Columbia Pipeline Group

201 Energy Parkway Suite 100, Lafayette, LA 70508
Phone: 337-241-0686
livey@cpg.com

April 29, 2016

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

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

Dear Mr. Durham,

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

- Two (2) Solar Turbines Titan 130E turbines (20,912 hp each);
- One (1) Waukesha emergency generator (1,175 hp);
- One (1) process heater (1.41 MMBtu/hr);
- Forty (40) catalytic heaters (0.072 MMBtu/hr each); and
- One (1) new 2,000 gallon condensate tank.

The Station's potential to emit (PTE) is over 100 tons per year for 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 facility is operational, 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 attachments 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 me at (337) 241-0686.

Sincerely,

Lacey A. Ivey
Principal Air
Columbia Pipeline Group

Attachments

APPLICATION FOR 45 CSR 13 CONSTRUCTION PERMIT

Columbia Gas Transmission, LLC
White Oak Compressor Station
Calhoun County, West Virginia

April 2016

Table of Contents

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF AIR QUALITY

601 57th Street, SE
Charleston, WV 25304
(304) 926-0475
www.dep.wv.gov/daq

APPLICATION FOR NSR PERMIT AND TITLE V PERMIT REVISION (OPTIONAL)

PLEASE CHECK ALL THAT APPLY TO **NSR (45CSR13)** (IF KNOWN):

☒ **CONSTRUCTION** ☐ **MODIFICATION** ☐ **RELOCATION**
☐ **CLASS I ADMINISTRATIVE UPDATE** ☐ **TEMPORARY**
☐ **CLASS II ADMINISTRATIVE UPDATE** ☐ **AFTER-THE-FACT**

PLEASE CHECK TYPE OF **45CSR30 (TITLE V)** REVISION (IF ANY):

☐ **ADMINISTRATIVE AMENDMENT** ☐ **MINOR MODIFICATION**
☐ **SIGNIFICANT MODIFICATION**

IF ANY BOX ABOVE IS CHECKED, INCLUDE TITLE V REVISION INFORMATION AS **ATTACHMENT S** TO THIS APPLICATION

FOR TITLE V FACILITIES ONLY: Please refer to "Title V Revision Guidance" in order to determine your Title V Revision options (Appendix A, "Title V Permit Revision Flowchart") and ability to operate with the changes requested in this Permit Application.

Section I. General

1. Name of applicant *(as registered with the WV Secretary of State's Office):*
Columbia Gas

2. Federal Employer ID No. ***(FEIN):***
310802435

3. Name of facility *(if different from above):*
White Oak Compressor Station

4. The applicant is the:
☐ **OWNER** ☐ **OPERATOR** ☒ **BOTH**

5A. Applicant's mailing address:
Columbia Gas Transmission LLC
1700 MacCorkle Ave, SE
Charleston, WV 25314

5B. Facility's present physical address:
Frederick Ridge Road (Rt. 21/3)
Brohard, West Virginia 26148

6. **West Virginia Business Registration.** Is the applicant a resident of the State of West Virginia? ☒ **YES** ☐ **NO**
- If **YES,** provide a copy of the **Certificate of Incorporation/Organization/Limited Partnership** (one page) including any name change amendments or other Business Registration Certificate as **Attachment A.**
- If **NO,** provide a copy of the **Certificate of Authority/Authority of L.L.C./Registration** (one page) including any name change amendments or other Business Certificate as **Attachment A.**

7. If applicant is a subsidiary corporation, please provide the name of parent corporation: Columbia Pipeline Group, Inc.

8. Does the applicant own, lease, have an option to buy or otherwise have control of the *proposed site?* ☒ **YES** ☐ **NO**
- If **YES,** please explain: 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.

12A.

- For **Modifications, Administrative Updates** or **Temporary permits** at an existing facility, please provide directions to the *present location* of the facility from the nearest state road;
- For **Construction** or **Relocation permits,** please provide directions to the *proposed new site location* from the nearest state road. Include a **MAP** as **Attachment B.**

From the town of Brohard, head southeast on Brohard Rd. toward Dutchman Run and turn right to stay on Brohard Rd. Continue on Co. Route 5/3. In approximately 1 mile, turn left onto Co. Route 21/3. The Station will be on the right in approximately 1.6 miles.

12.B. New site address (if applicable):	12C. Nearest city or town:	12D. County:
Frederick Ridge Road (Rt. 21/3) Brohard, West Virginia 26148	Brohard	Calhoun
12.E. UTM Northing (KM): 4,321.4	12F. UTM Easting (KM): 487.7	12G. UTM Zone: 17

13. Briefly describe the proposed change(s) at the facility:
Installation of two Solar Titan 130E turbines, one emergency generator, one process heater and 40 catalytic heaters

14A. Provide the date of anticipated installation or change: 10/01/2017 – If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen: / /	14B. Date of anticipated Start-Up if a permit is granted: 11/01/2018

14C. Provide a **Schedule** of the planned **Installation** of/**Change** to and **Start-Up** of each of the units proposed in this permit application as **Attachment C** (if more than one unit is involved).

15. Provide maximum projected **Operating Schedule** of activity/activities outlined in this application:
Hours Per Day 24 Days Per Week 7 Weeks Per Year 52

16. Is demolition or physical renovation at an existing facility involved? ☐ **YES** ☒ **NO**

17. **Risk Management Plans.** If this facility is subject to 112(r) of the 1990 CAAA, or will become subject due to proposed changes (for applicability help see www.epa.gov/ceppo), submit your **Risk Management Plan (RMP)** to U. S. EPA Region III.

18. **Regulatory Discussion.** List all Federal and State air pollution control regulations that you believe are applicable to the proposed process *(if known).* A list of possible applicable requirements is also included in Attachment S of this application (Title V Permit Revision Information). Discuss applicability and proposed demonstration(s) of compliance *(if known).* Provide this information as **Attachment D.**

Section II. Additional attachments and supporting documents.

19. Include a check payable to WVDEP – Division of Air Quality with the appropriate **application fee** (per 45CSR22 and 45CSR13).

20. Include a **Table of Contents** as the first page of your application package.

21. Provide a **Plot Plan,** e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is or is to be located as **Attachment E** (Refer to ***Plot Plan Guidance***) .
– Indicate the location of the nearest occupied structure (e.g. church, school, business, residence).

22. Provide a **Detailed Process Flow Diagram(s)** showing each proposed or modified emissions unit, emission point and control device as **Attachment F.**

23. Provide a **Process Description** as **Attachment G.**
– Also describe and quantify to the extent possible all changes made to the facility since the last permit review (if applicable).

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

24. Provide **Material Safety Data Sheets (MSDS)** for all materials processed, used or produced as **Attachment H.**

– For chemical processes, provide a MSDS for each compound emitted to the air.

25. Fill out the **Emission Units Table** and provide it as **Attachment I.**

26. Fill out the **Emission Points Data Summary Sheet (Table 1 and Table 2)** and provide it as **Attachment J.**

27. Fill out the **Fugitive Emissions Data Summary Sheet** and provide it as **Attachment K.**

28. Check all applicable **Emissions Unit Data Sheets** listed below:

☐ Bulk Liquid Transfer Operations	☐ Haul Road Emissions	☐ Quarry
☐ Chemical Processes	☐ Hot Mix Asphalt Plant	☐ Solid Materials Sizing, Handling and Storage Facilities
☐ Concrete Batch Plant	☐ Incinerator	☐ Storage Tanks
☐ Grey Iron and Steel Foundry	☐ Indirect Heat Exchanger	

☒ General Emission Unit, specify: Two (2) natural gas-fired turbines, one (1) emergency generator, one (1) process heater, 40 catalytic 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:

☐ Authority of Corporation or Other Business Entity	☐ Authority of Partnership
☐ Authority of Governmental Agency	☐ Authority of Limited Partnership

Submit completed and signed **Authority Form** as **Attachment R.**

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

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

Certification of Truth, Accuracy, and Completeness

I, the undersigned ☐ **Responsible Official** / ☒ **Authorized Representative,** hereby certify that all information contained in this application and any supporting documents appended hereto, is true, accurate, and complete based on information and belief after reasonable inquiry I further agree to assume responsibility for the construction, modification and/or relocation and operation of the stationary source described herein in accordance with this application and any amendments thereto, as well as the Department of Environmental Protection, Division of Air Quality permit issued in accordance with this application, along with all applicable rules and regulations of the West Virginia Division of Air Quality and W.Va. Code § 22-5-1 et seq. (State Air Pollution Control Act). If the business or agency changes its Responsible Official or Authorized Representative, the Director of the Division of Air Quality will be notified in writing within 30 days of the official change.

Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

SIGNATURE _____ *(Please use blue ink)* DATE: 4-25-2016 *(Please use blue ink)*

35B. Printed name of signee: Timothy L. Sweeney		35C. Title: Manager of Operations
35D. E-mail: tsweeney@cpg.com	36E. Phone: 304-722-8486	36F. FAX: 304-722-8420
36A. Printed name of contact person (if different from above): Lacey Ivey		36B. Title: Principal Air
36C. E-mail: livey@cpg.com	36D. Phone: 337-241-0686	36E. FAX:

PLEASE CHECK ALL APPLICABLE ATTACHMENTS INCLUDED WITH THIS PERMIT APPLICATION:

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

Please mail an original and three (3) copies of the complete permit application with the signature(s) to the DAQ, Permitting Section, at the address listed on the first page of this application. Please DO NOT fax permit applications.

FOR AGENCY USE ONLY – IF THIS IS A TITLE V SOURCE:

- ☐ ***Forward 1 copy of the application to the Title V Permitting Group and:***
- ☐ ***For Title V Administrative Amendments:***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit,***
- ☐ ***For Title V Minor Modifications:***
  - ☐ ***Title V permit writer should send appropriate notification to EPA and affected states within 5 days of receipt,***
  - ☐ ***NSR permit writer should notify Title V permit writer of draft permit.***
- ☐ ***For Title V Significant Modifications processed in parallel with NSR Permit revision:***
  - ☐ ***NSR permit writer should notify a Title V permit writer of draft permit,***
  - ☐ ***Public notice should reference both 45CSR13 and Title V permits,***
  - ☐ ***EPA has 45 day review period of a draft permit.***

All of the required forms and additional information can be found under the Permitting Section of DAQ's website, or requested by phone.

COLUMBIA GAS TRANSMISSION LLC
PO BOX 30130
COLLEGE STATION, TX 77842

S 000044 T1C7APN1 000044 E

00000044 01 SP 0.465 01 TR 00001 T1C7APN1 000000 001490

WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
601 57TH ST SE
DIVISION OF AIR QUALITY
CHARLESTON, WV 25304

PAGE: 1

PAYMENT SUMMARY

VENDOR NO: 2000001195
VOUCHER NO: 0351158920
PHONE NUMBER: 877-629-6286
VOUCHER DATE: 04/20/16

REF. DOC.	REFERENCE NUMBER	REF. DATE	DOCUMENT AMOUNT	DISCOUNT/ADJ AMOUNT	NET AMOUNT
SELLER INVCE	5115232	04/19/16	2,000.00	0.00	2,000.00
	PSDNSPS REQUIREMENTS FOR CEREDO				
		TOTALS:	2,000.00	0.00	2,000.00

(Detach Here)

DOCUMENT CONTAINS ANTI-COPY VOID PANTOGRAPH, MICRO PRINT BORDER, VERIFICATION BOX (TO RIGHT OF ARROW. HOLD BETWEEN THUMB AND FOREFINGER, OR BREATHE ON IT. COLOR WILL DISAPPEAR, THEN REAPPEAR), AND A SIMULATED WATERMARK ON THE BACK

COLUMBIA GAS TRANSMISSION LLC
PO BOX 30130
COLLEGE STATION, TX 77842

60-160/433

CHECK DATE 04/20/2016
CHECK NUMBER 0351158920

PAY...TWO THOUSAND DOLLARS 00 CENTS

VALID FOR 180 DAYS

$*****2,000.00

TO THE ORDER OF:
WEST VIRGINIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
601 57TH ST SE
DIVISION OF AIR QUALITY
CHARLESTON, WV 25304

Dean G. Bruso

THE BANK OF NEW YORK MELLON
PITTSBURGH, PENNSYLVANIA

⑈0351158920⑈ ⑆043301601⑆ 113⑈2005⑈

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.

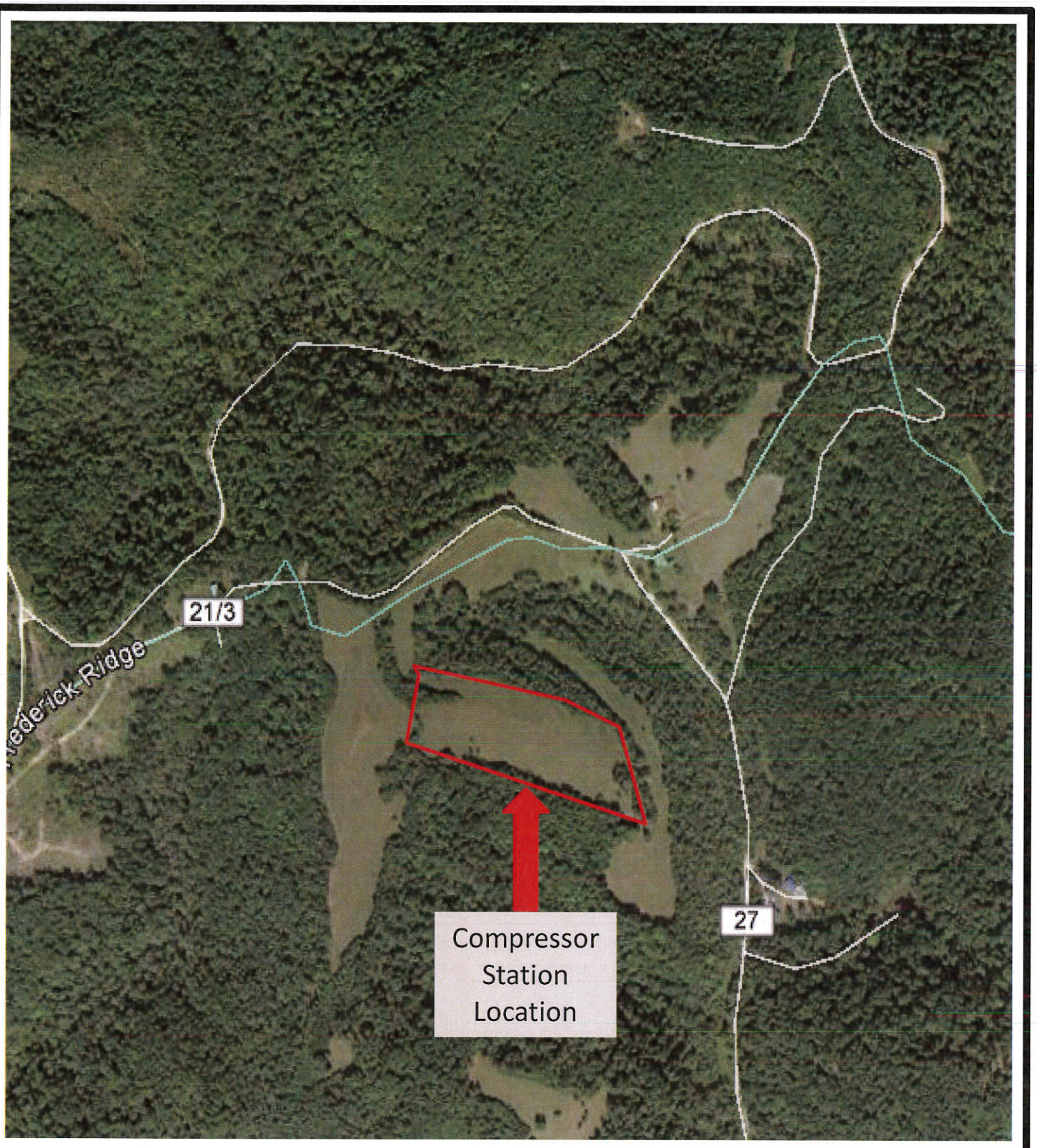
Change in name or change of location shall be considered a cessation of the business and a new certificate shall be required.

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.

atL006 v.4
L1430813824

Attachment B

Map



From the town of Brohard, head southeast on Brohard Rd. toward Dutchman Run and turn right to stay on Brohard Rd. Continue on Co. Route 5/3. In approximately 1 mile, turn left onto Co. Route 21/3. The Station will be on the right in approximately 1.6 miles.

	Attachment B
Date: April 2016	Facility Map White Oak Compressor Station

Attachment C

Installation and Start Up Schedule

Installation and Start Up Schedule

Emission Point	Installation Date	Start Up Date
T01 – 20,912 hp Solar Turbines Titan 130E Turbine #1	October 2017	November 2018
T02 – 20,912 hp Solar Turbines Titan 130E Turbine #2	October 2017	November 2018
G1 – 1,175 hp Waukesha Emergency Generator	October 2017	November 2018
H1 – 1.41 MMbtu/hr Process Heater	October 2017	November 2018
SH1 – 40 Catalytic Heaters	October 2017	November 2018

Attachment D

Regulatory Discussion

1.0 INTRODUCTION

1.1 Summary and Conclusions

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

- Install two (2) new 20,912 hp Solar Titan 130E turbines;
- Install one (1) new 1,175 hp Waukesha emergency generator;
- Install one (1) new 1.41 million British thermal units per hour [MMBtu/hr] process heater;
- Install forty (40) new catalytic heaters (0.072 MMBtu/hr each); and
- Install one (1) 2,000 gallon Condensate tank.

An analysis of federal and state regulations was performed to identify applicable air quality regulations. Federal and state regulations potentially applying to the proposed Project are summarized in Section 3.

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

Columbia's White Oak Compressor Station will be located in Calhoun County, West Virginia, near the town of Brohard. The Station will receive natural gas via pipeline from an upstream compressor station, compress it using natural gas-fired turbines, and 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.

The two (2) Solar Turbines Titan 130E turbines each have an output of 20,912 hp at 32 °F. These proposed turbines are designated Emission Point ID T01 and T02. Attachment F includes a process flow diagram showing the proposed turbines.

The new turbines will be equipped with advanced dry-low-NO_x combustion controls, known by the manufacturer as SoLoNOx. These controls reduce nitrogen oxides (NO_x) and peak combustion temperatures through the use of a lean, premixed air/fuel mixture and advanced combustion controls. The SoLoNOx system is operational at turbine loads from approximately 50% to 100% of full load. During operation at low turbine loads (<50% of full load), low ambient temperatures (<0 °F), and during turbine startup and shutdown, supplemental pilot fuel is fired for flame stability and results in NO_x, carbon monoxide (CO), and volatile organic compounds (VOC) concentrations that are higher than during SoLoNOx operation. Estimated emissions are included in the turbine calculations in Attachment N. Additional turbine emission data and calculations are presented in Attachment N.

The new Solar Turbines Titan 130E turbines are expected to continuously operate, therefore emission estimates are based on 8,760 operating hours per year. SoLoNOx controls cannot operate properly at low ambient temperatures or below 50% of peak load, the potential emission estimates presented in Table N-3 include separate lines for operating hours at: (1) ambient temperatures less than or equal to 0 °F, (2) low load (less than 50% load), and (3) startup/shutdown cycles. Annual emissions from the proposed turbines are conservatively based on an ambient temperature of 32 °F. Combustion turbine power varies with atmospheric conditions such that maximum heat input, maximum fuel consumption, and associated emissions generally increase as ambient temperature decreases. For the purpose of this application, turbine emissions have been characterized based on an ambient temperature of 32 °F. The annual average ambient temperature is approximately 54 °F.

The Project will include installation of one (1) 1,175 hp Waukesha natural gas-fired emergency generator for which potential emissions are based on operation of up to 500 hours per year. Potential emissions from this unit are based on NSPS Subpart JJJJ emission limitations for NO_x, CO, and VOC, and AP-42 emission factors for other air pollutants. The Station will also be installing one (1) process heater rated at 1.41 MMBtu/hr and forty (40) catalytic heaters, each rated at 0.72 MMBtu/hr. Emissions from these units are based on AP-42 emission factors. One (1) new 2,000 gallon condensate tank will be installed. This tanks will be a de minimis emission sources per Table 45-13B of West Virginia regulation 45 CSR 13.

Potential annual emissions of NO_x, CO, VOC, greenhouse gases as carbon dioxide equivalents (CO_2e), sulfur dioxide (SO_2), respirable particulate matter with an aerodynamic diameter of less than or equal to 10 microns (PM_{10}), fine particulate matter with an aerodynamic diameter of less than or equal to 2.5 microns ($PM_{2.5}$), formaldehyde [CH_2O, the primary hazardous air pollutant (HAP)], and total HAPs from all sources associated with the Project are provided in Table N-1 of Attachment N. Source-specific emissions calculations are also provided in Attachment N.

The target date for starting construction is October 2017. Initial commercial operation is scheduled for November 2018.

Calhoun County is classified as attainment or unclassifiable for all National Ambient Air Quality Standards.

The Station is located approximately 125 kilometers west of the nearest Class I area, the Otter Creek Wilderness Area.

3.0 REGULATORY ANALYSIS AND COMPLIANCE METHODS

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

3.1 Prevention of Significant Deterioration

West Virginia implements the Prevention of Significant Deterioration (PSD) permitting program pursuant to the USEPA-approved West Virginia State Implementation Plan and in accordance with Regulation 14 (a.k.a., Series 14) of Title 45 of the Code of State Rules (45 CSR 14). Regulation 14 closely mirrors federal PSD regulations at 40 CFR §52.21. PSD requirements for new emissions units apply when a proposed new facility has the potential to emit (PTE) 250 tpy or more of any PSD-regulated pollutant (such as NO_x, CO, PM_{10}, $PM_{2.5}$, or SO_2) per §45-14-2.43. Because the Station's PTE does not exceed 250 tpy for any PSD-regulated pollutant, the Station is not subject to PSD requirements.

Per §45-14-2.80.e.1, following July 1, 2011, new major stationary sources with the potential to emit greater than or equal to 100,000 tpy of CO_2e were required to meet the requirements set forth in the PSD program. The provisions of §45-14-2.80.f, however, clarify 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, CO_2e 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 units proposed for the new 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 (per 40 CFR §60.40c(a)). Steam generating units are defined in 40 CFR §60.41c as devices that combust fuel and heat water or any heat transfer medium. Since the proposed heater will be rated at 0.30 MMBtu/hr, this NSPS is not applicable. The proposed catalytic 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) per 40 CFR §60.5365.

Columbia requests a permit shield for NSPS Subpart Dc and Subpart OOOO.

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. The proposed Solar Titan 130E turbines, have a peak heat input of 10 MMBtu/hr or greater and therefore will be subject to the requirements of Subpart KKKK per 40 CFR §60.4305(a). Sources covered by Subpart KKKK are exempt from the requirements in Subpart GG (the previous combustion turbine NSPS)

per 40 CFR §60.4305(b). The subcategory and corresponding NO_x emission standard as established in Table 1 to Subpart KKKK for each of the proposed turbines is presented in Table 3-1.

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 Titan 130E (T01 & T02)	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% O_2 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 SO_2/MMBtu. Under 40 CFR §60.4365, a source is exempt from monitoring fuel sulfur content if the source burns natural gas with maximum sulfur content of 20 grains per 100 scf, which is the case for the proposed turbine fuel. Columbia will use the FERC gas tariff to show compliance with this requirement.

The proposed NO_x emission rates and fuel sulfur levels comply with NSPS limits. 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. Annual performance testing using EPA reference methods must be conducted within 14 calendar months following the previous performance test. The test frequency can be reduced to biennial if measured NO_x emissions are less than 75% of limit. In addition, Columbia will continuously monitor the turbines to document any operating periods during which the SoLoNOx system is not in service (e.g., during startup, shutdown, low-load, or a system malfunction). Records of turbine startup, shutdown, SoLoNOx malfunction, and/or SoLoNOx monitoring system malfunction will be recorded per Subpart KKKK and NSPS General Provisions in 40 CFR §60.7(b)&(c).

Columbia will use the FERC tariff to show compliance with the SO_2 and fuel sulfur limits per 40 CFR §60.4365(a).

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 specified in Table 1[1] of Subpart JJJJ as follows.

- For NO_x, the limit is 2.0 g/hp-hr or 160 ppmvd at 15 percent O_2;
- For CO, the limit is 4.0 g/hp-hr or 540 ppmvd at 15 percent O_2; and
- For VOC, the limit is 1.0 g/hp-hr or 86 ppmvd at 15 percent O_2.

The proposed emergency generator will be subject to the Subpart JJJJ emission limits for engines greater than 130 hp. In accordance with 40 CFR §60.4243(a)(2)(iii) if this engine is not certified an initial performance test is required within one year of startup. Subsequent performance testing is required every 8,760 hours of operation or every three years whichever comes first. Note that Waukesha does

[1] Compliance with the emission limits specified in Table 1 of Subpart JJJJ is required by 40 CFR §60.4233(e).

not currently certify this engine. Based on manufacturer data, the engine will comply with these emission limits.

3.3 National Emission Standards for Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants (NESHAP) are promulgated under 40 CFR Part 63 for specific processes and HAP emissions. The proposed Station has potential HAP emissions that are less than the major source threshold and will therefore be considered an area source of HAPs.[2]

40 CFR 63 Subpart YYYY for stationary combustion turbines is only applicable to major sources of HAPs per 40 CFR §63.6085; therefore, the turbines are not subject to this regulation.

Subpart ZZZZ for stationary reciprocating internal combustion engines is applicable to the proposed emergency generator. 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 meeting the requirements of NSPS Subpart JJJJ per 40 CFR §63.6590(c)(1). No further requirements apply.

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 JJJJJJ (area sources of HAPs). The proposed Station will be an area source of HAPs; Subpart JJJJJJ is the applicable NESHAP for the Station. Per 40 CFR §63.11195(e), 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 Part 70.

As defined in 40 CFR §64.1, "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 specified in 40 CFR §64.2(b) 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).

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 any fuel-burning unit (providing heat or power by indirect heat transfer) not exceed opacity levels of 10 percent

[2] Per 40 CFR §63.2, an area source of HAPs is defined as a stationary source or group of sources with the potential to emit less than 10 tpy of any HAP and less than 25 tpy of any combination of HAPs.

based on a six-minute block average (per §45-2-3.1). The proposed equipment (e.g., process heater) 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 limits SO_2 emissions from fuel-burning units, manufacturing processes, and combustion of refinery or process gas streams. The turbines and emergency generator are not considered fuel-burning units per the definition in §45-10-2. The Station is not defined as a manufacturing process and does not combust refinery or process gas streams. Additionally, fuel burning units less than 10 MMBtu/hr, including the proposed heater, are exempt from section 3 and sections 6 through 8 of this regulation. Therefore, 45 CSR 10 does not apply to the Project.

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 the permitting program.

3.8 Requirements for Operating Permits (45 CSR 30)

Because the PTE for the proposed Station will exceed the Title V threshold of 100 tpy for CO, a Title V permit is required for continued operation of 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

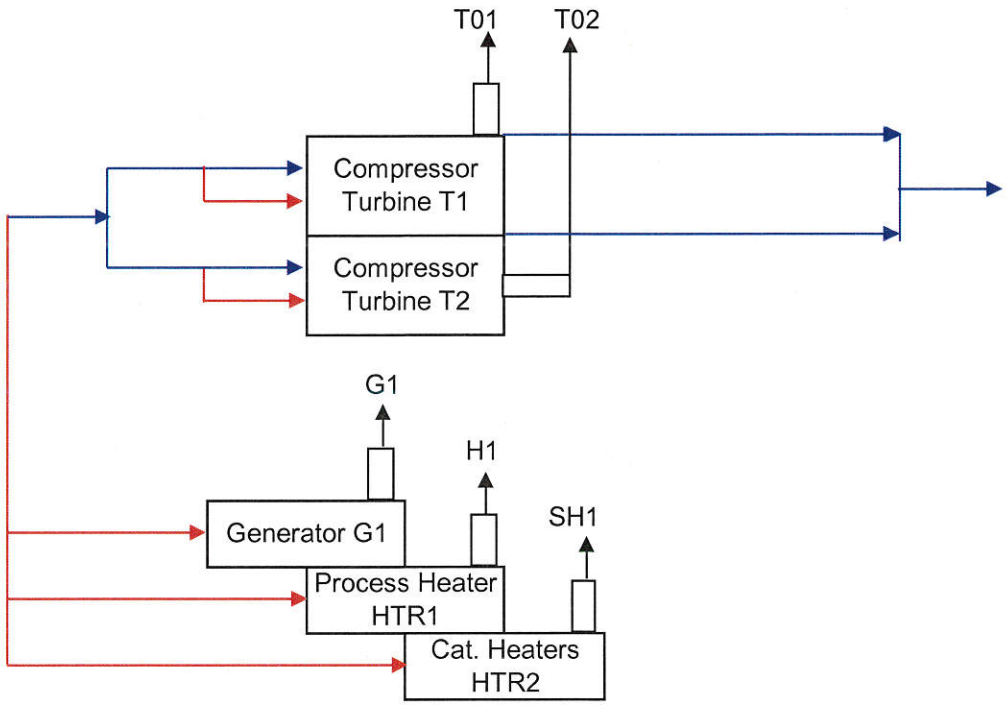
Plot Plan

	Attachment E
Date: April 2016	Plot Plan White Oak Compressor Station

Attachment F

Detailed Process Flow Diagram

ATTACHMENT F
WHITE OAK COMPRESSOR STATION PROCESS FLOW DIAGRAM



Transmission Gas Stream
Fuel Gas
Emission Stream

Columbia Pipeline Group

Attachment G

Process Description

Process Description

Pipeline transmission of natural gas requires that the gas be compressed. Two (2) Solar Turbines 20,912 hp Titan 130E turbine-driven compressors will be installed at the proposed White Oak Compressor Station. The Project also includes the installation of one (1) 1,175 hp Waukesha emergency generator, one (1) 1.41 MMbtu/hr process heater, forty (40) catalytic heaters, and one (1) new 2,000 gallon condensate tank. 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 SoLoNOx) limits formation of NO_x, CO, and VOC by pre-mixing air and fuel prior to combustion. When operating a Solar Titan 130E 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% O_2) 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 less than or equal to 0 °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).

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 Titan 130E turbine, the startup sequence takes less than 10 minutes to complete prior to engaging the DLN system. The shutdown sequence for a Solar Titan 130E turbine requires approximately 10 minutes. Emissions during each startup/shutdown cycle are estimated by Solar as provided in Attachment N.

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 presented in Table N-3 within Attachment N. Additional information on turbine operating characteristics and emissions is provided in Attachment N to this application.

Attachment H

SDSs

SDS 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]
T1	T01	Solar Turbines Titan 130E Turbine #1	2017	20,912 HP @ 32°F	New, 2017	-
T2	T02	Solar Turbines Titan 130E Turbine #2	2017	20,912 HP @ 32°F	New, 2017	-
G1	G1	Waukesha Emergency Generator	2017	1,175 HP	New, 2017	-
HTR1	H1	Process Heater	2017	1.41 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[7] (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	T1		-		-	-	NO_x	9.48	43.10			Gas	EE	
								CO	9.62	104.84			Gas	EE	
								VOC	1.10	5.52			Gas	EE	
								SO_2	10.02	0.55			Gas	EE	
								PM / PM_{10} / $PM_{2.5}$	1.16	5.08			Solid	EE	
								CH_2O	0.12	0.55			Gas	EE	
T02	Upward vertical stack	T2		-		-	-	NO_x	9.48	43.10			Gas	EE	
								CO	9.62	104.84			Gas	EE	
								VOC	1.10	5.52			Gas	EE	
								SO_2	10.02	0.55			Gas	EE	
								PM / PM_{10} / $PM_{2.5}$	1.16	5.08			Solid	EE	
								CH_2O	0.12	0.55			Gas	EE	
G1	Upward vertical stack	G1		-		-	-	NO_x	5.18	1.30			Gas	EE	
								CO	10.36	2.59			Gas	EE	
								VOC	2.59	0.65			Gas	EE	
								SO_2	0.52	0.0016			Gas	EE	
								PM / PM_{10} / $PM_{2.5}$	0.09	0.023			Solid	EE	
								CH_2O	0.49	0.12			Gas	EE	
H1		HTR1		-		-	-	NO_x	0.14	0.61			Gas	EE	
								CO	0.12	0.51			Gas	EE	
								VOC	0.0076	0.03			Gas	EE	
								SO_2	0.08	0.0044			Gas	EE	
								PM / PM_{10} / $PM_{2.5}$	0.015	0.05			Solid	EE	
								CH_2O	0.0001	0.00045			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[7] (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			
SH1		HTR2		-		-	-	NO_x	0.28	1.24			Gas	EE	
								CO	0.24	1.04			Gas	EE	
								VOC	0.02	0.07			Gas	EE	
								SO_2	0.16	0.009			Gas	EE	
								PM / PM_{10} / $PM_{2.5}$	0.02	0.09			Solid	EE	
								CH_2O	0.0002	0.0009			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.

[1] Please add descriptors such as upward vertical stack, downward vertical stack, horizontal stack, relief vent, rain cap, etc.

[2] Indicate by "C" if venting is continuous. Otherwise, specify the average short-term venting rate with units, for intermittent venting (ie., 15 min/hr). Indicate as many rates as needed to clarify frequency of venting (e.g., 5 min/day, 2 days/wk).

[3] List all regulated air pollutants. Speciate VOCs, including all HAPs. Follow chemical name with Chemical Abstracts Service (CAS) number. **LIST** Acids, CO, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. **DO NOT LIST** H_2, H_2O, N_2, O_2, and Noble Gases.

[4] Give maximum potential emission rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[5] Give maximum potential emission rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[6] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

[7] Provide for all pollutant emissions. Typically, the units of parts per million by volume (ppmv) are used. If the emission is a mineral acid (sulfuric, nitric, hydrochloric or phosphoric) use units of milligram per dry cubic meter (mg/m^3) at standard conditions (68 °F and 29.92 inches Hg) (see 45CSR7). If the pollutant is SO_2, use units of ppmv (See 45CSR10).

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 2: Release Parameter Data								
Emission Point ID No. *(Must match Emission Units Table)*	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (°F)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2] *(Release height of emissions above ground level)*	Northing	Easting
T01	10.16[3]	921	266,950	54.9	1,145	55.0	4,321.4	487.7
T02	10.16[3]	921	266,950	54.9	1,145	55.0	4,321.4	487.7
G1		755			1,145		4,321.4	487.7
H1					1,145		4,321.4	487.7
SH1					1,145		4,321.4	487.7

[1] Give at operating conditions. Include inerts.
[2] Release height of emissions above ground level.
[3] Effective diameter based on 9' x 9' 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? ☐ Yes ☒ No ☐ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☒ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☒ Yes ☐ No The emissions are de minimis ☐ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☒ Yes ☐ No ☒ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered "NO" to all of the items above, it is not necessary to complete the following table, "Fugitive Emissions Summary."

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads						
Unpaved Haul Roads						
Storage Pile Emissions						
Loading/Unloading Operations						
Wastewater Treatment Evaporation & Operations						
Equipment Leaks	Methane CO_2 GHG (CO_2e)	Does not apply	9.62 0.13 240.55	Does not apply	9.62 0.13 240.55	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, CS_2, VOCs, H_2S, Inorganics, Lead, Organics, O_3, NO, NO_2, SO_2, SO_3, all applicable Greenhouse Gases (including CO_2 and methane), etc. DO NOT LIST H_2, H_2O, N_2, O_2, and Noble Gases.

[2] Give rate with no control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[3] Give rate with proposed control equipment operating. If emissions occur for less than 1 hr, then record emissions per batch in minutes (e.g. 5 lb VOC/20 minute batch).

[4] Indicate method used to determine emission rate as follows: MB = material balance; ST = stack test (give date of test); EE = engineering estimate; O = other (specify).

Attachment L
EMISSIONS UNIT DATA SHEET
CHEMICAL PROCESS

For chemical processes please fill out this sheet and all supplementary forms (see below) that apply. Please check all supplementary forms that have been completed.

- ☐ *Emergency Vent Summary Sheet*
- ☒ *Leak Sources Data Sheet*
- ☐ *Toxicology Data Sheet*
- ☐ *Reactor Data Sheet*
- ☐ *Distillation Column Data Sheet*

1. Chemical process area name and equipment ID number (as shown in *Equipment List Form*)

2. Standard Industrial Classification Codes (SICs) for process(es)

3. List raw materials and ☐ attach MSDSs

4. List Products and Maximum Production and ☐ attach MSDSs

Description and CAS Number	Maximum Hourly (lb/hr)	Maximum Annual (ton/year)

5. Complete the *Emergency Vent Summary Sheet* for all emergency relief devices.

6. Complete the *Leak Source Data Sheet* and describe below or attach to application the leak detection or maintenance program to minimize fugitive emissions. Include detection instruments, calibration gases or methods, planned inspection frequency, and record-keeping, and similar pertinent information. If subject to a rule requirement (e.g. 40CFR60, Subpart VV), please list those here.

7. Clearly describe below or attach to application Accident Procedures to be followed in the event of an accidental spill or release.

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				
	Non-VOC	36	0	N/A	7,742 lb CH4/yr
Safety Relief Valves[11]	Gas VOC	N/A - less than 10% VOC			
	Non VOC	16	0	N/A	155 lb CH4/yr
Open-ended Lines[12]	VOC	N/A - less than 10% VOC			
	Non-VOC	77	0	N/A	6,066 lb CH4/yr
Sampling Connections[13]	VOC	N/A - less than 10% VOC			
	Non-VOC	6	0	N/A	98 lb CH4/yr
Compressors	VOC	N/A - less than 10% VOC			
	Non-VOC	3	0	N/A	N/A - emissions included in other component estimates
Flanges	VOC	N/A - less than 10% VOC			
	Non-VOC	314	0	N/A	5,153 lb CH4/yr
Other	VOC	N/A - less than 10% VOC			
	Non-VOC	2 meters	0	N/A	19 lb CH4/yr

[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

1. Name or type and model of proposed affected source:

   Solar Turbines Titan 130E turbine. Proposed emission point ID T01.

2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.

3. Name(s) and maximum amount of proposed process material(s) charged per hour:

   N/A

4. Name(s) and maximum amount of proposed material(s) produced per hour:

   N/A

5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants:

   Natural gas combustion products.

* 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:

1,507.7 million cubic feet per year (equivalent to 1,537,885 MMBtu/yr) for Turbine T01.

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Methane 86.9 All values in volume percent.
Ethane 11.7203
Propane 0.3553
I-Butane 0.0215
N-Butane 0.0334
I-Pentane 0.0098
N-Pentane 0.0071
Hexane 0.0147
Carbon Dioxide 0.4256 Nitrogen 0.5123 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:

175.56 MMBtu/hr at 32 °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: 175.56 × 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:

@ 32 °F and Full Load psia

a.	NO_X	9.48	lb/hr	grains/ACF
b.	SO_2	10.02	lb/hr	grains/ACF
c.	CO	9.62	lb/hr	grains/ACF
d.	PM_{10}	1.16	lb/hr	grains/ACF
e.	Hydrocarbons	5.51	lb/hr	grains/ACF
f.	VOCs	1.10	lb/hr	grains/ACF
g.	Pb	0	lb/hr	grains/ACF
h.	Specify other(s)			
	CO_2e	20,557	lb/hr	grains/ACF
	Formaldehyde	0.12	lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
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 or equal to 0 °F ambient temperature, and 4) Monthly number of startup and shutdown cycles.	Maintain records of monitored parameters.
REPORTING	**TESTING**
Notification of start-up date will be submitted within 15 days of start-up. Performance test reports will be submitted before the close of business on the 60th day following the completion of 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. 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.

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*): T2

1. Name or type and model of proposed affected source: Solar Turbines Titan 130E turbine. Proposed emission point ID T02.
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: N/A
4. Name(s) and maximum amount of proposed material(s) produced per hour: N/A
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: Natural gas combustion products.

* 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:

1,507.7 million cubic feet per year (equivalent to 1,537,885 MMBtu/yr) for Turbine T02.

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Methane 86.9 All values in volume percent.
Ethane 11.7203
Propane 0.3553
I-Butane 0.0215
N-Butane 0.0334
I-Pentane 0.0098
N-Pentane 0.0071
Hexane 0.0147
Carbon Dioxide 0.4256 Nitrogen 0.5123 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:

175.56 MMBtu/hr at 32 °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: 175.56 × 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:

@ 32 °F and Full Load psia

a.	NO_X	9.48	lb/hr	grains/ACF
b.	SO_2	10.02	lb/hr	grains/ACF
c.	CO	9.62	lb/hr	grains/ACF
d.	PM_{10}	1.16	lb/hr	grains/ACF
e.	Hydrocarbons	5.51	lb/hr	grains/ACF
f.	VOCs	1.10	lb/hr	grains/ACF
g.	Pb	0	lb/hr	grains/ACF
h.	Specify other(s)			
	CO_2e	20,557	lb/hr	grains/ACF
	Formaldehyde	0.12	lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
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 or equal to 0 °F ambient temperature, and 4) Monthly number of startup and shutdown cycles.	Maintain records of monitored parameters.
REPORTING	**TESTING**
Notification of start-up date will be submitted within 15 days of start-up. Performance test reports will be submitted before the close of business on the 60th day following the completion of 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. 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.

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

1. Name or type and model of proposed affected source: 1,175 hp Waukesha Emergency Generator. Proposed emission point ID G1.
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: N/A
4. Name(s) and maximum amount of proposed material(s) produced per hour: N/A
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: Natural gas combustion products.

* 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 8,908 scf/hr.

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Methane 86.9 All values in volume percent.
Ethane 11.7203
Propane 0.3553
I-Butane 0.0215
N-Butane 0.0334
I-Pentane 0.0098
N-Pentane 0.0071
Hexane 0.0147
Carbon Dioxide 0.4256 Nitrogen 0.5123 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:

9.09 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: 9.09 × 10^6 BTU/hr.

7. Projected operating schedule: 500 Hours/year

Hours/Day	Days/Week	Weeks/Year

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	10.36	lb/hr	grains/ACF
d.	PM_{10}	0.09	lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs	2.59	lb/hr	grains/ACF
g.	Pb	0	lb/hr	grains/ACF
h.	Specify other(s)			
	CO_2e	1064	lb/hr	grains/ACF
	Formaldehyde	0.49	lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
To demonstrate compliance, Columbia proposes to maintain monthly operating hours. This monthly record will be used to track 12-month rolling operating hours.	Maintain records of monitored parameters.
REPORTING	**TESTING**
The 12-month rolling operating hours will be reported to the state as part of the station's semi-annual monitoring report. Performance test reports will be submitted before the close of business on the 60th day following the completion of 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

1. Name or type and model of proposed affected source: 1.41 MMbtu/hr Process heater. Proposed emission point ID H1.
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: N/A
4. Name(s) and maximum amount of proposed material(s) produced per hour: N/A
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: Natural gas combustion products.

* 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 1382.4 scf/hr.

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

Methane 86.9 All values in volume percent.
Ethane 11.7203
Propane 0.3553
I-Butane 0.0215
N-Butane 0.0334
I-Pentane 0.0098
N-Pentane 0.0071
Hexane 0.0147
Carbon Dioxide 0.4256 Nitrogen 0.5123 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:

1.41 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: 1.41 × 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	0.14	lb/hr	grains/ACF
b.	SO_2	0.08	lb/hr	grains/ACF
c.	CO	0.12	lb/hr	grains/ACF
d.	PM_{10}	0.0105	lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs	0.0076	lb/hr	grains/ACF
g.	Pb	0	lb/hr	grains/ACF
h.	Specify other(s)			
	CO_2e	165	lb/hr	grains/ACF
	Formaldehyde	0.000104	lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

NOTE: (1) An Air Pollution Control Device Sheet must be completed for any air pollution device(s) used to control emissions from this affected source.

(2) Complete the Emission Points Data Sheet.

9. Proposed Monitoring, Recordkeeping, Reporting, and Testing
Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

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

1. Name or type and model of proposed affected source: 40 Catalytic heaters. Proposed emission point ID SH1.
2. On a separate sheet(s), furnish a sketch(es) of this affected source. If a modification is to be made to this source, clearly indicated the change(s). Provide a narrative description of all features of the affected source which may affect the production of air pollutants.
3. Name(s) and maximum amount of proposed process material(s) charged per hour: N/A
4. Name(s) and maximum amount of proposed material(s) produced per hour: N/A
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: Natural gas combustion products.

* 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 scf/hr for the combination of 40 heaters.

(b) Chemical analysis of proposed fuel(s), excluding coal, including maximum percent sulfur and ash:

All values in volume percent.

Methane	86.9
Ethane	11.7203
Propane	0.3553
I-Butane	0.0215
N-Butane	0.0334
I-Pentane	0.0098
N-Pentane	0.0071
Hexane	0.0147

Carbon Dioxide 0.4256 Nitrogen 0.5123 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/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: 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	RECORDKEEPING
Columbia assumes this unit will operate 8760 hours per year. No monitoring, recordkeeping, reporting, or testing is required for this unit. This should be considered an insignificant activity.	
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
White Oak Compressor Station
April 2016

Table N-1 - Facility Total PTE

Source	Capacity	Annual Emissions (tpy)							
		NO_x	CO	CO_2e	$PM_{10}/PM_{2.5}$	VOC	SO_2	CH_2O	Total HAP
T01 - Solar Titan 130E Turbine #1	20,912 hp (32 °F)	43.10	104.84	90,042	5.08	5.52	0.55	0.55	0.79
T02 - Solar Titan 130E Turbine #2	20,912 hp (32 °F)	43.10	104.84	90,042	5.08	5.52	0.55	0.55	0.79
G1 - Waukesha Emergency Generator	1,175 hp	1.30	2.59	266	0.02	0.65	1.62E-03	0.12	0.17
H1 - Process Heater	1.41 MMBtu/hr	0.61	0.51	723	0.05	0.03	4.41E-03	4.54E-04	0.01
SH1 - (40) Catalytic Heaters	Various	1.24	1.04	1,477	0.09	0.07	9.01E-03	9.28E-04	0.02
Equipment Leaks (fugitive emissions)[1]				241		0.15			
Venting (except blowdowns)				653		0.40			
Blowdowns				9,992		6.12			
Facility PTE[2]		89.34	213.81	193,194	10.31	18.31	1.11	1.22	1.78
Title V Threshold		100	100	n/a	100	100	100	10	25
PSD Major Source Threshold		250	250	n/a	250	250	250	n/a	n/a
Applicability		None, Natural Minor	Title V	None, Natural Minor	None, Natural Minor	None, Natural Minor	None, Natural Minor	None, Area Source	None, Area Source

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).

Columbia Gas Transmission, LLC
White Oak Compressor Station
April 2016
Table N-2 - Solar Titan 130E Turbines (T01 & T02)

Horsepower	20,912	hp (32 °F)
Brake Specific Fuel Consumption	7,563	Btu/bhp-hr (LHV, 32 °F)
Total Heat Input	158.16	MMBtu/hr (LHV, 32 °F)
	175.56	MMBtu/hr (HHV, 32 °F)[3]
Operating Hours	8,760	hr/yr
Natural Gas Heat Content	1,020	Btu/scf
Fuel Consumption	1,507.73	MMscf/yr
	172,115.3	scf/hr (based on 32 °F)
Quantity	2	

Pollutant	Emission Factor			Emission Rate			Emission Factor Reference
	ppmvd@15%O_2	lb/MMBtu		lb/hr[1]	ton/yr[2]	ton/yr (2 turbines)	
NO_x	15.00	0.060	LHV	9.48	43.10	86.20	Vendor Data
CO	25.00	0.061	LHV	9.62	104.84	209.67	Vendor Data
CO_2e		117.1	HHV	20,557	90,042	180,083	40 CFR 98 Subpart C
PM_{10}		0.0066	HHV	1.16	5.08	10.15	AP-42 Table 3.1-2a (4/00)
$PM_{2.5}$		0.0066	HHV	1.16	5.08	10.15	AP-42 Table 3.1-2a (4/00)
VOC	5.00	0.007	LHV	1.10	5.52	11.04	Vendor Data (20% of UHC)[4]
SO_2 (Maximum Hourly)		0.0571	HHV	10.02			20 grains S / 100 scf
SO_2 (Average Annual)		0.000714	HHV		0.55	1.10	0.25 grains S / 100 scf
Formaldehyde		0.00071	HHV	0.12	0.55	1.09	AP-42 Table 3.1-3 (4/00)
Total HAPs		0.00103	HHV	0.18	0.79	1.58	AP-42 Table 3.1-3 (4/00)

1. Maximum hourly emission rate based on normal operation at 32 °F. Heat input, fuel consumption, and emissions increase as temperature decreases, and for the purpose of this application, hourly emissions are characterized by Solar emissions data for 32 °F.
2. Annual emission rate based on maximum of: (1) normal operation or (2) normal operation plus non-SoLoNOx operation.
3. HHV heat input based on HHV=1.11*LHV
4. VOC based on 20% of vendor data for unburned hydrocarbon.

Columbia Gas Transmission, LLC
White Oak Compressor Station
April 2016
Table N-3 - Solar Titan 130E (T01 & T02) - Normal and Non-SoLoNOx Emission Rates

Normal and Non-SoLoNOx Emission Rates

Operating Mode	Units	NO_x	CO	VOC
Normal Load @ 32 °F[1]	lb/hr	9.48	9.62	1.10
Normal Load @ 32 °F[2]	tpy	41.52	42.14	4.83
Non-SoLoNOx Operation[3]	tpy	1.58	62.70	0.70
Total Emissions per Turbine	tpy	43.10	104.84	5.52

1. Based on data from Solar Titan 130E Compressor Set data sheet and the following concentrations: 15 ppm NO_x; 25 ppm CO; 5 ppm VOC
2. Based on 8760 hr/yr of normal operation.
3. Potential emissions in excess of 8760 hr/yr at normal operation that may occur when turbine operates in non-SoLoNOx mode such as during low ambient temperatures (<0 °F), low load (< 50%), and during startup and shutdown events. This annual total represents the difference between the aggregate total with non-SoLoNOx operation and 8760 hr/yr of normal operation.

Emission Rates During Normal Operation (g/hp-hr)[1]

Emission Point ID / Model	NO_x	CO	VOC[2]	SO_2[3]	PM_{10} / $PM_{2.5}$	CH_2O
T01 & T02 / Solar Titan 130E	0.21	0.21	0.02	0.22	*0.03*	*0.003*

1. Based on vendor performance data; 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.

Columbia Gas Transmission, LLC
White Oak Compressor Station
April 2016
Table N-4 - Emissions from Venting, Blowdowns & Equipment Leaks (Fugitives)

Component	Emission Rate (ton/yr)			
	CH_4 [1]	CO_2 [1]	CO_2e [2]	VOC [3]
Venting (except blowdowns)	26.10	0.35	653	0.40
Blowdowns	399.45	5.36	9,992	6.12
Equipment Leaks (Fugitives)	9.62	0.13	241	0.15

1. CH_4 and CO_2 emission rates based on 86.90 vol% CH_4 and 0.43 vol% CO_2 in natural gas
2. Based on 40 CFR 98 Subpart A Global Warming Potentials
3. Based on a 0.0153 ratio of VOC to methane as calculated from gas composition

Columbia Gas Transmission, LLC
White Oak Compressor Station
April 2016
Table N-5 - Waukesha VGF-P48GL Emergency Generator (G1)

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	NSPS Subpart JJJJ Limitation
CO	4.00		10.36	2.59	NSPS Subpart JJJJ Limitation
CO_2e		117.1	1,064	266	40 CFR 98 Subpart C
PM_{10}		0.010	0.09	2.27E-02	AP-42 Table 3.2-2 (7/00) - 4SLB
$PM_{2.5}$		0.010	0.09	2.27E-02	AP-42 Table 3.2-2 (7/00) - 4SLB
VOC	1.00		2.59	0.65	NSPS Subpart JJJJ Limitation
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	0.19		0.49	0.12	Vendor Data
Total HAPs		0.07356	0.67	0.17	AP-42 Table 3.2-2 (7/00) - 4SLB

Columbia Gas Transmission, LLC
White Oak Compressor Station
April 2016
Table N-6 - Process Heater (H1)

Heat Input	1.41	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	12.11	MMscf/yr
	1382.4	scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	lb/MMscf	lb/MMBtu	lb/hr	ton/yr	
NO_x	100	0.098	0.14	0.61	AP-42 Table 1.4-1 (7/98)
CO	84	0.082	0.12	0.51	AP-42 Table 1.4-1 (7/98)
CO_2e		117.1	165	723	40 CFR 98 Subpart C
PM_{10}	7.6	0.007	1.05E-02	0.05	AP-42 Table 1.4-2 (7/98)
$PM_{2.5}$	7.6	0.007	1.05E-02	0.05	AP-42 Table 1.4-2 (7/98)
VOC	5.5	0.005	7.60E-03	0.03	AP-42 Table 1.4-2 (7/98)
SO_2 (Maximum Hourly)		0.0571	0.08		20 grains S / 100 scf
SO_2 (Average Annual)		0.000714		4.41E-03	0.25 grains S / 100 scf
Formaldehyde	0.075	0.00007	1.04E-04	4.54E-04	AP-42 Table 1.4-3 (7/98)
Total HAPs	1.89	0.00185	2.61E-03	1.14E-02	AP-42 Table 1.4-3 & 4 (7/98)

Columbia Gas Transmission, LLC
White Oak Compressor Station
April 2016
Table N-7 - Catalytic Heaters (SH1)

Heat Input	0.072	MMBtu/hr
Quantity	40	
Total Heat Input	2.88	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	24.73	MMscf/yr
	2,823.5	scf/hr

Pollutant	Emission Factor		Emission Rate (40 heaters)		Emission Factor Reference
	lb/MMscf	lb/MMBtu	lb/hr	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_2e		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		9.01E-03	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)

Attachment O

Monitoring / Recordkeeping / Reporting / Testing Plans

Monitoring/Recordkeeping/Reporting/Testing Plans

Turbines T01 and T02

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 °F ambient temperature, and
4) 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:

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

where:

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

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. 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. In addition, the Station will continuously monitor the turbines to document any periods during which the SoLoNOx system is not in service (e.g., during startup, shutdown, low-load, or a system malfunction). Records of turbine startup, shutdown, SoLoNOx malfunction, and/or SoLoNOx monitoring system malfunction will be recorded per Subpart KKKK and NSPS General Provisions in 40 CFR §60.7(b)&(c).

Emergency Generator G1

Columbia will submit the initial notification as per 40 CFR Part 60 to comply with Subpart JJJJ for the emergency generator. Compliance with the 40 CFR 60 Subpart JJJJ emission limitations will be demonstrated through the 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 Construction Permit for the proposed White Oak Compressor Station natural gas compressor station located near Brohard, in Calhoun County, West Virginia. The latitude and longitude coordinates are: 39.04113° N and 81.14200° W.

The applicant estimates, if the construction application is approved, the potential to discharge the following Regulated Air Pollutants will be: Carbon Monoxide at 213.81 tons per year, Nitrogen Oxides at 89.34 tons per year, PM10 and PM2.5 at 10.31 tons per year, Sulfur Dioxide at 1.11 tons per year, Volatile Organic Compounds (VOC) at 18.31 tons per year, Carbon Dioxide Equivalents (CO2e) at 193,194 tons per year, and Formaldehyde at 1.22 tons per year.

Startup of operation is planned to begin on or about the 1st day of November, 2018. 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 29th day of April, 2016.

By: Columbia Gas Transmission LLC
Tim Sweeney
Manager of Operations
485 Industrial Road
St. Albans, WV 25177-1831

Solar Turbines
A Caterpillar Company

PREDICTED ENGINE PERFORMANCE

Customer: *Columbia Pipeline Group*	Model: TITAN 130-22402S
Job ID: White Oak CS	Package Type: CS/MD
Run By: Nima Bahrami / Date Run: 26-Feb-16	Match: 59F MATCH
Engine Performance Code: REV. 4.17.1.19.11 / Engine Performance Data: REV. 0.0	Fuel System: GAS
	Fuel Type: CHOICE GAS

DATA FOR MINIMUM PERFORMANCE

Elevation	feet	1145
Inlet Loss	in H2O	4.5
Exhaust Loss	in H2O	10.0
Accessory on GP Shaft	HP	44.9

		1	2	3	4	5	6
Engine Inlet Temperature	deg F	0	0	32.0	32.0	59.0	59.0
Relative Humidity	%	81.0	81.0	81.0	81.0	81.0	81.0
Driven Equipment Speed	RPM	7094	8856	6905	8837	7150	8699
Specified Load	HP	50.0%	FULL	50.0%	FULL	50.0%	FULL
Net Output Power	HP	11122	22244	10457	20913	9888	19775
Fuel Flow	mmBtu/hr	121.94	168.62	115.86	158.16	111.65	149.75
Heat Rate	Btu/HP-hr	10964	7581	11080	7563	11291	7573
Therm Eff	%	23.207	33.565	22.963	33.645	22.535	33.600
Engine Exhaust Flow	lbm/hr	388572	461020	354362	440078	325011	421421
PT Exit Temperature	deg F	893	910	923	921	934	932
Exhaust Temperature	deg F	842	910	886	921	912	932

Fuel Gas Composition (Volume Percent)

Methane (CH4)	86.90
Ethane (C2H6)	11.72
Propane (C3H8)	0.36
I-Butane (C4H10)	0.02
N-Butane (C4H10)	0.03
I-Pentane (C5H12)	0.0098
N-Pentane (C5H12)	0.0071
Hexane (C6H14)	0.0098
Heptane (C7H16)	0.0049
Carbon Dioxide (CO2)	0.43
Nitrogen (N2)	0.51
Sulfur Dioxide (SO2)	0.0001

Fuel Gas Properties

LHV (Btu/Scf)	991.1	Specific Gravity	0.6218	Wobbe Index at 60F	1256.9

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.

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

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PIL 167
Product Information Letter

SoLoNOx Products: Emissions in Non-SoLoNOx Modes

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

Solar's gas turbine dry low NOx emissions combustion systems, known as *SoLoNOx*™, have been developed to provide the lowest emissions possible during normal operating conditions. In order to optimize the performance of the turbine, the combustion and fuel systems are designed to reduce NOx, CO and unburned hydrocarbons (UHC) without penalizing stability or transient capabilities. At very low load and cold temperature extremes, the *SoLoNOx* system must be controlled differently in order to assure stable operation. The required adjustments to the turbine controls at these conditions cause emissions to increase.

The purpose of this Product Information Letter is to provide emissions estimates, and in some cases warrantable emissions for NOx, CO and UHC, at off-design conditions.

Historically, regulatory agencies have not required a specific emissions level to be met at low load or cold ambient operating conditions, but have asked what emissions levels are expected. The expected values are necessary to appropriately estimate emissions for annual emissions inventory purposes and for New Source Review applicability determinations and permitting.

COLD AMBIENT EMISSIONS ESTIMATES

Solar's standard temperature range warranty for gas turbines with *SoLoNOx* combustion is ≥ 0°F (–20°C). The *Titan*™ 250 is an exception, with a lower standard warranty at ≥ –20°F (–29°C). At ambient temperatures below 0°F, many of Solar's turbine engine models are controlled to increase pilot fuel to improve flame stability and emissions are higher. Without the increase in pilot fuel at temperatures below 0°F the engines may exhibit combustor rumble, as operation may be near the lean stability limit.

If a cold ambient emissions warranty is requested, a new production turbine configured with the latest combustion hardware is required. For most models this refers to the inclusion of Cold Ambient Fuel Control Logic.

Emissions warranties are not offered for ambient temperatures below –20°F (–29°C). In addition, cold ambient emissions warranties cannot be offered for the *Centaur*® 40 turbine.

Table 1 provides expected and warrantable (upon Solar's documented approval) emissions levels for Solar's *SoLoNOx* combustion turbines. All emissions levels are in ppm at 15% O_2. Refer to Product Information Letter 205 for *Mercury*™ 50 turbine emissions estimates.

For information on the availability and approvals for cold ambient temperature emissions warranties, please contact Solar's sales representatives.

Table 2 summarizes "expected" emissions levels for ambient temperatures below 0°F (–20°C) for Solar's *SoLoNOx* turbines that do not have current production hardware or for new production hardware that is not equipped with the cold ambient fuel control logic. The emissions levels are extrapolated from San Diego factory tests and may vary at extreme temperatures and as a result of variations in other parameters, such as fuel composition, fuel quality, etc.

For more conservative NOx emissions estimate for new equipment, customers can refer to the New Source Performance Standard (NSPS) 40CFR60, subpart KKKK, where the allowable NOx emissions level for ambient temperatures < 0°F (–20°F) is 150 ppm NOx at 15% O_2. For pre-February 18, 2005, *SoLoNOx* combustion turbines subject to 40CFR60 subpart GG, a conservative estimate is the appropriate subpart GG emissions level. Subpart GG levels range from 150 to 214 ppm NOx at 15% O_2 depending on the turbine model.

Table 3 summarizes emissions levels for ambient temperatures below –20°F (–29°C) for the *Titan* 250.

Table 1. Warrantable Emissions Between 0°F and –20°F (–20° to –29°C) for New Production

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 50	Gas Only	Gas	50 to 100% load	42	100	50
	Dual Fuel	Gas	50 to 100% load	72	100	50
Taurus™ 60	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Taurus 65	Gas Only	Gas	50 to 100% load	42	100	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Mars® 90	Gas Only	Gas	50 to 100% load	42	100	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	42	100	50
Titan 250	Gas Only	Gas	40 to 100% load	25	50	25
	Gas Only	Gas	40 to 100% load	15	25	25
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

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

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Centaur 40	Gas Only or Dual Fuel	Gas	80 to 100% load	120	150	50
Centaur 50	Gas Only	Gas	50 to 100% load	120	150	50
	Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 60	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Taurus 65	Gas Only	Gas	50 to 100% load	120	150	50
Taurus 70	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Mars 90	Gas Only	Gas	80 to 100% load	120	150	50
Mars 100	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Titan 130	Gas Only or Dual Fuel	Gas	50 to 100% load	120	150	50
Centaur 40	Dual Fuel	Liquid	80 to 100% load	120	150	75
Centaur 50	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 60	Dual Fuel	Liquid	65 to 100% load	120	150	75
Taurus 70	Dual Fuel	Liquid	65 to 100% load	120	150	75
Mars 100	Dual Fuel	Liquid	65 to 100% load	120	150	75
Titan 130	Dual Fuel	Liquid	65 to 100% load	120	150	75

Table 3. Expected Emissions below –20°F (–29°C) for the Titan 250 SoLoNOx Combustion Turbine

Turbine Model	Fuel System	Fuel	Applicable Load	NOx, ppm	CO, ppm	UHC, ppm
Titan 250	Gas Only	Gas	40 to 100% load	70	150	50

COLD AMBIENT PERMITTING STRATEGY

There are several permitting options to consider when permitting in cold ambient climates. Customers can use a tiered permitting approach or choose to permit a single emission rate over all temperatures. Historically, most construction and operating permits were silent on the ambient temperature boundaries for *SoLoNOx* operation.

Some customers have used a tiered permitting strategy. For purposes of compliance and annual emissions inventories, a digital thermometer is installed to record ambient temperature. The amount of time is recorded that the ambient temperature falls below 0°F. The amount of time below 0°F is then used with the emissions estimates shown in Tables 1 and 2 to estimate "actual" emissions during sub-zero operation.

A conservative alternative to using the NOx values in Tables 1, 2 and 3 is to reference 40CFR60 subpart KKKK, which allows 150 ppm NOx at 15% O_2 for sub-zero operation.

For customers who wish to permit at a single emission rate over all ambient temperatures, inlet air heating can be used to raise the engine inlet air temperature (T_1) above 0°F. With inlet air heating to keep T_1 above 0°F, standard emission warranty levels may be offered.

Inlet air heating technology options include an electric resistance heater, an inlet air to exhaust heat exchanger and a glycol heat exchanger.

If an emissions warranty is desired and ambient temperatures are commonly below –20°F (–29°C), inlet air heating can be used to raise the turbine inlet temperature (T_1) to at least –20°F. In such cases, the values shown in Table 1 can be warranted for new production.

EMISSIONS ESTIMATES IN NON-SOLONOX MODE (LOW LOAD)

At operating loads < 50% (<40% load for the *Titan* 250) on natural gas fuel and < 65% (< 80% load for *Centaur* 40) on liquid fuels, *SoLoNOx* engines are controlled to increase stability and transient response capability. The control steps that are required affect emissions in two ways: 1) pilot fuel flow is increased, increasing NOx emissions, and 2) airflow through the combustor is increased, increasing CO emissions. Note that the load levels are approximate. Engine controls are triggered either by power output for single-shaft engines or gas producer speed for two-shaft engines.

A conservative method for estimating emissions of NOx at low loads is to use the applicable NSPS: 40CFR60 subpart GG or KKKK. For projects that commence construction after February 18, 2005, subpart KKKK is the applicable NSPS and contains a NOx level of 150 ppm @ 15% O_2 for operating loads less than 75%.

Table 4 provides estimates of NOx, CO, and UHC emissions when operating in non-SoLoNOx mode for natural gas or liquid fuel. The estimated emissions can be assumed to vary linearly as load is decreased from just below 50% load for natural gas (or 65% load for liquid fuel) to idle.

The estimates in Table 4 apply for any product for gas only or dual fuel systems using pipeline quality natural gas. Refer to Product Information Letter 205 for *Mercury* 50 emissions estimates.

Table 4. Estimated Emissions in non-SoLoNOx Mode

Ambient	Fuel System	Engine Load	NOx, ppm	CO, ppm	UHC, ppm
***Centaur* 40/50, *Taurus* 60/65/70, *Mars* 90/100, *Titan* 130**					
≥ –20°F (–29°C)	Natural Gas	Less than 50%	70	8,000	800
		Idle	50	10,000	1,000
< –20°F (–29°C)	Natural Gas	Less than 50%	120	8,000	800
		Idle	120	10,000	1,000
***Titan* 250**					
≥ –20°F (–29°C)	Natural Gas	Less than 40%	50	25	20
		Idle	50	2,000	200
< –20°F (–29°C)	Natural Gas	Less than 40%	70	150	50
		Idle	70	2,000	200
***Centaur* 50, *Taurus* 60/70, *Mars* 100, *Titan* 130**					
≥ –20°F (–29°C)	Liquid	Less than 65%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 65%	120	1,000	150
		Idle	120	10,000	3,000
***Centaur* 40**					
≥ –20°F (–29°C)	Liquid	Less than 80%	120	1,000	100
		Idle	120	10,000	3,000
< –20°F (–29°C)	Liquid	Less than 80%	120	1,000	150
		Idle	120	10,000	3,000

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Solar Turbines
A Caterpillar Company

PIL 168
Product Information Letter

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

This Product Information Letter summarizes methods that are available to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO_2), and formaldehyde from gas turbines. Emissions estimates of these pollutants are often necessary during the air permitting process.

INTRODUCTION

In absence of site-specific or representative source test data, Solar refers customers to a United States Environmental Protection Agency (EPA) document titled "AP-42" or other appropriate EPA reference documents. AP-42 is a collection of emission factors for different emission sources. The emission factors found in AP-42 provide a generally accepted way of estimating emissions when more representative data are not available. The most recent version of AP-42 (dated April 2000) can be found at:

http://www.epa.gov/ttn/chief/ap42/ch03/index.html

Solar does not typically warranty the emission rates for VOC, SO_2 or formaldehyde.

Volatile Organic Compounds

Many permitting agencies require gas turbine users to estimate emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are some of the many ways of referring to the non-methane (and non-ethane) portion of an "unburned hydrocarbon" emission estimate.

For natural gas fuel, Solar's customers use 10-20% of the UHC emission rate to represent VOC emissions. The estimate of 10-20% is based on a ratio of total non-methane hydrocarbons to total organic compounds. The use of 10-20% provides a conservative estimate of VOC emissions. The balance of the UHC is assumed to be primarily methane.

For liquid fuel, it is appropriate to estimate that 100% of the UHC emission estimate is VOC.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of sulfur in the fuel to SO_2. Since Solar does not control the amount of sulfur in the fuel, we are unable to predict SO_2 emissions without a site fuel composition analysis. Customers generally estimate SO_2 emissions with a mass balance calculation by assuming that any sulfur in the fuel will convert to SO_2. For reference, the typical mass balance equation is shown below.

Variables: wt % of sulfur in fuel
Btu/lb fuel (LHV*)
MMBtu/hr fuel flow (LHV)

$$\frac{\text{lb } SO_2}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100}\right)\left(\frac{\text{lb fuel}}{\text{Btu}}\right)\left(\frac{10^6 \text{ Btu}}{\text{MMBtu}}\right)\left(\frac{\text{MMBtu fuel}}{\text{hr}}\right)\left(\frac{\text{MW } SO_2}{\text{MW Sulfur}}\right)$$

As an alternative to the mass balance calculation, EPA's AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.0034 lb/MMBtu for gas fuel (HHV*) and 0.033 lb/MMBtu for liquid fuel (HHV).

*LHV = Lower Heating Value; HHV = Higher Heating Value

Formaldehyde

In gas turbines, formaldehyde emissions are a result of incomplete combustion. Formaldehyde

in the exhaust stream is unstable and very difficult to measure. In addition to turbine characteristics including combustor design, size, maintenance history, and load profile, the formaldehyde emission level is also affected by:

- Ambient temperature
- Humidity
- Atmospheric pressure
- Fuel quality
- Formaldehyde concentration in the ambient air
- Test method measurement variability
- Operational factors

The emission factor data in Table 1 is an excerpt from an EPA memo: "Revised HAP Emission Factors for Stationary Combustion Turbines, 8/22/03." The memo presents hazardous air pollutant (HAP) emission factor data in several categories including: mean, median, maximum, and minimum. The emission factors in the memo are a compilation of the HAP data EPA collected during the Maximum Achievable Control Technology (MACT) standard development process. The emission factor documentation shows there is a high degree of variability in formaldehyde emissions from gas turbines, depending on the manufacturer, rating size of equipment, combustor design, and testing events. To estimate formaldehyde emissions from gas turbines, users should use the emission factor(s) that best represent the gas turbines actual / planned operating profile. Refer to the memo for alternative emission factors.

Table 1. EPA's Total HAP and Formaldehyde Emission Factors for <50 MW Lean-Premix Gas Turbines burning Natural Gas

(Source: Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09, 8/22/03)

Pollutant	Engine Load	95% Upper Confidence of Mean, lb/MMBtu HHV	95% Upper Confidence of Data, lb/MMBtu HHV	Memo Reference
Total HAP	> 90%	0.00144	0.00258	Table 19
Total HAP	All	0.00160	0.00305	Table 16
Formaldehyde	> 90%	0.00127	0.00241	Table 19
Formaldehyde	All	0.00143	0.00288	Table 16

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Solar® Turbines
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PIL 170
Product Information Letter

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

Leslie Witherspoon
Solar Turbines Incorporated

PURPOSE

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

INTRODUCTION

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

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

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

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

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

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

START-UP SEQUENCE

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

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

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

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

The third step consists of applying up to 50% load[1] while allowing the combustion flame to transition and stabilize. Once 50% load is achieved, the turbine transitions to *SoLoNOx* combustion mode and the engine control system begins to hold the combustion primary zone temperature and limit pilot fuel to achieve the targeted nitrogen oxides (NOx), carbon monoxide (CO), and unburned hydrocarbons (UHC) emission levels.

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

SHUTDOWN PROCESS

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

START-UP AND SHUTDOWN EMISSIONS ESTIMATES

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

COMMISSIONING EMISSIONS

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

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

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

10 Minute Start-up and 10 Minute Shutdown

Natural Gas Fuel

Data will NOT be warranted under any circumstances

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

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

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

Assumes unit is operating at full load prior to shutdown.

Assumes natural gas fuel; ES 9-98 compliant.

GE Power & Water

VGF - P48GL

Power Generation - Standby

ENGINE SPEED (rpm):	1800		
DISPLACEMENT (in3):	2924	COOLING SYSTEM:	JW, IC + OC
COMPRESSION RATIO:	11:1	INTERCOOLER WATER INLET (°F):	130
IGNITION SYSTEM:	CEC	JACKET WATER OUTLET (°F):	180
EXHAUST MANIFOLD:	Water Cooled	JACKET WATER CAPACITY (gal):	58
COMBUSTION:	Lean Burn, Open Chamber	AUXILIARY WATER CAPACITY (gal):	14
ENGINE DRY WEIGHT (lbs):	14900	LUBE OIL CAPACITY (gal):	113
AIR/FUEL RATIO SETTING:	7.8% O2	MAX. EXHAUST BACKPRESSURE (in. H2O):	15
ENGINE SOUND LEVEL (dBA)	101	MAX. AIR INLET RESTRICTION (in. H2O):	15
IGNITION TIMING:	13° BTDC	EXHAUST SOUND LEVEL (dBA)	112
FREQUENCY (Hz):	60	PHASE:	3
GENERATOR TYPE:	Synchronous	PHASE ROTATION:	T1-T2-T3
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/ft3):	1,035.2	FUEL WKI:	91.8
FUEL LHV (BTU/ft3):	935.8		

SITE SPECIFIC TECHNICAL DATA

POWER RATING	UNITS	MAX RATING AT 100 °F AIR TEMP	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE OF 90 °F		
			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 *based on fuel analysis LHV*	SCFM	146	146	115	83
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 + NO2)	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
CH4	g/bhp-hr	1.36	1.36	1.60	1.81
CO2	g/bhp-hr	433	433	453	493
CO2e	g/bhp-hr	463	463	489	534
CH2O	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 *at exhaust temp, 14.5 psia*	ACFM	6171	6166	4807	3443
EXHAUST TEMPERATURE	°F	839	839	830	819

HEAT EXHANGER 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

All data provided per the condtions listed in the notes section on page three.

Data Generated by EngCalc Program Version 3.3 Dresser Inc.

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VGF - P48GL

Power Generation - Standby

FUEL COMPOSITION

HYDROCARBONS:		Mole or Volume %
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 Cloride	0	% volume
Total Ammonia	0	% volume
Siloxanes		
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 Cloride	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 ± 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 ± 30% for radiation, and ± 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. NOx, 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 ± 7%.

7. Exhaust temperature given at engine exhaust outlet flange with a tolerance of ± 75°F (42°C).

8. Exhaust gas mass flow value is based on a "wet basis" with a tolerance of ± 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 (kWe): 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.