checkbox"/> OWNER <input type="checkbox"/> OPERATOR <input checked="" type="checkbox"/> BOTH	
5A. Applicant's mailing address: Columbia Gas Transmission LLC 1700 MacCorkle Ave, SE Charleston, WV 25314		5B. Facility's present physical address:	
6. West Virginia Business Registration. Is the applicant a resident of the State of West Virginia? <input checked="" type="checkbox"/> YES <input type="checkbox"/> 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: Columbia Energy Group, Inc.			
8. Does the applicant own, lease, have an option to buy or otherwise have control of the proposed site? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO - If YES, please explain: Application is for a greenfield natural gas compressor station which Columbia Gas will own and operate - 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): N/A	11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only): N/A		
All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.			

<p>12A.</p> <ul style="list-style-type: none"> For Modifications, Administrative Updates or Temporary permits at an existing facility, please provide directions to the <i>present location</i> of the facility from the nearest state road; For Construction or Relocation permits, please provide directions to the <i>proposed new site location</i> from the nearest state road. Include a MAP as Attachment B. From the town of Lone Oak, travel south on Waynesburg Pike for approximately 1.7 miles. Compressor Station will be on the left. 		
<p>12.B. New site address (if applicable): Waynesburg Pike</p>	<p>12C. Nearest city or town: Lone Oak</p>	<p>12D. County: Marshall</p>
<p>12.E. UTM Northing (KM): 4,414.8</p>	<p>12F. UTM Easting (KM): 535.8</p>	<p>12G. UTM Zone: 17</p>
<p>13. Briefly describe the proposed change(s) at the facility: This is a new facility.</p>		
<p>14A. Provide the date of anticipated installation or change: 3/16/2017</p> <ul style="list-style-type: none"> If this is an After-The-Fact permit application, provide the date upon which the proposed change did happen: / / 	<p>14B. Date of anticipated Start-Up if a permit is granted: 11/01/2017</p>	
<p>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).</p>		
<p>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</p>		
<p>16. Is demolition or physical renovation at an existing facility involved? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO</p>		
<p>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.</p>		
<p>18. Regulatory Discussion. List all Federal and State air pollution control regulations that you believe are applicable to the proposed process (<i>if known</i>). 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 (<i>if known</i>). Provide this information as Attachment D.</p>		

Section II. Additional attachments and supporting documents.

<p>19. Include a check payable to WVDEP – Division of Air Quality with the appropriate application fee (per 45CSR22 and 45CSR13).</p>
<p>20. Include a Table of Contents as the first page of your application package.</p>
<p>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).</p> <ul style="list-style-type: none"> Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).
<p>22. Provide a Detailed Process Flow Diagram(s) showing each proposed or modified emissions unit, emission point and control device as Attachment F.</p>
<p>23. Provide a Process Description as Attachment G.</p> <ul style="list-style-type: none"> Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).
<p><i>All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.</i></p>

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 Four (4) natural gas-fired turbines, one (1) emergency generator, one (1) heater, 40 catalytic space heaters

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:

<input type="checkbox"/> Authority of Corporation or Other Business Entity	<input type="checkbox"/> Authority of Partnership
<input type="checkbox"/> Authority of Governmental Agency	<input type="checkbox"/> 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.

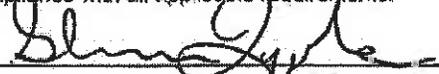
35A. Certification of Information. To certify this permit application, a Responsible Official (per 45CSR§13-2.22 and 45CSR§30-2.28) or Authorized Representative shall check the appropriate box and sign below.

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: 6/1/15
(Please use blue ink) (Please use blue ink)

35B. Printed name of signer: Glenn Fyola		35C. Title: Operations Manager
35D. E-mail: gfyola@nresource.com	36E. Phone: 724-825-9098	36F. FAX: 724-223-2774
36A. Printed name of contact person (if different from above): Jim Alexander		36B. Title: Air Permitting
36C. E-mail: jamesalexander@nresource.com	36D. Phone: 219-647-5924	36E. FAX: 219-647-5271

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Attachment A: Business Certificate
<input checked="" type="checkbox"/> Attachment B: Map(s)
<input checked="" type="checkbox"/> Attachment C: Installation and Start Up Schedule
<input checked="" type="checkbox"/> Attachment D: Regulatory Discussion
<input checked="" type="checkbox"/> Attachment E: Plot Plan
<input checked="" type="checkbox"/> Attachment F: Detailed Process Flow Diagram(s)
<input checked="" type="checkbox"/> Attachment G: Process Description
<input checked="" type="checkbox"/> Attachment H: Material Safety Data Sheets (MSDS)
<input checked="" type="checkbox"/> Attachment I: Emission Units Table
<input checked="" type="checkbox"/> Attachment J: Emission Points Data Summary Sheet | <input checked="" type="checkbox"/> Attachment K: Fugitive Emissions Data Summary Sheet
<input checked="" type="checkbox"/> Attachment L: Emissions Unit Data Sheet(s)
<input checked="" type="checkbox"/> Attachment M: Air Pollution Control Device Sheet(s)
<input checked="" type="checkbox"/> Attachment N: Supporting Emissions Calculations
<input checked="" type="checkbox"/> Attachment O: Monitoring/Recordkeeping/Reporting/Testing Plans
<input checked="" type="checkbox"/> Attachment P: Public Notice
<input type="checkbox"/> Attachment Q: Business Confidential Claims
<input type="checkbox"/> Attachment R: Authority Forms
<input type="checkbox"/> Attachment S: Title V Permit Revision Information
<input checked="" type="checkbox"/> 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

Business Certificate

**WEST VIRGINIA
STATE TAX DEPARTMENT
BUSINESS REGISTRATION
CERTIFICATE**

ISSUED TO:
**COLUMBIA GAS TRANSMISSION LLC
5151 SAN FELIPE ST 2500
HOUSTON, TX 77056-3639**

BUSINESS REGISTRATION ACCOUNT NUMBER: 1025-1555

This certificate is issued on: 07/1/2011

*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.*

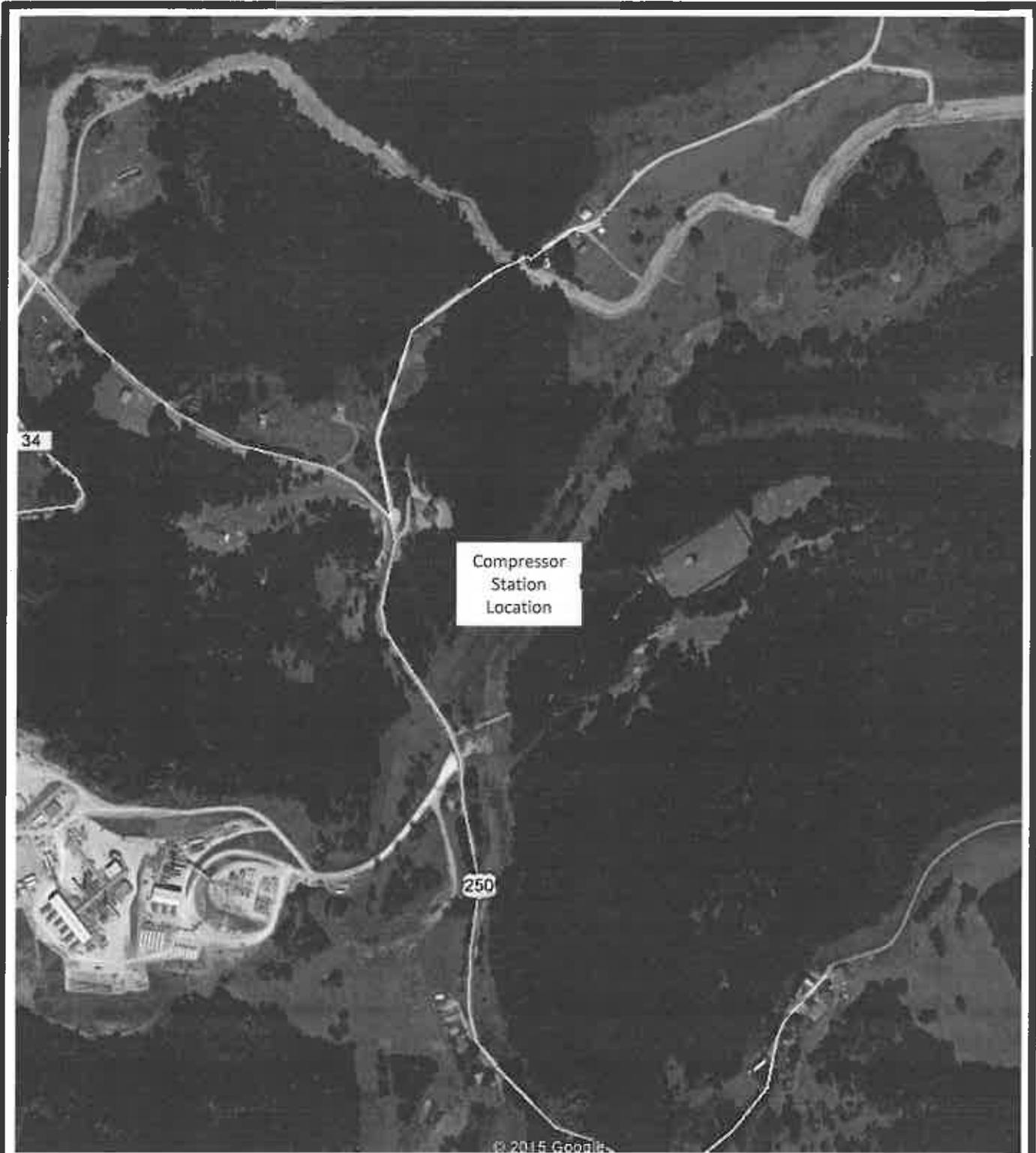
This certificate is not transferrable and must be displayed at the location for which issued. This certificate shall be permanent until cessation of the business for which the certificate of registration was granted or until it is suspended, revoked or cancelled by the Tax Commissioner.

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.

Attachment B

Map



From the town of Lone Oak, travel south on Waynesburg Pike for approximately 1.7 miles. Compressor Station will be on the left.

	Attachment B
Date: June 2015	Facility Map Lone Oak Compressor Station

Attachment C

Installation and Start Up Schedule

Installation and Start Up Schedule

Emission Point	Installation Date	Start Up Date
T01 - Solar Mars 100 Turbine	March 2017	November 2017
T02 - Solar Mars 100 Turbine	March 2017	November 2017
T03 - Solar Mars 100 Turbine	March 2017	November 2017
T04 - Solar Mars 100 Turbine	March 2017	November 2017
G1 - Waukesha Generator	March 2017	November 2017
H1 - Process Heater	March 2017	November 2017
SH1 - 40 Catalytic Heaters	March 2017	November 2017

Attachment D

Regulatory Discussion

1.0 INTRODUCTION

1.1 Summary and Conclusions

Columbia Gas Transmission, LLC (Columbia) is proposing to construct the Lone Oak Compressor Station (the "Station"). Construction of the Lone Oak Compressor Station (the "Project") is scheduled to begin in March 2017. This application package contains Columbia's application to:

- Install four (4) Solar Mars turbines;
- Install an emergency generator;
- Install a small process heater;
- Install 40 catalytic space heaters; and
- Install various small insignificant storage tanks (condensate, waste liquid, lube oil).

An analysis of federal and state regulations was performed to identify applicable air quality regulations. Federal and state regulations potentially applying to the proposed turbines include the following.

- The Station will not be a major source under Prevention of Significant Deterioration (PSD) rules.
- New Source Performance Standards (NSPS) for stationary combustion turbines (40 CFR 60 Subpart KKKK) are applicable. The proposed nitrogen oxide (NO_x) emission rates and fuel sulfur levels comply with NSPS limits.
- NSPS for stationary spark-ignition internal combustion engines (40 CFR 60 Subpart JJJJ) are applicable. The proposed emergency generator will comply with the NSPS emission limits.
- National Emission Standards for Hazardous Air Pollutants (NESHAP) for stationary combustion turbines (40 CFR 63 Subpart YYYY) and NESHAP for Industrial, Commercial, and Institutional Boilers and Process Heaters (40 CFR 63 Subpart DDDDD) are not applicable. The proposed Station will not be a major hazardous air pollutant (HAP) source under 40 CFR 63.
- NESHAP for stationary reciprocating internal combustion engines (40 CFR 63 Subpart ZZZZ) are applicable. The proposed emergency generator is a new stationary reciprocating internal combustion engine located at an area source of HAPs. As such, the engine meets the requirements of Subpart ZZZZ by complying with NSPS Subpart JJJJ per 40 CFR 63.6590(c)(1). No further requirements apply.
- NESHAP for Industrial, Commercial, and Institutional Boilers (40 CFR 63 Subpart JJJJJ) are not applicable to natural gas-fired heaters.
- Compliance Assurance Monitoring (CAM) for major sources (40 CFR 64) is not applicable. This regulation does not apply because the proposed turbines do not use add-on emission controls.
- Prevention and Control of Smoke and Particulate Matter (45 CSR 2) is applicable. The proposed turbines are inherently compliant with these rules by combusting only natural gas.
- Prevention and Control of Sulfur Dioxide (45 CSR 10) is applicable. The proposed turbines are subject to the more stringent fuel sulfur limit in NSPS Subpart KKKK and therefore comply with this rule.
- Permits for Construction or Modification of Stationary Sources of Air Pollutants (45 CSR 13) is applicable. A permit application is being submitted to WVDAQ as part of this application package.

- Requirements for Operating Permits (45 CSR 30) is applicable. A Title V application will be completed upon the approval of this NSR preconstruction permit.

1.2 Report Organization

The proposed Project is described in Section 2.0. An analysis of applicable regulations and proposed compliance procedures is presented in Section 3.0. Completed permit application forms, including emissions estimating basis, emission calculations and supporting data are contained within this application package.

2.0 PROJECT DESCRIPTION

2.1 Description of Proposed Facility

The Lone Oak Station will be located in Marshall County, West Virginia, near the town of Lone Oak. The Station will receive natural gas via pipeline from an upstream compressor station, compress it using natural gas-fired turbines, and then transmit it via pipeline to a downstream station. The Station is covered by Standard Industrial Classification (SIC) 4922 and has the potential to operate seven (7) days per week, twenty-four (24) hours per day.

Columbia is proposing to:

- Install four (4) new Solar Mars 100 turbines;
- Install one new 1,175-hp Waukesha emergency generator;
- Install one new 1.0-MMBtu/hr process heater;
- Install 40 new catalytic space heaters (0.072 MMBtu/hr each); and
- Install various small insignificant storage tanks (condensate, waste liquid, lube oil).

The four (4) Solar Mars 100 turbines each have an output of 15,339 hp at 32 °F. These proposed turbines are designated Emission Point ID T01 through T04. Attachment F includes a process flow diagram showing the proposed turbines. The U.S. Environmental Protection Agency (USEPA) Source Classification Code (SCC) for the proposed turbines is 2-02-002-01.

The new turbines will be equipped with advanced dry low NO_x combustion controls, known by the manufacturer as SoLoNO_x. These controls reduce NO_x and peak combustion temperatures through the use of a lean, premixed air/fuel mixture and advanced combustion controls. The SoLoNO_x system is operational at turbine loads from approximately 50% to 100% of full load. The NO_x emission rates are at or below those required by the NSPS Subpart KKKK (as discussed in Section 3.2.1 of this document).

Emission rates are summarized in Table 2-1 for NO_x, carbon monoxide (CO), volatile organic compounds (VOC), sulfur dioxide (SO₂), particulate matter with an aerodynamic diameter of less than or equal to 10 microns (PM₁₀), particulate matter with an aerodynamic diameter of less than or equal to 2.5 microns (PM_{2.5}), and formaldehyde (CH₂O, the primary HAP) for the proposed turbines at normal operating conditions and maximum power output. The turbine emission rates in Table 2-1 are based on 16,231 hp (operating at 0 °F). NO_x, CO and VOC emission rates for the new turbines are based on manufacturer performance data and include firing of supplemental fuel to maintain flame stability at ambient temperatures below 0 °F. Supporting materials related to emissions from the proposed turbines are included in Attachment N.

Table 2-1 Emission Rates for Proposed Turbines During Normal Operation (g/hp-hr)¹

Emission Point ID	Model	Basis	NO _x	CO	VOC ²	SO ₂ ³	PM ₁₀ / PM _{2.5}	CH ₂ O
T01, T02, T03, T04	Solar Mars 100	16,231 HP (at 0 °F)	0.21	0.21	0.02	0.22	0.03	0.003

¹ Based on vendor performance data at 0 °F; values in italics based on AP-42 emission factors.

² VOC is based on 20 percent of unburned hydrocarbons per Solar Product Information Letter 168.

³ Conservatively based on 20 grains sulfur per 100 standard cubic feet of natural gas for maximum short-term emissions.

During operation at low turbine loads (<50% of full load), low ambient temperatures (<0 °F), and during turbine startup and shutdown, supplemental fuel is fired through the pilot burners for flame stability and results in NO_x, CO, and VOC concentrations that are higher than during SoLoNO_x operation. At low ambient temperatures, the turbine operates in one mode at temperatures between 0 °F and -20 °F and in a different mode at temperatures below -20 °F. Estimated emissions during each of the operation modes are summarized in Table 2-2. These values are based on manufacturer information provided in Attachment N. Additional turbine emission data and calculations are presented in Attachment N.

Table 2-2 Emissions from Proposed Mars 100 Turbines during non-SoLoNO_x Operation

Mode	Basis	ppmv @ 15% O ₂			lb/hr		
		NO _x	CO	VOC	NO _x	CO	VOC ⁴
Low Ambient Temperature ¹	0 to -20 °F	42	100	10	21.33	30.91	1.77
Low Load ²	<50%	66	4,400	88	16.10	653.41	7.47
Startup/Shutdown ³	Per cycle				3.10	272.70	3.12

¹Emission rates in ppmv @ 15% O₂ are per Solar Product Information Letter 167 (Included in Attachment N).

²Emission rates provided by Solar at 40% load.

³Values are from Solar Product Information Letter 170 and are in lbs per startup/shutdown cycle (cycle includes 10 minutes for startup and 10 minutes for shutdown).

⁴VOC is based on 20 percent of unburned hydrocarbons per Solar Product Information Letter 168.

The Project will include installation of one (1) 1,175-hp, natural gas-fired emergency generator for which potential emissions are based on operation of up to 500 hours per year. Emissions from this unit are based on vendor data for NO_x, CO and VOC and AP-42 emission factors for other air pollutants. The station will also be installing one (1) 1.0 MMBtu/hr process heater and 40 catalytic heaters, each rated at 72,000 Btu/hr, for comfort heating. Emissions from these units are based on AP-42 emission factors. In addition, small storage tanks with capacities less than 2,000 gallons will be installed for the storage of low vapor pressure materials, including condensate, waste liquid, and lubricating oil. These tanks will be de minimis sources per Table 45-13B of West Virginia regulation 45 CSR 13.

The target date for starting construction is March 2017. Initial commercial operation is scheduled for November 2017.

Based on potential annual emissions (shown below in Table 2-3), the proposed Station is classified as a minor source of emissions under new source review (NSR) regulations; therefore, the Station will not be subject to PSD requirements.

Table 2-3 Potential Annual Emissions (tpy)

Source	NO _x	CO	VOC ¹	SO ₂	PM ₁₀ / PM _{2.5}	CH ₂ O	Total HAP
Facility-Wide	127.91	188.71	27.54	1.64	15.17	1.74	2.53

¹Includes VOC component of vented natural gas (e.g., pneumatic actuators, blowdown events); combustion-related VOC emissions are 15.13 tpy.

Marshall County is classified as non-attainment for the 2010 1-hour SO₂ NAAQS in the Clay, Franklin, and Washington tax districts. The proposed Station will be located in the Webster tax district which is classified as attainment or unclassifiable. For all other National Ambient Air Quality Standards, Marshall County is classified as attainment or unclassifiable. There are no Class I areas within 100 kilometers of the proposed Station.

3.0 REGULATORY ANALYSIS AND COMPLIANCE METHODS

This section reviews the applicability of state and federal regulations potentially affecting the new turbines and proposed compliance procedures. Supporting calculations are included in Attachment N.

3.1 Prevention of Significant Deterioration

Prevention of Significant Deterioration (PSD) requirements for new emissions units apply when the proposed new facility has the potential to emit 250 tpy of any PSD-regulated pollutant (such as NO_x, CO, PM₁₀, PM_{2.5}, or SO₂). Because the potential to emit (PTE) for this Project does not exceed 250 tpy for any PSD-regulated pollutant, the Lone Oak Compressor Station is not subject to PSD requirements.

Per 45 CSR 14-2.80.e.1, following July 1, 2011, for new major stationary sources that will emit or have the potential to emit greater than or equal to 100,000 tpy of CO₂ equivalent (CO₂e) emissions of greenhouse gases were required to meet the requirements set forth in the PSD program. The provisions of 45 CSR 14-2.80.f, however, clarified that this portion of the rule ceases to be effective under certain circumstances, including a federal court decision invalidating provisions of the rule. On June 23, 2014, the U.S. Supreme Court issued a decision that greenhouse gas emissions could not be a basis for PSD or Title V applicability, and this decision was followed by a July 24, 2014 memorandum from the USEPA that stated that the USEPA will comply with the Court's decision and will not apply or enforce regulations that would require a PSD permit where PSD would be applicable solely because of GHG emissions. Therefore, CO₂e emissions are no longer considered for PSD applicability.

3.2 New Source Performance Standards

New Source Performance Standards (NSPS) apply to new, modified or reconstructed stationary sources meeting criteria established in 40 CFR Part 60. Sections 3.2.1 and 3.2.2 describe requirements that apply to the proposed units at the proposed Station.

Subpart Dc (Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units) applies to steam generating units with a maximum design heat input capacity of greater than or equal to 10 MMBtu/hr, but less than or equal to 100 MMBtu/hr, which are constructed, modified or reconstructed after June 9, 1989. Steam generating units are defined as devices that combust fuel and heat water or any heat transfer medium. Since the proposed heater will be rated at 1.0 MMBtu/hr, this NSPS is not applicable. The proposed space heaters are not steam generating units.

Subpart OOOO (Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution) is not applicable to the proposed new equipment (no affected facilities proposed).

3.2.1 Stationary Gas Turbines (40 CFR 60 Subpart KKKK)

The USEPA has promulgated NSPS for stationary combustion turbines in 40 CFR 60 Subpart KKKK. Subpart KKKK applies to combustion turbines with a peak heat input of 10 MMBtu/hr and greater. The proposed Solar Mars turbines each have a heat input of 123.18 MMBtu/hr at 59 °F based on the higher heating value (HHV) of the fuel, and they will be subject to the requirements of Subpart KKKK. Sources covered by Subpart KKKK are exempt from the requirements in Subpart GG (the previous combustion turbine NSPS). The subcategory and corresponding NO_x emission standard as established in Table 1 to Subpart KKKK for each of the proposed turbines is shown in Table 3-1 below.

Table 3-1 Proposed Turbines and Corresponding Category and Emission Standard

Unit	Table 1 subcategory	Heat input	NO _x Emission Standard	Manufacturer's Warranty
Solar Mars 100 (T01 through T04)	New turbine firing natural gas	> 50 MMBtu/hr and ≤ 850 MMBtu/hr	25 ppm at 15 percent O ₂ or 150 ng/J of useful output (1.2 lb/MWh)	15 ppm at 15% O ₂

Table 1 to Subpart KKKK also establishes a NO_x emission limit of 150 ppm at 15% O₂ or 1,100 ng/J of useful output (8.7 lb/MWh) for turbines with a peak capacity equal to or less than 30 MW output which are operating at less than 75% of peak load or at temperatures less than 0 °F.

The fuel sulfur limit in Subpart KKKK is 0.060 lb SO₂/MMBtu. Under 40 CFR 60.4365, a source is exempt from monitoring fuel sulfur content if the source burns natural gas that is covered by a purchase or transportation agreement with maximum sulfur content of 20 grains per 100 scf, which is the case for the proposed turbine fuel.

To demonstrate compliance with Subpart KKKK, 40 CFR 60.4400 requires an initial NO_x performance test using EPA reference methods. The initial compliance test must be conducted within 60 days after achieving full-load operation or within 180 days of startup if the turbines are not operated at full load. Unless continuous parameter monitoring is implemented, annual performance testing using EPA reference methods must be conducted within 14 calendar months following the previous performance test. Test frequency can be reduced to biennial if measured NO_x emissions are < 75% of limit. Columbia requests that portable emissions analyzers be approved for annual turbine testing. In addition, Columbia will continuously monitor the turbines to document any operating periods during which the SoLoNO_x system is not in service (e.g., during startup, shutdown, low-load, or a system malfunction). Records of turbine startup, shutdown, SoLoNO_x malfunction, and/or SoLoNO_x monitoring system malfunction will be recorded per Subpart KKKK and NSPS General Provisions in 40 CFR 60.7(b)&(c).

Compliance with the SO₂ and fuel sulfur limits can be demonstrated by monitoring natural gas sulfur content annually. However, per 40 CFR 60.4365(a), the turbines will be exempt from periodic monitoring by demonstrating compliance with the FERC tariff limit on total sulfur content of < 20 grains of sulfur per 100 standard cubic feet.

3.2.2 Stationary Spark Ignition Internal Combustion Engines (40 CFR 60 Subpart JJJJ)

Subpart JJJJ (Standards of Performance for Stationary Spark Ignition Internal Combustion Engines) applies to stationary spark ignition engine manufacturers and owners/operators. For natural gas-fired emergency engines manufactured after January 1, 2009, the applicable emission limits for engines greater than 130 hp rated capacity are as follows.

- For NO_x, the limit is 2.0 g/hp-hr or 160 ppmvd at 15 percent O₂;
- For CO, the limit is 4.0 g/hp-hr or 540 ppmvd at 15 percent O₂; and
- For VOC, the limit is 1.0 g/hp-hr or 86 ppmvd at 15 percent O₂.

The proposed emergency generator will be subject to the Subpart JJJJ emission limits for engines greater than 130 hp. Based on manufacturer data, as supplied in Appendix N, the engine will comply with these emission limits.

3.3 National Emission Standards for Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants (NESHAPs) are promulgated under 40 CFR Part 63 for specific processes and HAP emissions. The proposed Station has potential HAP emissions that are less than major source threshold and will therefore be considered an area source of HAPs.

40 CFR 63 Subpart YYYY (Stationary Combustion Turbines) is only applicable to major sources of HAPs; therefore, the turbines are not subject to this regulation.

Subpart ZZZZ (Stationary Reciprocating Internal Combustion Engines) is applicable to the proposed emergency generator; however, for this source type, Subpart ZZZZ requirements are met by complying with NSPS Subpart JJJJ as described above.

There are two NESHAPs which regulate emissions from industrial, commercial and institutional boilers – 40 CFR 63 Subpart DDDDD (major sources of HAPs) and 40 CFR 63 Subpart JJJJJ (area sources of HAPs). The proposed Station will be an area source of HAPs; Subpart JJJJJ is the applicable NESHAP for the Station. Per the regulation, natural gas-fired sources are exempt from the requirements of this Subpart.

3.4 Compliance Assurance Monitoring (40 CFR 64)

Compliance Assurance Monitoring (CAM) requirements in 40 CFR Part 64 are intended to assure that emission control equipment is properly operated and maintained. CAM applies to emissions units that:

1. have an emission limitation,
2. use a control device to comply with the emissions limit, and
3. have sufficient emissions to be classified as a major emission source under 40 CFR Parts 70.

As defined in Part 64, "control device" means add-on control equipment other than inherent process equipment that is used to destroy or remove air pollutant(s) prior to discharge to the atmosphere. The definition also states that "a control device does not include use of combustion or other process design features or characteristics."

Exemptions include units complying with an emission limitation or standard proposed by the USEPA after November 15, 1990 pursuant to Section 111 or 112 of the Clean Air Act (NSPS or NESHAP).

Potential emissions from each turbine are less than the Part 70 major source threshold. Additionally, the proposed turbines will not use any add-on emission controls and will be subject to a federal NSPS promulgated after 1990. As such, the proposed turbines are exempt from CAM requirements.

3.5 Prevention and Control of Emission of Smoke and Particulate Matter (45 CSR 2)

West Virginia Regulation 45 CSR 2 requires that smoke and particulate matter emissions from the proposed engine not exceed opacity levels of 10 percent based on a six-minute block average. The proposed equipment is inherently compliant with this requirement by combusting only pipeline quality natural gas.

3.6 Prevention and Control of Emission of Sulfur Dioxide (45 CSR 10)

West Virginia Regulation 45 CSR 10 requires that the in-stack SO₂ concentration from the proposed source not to exceed 2,000 ppm by volume (45 CSR 10-4.1). As stated in Section 3.2.1 above, the turbines will be subject to NSPS Subpart KKKK. The NSPS limit on fuel sulfur content of 20 grains sulfur per 100 scf equates to an exhaust gas SO₂ concentration of < 1 ppmv SO₂ in the turbine exhaust, which is less than the 2,000 ppmv limit. Therefore, the turbines will be in compliance with 45 CSR 10-4.1. The

combustion of natural gas produces inherently low SO₂ emissions, which ensures that the emergency generator and heaters will also be in compliance with this regulation.

Also, 45 CSR 10-5.1 requires that any combusted process gas stream contains hydrogen sulfide of less than 50 grains per 100 cubic feet of gas. Proof of compliance with the FERC limit of 20 grains sulfur per 100 scf is sufficient to document compliance with both of the 45 CSR 10 limitations.

3.7 Pre-construction Permitting under West Virginia Air Regulation 13 (45 CSR 13)

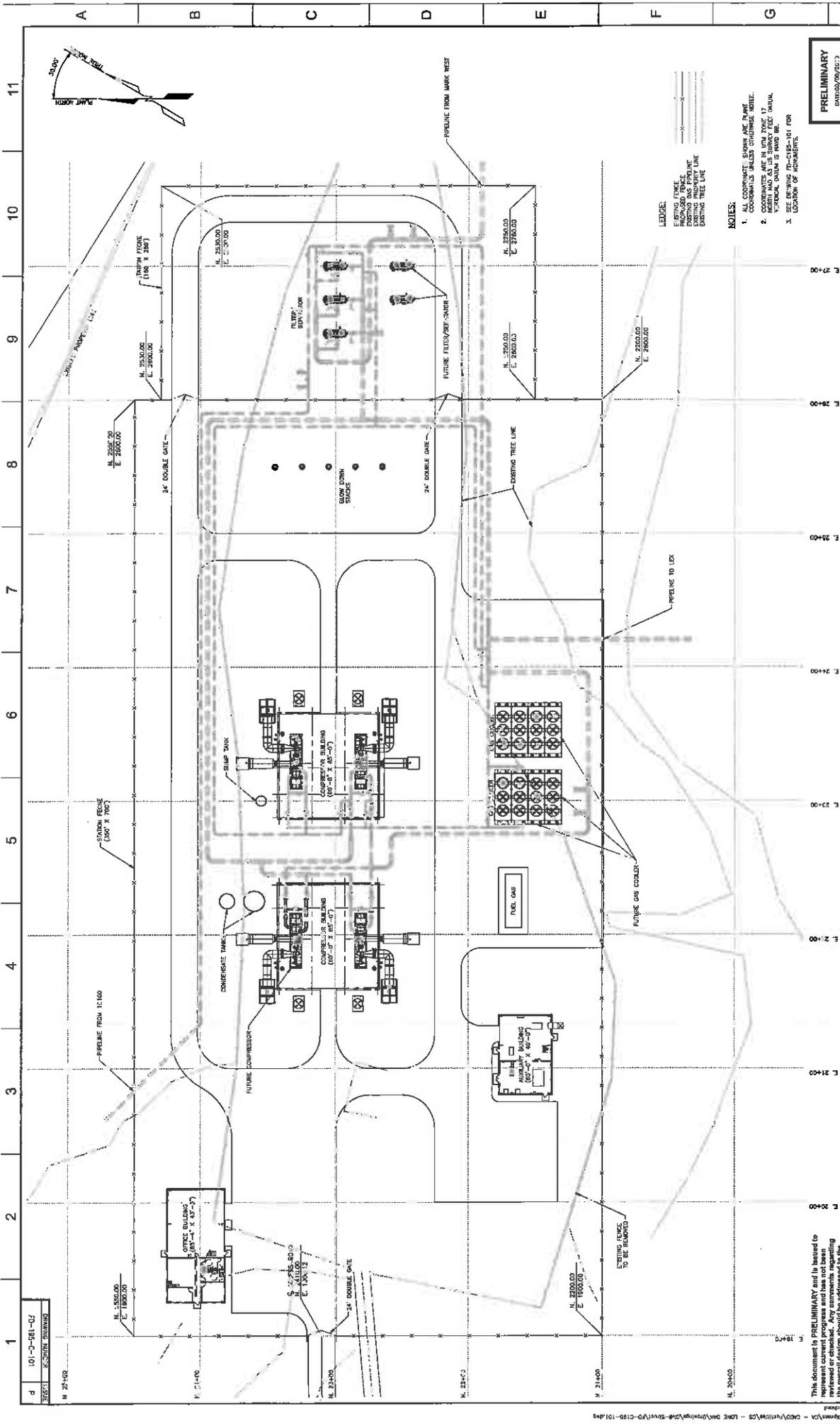
Because the potential to emit from the proposed Project does not exceed PSD applicability thresholds, the Project is not classified as major for PSD purposes and is required to obtain a construction permit per 45 CSR 13. This document contains the information required by this permitting program.

3.8 Requirements for Operating Permits (45 CSR 30)

Because the PTE for the Lone Oak CS will exceed the Title V threshold of 100 tpy for NO_x and CO, a Title V permit is required to operate the Station. In accordance with 45 CSR §30-4.1.a.2, a Title V permit application will be submitted within 12 months after commencement of operation of the permitted emissions sources.

Attachment E

Plot Plan



LEGEND:
 - - - - - EXISTING FENCE
 - - - - - PROPOSED FENCE
 - - - - - EXISTING PROPERTY LINE
 - - - - - EXISTING TREE LINE

NOTES:
 1. COORDINATES SHOWN ARE STATE COORDINATES UNLESS OTHERWISE NOTED.
 2. COORDINATES ARE IN UTM ZONE 17 NORTH AND UTM SURVEY FOOT. INITIAL COORDINATES ARE TO 5 FEET ACCURACY.
 3. SEE DRAWING FOR LOCATION FOR LOCATION OF ADJUSTMENTS.

LEDE:
 - - - - - EXISTING FENCE
 - - - - - PROPOSED FENCE
 - - - - - EXISTING PROPERTY LINE
 - - - - - EXISTING TREE LINE

PRELIMINARY
 DATE: 02/20/2018

Columbia
 Gas Transmission

PROJECT: LONE OAK COMPRESSOR STATION
TITLE: LONE OAK COMPRESSOR STATION
PILOT PLAN

NO.	DATE	BY	CHKD.	DESCRIPTION
1				PRELIMINARY
2				REVISIONS
3				REVISIONS
4				REVISIONS
5				REVISIONS
6				REVISIONS
7				REVISIONS
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47				REVISIONS
48				REVISIONS
49				REVISIONS
50				REVISIONS

SCALE: 1" = 30'-0"

DATE: 02/20/2018

PROJECT: LONE OAK COMPRESSOR STATION

TITLE: LONE OAK COMPRESSOR STATION

PILOT PLAN

PRELIMINARY

REVISIONS

NO.

DATE

BY

CHKD.

DESCRIPTION

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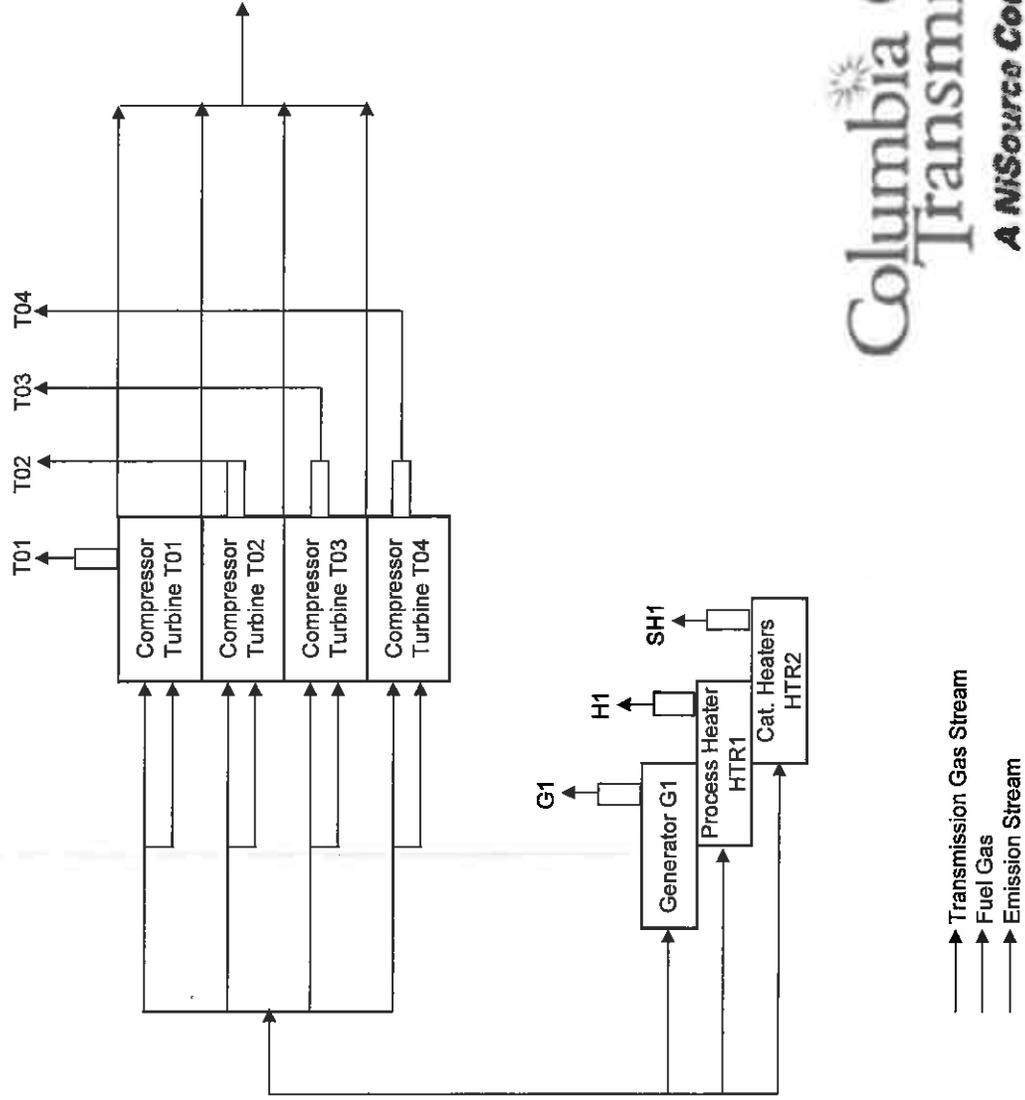
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Attachment F

Detailed Process Flow Diagram

ATTACHMENT F
PROPOSED LONE OAK COMPRESSOR STATION PROCESS FLOW DIAGRAM



Attachment G

Process Description

Process Description

Pipeline transmission of natural gas requires that the gas be compressed. The proposed Lone Oak Compressor Station will install four Solar turbine-driven gas compressors. The Project also includes the installation of one emergency generator, one process heater, forty catalytic space heaters, and numerous insignificant storage tanks. The remainder of this discussion is specific to the turbine technology.

The power output from a natural gas-fired turbine is directly related to the fuel input rate and to the ratio of combustion air to fuel. As ambient temperatures decrease, a turbine's maximum power output will increase due to the increased density of inlet air. The Solar dry low NO_x (DLN) combustion system (known as SoLoNO_x) limits formation of NO_x, CO, and VOC by pre-mixing air and fuel prior to combustion. When operating a Solar Mars 100 turbine at ambient temperatures ≥ 0 °F and at loads ≥ 50%, this DLN system is able to limit the exhaust gas concentration of these pollutants (corrected to 15% O₂) to 15 ppm NO_x, 25 ppm CO, and 25 ppm unburned hydrocarbons (UHC, containing at least 80% non-VOC methane and ethane; therefore, 5 ppm VOC). At ambient temperatures of 0 to -20 °F, additional pilot fuel is required by the turbine to maintain flame stability, which increases estimated emission concentrations to 42 ppm NO_x, 100 ppm CO, and 50 ppm UHC (10 ppm VOC). At turbine loads < 50%, additional pilot fuel and air flow are required to maintain flame stability and turbine responsiveness. These changes increase estimated emission concentrations to 66 ppm NO_x, 4,400 ppm CO, and 440 ppm UHC (88 ppm VOC). Should loads drop below 50%, Columbia will make every effort to either bring the load back above 50% or shut a turbine down (e.g., shut down another turbine and move that volume to the turbine, or shift the turbine volume to another turbine and shut down the turbine).

In addition, there are changes in NO_x, CO, and VOC emissions during the initial fuel light-off, turbine loading, and flame stabilization steps associated with turbine startup. There are also changes in emissions during the normal turbine shutdown sequence. For a Solar Mars 100 turbine, the startup sequence takes less than 10 minutes to complete prior to engaging the DLN system. The shutdown sequence for a Solar Mars 100 turbine requires approximately 10 minutes. Emissions during each startup/shutdown cycle are estimated by Solar at 3.10 lb NO_x, 272.70 lb CO, and 3.12 lb VOC.

Based on the manufacturer's estimated emission concentrations (ppm) and exhaust flow rates (scf), mass emissions rates (lb/hr) during the above operating modes are:

Operating Mode	Units	NO _x	CO	VOC
Full Load @ 32 °F	lb/hr	7.02	7.12	0.82
Low-Temp Operation (<0 to -20 °F)	lb/hr	21.33	30.91	1.77
Low-Load Operation (<50%)	lb/hr	16.10	653.41	7.47
Startup/Shutdown	lb/event*	3.10	272.70	3.12

*Startup/Shutdown values are lb/event not lb/hr

Additional information on turbine operating characteristics and emissions is provided in Attachment N to this application.

Attachment H

MSDSs

MSDS will be provided upon request. The proposed facility will use, handle, and store materials that are typical for a natural gas compressor station. Pipeline quality natural gas will be the primary raw material and fuel. Small quantities of lubricating oils, pipeline condensate and waste liquids will also be handled and stored at the facility.

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
T01	T01	Solar Mars 100 Turbine #1	2017	15,339 HP 32°F; 16,231 HP 0 °F	New, 2017	-
T02	T02	Solar Mars 100 Turbine #2	2017	15,339 HP 32°F; 16,231 HP 0 °F	New, 2017	-
T03	T03	Solar Mars 100 Turbine #3	2017	15,339 HP 32°F; 16,231 HP 0 °F	New, 2017	-
T04	T04	Solar Mars 100 Turbine #4	2017	15,339 HP 32°F; 16,231 HP 0 °F	New, 2017	-
G1	G1	Emergency Generator #1	2017	1,175 HP	New, 2017	-
HTR1	H1	Process Heater	2017	1.0 MMBtu/hr	New, 2017	-
HTR2	SH1	40 Catalytic Heaters	2017	40 x 0.072 MMBTU/hr	New, 2017	-

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 (ppmv or mg/m ³)
		ID No.	Source	ID No.	Device Type	Short Term ²	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
T01	Upward vertical stack	T01						NO _x	7.42	31.24			Gas	EE	
								CO	7.53	46.62			Gas	EE	
								VOC	0.86	3.75			Gas	EE	
				-			-	SO ₂	7.83	0.41			Gas	EE	
								PM	0.90	3.75			Solid	EE	
								CH ₂ O	0.10	0.40			Gas	EE	
T02	Upward vertical stack	T02						NO _x	7.42	31.24			Gas	EE	
								CO	7.53	46.62			Gas	EE	
								VOC	0.86	3.75			Gas	EE	
				-			-	SO ₂	7.83	0.41			Gas	EE	
								PM	0.90	3.75			Solid	EE	
								CH ₂ O	0.10	0.40			Gas	EE	
T03	Upward vertical stack	T03						NO _x	7.42	31.24			Gas	EE	
								CO	7.53	46.62			Gas	EE	
								VOC	0.86	3.75			Gas	EE	
				-			-	SO ₂	7.83	0.41			Gas	EE	
								PM	0.90	3.75			Solid	EE	
								CH ₂ O	0.10	0.40			Gas	EE	
T04	Upward vertical stack	T04						NO _x	7.42	31.24			Gas	EE	
								CO	7.53	46.62			Gas	EE	
								VOC	0.86	3.75			Gas	EE	
				-			-	SO ₂	7.83	0.41			Gas	EE	
								PM	0.90	3.75			Solid	EE	
								CH ₂ O	0.10	0.40			Gas	EE	
G1	Upward Vertical Stack	G1						NO _x	5.18	1.30			Gas	EE	
								CO	3.37	0.84			Gas	EE	
								VOC	0.10	0.03			Gas	EE	
				-			-	SO ₂	0.52	0.002			Gas	EE	
								PM	0.09	0.02			Solid	EE	
								CH ₂ O	0.48	0.12			Gas	EE	

**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 (ppmv or mg/m ³)
		ID No.	Source	ID No.	Device Type	Short Term ²	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
H1	To be determined	HTR1						NO _x	0.10	0.43			Gas	EE	
									0.08	0.36			Gas	EE	
									0.01	0.02			Gas	EE	
									0.06	0.003			Gas	EE	
									0.01	0.03			Solid	EE	
									0.00007	0.0003			Gas	EE	
SH1	Horizontal	HTR2					NO _x	0.28	1.24			Gas	EE		
								0.24	1.04			Gas	EE		
								0.02	0.07			Gas	EE		
								0.16	0.01			Gas	EE		
								0.02	0.09			Solid	EE		
								0.0002	0.001			Gas	EE		

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.

- Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.
- 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).
- List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS₂, VOCs, H₂S, Inorganics, Lead, Organics, O₃, NO, NO₂, SO₂, SO_x, all applicable Greenhouse Gases (including CO₂ and methane), etc. DO NOT LIST H₂, H₂O, N₂, O₂, and Noble Gases.
- 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).
- 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).
- 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).
- 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/m³) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO₂, 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.)	Temp. (°F)	Exit Gas		Emission Point Elevation (ft)		UTM Coordinates (km)	
			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
T01	8.46 ³	864	203,261	60.23	1,265	45	4414.8	535.8
T02	8.46 ³	864	203,261	60.23	1,265	45	4414.8	535.8
T03	8.46 ³	864	203,261	60.23	1,265	45	4414.8	535.8
T04	8.46 ³	864	203,261	60.23	1,265	45	4414.8	535.8
G1	1.0	839	6,171	131.0	1,265	22	4414.8	535.8
H1					1,265		4414.8	535.8
SH1					1,265		4414.8	535.8

¹ Give at operating conditions. Include inerts.

² Release height of emissions above ground level.

³ Effective diameter based on 90" square duct.

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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> 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.)? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> 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? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> 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							
Unpaved Haul Roads							
Storage Pile Emissions							
Loading/Unloading Operations							
Wastewater Treatment Evaporation & Operations							
Equipment Leaks		Methane CO ₂ GHG (CO ₂ e)	20.64 0.60 516.58	Does not apply	Does not apply	20.64 0.60 516.58	EE EE EE
General Clean-up VOC Emissions							
Other							

¹ List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. LIST Acids, CO, CS₂, VOCs, H₂S, Inorganics, Lead, Organics, O₃, NO, NO₂, SO₂, SO₃, all applicable Greenhouse Gases (including CO₂ and methane), etc. DO NOT LIST H₂, H₂O, N₂, O₂, 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).

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	N/A - less than 10% VOC			
	Light Liquid VOC				
	Heavy Liquid VOC				
Safety Relief Valves ¹¹	Non-VOC	36	0	N/A	16,616 lb CH ₄ /yr
	Gas VOC	N/A - less than 10% VOC			
	Non VOC	16	0	N/A	334 lb CH ₄ /yr
Open-ended Lines ¹²	VOC	N/A - less than 10% VOC			
	Non-VOC	77	0	N/A	13,018 lb CH ₄ /yr
	VOC	N/A - less than 10% VOC			
Sampling Connections ¹³	VOC	N/A - less than 10% VOC			
	Non-VOC	6	0	N/A	211 lb CH ₄ /yr
	VOC	N/A - less than 10% VOC			
Compressors	VOC	N/A - less than 10% VOC			
	Non-VOC	2	0	N/A	N/A - emissions included in other component estimates
	VOC	N/A - less than 10% VOC			
Flanges	VOC	N/A - less than 10% VOC			
	Non-VOC	314	0	N/A	11,058 lb CH ₄ /yr
	VOC	N/A - less than 10% VOC			
Other	VOC	N/A - less than 10% VOC			
	Non-VOC	2 meters	0	N/A	41 lb CH ₄ /yr
	VOC				

1 - 13 See notes on the following page.

Attachment L

Emissions Unit Data Sheets

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*): T1

<p>1. Name or type and model of proposed affected source:</p> <p>Solar Mars Model 100 turbine. Proposed emission unit number T01.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

* 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:			
1,115.35 million cubic feet per year (equivalent to 1,137,661 MMBtu/hr) for Turbine T01			
(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:			
methane	93.25	All values in volume percent.	
ethane	3.68		
propane	0.88		
I-Butane	0.07		
N-Butane	0.19		
I-Pentane	0.03		
N-Pentane	0.003		
Hexane	0.012		
Carbon Dioxide	0.99	Nitrogen 0.89	Sulfur Dioxide 0.0001 ash - nil
(c) Theoretical combustion air requirement (ACF/unit of fuel):			
	@	°F and	psia.
(d) Percent excess air:			
(e) Type and BTU/hr of burners and all other firing equipment planned to be used:			
137.10 MMBtu/hr at 0 °F			
(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:			
N/A			
(g) Proposed maximum design heat input:		137.10	× 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:					
@	0	°F and		Full Load	psia
a.	NO _x	7.42	lb/hr		grains/ACF
b.	SO ₂	7.83	lb/hr		grains/ACF
c.	CO	7.53	lb/hr		grains/ACF
d.	PM ₁₀	0.90	lb/hr		grains/ACF
e.	Hydrocarbons	4.31	lb/hr		grains/ACF
f.	VOCs	0.86	lb/hr		grains/ACF
g.	Pb	0.00	lb/hr		grains/ACF
h.	Specify other(s)				
	CO _{2e}	16,054	lb/hr		grains/ACF
	Formaldehyde	0.10	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.

<p>MONITORING To demonstrate compliance with the turbine annual emission rates in the permit, Columbia proposes to maintain the following records:</p> <ol style="list-style-type: none"> 1) Monthly operating hours, 2) Monthly operating hours at less than 50% load, 3) Monthly operating hours at less than 0 to -20°F ambient temperature, 4) Monthly operating hours at less than -20°F, and 5) Monthly number of startup and shutdown cycles. 	<p>RECORDKEEPING Maintain records of monitored parameters.</p>
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<p>REPORTING Notification of start-up date will be submitted within 15 days of start-up. Facility will follow same reporting requirements as currently being conducted. Performance test report will be submitted before the close of business on the 60th day following the completion of testing.</p>	<p>TESTING Columbia will conduct an initial compliance test within 60 days after achieving full-load operation or within 180 days of startup if the turbines are not operated at full load. Unless continuous parameter monitoring is implemented by Columbia, annual performance testing using EPA reference methods will be conducted within 14 calendar months following the previous performance test. Columbia will reduce the test frequency to biennial if measured NOx emissions are less than 75% of limit. Columbia requests that portable emissions analyzers be allowed for annual turbine testing.</p>
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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
 Emissions warranted above ambient temperatures of -20° F and at loads between 50 and 100% of design. Solar provides guidance on estimating emission outside those conditions but does not warrant the rates. A complete maintenance manual is beyond the scope of this form but can be provided upon request.

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*): T02

<p>1. Name or type and model of proposed affected source:</p> <p>Solar Mars Model 100 turbine. Proposed emission unit number T02.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

* 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:			
1,115.35 million cubic feet per year (equivalent to 1,137,661 MMBtu/hr) for Turbine T02			
(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:			
methane	93.25	All values in volume percent.	
ethane	3.68		
propane	0.88		
I-Butane	0.07		
N-Butane	0.19		
I-Pentane	0.03		
N-Pentane	0.003		
Hexane	0.012		
Carbon Dioxide	0.99	Nitrogen 0.89	Sulfur Dioxide 0.0001 ash - nil
(c) Theoretical combustion air requirement (ACF/unit of fuel):			
	@	°F and	psia.
(d) Percent excess air:			
(e) Type and BTU/hr of burners and all other firing equipment planned to be used:			
137.10 MMBtu/hr at 0 °F			
(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:			
N/A			
(g) Proposed maximum design heat input:		137.10	× 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:				
@	0	°F and	Full Load	psia
a. NO _x		7.42	lb/hr	grains/ACF
b. SO ₂		7.83	lb/hr	grains/ACF
c. CO		7.53	lb/hr	grains/ACF
d. PM ₁₀		0.90	lb/hr	grains/ACF
e. Hydrocarbons		4.31	lb/hr	grains/ACF
f. VOCs		0.86	lb/hr	grains/ACF
g. Pb		0.00	lb/hr	grains/ACF
h. Specify other(s)				
CO _{2e}		16,054	lb/hr	grains/ACF
Formaldehyde		0.10	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

To demonstrate compliance with the turbine annual emission rates in the permit, Columbia proposes to maintain the following records:

- 1) Monthly operating hours,
- 2) Monthly operating hours at less than 50% load,
- 3) Monthly operating hours at less than 0 to -20°F ambient temperature, and
- 4) Monthly number of startup and shutdown cycles.

RECORDKEEPING

Maintain records of monitored parameters.

REPORTING

Notification of start-up date will be submitted within 15 days of start-up. An excess emissions and monitoring systems performance report will be submitted semi-annually. Performance test report will be submitted before the close of business on the 60th day following the completion of testing.

TESTING

Columbia will conduct an initial compliance test within 60 days after achieving full-load operation or within 180 days of startup if the turbines are not operated at full load. Unless continuous parameter monitoring is implemented by Columbia, annual performance testing using EPA reference methods will be conducted within 14 calendar months following the previous performance test. Columbia will reduce the test frequency to biennial if measured NOx emissions are less than 75% of limit. Columbia requests that portable emissions analyzers be allowed for annual turbine testing.

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

Emissions warranted above ambient temperatures of -20° F and at loads between 50 and 100% of design. Solar provides guidance on estimating emission outside those conditions but does not warrant the rates. A complete maintenance manual is beyond the scope of this form but can be provided upon request.

**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*): T03

<p>1. Name or type and model of proposed affected source:</p> <p>Solar Mars Model 100 turbine. Proposed emission unit number T03.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

- * 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:			
1,115.35 million cubic feet per year (equivalent to 1,137,661 MMBtu/hr) for Turbine T03			
(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:			
methane	93.25	All values in volume percent.	
ethane	3.68		
propane	0.88		
I-Butane	0.07		
N-Butane	0.19		
I-Pentane	0.03		
N-Pentane	0.003		
Hexane	0.012		
Carbon Dioxide	0.99	Nitrogen	0.89 Sulfur Dioxide 0.0001 ash - nil
(c) Theoretical combustion air requirement (ACF/unit of fuel):			
	@	°F and	psia.
(d) Percent excess air:			
(e) Type and BTU/hr of burners and all other firing equipment planned to be used:			
137.10 MMBtu/hr at 0 °F			
(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:			
N/A			
(g) Proposed maximum design heat input:		137.10	× 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:

@	0	°F and	Full Load	psia
a. NO _x		7.42	lb/hr	grains/ACF
b. SO ₂		7.83	lb/hr	grains/ACF
c. CO		7.53	lb/hr	grains/ACF
d. PM ₁₀		0.90	lb/hr	grains/ACF
e. Hydrocarbons		4.31	lb/hr	grains/ACF
f. VOCs		0.86	lb/hr	grains/ACF
g. Pb		0.00	lb/hr	grains/ACF
h. Specify other(s)				
CO _{2e}		16,054	lb/hr	grains/ACF
Formaldehyde		0.10	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.

<p>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.</p>	
<p>MONITORING To demonstrate compliance with the turbine annual emission rates in the permit, Columbia proposes to maintain the following records:</p> <ol style="list-style-type: none"> 1) Monthly operating hours, 2) Monthly operating hours at less than 50% load, 3) Monthly operating hours at less than 0 to -20°F ambient temperature, and 4) Monthly number of startup and shutdown cycles. 	<p>RECORDKEEPING Maintain records of monitored parameters.</p>
<p>REPORTING Notification of start-up date will be submitted within 15 days of start-up. An excess emissions and monitoring systems performance report will be submitted semi-annually. Performance test report will be submitted before the close of business on the 60th day following the completion of testing.</p>	<p>TESTING Columbia will conduct an initial compliance test within 60 days after achieving full-load operation or within 180 days of startup if the turbines are not operated at full load. Unless continuous parameter monitoring is implemented by Columbia, annual performance testing using EPA reference methods will be conducted within 14 calendar months following the previous performance test. Columbia will reduce the test frequency to biennial if measured NOx emissions are less than 75% of limit. Columbia requests that portable emissions analyzers be allowed for annual turbine testing.</p>
<p>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.</p> <p>RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.</p> <p>REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.</p> <p>TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.</p>	
<p>10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty Emissions warranted above ambient temperatures of -20° F and at loads between 50 and 100% of design. Solar provides guidance on estimating emission outside those conditions but does not warrant the rates. A complete maintenance manual is beyond the scope of this form but can be provided upon request.</p>	

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*): T04

<p>1. Name or type and model of proposed affected source:</p> <p>Solar Mars Model 100 turbine. Proposed emission unit number T04.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

* 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:			
1,115.35 million cubic feet per year (equivalent to 1,137,661 MMBtu/hr) for Turbine T04			
(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:			
methane	93.25	All values in volume percent.	
ethane	3.68		
propane	0.88		
I-Butane	0.07		
N-Butane	0.19		
I-Pentane	0.03		
N-Pentane	0.003		
Hexane	0.012		
Carbon Dioxide	0.99	Nitrogen	0.89
		Sulfur Dioxide	0.0001
		ash	- nil
(c) Theoretical combustion air requirement (ACF/unit of fuel):			
	@	°F and	psia.
(d) Percent excess air:			
(e) Type and BTU/hr of burners and all other firing equipment planned to be used:			
137.10 MMBtu/hr at 0 °F			
(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:			
N/A			
(g) Proposed maximum design heat input:		137.10	× 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:				
@	0	°F and	Full Load	psia
a. NO _x		7.42	lb/hr	grains/ACF
b. SO ₂		7.83	lb/hr	grains/ACF
c. CO		7.53	lb/hr	grains/ACF
d. PM ₁₀		0.90	lb/hr	grains/ACF
e. Hydrocarbons		4.31	lb/hr	grains/ACF
f. VOCs		0.86	lb/hr	grains/ACF
g. Pb		0.00	lb/hr	grains/ACF
h. Specify other(s)				
CO ₂ e		16,054	lb/hr	grains/ACF
Formaldehyde		0.10	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

To demonstrate compliance with the turbine annual emission rates in the permit, Columbia proposes to maintain the following records:

- 1) Monthly operating hours,
- 2) Monthly operating hours at less than 50% load,
- 3) Monthly operating hours at less than 0 to -20°F ambient temperature, and
- 4) Monthly number of startup and shutdown cycles.

RECORDKEEPING

Maintain records of monitored parameters.

REPORTING

Notification of start-up date will be submitted within 15 days of start-up. An excess emissions and monitoring systems performance report will be submitted semi-annually. Performance test report will be submitted before the close of business on the 60th day following the completion of testing.

TESTING

Columbia will conduct an initial compliance test within 60 days after achieving full-load operation or within 180 days of startup if the turbines are not operated at full load. Unless continuous parameter monitoring is implemented by Columbia, annual performance testing using EPA reference methods will be conducted within 14 calendar months following the previous performance test. Columbia will reduce the test frequency to biennial if measured NOx emissions are less than 75% of limit. Columbia requests that portable emissions analyzers be allowed for annual turbine testing.

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

Emissions warranted above ambient temperatures of -20° F and at loads between 50 and 100% of design. Solar provides guidance on estimating emission outside those conditions but does not warrant the rates. A complete maintenance manual is beyond the scope of this form but can be provided upon request.

**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*): G1

<p>1. Name or type and model of proposed affected source:</p> <p>Waukesha Emergency Generator. Proposed emission point ID G1.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

* The identification number which appears here must correspond to the air pollution control device identification number appearing on the *List Form*.

8. Projected amount of pollutants that would be emitted from this affected source if no control devices were used:

@	°F and	14.7	psia
a. NO _x	5.18	lb/hr	grains/ACF
b. SO ₂	0.52	lb/hr	grains/ACF
c. CO	3.37	lb/hr	grains/ACF
d. PM ₁₀	0.09	lb/hr	grains/ACF
e. Hydrocarbons		lb/hr	grains/ACF
f. VOCs	0.10	lb/hr	grains/ACF
g. Pb	0	lb/hr	grains/ACF
h. Specify other(s)			
CO _{2e}	1,064	lb/hr	grains/ACF
Formaldehyde	0.48	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

To demonstrate compliance, Columbia proposes to maintain monthly operating hours. This monthly record will be used to track 12-month rolling operating hours.

RECORDKEEPING

Maintain records of monitored parameters

REPORTING

The 12-month rolling operating hours will be reported to the state as part of the station's semi-annual monitoring report. Performance test report will be submitted before the close of business on the 60th day following the completion of testing.

TESTING

Initial and subsequent performance tests per 40 CFR 60 Subpart JJJJ.

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
 N/A

**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*): HTR1

<p>1. Name or type and model of proposed affected source:</p> <p>Fuel gas heater. Proposed emission point ID H1.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

* 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 at a designed fuel usage of 980 ft ³ /hr.			
(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:			
methane	93.25	All values in volume percent.	
ethane	3.68		
propane	0.88		
I-Butane	0.07		
N-Butane	0.19		
I-Pentane	0.03		
N-Pentane	0.003		
Hexane	0.012		
Carbon Dioxide	0.99	Nitrogen	0.89 Sulfur Dioxide 0.0001 ash - nil
(c) Theoretical combustion air requirement (ACF/unit of fuel):			
	@	°F and	psia.
(d) Percent excess air:			
(e) Type and BTU/hr of burners and all other firing equipment planned to be used:			
1.0 MMBtu/hr			
(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:			
N/A			
(g) Proposed maximum design heat input:		1.0	× 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:

@	°F and	14.7	psia
a. NO _x	0.10	lb/hr	grains/ACF
b. SO ₂	0.06	lb/hr	grains/ACF
c. CO	0.08	lb/hr	grains/ACF
d. PM ₁₀	0.01	lb/hr	grains/ACF
e. Hydrocarbons		lb/hr	grains/ACF
f. VOCs	0.01	lb/hr	grains/ACF
g. Pb	0	lb/hr	grains/ACF
h. Specify other(s)			
CO ₂ e	117	lb/hr	grains/ACF
Formaldehyde	0.00007	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

Columbia assumes this unit will operate 8760 hours per year. No monitoring, recordkeeping, reporting, or testing is required for this unit.

RECORDKEEPING

REPORTING

TESTING

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
 N/A

**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*): HTR2

<p>1. Name or type and model of proposed affected source:</p> <p>40 Catalytic heaters for space heating. Proposed emission point ID SH1.</p>
<p>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.</p>
<p>3. Name(s) and maximum amount of proposed process material(s) charged per hour:</p> <p>N/A</p>
<p>4. Name(s) and maximum amount of proposed material(s) produced per hour:</p> <p>N/A</p>
<p>5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:</p> <p>Natural gas combustion products.</p>

* 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 at a designed maximum fuel usage of 2,824 ft ³ /hr for the combination of 40 heaters.			
(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:			
methane	93.25	All values in volume percent.	
ethane	3.68		
propane	0.88		
I-Butane	0.07		
N-Butane	0.19		
I-Pentane	0.03		
N-Pentane	0.003		
Hexane	0.012		
Carbon Dioxide	0.99	Nitrogen	0.89 Sulfur Dioxide 0.0001 ash - nil
(c) Theoretical combustion air requirement (ACF/unit of fuel):			
	@	°F and	psia.
(d) Percent excess air:			
(e) Type and BTU/hr of burners and all other firing equipment planned to be used:			
40 x 72,000 BTU/hour			
(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:			
N/A			
(g) Proposed maximum design heat input:		2.88 (combination of 40 heaters)	× 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:			
@	°F and	14.7	psia
a. NO _x	0.28	lb/hr	grains/ACF
b. SO ₂	0.16	lb/hr	grains/ACF
c. CO	0.24	lb/hr	grains/ACF
d. PM ₁₀	0.02	lb/hr	grains/ACF
e. Hydrocarbons		lb/hr	grains/ACF
f. VOCs	0.02	lb/hr	grains/ACF
g. Pb	0	lb/hr	grains/ACF
h. Specify other(s)			
CO _{2e}	337	lb/hr	grains/ACF
Formaldehyde	0.0002	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

Columbia assumes this unit will operate 8760 hours per year. No monitoring, recordkeeping, reporting, or testing is required for this unit.

RECORDKEEPING

REPORTING

TESTING

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

N/A

Attachment N

Supporting Emissions Calculations

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Facility Total PTE

Source	Annual Emissions (tpy)										Total HAP
	NO _x	CO	CO _{2e}	PM ₁₀ /PM _{2.5}	VOC	SO ₂	CH ₂ O				
Solar Mars 100 Turbine #1	31.24	46.62	66,609	3.75	3.75	0.41	0.40				0.58
Solar Mars 100 Turbine #2	31.24	46.62	66,609	3.75	3.75	0.41	0.40				0.58
Solar Mars 100 Turbine #3	31.24	46.62	66,609	3.75	3.75	0.41	0.40				0.58
Solar Mars 100 Turbine #4	31.24	46.62	66,609	3.75	3.75	0.41	0.40				0.58
Emergency Generator	1.30	0.84	266	0.02	0.03	1.62E-03	0.12				0.16
Line Heater	0.43	0.36	513	0.03	0.02	3.13E-03	3.22E-04				0.01
(40) Catalytic Heaters	1.24	1.04	1,477	0.09	0.07	9.01E-03	9.28E-04				0.02
Equipment Leaks (fugitive emissions) ¹			517		0.80						
Venting			8,034		12.41						
Proposed PTE ²	127.91	188.71	276,725	15.17	27.54	1.64	1.74				2.53
Title V Threshold	100	100	-- ³	100	100	100	10				25
PSD Applicability Threshold	250	250	-- ³	250	250	250	--				--

1. Fugitive emissions are not part of the PSD or Title V applicability analyses.

2. Excludes fugitive emissions (compressor stations are not one of the named source categories that include fugitive emissions).

3. Per 6-23-2014 Supreme Court decisions, applicability of PSD permitting cannot be triggered by GHG emissions.

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Solar Mars 100 Turbines

Horsepower 15,339 hp (32 °F)
 Brake Specific Fuel Consumption 7,628 Btu/Bhp-hr (LHV, 32 °F)
 Total Heat Input 117.00 MMBtu/hr (LHV, 32 °F)
 Maximum Heat Input (at 0 °F) 129.87 MMBtu/hr (HHV, 32 °F)³
 123.51 MMBtu/hr (LHV, 0 °F)
 137.10 MMBtu/hr (HHV, 0 °F)³
 Operating Hours 8,760 hr/yr
 Natural Gas Heat Content 1,020 Btu/scf
 Fuel Consumption 1,115.35 MMscf/yr (based on 32 °F)
 134,408 scf/hr (based on 0 °F)

4

Quantity

Pollutant	Emission Factor		lb/hr ¹	Emission Rate		Emission Factor Reference
	ppmvd@15%O ₂	lb/MMBtu		ton/yr ²	ton/yr (2 turbines)	
NO _x	15.00	0.060 LHV	7.42	31.24	124.95	Vendor Data
CO	25.00	0.061 LHV	7.53	46.62	186.47	Vendor Data
CO ₂ e		117.1 HHV	16,054	66,609	266,436	40 CFR 98 Subpart C
PM ₁₀		0.0066 HHV	0.90	3.75	15.02	AP-42 Table 3.1-2a (4/00)
PM _{2.5}		0.0066 HHV	0.90	3.75	15.02	AP-42 Table 3.1-2a (4/00)
VOC	5.00	0.007 LHV	0.86	3.75	15.01	Vendor Data (20% of UHC) ⁴
SO ₂ (Maximum Hourly)		0.0571 HHV	7.83			20 grains S / 100 scf
SO ₂ (Average Annual)		0.000714 HHV		0.41	1.62	0.25 grains S / 100 scf
Formaldehyde		0.00071 HHV	0.10	0.40	1.62	AP-42 Table 3.1-3 (4/00)
Total HAPs		0.00103 HHV	0.14	0.58	2.34	AP-42 Table 3.1-3 (4/00)

1. Maximum hourly emission rate based on 0 °F.
2. Annual emission rate based on combination of potential operating modes as provided on following page for NO_x, CO, and VOC.
3. All other pollutants based on horsepower and brake specific fuel consumption.
3. HHV heat input based on HHV=1.11*LHV
4. VOC based on 20% of vendor data for unburned hydrocarbon (UHC).

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Solar Mars 100 - Vendor Supplied Emission Rates

Operating Mode	Units	NO _x	CO	VOC
Normal Load @ 32 °F ¹	lb/hr	7.02	7.12	0.82
Low Temp (<0 to -20 °F) ²	lb/hr	21.33	30.91	1.77
Very Low Temp (<-20 °F) ²	lb/hr	60.93	46.36	1.77
Low-Load (<50%) ³	lb/hr	16.10	653.41	7.47
Startup/ Shutdown ⁴	lb/event	3.10	272.7	3.12

1. Based on data from Solar Mars 100 Compressor Set data sheet and the following concentrations:
15 ppm NO_x; 25 ppm CO; 5 ppm VOC
2. Based on data from Solar Product Information Letter (PIL) 167
3. Based on data provided by Solar for 40% load
4. Based on data from Solar PIL.170

Potential Annual Emissions Per Turbine

Operating Mode	Operating Time		NO _x ton/yr	CO ton/yr	VOC ton/yr
	Cycles	hr/yr			
Normal Load @ 32 °F		8668	30.43	30.86	3.54
Low Temp (<0 to -20 °F)		50	0.53	0.77	0.04
Very Low Temp (<-20 °F)		0	0.00	0.00	0.00
Low-Load (<50%)		25	0.20	8.17	0.09
Startup/ Shutdown	50	17	0.08	6.82	0.08
Total		8,760	31.24	46.62	3.75

Columbia Gas Transmission, LLC
Lone Oak Compressor Station

Fugitive Emissions from Leaks - Leach Xpress Project

Number of Compressors: 4
Annual Operating Hours: 8,760

Component	Average Number of Leaking Components ¹ / compressor	Emission Factor ² / component	Total Emission Rate (3 compressors)																	
			Total	CH ₄ ³ / scf/hr	CO ₂ ³ / scf/hr	CH ₄ ⁴ / lb/hr	CO ₂ ⁴ / lb/hr	CH ₄ / ton/yr	CO ₂ / ton/yr	CO ₂ e ⁵ / ton/yr	VOC ⁶ / ton/yr									
Compressor Service																				
Valve	0.55	14.84	32.65	30.44	0.32	1.29	0.04	0.04	0.04	5.64	0.16	141.27	2.18E-01							
Connector	0.62	5.59	13.86	12.93	0.14	0.55	0.02	0.02	0.02	2.40	0.07	59.99	9.27E-02							
Open-Ended Line	0.16	17.27	11.05	10.31	0.11	0.44	0.01	0.01	0.01	1.91	0.06	47.83	7.39E-02							
Pressure Relief Valve	0.00	39.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00							
Meter	0.00	19.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00							
Non-Compressor Service																				
Valve	0.60	6.42	15.41	14.37	0.15	0.61	0.02	0.02	0.02	2.66	0.08	66.67	1.03E-01							
Connector	0.82	5.71	18.73	17.46	0.19	0.74	0.02	0.02	0.02	3.24	0.09	81.04	1.25E-01							
Open-Ended Line	0.59	11.27	26.60	24.80	0.26	1.05	0.03	0.03	0.03	4.60	0.13	115.09	1.78E-01							
Pressure Relief Valve	0.12	2.01	0.96	0.90	0.01	0.04	0.00	0.00	0.00	0.17	0.00	4.17	6.45E-03							
Meter	0.01	2.93	0.12	0.11	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.51	7.83E-04							
										Total:	20.64	517	0.80							

1. Estimated component leaks per compressor based on average measurements throughout the Columbia pipeline system
2. Emission factors from 40 CFR 98 Subpart W Table W-3
3. CH₄ and CO₂ emission rates based on 93.25 vol% CH₄ and 0.99 vol% CO₂ in natural gas
4. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
5. Based on 40 CFR 98 Subpart A Global Warming Potentials
6. Based on a 0.039 ratio of VOC to methane as calculated from gas composition.

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Solar Mars 100 - Emissions from Venting - Leach Xpress Project

Number of Pneumatic Actuators:	7	per turbine
Pneumatic Actuator Vent Rate:	3	scf/hr/actuator
Number of Turbines	4	
Number of Startup/Shutdown Cycles:	50	per turbine per year
Electric Starter Emissions per Startup:	0	scf
Blowdown Emissions per Shutdown:	67,126	scf
Number of Dry Seals:	2	per turbine
Dry Seal Vent Rate:	0.5	scf/min/seal
Annual Operating Hours:	8760	

Component	Emission Rate									
	Total	CH ₄ ² scf/hr	CO ₂ ² scf/hr	CH ₄ ³ lb/hr	CO ₂ ³ lb/hr	CH ₄ ⁴ ton/yr	CO ₂ ⁴ ton/yr	CO ₂ ^{e4} ton/yr	VOC ⁶ ton/yr	
Continuous During Operation	scf/hr	scf/hr	scf/hr	lb/hr	lb/hr	ton/yr	ton/yr	ton/yr	ton/yr	
Pneumatic Actuator (Total for number of units) ¹	84.00	78.33	0.83	3.32	0.10	14.52	0.42	363.48	0.56	
Dry Seals (Total for number of units)	240.00	223.80	2.38	9.47	0.28	41.49	1.21	1038.52	1.60	
Intermittent During Startup/Shutdown	scf/event	scf/event	scf/event	lb/event	lb/event	ton/yr	ton/yr	ton/yr	ton/yr	
Electric Starter (Total for number of units) ¹	0	0	0	0	0	0	0	0	0.00	
Blowdowns (Total for number of units) ^{1,5}	67,126	62,595	665	2,650	77	265	8	6,632	10.24	
Total:							Total:	8,034	12.41	

1. Emission rates per event instead of per hour
2. CH₄ and CO₂ emission rates based on 93.25 vol% CH₄ and 0.99 vol% CO₂ in natural gas
3. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
4. Based on 40 CFR 98 Subpart A Global Warming Potentials
5. Conservative estimate based on 1 blowdown per shutdown. It is not expected that a blowdown will occur after each shutdown.
6. Based on a 0.039 ratio of VOC to methane as calculated from gas composition

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Waukesha Emergency Generator

Horsepower 1,175 hp
 Brake Specific Fuel Consumption 7,733 Btu/Bhp-hr
 Total Heat Input 9.09 MMBtu/hr
 Operating Hours 500 hr/yr
 Natural Gas Heat Content 1,020 Btu/scf
 Fuel Consumption 4.45 MMscf/yr
 8,908 scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	g/bhp-hr	lb/MMBtu	lb/hr	ton/yr	
NO _x	2.00		5.18	1.30	Vendor Data
CO	1.30		3.37	0.84	Vendor Data
CO ₂ e		117.1	1,064	266	40 CFR 98 Subpart C
PM ₁₀		0.010	0.09	0.02	AP-42 Table 3.2-2 (700) - 4SLB
PM _{2.5}		0.010	0.09	0.02	AP-42 Table 3.2-2 (700) - 4SLB
VOC	0.04		0.10	0.03	Vendor Data
SO ₂ (Maximum Hourly)		0.0571	0.52		20 grains S / 100 scf
SO ₂ (Average Annual)		0.000714		1.62E-03	0.25 grains S / 100 scf
Formaldehyde		0.05280	0.48	0.12	AP-42 Table 3.2-2 (700) - 4SLB
Total HAPs		0.07220	0.66	0.16	AP-42 Table 3.2-2 (700) - 4SLB

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Indirect-fired Heat Exchanger

Heat Input 1.00 MMBtu/hr
 Operating Hours 8,760 hr/yr
 Natural Gas Heat Content 1,020 Btu/scf
 Fuel Consumption 8.59 MMscf/yr
 980 scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	lb/MMscf	lb/MMBtu	lb/hr	ton/yr	
NO _x	100	0.098	0.10	0.43	AP-42 Table 1.4-1 (7/98)
CO	84	0.082	0.08	0.36	AP-42 Table 1.4-1 (7/98)
CO ₂ e		117.1	117	513	40 CFR 98 Subpart C
PM ₁₀	7.6	0.007	0.01	0.03	AP-42 Table 1.4-2 (7/98)
PM _{2.5}	7.6	0.007	0.01	0.03	AP-42 Table 1.4-2 (7/98)
VOC	5.5	0.005	0.01	0.02	AP-42 Table 1.4-2 (7/98)
SO ₂ (Maximum Hourly)		0.0571	0.06		20 grains S / 100 scf
SO ₂ (Average Annual)		0.000714		3.13E-03	0.25 grains S / 100 scf
Formaldehyde	0.075	0.00007	7.35E-05	3.22E-04	AP-42 Table 1.4-3 (7/98)
Total HAP's	1.89	0.00185	1.85E-03	8.11E-03	AP-42 Table 1.4-3 & 4 (7/98)

**Columbia Gas Transmission, LLC
Lone Oak Compressor Station**

Catalytic Space Heaters

Heat Input 0.072 MMBtu/hr
 Quantity 40
 Total Heat Input 2.88 MMBtu/hr
 Operating Hours 8,760 hr/yr
 Natural Gas Heat Content 1,020 Btu/scf
 Fuel Consumption 24.73 MMscf/yr
 2,824 scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	lb/MMscf	lb/MMBtu	lb/hr (40 heaters)	ton/yr	
NO _x	100	0.098	0.28	1.24	AP-42 Table 1.4-1 (7/98)
CO	84	0.082	0.24	1.04	AP-42 Table 1.4-1 (7/98)
CO ₂ e		117.1	337	1,477	40 CFR 98 Subpart C
PM ₁₀	7.6	0.007	0.02	0.09	AP-42 Table 1.4-2 (7/98)
PM _{2.5}	7.6	0.007	0.02	0.09	AP-42 Table 1.4-2 (7/98)
VOC	5.5	0.005	0.02	0.07	AP-42 Table 1.4-2 (7/98)
SO ₂ (Maximum Hourly)		0.0571	0.16		20 grains S / 100 scf
SO ₂ (Average Annual)		0.000714		0.01	0.25 grains S / 100 scf
Formaldehyde	0.075	0.00007	2.12E-04	9.28E-04	AP-42 Table 1.4-3 (7/98)
Total HAPs	1.89	0.00185	5.33E-03	0.02	AP-42 Table 1.4-3 & 4 (7/98)

Solar Turbines

A Caterpillar Company

PREDICTED EMISSION PERFORMANCE

Customer	
Job ID	
Inquiry Number	
Run By Trevor T Keeney	Date Run 22-Aug-14

Engine Model MARS 100-16000S CS/MD STANDARD	
Fuel Type CHOICE GAS	Water Injection NO
Engine Emissions Data REV. 1.0	

NOx EMISSIONS	CO EMISSIONS	UHC EMISSIONS
----------------------	---------------------	----------------------

2	16231 HP	100.0% Load	Elev. 1330 ft	Rel. Humidity 60.0%	Temperature 0 Deg. F
	PPMvd at 15% O2		15.00	25.00	25.00
	ton/yr		32.52	32.99	18.90
	lbm/MMBtu (Fuel LHV)		0.060	0.061	0.035
	lbm/(MW-hr)		0.61	0.62	0.36
	(gas turbine shaft pwr) lbm/hr		7.42	7.53	4.31

3	15339 HP	100.0% Load	Elev. 1330 ft	Rel. Humidity 60.0%	Temperature 32.0 Deg. F
	PPMvd at 15% O2		15.00	25.00	25.00
	ton/yr		30.74	31.20	17.87
	lbm/MMBtu (Fuel LHV)		0.060	0.061	0.035
	lbm/(MW-hr)		0.61	0.62	0.36
	(gas turbine shaft pwr) lbm/hr		7.02	7.12	4.08

4	14340 HP	100.0% Load	Elev. 1330 ft	Rel. Humidity 60.0%	Temperature 59.0 Deg. F
	PPMvd at 15% O2		15.00	25.00	25.00
	ton/yr		29.03	29.46	16.87
	lbm/MMBtu (Fuel LHV)		0.060	0.061	0.035
	lbm/(MW-hr)		0.62	0.63	0.36
	(gas turbine shaft pwr) lbm/hr		6.63	6.73	3.85

Notes

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

Solar Turbines

A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer	
Job ID	
Run By Trevor T Keeney	Date Run 22-Aug-14
Engine Performance Code REV. 4.13.1.15.9	Engine Performance Data REV. 1.0

Model MARS 100-16000S
Package Type CS/MD
Match STANDARD
Fuel System GAS
Fuel Type CHOICE GAS

DATA FOR MINIMUM PERFORMANCE

Elevation	feet	1330
Inlet Loss	in H2O	4.0
Exhaust Loss	in H2O	4.0
Accessory on GP Shaft	HP	27.8

		1	2	3	4
Engine Inlet Temperature	deg F	-20.0	0	32.0	59.0
Relative Humidity	%	60.0	60.0	60.0	60.0
Driven Equipment Speed	RPM	9444	9387	9247	9067
Specified Load	HP	FULL	FULL	FULL	FULL
Net Output Power	HP	16493	16231	15339	14340
Fuel Flow	mmBtu/hr	126.75	123.51	117.00	110.97
Heat Rate	Btu/HP-hr	7685	7609	7628	7738
Therm Eff	%	33.110	33.438	33.358	32.880
Engine Exhaust Flow	lbm/hr	357399	349513	334858	318350
PT Exit Temperature	deg F	855	864	885	908
Exhaust Temperature	deg F	854	864	885	908

Fuel Gas Composition (Volume Percent)	Methane (CH4)	96.19
	Ethane (C2H6)	1.73
	Propane (C3H8)	0.22
	I-Butane (C4H10)	0.04
	N-Butane (C4H10)	0.05
	I-Pentane (C5H12)	0.02
	N-Pentane (C5H12)	0.05
	Hexane (C6H14)	0.02
	Carbon Dioxide (CO2)	1.44
	Nitrogen (N2)	0.25
Sulfur Dioxide (SO2)	0.0001	

Fuel Gas Properties	LHV (Btu/Scf)	913.6	Specific Gravity	0.5823	Wobbe Index at 60F	1197.3
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This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.

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 $\geq 0^{\circ}\text{F}$ (-20°C). The *Titan*[™] 250 is an exception, with a lower standard warranty at $\geq -20^{\circ}\text{F}$ (-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% O₂. 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.

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% O₂. 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% O₂ 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
<i>Centaur 50</i>	Gas Only	Gas	50 to 100% load	42	100	50
	Dual Fuel	Gas	50 to 100% load	72	100	50
<i>Taurus™ 60</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
<i>Taurus 65</i>	Gas Only	Gas	50 to 100% load	42	100	50
<i>Taurus 70</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
<i>Mars® 90</i>	Gas Only	Gas	50 to 100% load	42	100	50
<i>Mars 100</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
<i>Titan 130</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
<i>Titan 250</i>	Gas Only	Gas	40 to 100% load	25	50	25
	Gas Only	Gas	40 to 100% load	15	25	25
<i>Centaur 50</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Taurus 60</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Taurus 70</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Mars 100</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Titan 130</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75

Table 2. Expected Emissions below 0°F (-20°C) for SoLoNOx Combustion Turbines

Turbine Model	Fuel System	Fuel	Applicable Load	NO _x , ppm	CO, ppm	UHC, ppm
<i>Centaur 40</i>	Gas Only or Dual Fuel	Gas	80 to 100% load	120	150	50
<i>Centaur 50</i>	Gas Only	Gas	50 to 100% load	120	150	50
	Dual Fuel	Gas	50 to 100% load	120	150	50
<i>Taurus 60</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
<i>Taurus 65</i>	Gas Only	Gas	50 to 100% load	120	150	50
<i>Taurus 70</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
<i>Mars 90</i>	Gas Only	Gas	80 to 100% load	120	150	50
<i>Mars 100</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
<i>Titan 130</i>	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
<i>Centaur 40</i>	Dual Fuel	Liquid	80 to 100% load	120	150	75
<i>Centaur 50</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Taurus 60</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Taurus 70</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Mars 100</i>	Dual Fuel	Liquid	65 to 100% load	120	150	75
<i>Titan 130</i>	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	NO _x , ppm	CO, ppm	UHC, ppm
<i>Titan 250</i>	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 NO_x values in Tables 1, 2 and 3 is to reference 40CFR60 subpart KKKK, which allows 150 ppm NO_x at 15% O₂ 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 (T₁) above 0°F. With inlet air heating to keep T₁ 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 (T₁) to at least -20°F. In such cases, the values shown in Table 1 can be warranted for new production.

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% O₂ 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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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 (SO₂), 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, SO₂ 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 SO₂. Since Solar does not control the amount of sulfur in the fuel, we are unable to predict SO₂ emissions without a site fuel composition analysis. Customers generally estimate SO₂ emissions with a mass balance calculation by assuming that any sulfur in the fuel will convert to SO₂. 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-

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

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

**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 47025				Centaur 50 48025				Taurus 60 78025			
	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)	0.1	64.4	3.7	392	0.8	69.1	4.0	429	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	208

	Taurus 70 183025				Herc 90 138025 CS/MD				Eurus 100 160025 (SR10)				Titan 250 160025			
	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	73.7	4.2	516	1.7	109.1	6.2	602	1.4	121.5	7.1	829	1.9	176.9	10.1	1,151
Total Emissions per Shutdown (lbs)	1.1	93.4	5.2	575	1.5	132.6	7.6	617	1.7	140.2	8.5	920	2.4	207.6	11.9	1,232

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.

Solar Turbines Estimated Emissions

Assumptions: pipeline nat gas gas, 32F, 0' MSL, 4" inlet/outlet losses, nominal perf.

Centaur 40S						
Load	NOx ppm	NOx lb/hr	CO ppm	CO lb/hr	UHC ppm	UHC lb/hr
10%	54	3.3	9600	358	960	20.5
40%	66	7.5	4400	305	440	17.4
Taurus 60S						
Load	NOx ppm	NOx lb/hr	CO ppm	CO lb/hr	UHC ppm	UHC lb/hr
10%	54	3.1	9600	337	960	19.3
40%	66	8.5	4400	345	440	19.7
Taurus 70S						
Load	NOx ppm	NOx lb/hr	CO ppm	CO lb/hr	UHC ppm	UHC lb/hr
10%	54	4.9	9600	531	960	30.3
40%	66	14.5	4400	586	440	33.5
Mars 90S						
Load	NOx ppm	NOx lb/hr	CO ppm	CO lb/hr	UHC ppm	UHC lb/hr
10%	54	5.2	9600	528	960	32.5
40%	66	14.3	4400	582	440	33.2
Mars 100S						
Load	NOx ppm	NOx lb/hr	CO ppm	CO lb/hr	UHC ppm	UHC lb/hr
10%	54	5.9	9600	636	960	36.4
40%	66	16.1	4400	653	440	37.3
Titan 130S						
Load	NOx ppm	NOx lb/hr	CO ppm	CO lb/hr	UHC ppm	UHC lb/hr
10%	54	7.5	9600	825	960	45.2
40%	66	21.0	4400	851	440	48.6



VGf - P48GL

Power Generation - Standby

ENGINE SPEED (rpm):	1800	COOLING SYSTEM:	JW, IC + OC
DISPLACEMENT (in ³):	2924	INTERCOOLER WATER INLET (°F):	130
COMPRESSION RATIO:	11:1	JACKET WATER OUTLET (°F):	180
IGNITION SYSTEM:	CEC	JACKET WATER CAPACITY (gal):	58
EXHAUST MANIFOLD:	Water Cooled	AUXILIARY WATER CAPACITY (gal):	14
COMBUSTION:	Lean Burn, Open Chamber	LUBE OIL CAPACITY (gal):	113
ENGINE DRY WEIGHT (lbs):	14900	MAX. EXHAUST BACKPRESSURE (in. H ₂ O):	15
AIR/FUEL RATIO SETTING:	7.8% O ₂	MAX. AIR INLET RESTRICTION (in. H ₂ O):	15
ENGINE SOUND LEVEL (dBA)	101	EXHAUST SOUND LEVEL (dBA)	112
IGNITION TIMING:	13° BTDC	PHASE:	3
FREQUENCY (Hz):	60	PHASE ROTATION:	T1-T2-T3
GENERATOR TYPE:	Synchronous		
VOLTAGE:	480		

SITE CONDITIONS:

FUEL:	Commercial Quality Natural Gas	ALTITUDE (ft):	1500
FUEL PRESSURE RANGE (psig):	26 - 50	MAXIMUM INLET AIR TEMPERATURE (°F):	90
FUEL HHV (BTU/r ³):	1,035.2	FUEL WKI:	91.8
FUEL LHV (BTU/r ³):	935.8		

SITE SPECIFIC TECHNICAL DATA

POWER RATING	UNITS	MAX RATING	RTE RATING AT MAXIMUM INLET AIR TEMPERATURE OF 90 °F		
		AT 180 °F AIR TEMP	100%	75%	50%
CONTINUOUS ENGINE POWER	BHP	1175	1174	881	585
OVERLOAD	% 2/24 hr	5	5	-	-
ELECTRICAL EFFICIENCY (LHV)	%	34.6	34.5	33.0	30.3
GENERATOR OUTPUT	kWe	831	830	623	413
GENERATOR KVA	kVA	1039	1038	779	516
GENERATOR CURRENT	Amps	1251	1250	938	621

based on 94.8% generator efficiency at 0.8 PF, no auxiliary engine driven equipment

FUEL CONSUMPTION

FUEL CONSUMPTION (LHV)	BTU/BHP-hr	6991	6991	7314	7964
FUEL CONSUMPTION (HHV)	BTU/BHP-hr	7733	7734	8090	8809
FUEL FLOW	SCFM	146	146	115	83

based on fuel analysis LHV

HEAT REJECTION

JACKET WATER (JW)	BTU/hr x 1000	2133	2119	1848	1502
LUBE OIL (OC)	BTU/hr x 1000	260	259	238	223
INTERCOOLER (IC)	BTU/hr x 1000	595	569	367	198
EXHAUST	BTU/hr x 1000	2277	2303	1746	1209
RADIATION	BTU/hr x 1000	118	130	128	127

EMISSIONS

NOx (NO + NO ₂)	g/bhp-hr	2.0	2.0	2.0	2.0
CO	g/bhp-hr	1.3	1.3	1.4	1.6
THC	g/bhp-hr	1.6	1.6	1.9	2.1
NMHC	g/bhp-hr	0.24	0.24	0.28	0.32
NM, NEHC	g/bhp-hr	0.04	0.04	0.05	0.06
CH ₄	g/bhp-hr	1.36	1.36	1.60	1.81
CO ₂	g/bhp-hr	433	433	453	493
CO _{2e}	g/bhp-hr	463	463	489	534
CH ₂ O	g/bhp-hr	0.19	0.19	0.22	0.25

AIR INTAKE / EXHAUST GAS

INDUCTION AIR FLOW	SCFM	2479	2477	1945	1405
EXHAUST GAS MASS FLOW	lb/hr	10805	10798	8478	6126
EXHAUST GAS FLOW	ACFM	6171	6166	4807	3443
EXHAUST TEMPERATURE	°F	839	839	830	819

at exhaust temp, 14.5 psia

HEAT EXCHANGER SIZING

TOTAL JACKET WATER CIRCUIT (JW)	BTU/hr x 1000	2419
TOTAL AUXILIARY WATER CIRCUIT (IC + OC)	BTU/hr x 1000	970

COOLING SYSTEM WITH ENGINE MOUNTED WATER PUMPS

JACKET WATER PUMP MIN. DESIGN FLOW	GPM	280
JACKET WATER PUMP MAX. EXTERNAL RESTRICTION	psig	27
AUX WATER PUMP MIN. DESIGN FLOW	GPM	87
AUX WATER PUMP MAX. EXTERNAL RESTRICTION	psig	8



VGF - P48GL

Power Generation - Standby

FUEL COMPOSITION

HYDROCARBONS:

		<u>Mole or Volume %</u>
Methane	CH4	93
Ethane	C2H6	4
Propane	C3H8	1
Iso-Butane	I-C4H10	0
Normal Butane	N-C4H10	0
Iso-Pentane	I-C5H12	0
Normal Pentane	N-C5H12	0
Hexane	C6H14	0
Heptane	C7H16	0
Ethene	C2H4	0
Propene	C3H6	0

SUM HYDROCARBONS 98

NON-HYDROCARBONS:

Nitrogen	N2	0
Oxygen	O2	0
Helium	He	0
Carbon Dioxide	CO2	2
Carbon Monoxide	CO	0
Hydrogen	H2	0
Water Vapor	H2O	0

TOTAL FUEL 100

FUEL:	Commercial Quality Natural Gas
FUEL PRESSURE RANGE (psig):	26 - 50
FUEL WKI:	91.8
FUEL SLHV (BTU/ft3):	919.50
FUEL SLHV (MJ/Nm3):	36.16
FUEL LHV (BTU/ft3):	935.78
FUEL LHV (MJ/Nm3):	36.80
FUEL HHV (BTU/ft3):	1035.15
FUEL HHV (MJ/Nm3):	40.71
FUEL DENSITY (SG):	0.60

Standard Conditions per ASTM D3588-91 [60°F and 14.696psia] and ISO 6976:1996-02-01[25, V(0;101.325)].
 Based on the fuel composition, supply pressure and temperature, liquid hydrocarbons may be present in the fuel. No liquid hydrocarbons are allowed in the fuel. The fuel must not contain any liquid water.
 Waukesha recommends both of the following:
 1) Dew point of the fuel gas to be at least 20°F (11°C) below the measured temperature of the gas at the inlet of the engine fuel regulator.
 2) A fuel filter separator to be used on all fuels except commercial quality natural gas.
 Refer to the 'Fuel and Lubrication' section of 'Technical Data' or contact the Waukesha Application Engineering Department for additional information on fuels, or LHV and WKI* calculations.
 * Trademark of General Electric Company

FUEL CONTAMINANTS

Total Sulfur Compounds	0 % volume
Total Halogen as Chloride	0 % volume
Total Ammonia	0 % volume
<u>Siloxanes</u>	
Tetramethyl silane	0 % volume
Trimethyl silanol	0 % volume
Hexamethyldisiloxane (L2)	0 % volume
Hexamethylcyclotrisiloxane (D3)	0 % volume
Octamethyltrisiloxane (L3)	0 % volume
Octamethylcyclotetrasiloxane (D4)	0 % volume
Decamethyltetrasiloxane (L4)	0 % volume
Decamethylcyclopentasiloxane (D5)	0 % volume
Dodecamethylpentasiloxane (L5)	0 % volume
Dodecamethylcyclohexasiloxane (D6)	0 % volume
Others	0 % volume

Total Sulfur Compounds	0 µg/BTU
Total Halogen as Chloride	0 µg/BTU
Total Ammonia	0 µg/BTU
Total Siloxanes (as Si)	0 µg/BTU

Calculated fuel contaminant analysis will depend on the entered fuel composition and selected engine model.

**NOTES**

1. All data is based on engines with standard configurations unless noted otherwise.
2. Power rating is adjusted for fuel, site altitude, and site air inlet temperature, in accordance with ISO 3046/1 with tolerance of $\pm 3\%$.
3. Fuel consumption is presented in accordance with ISO 3046/1 with a tolerance of $-0 / +5\%$ at maximum rating. Fuel flow calculation based on fuel LHV and fuel consumption with a tolerance of $-0/+5\%$. For sizing piping and fuel equipment, it is recommended to include the 5% tolerance.
4. Heat rejection tolerances are $\pm 30\%$ for radiation, and $\pm 8\%$ for jacket water, lube oil, intercooler, and exhaust energy.
5. Emission levels are given at engine exhaust outlet flange prior to any after treatment. Values are based on a new engine operating at indicated site conditions, and adjusted to the specified timing and air/fuel ratio at rated load. Emissions are at an absolute humidity of 75 grains H₂O/lb (10.71 g H₂O/kg) of dry air. Emission levels may vary subject to instrumentation, measurement, ambient conditions, fuel quality, and engine variation. Engine may require adjustment on-site to meet emission values, which may affect engine performance and heat output. NO_x, CO, THC, and NMHC emission levels are listed as a not to exceed limit, all other emission levels are estimated. CO₂ emissions based on EPA Federal Register/Vol. 74, No. 209/Friday, October 30, 2009 Rules and Regulations 56398, 56399 (3) Tier 3 Calculation Methodology, Equation C-5.
6. Air flow is based on undried air with a tolerance of $\pm 7\%$.
7. Exhaust temperature given at engine exhaust outlet flange with a tolerance of $\pm 75^\circ\text{F}$ (42°C).
8. Exhaust gas mass flow value is based on a "wet basis" with a tolerance of $\pm 7\%$.
9. Inlet air restrictions based on full rated engine load. Exhaust backpressure based on 176 PSI BMEP and 1800 RPM. Refer to the engine specification section of Waukesha's standard technical data for more information.
10. Cooling circuit capacity, lube oil capacity, and engine dry weight values are typical.
11. Fuel must conform to Waukesha's "Gaseous Fuel Specification" S7884-7 or most current version. Fuel may require treatment to meet current fuel specification.
12. Heat exchanger sizing values given as the maximum heat rejection of the circuit, with applied tolerances and an additional 5% reserve factor.
13. Fuel volume flow calculation in english units is based on 100% relative humidity of the fuel gas at standard conditions of 60°F and 14.696 psia (29.92 inches of mercury; 101.325 kPa).
14. Fuel volume flow calculation in metric units is based on 100% relative humidity of the fuel gas at a combustion temperature of 25°C and metering conditions of 0°C and 101.325 kPa (14.696 psia; 29.92 inches of mercury). This is expressed as $[25, V(0;101.325)]$.
15. Engine sound data taken with the microphone at 1 m (3.3 ft) from the side of the engine at the approximate front-to-back centerline. Microphone height was at intake manifold level. Engine sound pressure data may be different at front, back and opposite side locations. Exhaust sound data taken with microphone 1 meter (3.3 ft) away and 1 meter (3.3 ft) to the side of the exhaust outlet.
16. Due to variation between test conditions and final site conditions, such as exhaust configuration and background sound level, sound pressure levels under site conditions may be different than those tabulated above.
17. Cooling system design flow is based on minimum allowable cooling system flow. Cooling system maximum external restriction is defined as the allowable restriction at the minimum cooling system flow. Refer to technical data sheets S-7788 and S-7788-1 (or latest version) for more information.
18. Generator Standby Power Rating (kW_e): This rating applies to those systems used as a secondary source of electrical power. This rating is the output the system will produce continuously 24 hours per day for the duration of the prime power source outage. No overload is allowed. This rating may reduce the lifecycle intervals.

REQUIRED OPTION CODES

Requires option code 1100 for continuous operation up to 176 psi (12.1 bar) BMEP.

Attachment O

**Monitoring / Recordkeeping / Reporting /
Testing Plans**

Monitoring/Recordkeeping/Reporting/Testing Plans

Turbines T01, T02, T03, & T04

To demonstrate compliance with the turbine annual emission rates in the permit, Columbia proposes to maintain the following records:

- 1) Monthly operating hours,
- 2) Monthly operating hours at less than 50% load,
- 3) Monthly operating hours at less than 0 to -20 °F ambient temperature,
- 4) Monthly operating hours at less than -20 °F, and
- 5) Monthly number of startup and shutdown cycles.

These monthly records will be used in conjunction with the emission factors in Attachment N to calculate monthly emissions and 12-month rolling sums. Monthly emission (ME) for each regulated pollutant (P_x) will be calculated using the following equation:

$$ME_{P_x} = DLN_{P_x} * DLN \text{ hrs} + LL_{P_x} * LL \text{ hrs} + LT_{P_x} * LT \text{ hrs} + SS_{P_x} * SS \text{ cycles}$$

where:

DLN_{P_x} is the unit emission rates (lb/hr) for pollutant X during normal DLN operation,
 LL_{P_x} is the unit emission rates (lb/hr) for pollutant X during low-load operation,
 LT_{P_x} is the unit emission rates (lb/hr) for pollutant X during low-temperature operation, and
 SS_{P_x} is the unit emission rates (lb/cycle) for pollutant X during startup/shutdown operation.

The unit emission rates for each pollutant during DLN, LL, LT, VLT, and SS operation are summarized in the following table.

Operating Mode	Units	NO _x	CO	VOC	SO ₂ ^{1,2}	PM ²
Full Load @ 32 °F	lb/hr	7.02	7.12	0.82	0.09	0.86
Low-Temp Operation (< 0 to -20 °F)	lb/hr	21.33	30.91	1.77	0.09	0.86
Low-Load Operation (< 50%)	lb/hr	16.10	653.41	7.47	0.09	0.86
Startup/Shutdown	lb/event ³	3.10	272.70	3.12	0.03	0.29

¹ Based on typical U.S. gas quality of 0.25 gr/100 scf.

² Based on annual average potential to emit.

³ Sum of expected shutdown and startup lb/event emissions.

At the end of each month, the monthly emissions will be summed for the preceding 12 months to determine compliance with the proposed annual emission limits. The 12-month rolling emissions will be reported to the state as part of the station's semi-annual monitoring report.

To demonstrate compliance with Subpart KKKK, 40 CFR §60.4400, an initial NO_x performance test using EPA reference methods is required. Therefore, Columbia will conduct an initial compliance test within 60 days after achieving full-load operation or within 180 days of startup if the turbines are not operated at full load. Unless continuous parameter monitoring is implemented by Columbia, annual performance testing using EPA reference methods will be conducted within 14 calendar months following the

previous performance test. Columbia will reduce the test frequency to biennial if measured NO_x emissions are less than 75% of limit. Columbia requests that portable emissions analyzers be approved for annual turbine testing. In addition, the station will continuously monitor the turbines to document any periods during which the SoLoNO_x system is not in service (e.g., during startup, shutdown, low-load, or a system malfunction). Records of turbine startup, shutdown, SoLoNO_x malfunction, and/or SoLoNO_x monitoring system malfunction will be recorded per Subpart KKKK and NSPS General Provisions in 40 CFR §60.7(b) & (c). Compliance with the SO₂ and fuel sulfur content limits can be demonstrated by monitoring natural gas sulfur content annually. However, per 40 CFR §60.4365(a), Columbia will exempt the proposed turbines from periodic monitoring by demonstrating compliance with the FERC tariff limit on total sulfur content of 20 grains of sulfur per 100 standard cubic feet.

Emergency Generator G1

Columbia will submit the initial notification as per 40 CFR Part 60 to comply with Subpart JJJJ for the emergency generator. This preconstruction permit application will satisfy the initial notification requirement. Compliance with the 40 CFR 60 Subpart JJJJ emission limitations will be demonstrated through the required initial and subsequent testing required by the Subpart. Columbia will maintain records of monthly operating hours to demonstrate compliance with the proposed annual emissions limitations.

Attachment P

Public Notice

AIR QUALITY PERMIT NOTICE Notice of Application

Notice is given that Columbia Gas Transmission LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a New Source Review (NSR) preconstruction permit for a proposed natural gas compression station located off Waynesburg Pike in Marshall County, West Virginia. The latitude and longitude coordinates are: 39° 52' 56.53" N and 80° 34' 51.95" W.

The applicant estimates, if the preconstruction application is approved, the potential to discharge the following Regulated Air Pollutants will be: Carbon Monoxide at 188.7 tons per year, Nitrogen Oxides at 127.9 tons per year, PM10 and PM2.5 at 15.2 tons per year, Sulfur Dioxide at 1.64 tons per year, Volatile Organic Compounds (VOC) at 27.5 tons per year, Carbon Dioxide Equivalents (CO₂e) at 276,725 tons per year, Formaldehyde at 1.74 tons per year, and Total Hazardous Air Pollutants (HAPs) at 2.53 tons per year.

Startup of operation is planned to begin on or about the 1st day of November, 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 1227, during normal business hours.

Dated this the 3rd day of June, 2015.

By: Columbia Gas Transmission LLC
Glenn Fyola
Manager of Operations
950 Manifold Road
Washington, PA 15301