global environmental solutions

CNX Gas Company, LLC

Oxford 11 Well Pad, ID 017-00148

New Milton, West Virginia

Class II Update R13-3237B

SLR Ref: 116.00894.00046

November 2015

Oxford 11 Well Pad Class II Update R13-3237B

Prepared for:

CNX Gas Company, LLC
PO Box 1248
Jane Lew, WV 26378

This document has been prepared by SLR International Corporation. The material and data in this permit application were prepared under the supervision and direction of the undersigned.

Nathaniel Lanham
West Virginia Operations Manager

Jesse Hanshaw, P.E.
Principal Engineer

CONTENTS

ATTACHMENTS

Notes:

ATTACHMENT H – No new SDS Sheets Related to this Class II Update
ATTACHMENT K – No Change to Fugitive Emissions Data Sheet
ATTACHMENT M – Air Pollution Control Devices not Applicable on Updated Equipment
ATTACHMENT Q - No information contained within this application is claimed confidential
ATTACHMENT R - No delegation of authority
ATTACHMENT S - Not a Title V Permit Revision

APPLICATION FOR PERMIT

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

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):*
CNX Gas Company, LLC

2. Federal Employer ID No. ***(FEIN):***
550738862

3. Name of facility *(if different from above):*
Oxford 11 Well Pad

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

5A. Applicant's mailing address:
1000 Consol Energy Drive
Canonsburg, PA 15317

5B. Facility's present physical address:
Access road off S. Fork of Hughes River (See Coordinates)

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:

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: **The applicant leases the site.**

➪ If **NO,** you are not eligible for a permit for this source.

9. Type of plant or facility (stationary source) to be **constructed, modified, relocated, administratively updated** or **temporarily permitted** (e.g., coal preparation plant, primary crusher, etc.): **Natural Gas Well Pad**

10. North American Industry Classification System **(NAICS)** code for the facility:
212111

11A. DAQ Plant ID No. (for existing facilities only):
017-00148

11B. List all current 45CSR13 and 45CSR30 (Title V) permit numbers associated with this process (for existing facilities only):
R13-3237A

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 intersection of WV-Hwy. 18 and Co. Rte. 25 near New Milton, WV, travel south on WV-Hwy. 18 for 3 miles. Turn right on Porto Rico Rd. for 0.7 miles, then continue straight onto Toms Fork Road for another 0.7 miles. Take slight right onto Co. Rte. 54/1 for 2.5 miles, then turns right and becomes Cain Run for 0.3 miles. Then take sharp left onto S. Fork of Hughes River for 1.0 mile. Take access road to left and to the top of the hill and stay to the left to arrive at site

12B. New site address (if applicable):	12C. Nearest city or town:	12D. County:
N/A	New Milton	Doddridge
12.E. UTM Northing (KM): 4335.746	12F. UTM Easting (KM): 520.430	12G. UTM Zone: 17N

13. Briefly describe the proposed change(s) at the facility:

This Class II Administrative Permit Update is proposed to cover the installation of a micro turbine generator which has become necessary to power metering equipment. The micro turbine is a Capstone C30, which produces 30kW of power. In addition, a de minimis 100 bbl pipeline liquids tank was added to the facility to handle liquids from CONE's salt dryer. The salt dryer was evaluated within the original permit application and found to have no direct emission points. However, it is still included in fugitive leak component counts and leak check maintenance.

14A. Provide the date of anticipated installation or change: **12/01/2015** ➪ If this is an **After-The-Fact** permit application, provide the date upon which the proposed change did happen:	14B. Date of anticipated Start-Up if a permit is granted: **12/01/2015**

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). See attached check for $300 which covers the Class II fees

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: Micro-turbine Generator Capstone C30

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 Craig Neal *(Please use blue ink)* DATE: _____ *(Please use blue ink)*

35B. Printed name of signee: Craig Neal		35C. Title: Vice President Gas Operations
35D. E-mail: craigneal@consolenergy.com	36E. Phone: 724-485-4000	36F. FAX
36A. Printed name of contact person (if different from above): Jesse Hanshaw		36B. Title: Principal Engineer, SLR
36C. E-mail: jhanshaw@slrconsulting.com	36D. Phone: 304-545-8563	36E. FAX: 681-205-8969

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.***

ATTACHMENT A

BUSINESS CERTIFICATE

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

State of West Virginia

Certificate

I, Natalie E. Tennant, Secretary of State of the State of West Virginia, hereby certify that

CNX GAS COMPANY LLC

was duly authorized under the laws of this state to transact business in West Virginia as a foreign limited liability company on June 29, 2001.

The company is filed as a term company, for the term ending June 29, 2026.

I further certify that the company's most recent annual report, as required by West Virginia Code §31B-2-211, has been filed with our office and that a certificate of cancellation has not been filed.

Therefore, I hereby issue this

CERTIFICATE OF AUTHORIZATION

Given under my hand and the Great Seal of the State of West Virginia on this day of October 28, 2011

Natalie E. Tennant

Secretary of State

ATTACHMENT B

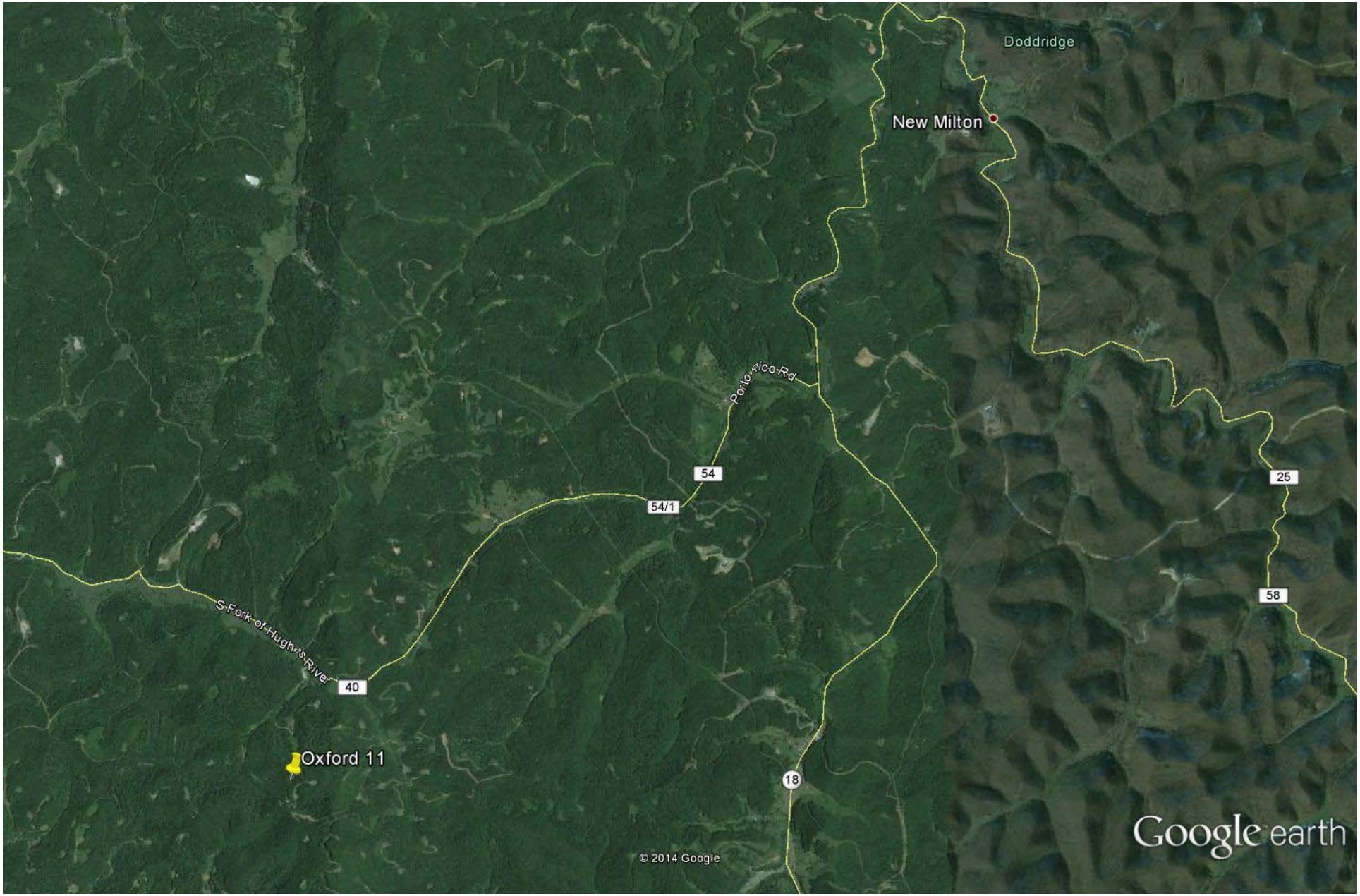
MAP

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015



Google earth

miles 5
km 8

ATTACHMENT C

INSTALLATION AND START-UP

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

INSTALLATION AND STARTUP SCHEDULE

CNX Gas Company, previously installed the 100 bbl compressor skid slop water tank as a de minimis source under 45CSR13 and would like to install the 30 kW micro turbine as soon as possible.

ATTACHMENT D

REGULATORY DISCUSSION

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

REGULATORY DISCUSSION

The installation of a micro turbine generator and the inclusion of a small compressor skid rain water tank encompassed by this class II administrative amendment was evaluated with respect to the following rules and regulations:

Federal and State:

45 CSR 13 – Minor New Source Review Permitting Requirements

The emission changes associated with the requested turbine combustion unit and de minimis water tank increases the facility's emissions of NOx by 0.09 tpy, CO by 0.24 tpy, and VOC's by 0.03 tpy.

Additionally, the new units do not trigger any substantive requirements under the State or Federal Rules and Regulations. Even though emissions are below permit modification thresholds and no new substantive requirements are applicable the new equipment is being proposed via a Class II Administrative Update to reflect the facility's change to PTE in an effort to preserve it's synthetic minor status and eliminate any conflicts with existing permit terms or conditions, such as 4.1.1. This will encompass a 30 day public comment period on the application, which satisfies the third party review stipulation of the Clean Air Act Amendments.

The $300 Class II application fee has been supplied with this application to satisfy processing cost in accordance with Rule 13 and 22.

40 CFR 60, Subpart KKKK – New Stationary Combustion Turbines

This Federal regulation was evaluated for turbines that commence construction after February 18, 2005, but these standards apply only to units with a design heat input equaling or exceeding 10 MMBtu/hr. The subject of this permit update is a 30 kW unit with a design heat input rating of 0.433 MMBtu/hr. Therefore, the NSPS for Turbines will not apply to this unit.

ATTACHMENT E

PLOT PLAN

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

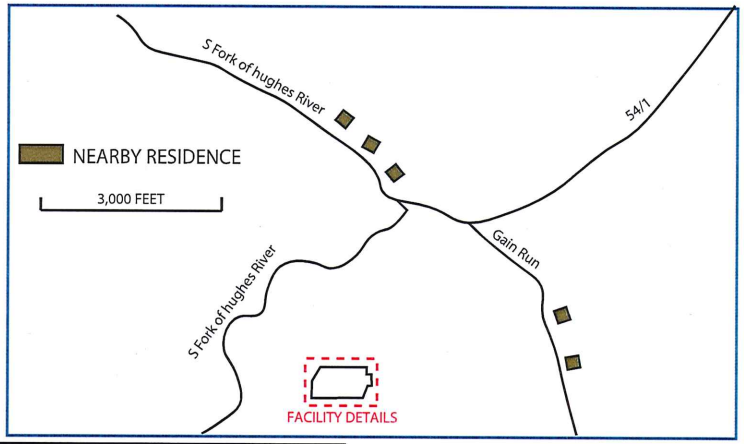
November 2015

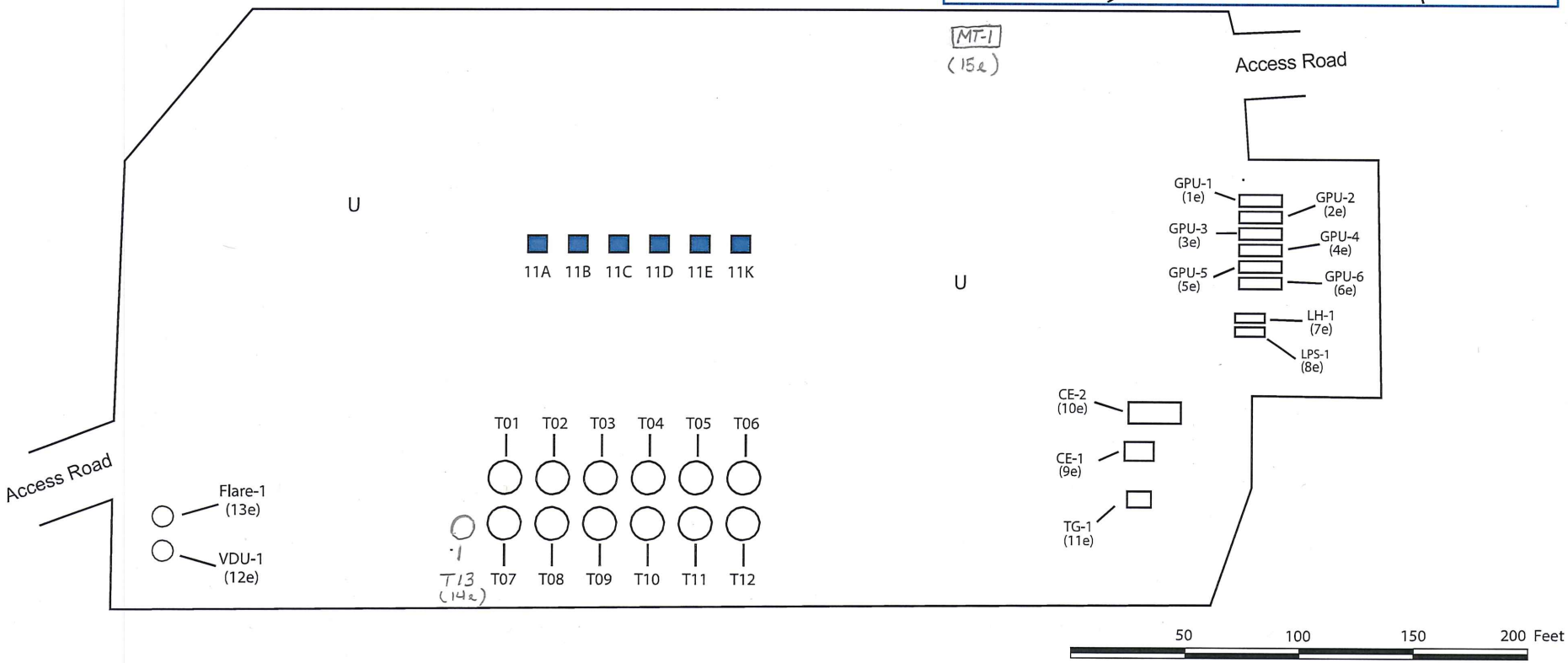
ELEVATION: 1335 FEET

REFERENCE CORDINATES (LAT/LONG):
39.4170698/-80.763494°

LEGEND

- BUILDING
- NATURAL GAS WELL
- U UNPAVED
- P PAVED





Report: G 70-A PERMIT APPLICATION		
Drawing: PLOT PLAN		
Date: January 14, 2015		FIGURE 1

CNX Gas Company, LLC
Oxford 11 Well Pad
New Milton, West Virginia

SLR

ATTACHMENT F

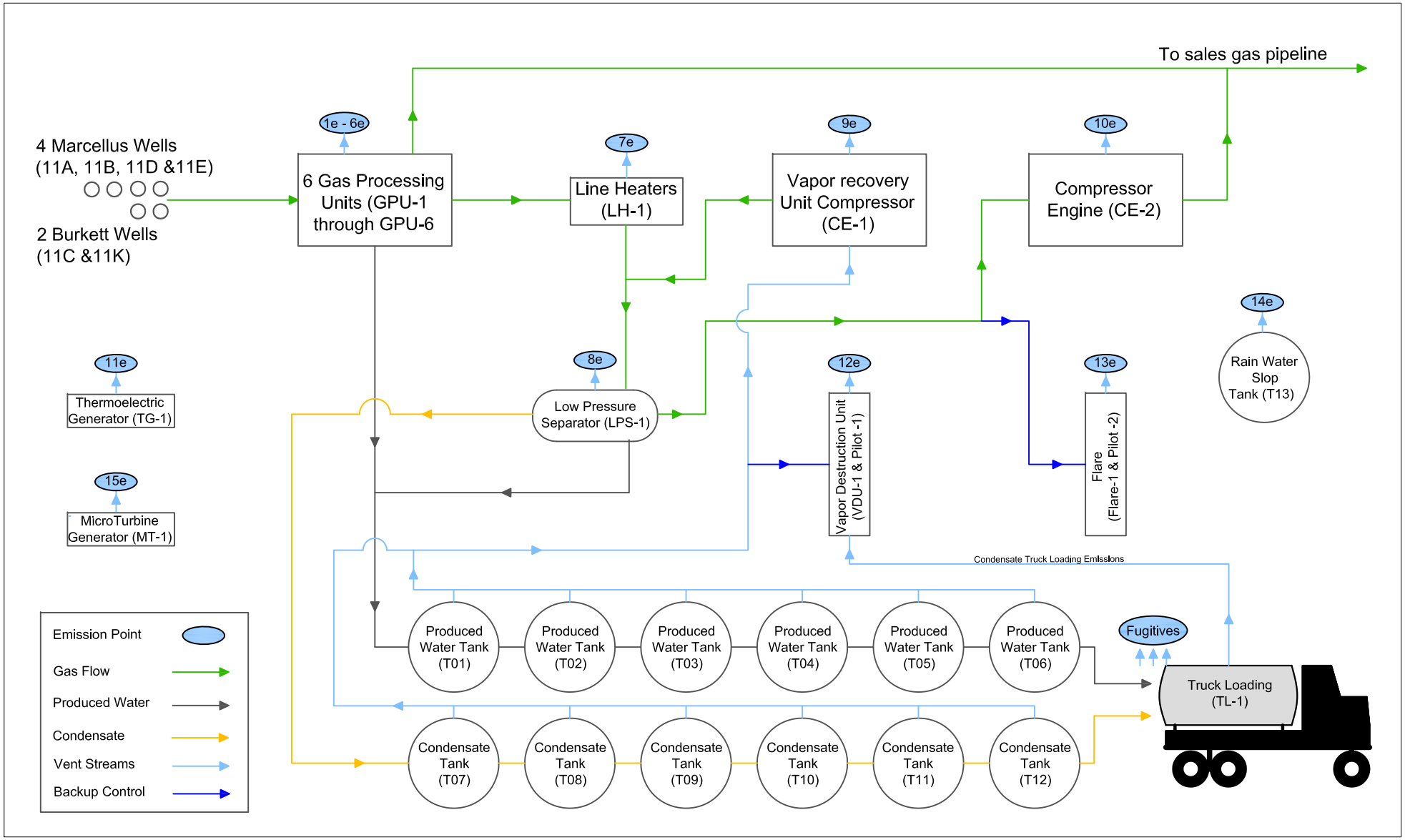
PROCESS FLOW DIAGRAM

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015



Process Flow Diagram
CNX Gas Company, LLC
Oxford 11 Well Pad
New Milton, West Virginia

ATTACHMENT G

PROCESS DESCRIPTION

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

PROCESS DESCRIPTION

CNX Gas Company, LLC is applying for coverage under 45CSR13, Rule 13, for a Class II Administrative Update to Permit Number R13-3237A for the construction and operation of a new micro turbine generator at the Oxford 11 natural gas well pad. This update will also reflect the installation of a small de minimis rain water slop tank having a capacity of 100 bbls.

DESCRIPTION OF PROCESS CHANGE

The proposed micro turbine is a 30 kW natural gas fired Capstone generator unit, which will be used to power gas measurement and monitoring equipment at the facility's exiting sales pipeline. The turbine unit is very clean burning and small with respect to other onsite fuel burning units. The Capstone spec sheet defines an electrical efficiency of 26% and a maximum design heat input of 0.433 MMBtu/hr.

Additionally, within this update the site would like to reflect the installation of a de minimis 100 bbl storage vessel that was installed to receive rain water and any oil slop originating from the drip pans on the outdoor VRU and flash gas compressors. Therefore, the liquid sent to this tank is expected to be mostly rain water with no potential for VOC emissions.

The facility's overall increase in emissions is as follows:

Pollutant	Tons/yr
NOx	0.084
CO	0.237
VOC	0.03

ATTACHMENT H

SAFETY DATA SHEETS (SDS)

NOT APPLICABLE (SEE NOTE)

Note: No Changes to the Chemicals Utilized at the Facility.

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

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ATTACHMENT I

EMISSION UNITS TABLE

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

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]
MT-1	15e	30 kW MicroTurbine Generator	2015	30 kW	New	None
T13	14e	Compressor Rain Water Slop Tank	2015	100 bbl	New	None

[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

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
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Jane Lew, West Virginia

November 2015

Attachment J
EMISSION POINTS DATA SUMMARY SHEET

Table 1: Emissions Data

Emission Point ID No. *(Must match Emission Units Table & Plot Plan)*	Emission Point Type[1]	Emission Unit Vented Through This Point *(Must match Emission Units Table & Plot Plan)*		Air Pollution Control Device *(Must match Emission Units Table & Plot Plan)*		Vent Time for Emission Unit *(chemical processes only)*		All Regulated Pollutants - Chemical Name/CAS[3] *(Speciate VOCs & HAPS)*	Maximum Potential Uncontrolled Emissions[4]		Maximum Potential Controlled Emissions[5]		Emission Form or Phase *(At exit conditions, Solid, Liquid or Gas/Vapor)*	Est. Method Used[6]	Emission Concentration[7] (ppmv or mg/m^4)
		ID No.	Source	ID No.	Device Type	Short Term[2]	Max (hr/yr)		lb/hr	ton/yr	lb/hr	ton/yr			
14e	Vertical Stack	T13	Rain Water Slop Tank	NA	NA	NA	NA	VOC	0.00	0.00	0.00	0.00	Gas/ Vapor	EE	Can Supply Upon Request
15e	Vertical Stack	MT-1	Micro Turbine	NA	NA	NA	NA	NOx CO VOC	0.02 0.05 0.01	0.09 0.24 0.03	0.02 0.05 0.01	0.09 0.24 0.03	Gas/ Vapor	EE	Can Supply Upon Request

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 K

FUGITIVE EMISSIONS DATA SHEET

NOT APPLICABLE (SEE NOTE)

Note: No Changes to Fugitive Equipment Related to this Update.

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

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November 2015

ATTACHMENT L

EMISSION UNIT DATA SHEET

Class II Update R13-3237A

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

June 2015

NATURAL GAS WELL AFFECTED FACILITY DATA SHEET

STORAGE VESSEL EMISSION UNIT DATA SHEET

Provide the following information for each new or modified bulk liquid storage tank.

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Oxford 11Well Pad	2. Tank Name Slop Water Tank
3. Emission Unit ID number T13	4. Emission Point ID number 14e
5. Date Installed or Modified *(for existing tanks)* 2015	6. Type of change: ☒ New construction ☐ New stored material ☐ Other
7A. Description of Tank Modification *(if applicable) NA*	
7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* ☐ Yes ☒ No	
7C. Provide any limitations on source operation affecting emissions. (production variation, etc.) None	

II. TANK INFORMATION (required)

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 100 BBl	
9A. Tank Internal Diameter (ft.) 8.5	9B. Tank Internal Height (ft.) 10
10A. Maximum Liquid Height (ft.) 9.5	10B. Average Liquid Height (ft.) 5
11A. Maximum Vapor Space Height (ft.) 10	11B. Average Vapor Space Height (ft.) 5
12. Nominal Capacity *(specify barrels or gallons).* This is also known as "working volume. 100 BBL	
13A. Maximum annual throughput (gal/yr) 15,330	13B. Maximum daily throughput (gal/day) 42
14. Number of tank turnovers per year 3.65	15. Maximum tank fill rate (gal/min) 5
16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading	
17. Is the tank system a variable vapor space system? ☐ Yes ☒ No If yes, (A) What is the volume expansion capacity of the system (gal)? (B) What are the number of transfers into the system per year?	
18. Type of tank (check all that apply): ☒ Fixed Roof _x_ vertical ___ horizontal _x_ flat roof ___ cone roof ___ dome roof ___ other (describe) ☐ External Floating Roof ___ pontoon roof ___ double deck roof ☐ Domed External (or Covered) Floating Roof ☐ Internal Floating Roof ___ vertical column support ___ self-supporting ☐ Variable Vapor Space ___ lifter roof ___ diaphragm ☐ Pressurized ___ spherical ___ cylindrical ☐ Underground ☐ Other (describe)	

III. TANK CONSTRUCTION AND OPERATION INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 19 – 26 in section VII

IV. SITE INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 27 – 33 in section VII

V. LIQUID INFORMATION *(check which one applies)*

☐ Refer to enclosed TANKS Summary Sheets
☒ Refer to the responses to items 34 – 39 in section VII

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply):

☒ Does Not Apply
☐ Carbon Adsorption[1]
☐ Vent to Vapor Combustion Device[1] (vapor combustors, flares, thermal oxidizers)
☐ Condenser[1]
☐ Other[1] (describe)
☐ Rupture Disc (psig)
☐ Inert Gas Blanket of _____
☐ Conservation Vent (psig
Vacuum Setting Pressure Setting
☐ Emergency Relief Valve (psig)

[1] Complete appropriate Air Pollution Control Device Sheet

41. Expected Emission Rate (submit Test Data or Calculations here or elsewhere in the application). See Attachment I

Material Name and CAS No.	**Flashing Loss**		**Breathing Loss**		**Working Loss**		**Total Emissions Loss**		**Estimation Method[1]**
	lb/hr	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	
See Calculations for details									Promax Simulation

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)
Remember to attach emissions calculations, including TANKS Summary Sheets and other modeling summary sheets if applicable.

SECTION VII (required if did not provide TANKS Summary Sheets)

TANK CONSTRUCTION AND OPERATION INFORMATION

19. Tank Shell Construction:
☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded

20A. Shell Color: Gray	20B. Roof Color: Gray	20C. Year Last Painted: New 2015

21. Shell Condition (if metal and unlined):
☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ Yes ☒ No	22B. If yes, operating temperature:	22C. If yes, how is heat provided to tank?

23. Operating Pressure Range (psig): Atmospheric tank

24. Is the tank a **Vertical Fixed Roof Tank**? ☒ Yes ☐ No	24A. If yes, for dome roof provide radius (ft): NA – flat roof	24B. If yes, for cone roof, provide slop (ft/ft):

25. Complete item 25 for **Floating Roof Tanks** ☐ Does not apply ☒

25A. Year Internal Floaters Installed:

25B. Primary Seal Type *(check one):* ☐ Metallic (mechanical) shoe seal ☐ Liquid mounted resilient seal ☐ Vapor mounted resilient seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a secondary seal? ☐ Yes ☐ No

25D. If yes, how is the secondary seal mounted? *(check one)* ☐ Shoe ☐ Rim ☐ Other (describe):

25E. Is the floating roof equipped with a weather shield? ☐ Yes ☐ No

25F. Describe deck fittings:

26. Complete the following section for **Internal Floating Roof Tanks** ☒ Does not apply

26A. Deck Type: ☐ Bolted ☐ Welded	26B. For bolted decks, provide deck construction:

26C. Deck seam. Continuous sheet construction:
☐ 5 ft. wide ☐ 6 ft. wide ☐ 7 ft. wide ☐ 5 x 7.5 ft. wide ☐ 5 x 12 ft. wide ☐ other (describe)

26D. Deck seam length (ft.):	26E. Area of deck (ft^2):	26F. For column supported tanks, # of columns:	26G. For column supported tanks, diameter of column:

SITE INFORMATION:

27. Provide the city and state on which the data in this section are based: New Milton, WV

28. Daily Avg. Ambient Temperature (°F): 65		29. Annual Avg. Maximum Temperature (°F): 75	
30. Annual Avg. Minimum Temperature (°F): 55		31. Avg. Wind Speed (mph): 4	
32. Annual Avg. Solar Insulation Factor (BTU/ft^2-day):1211		33. Atmospheric Pressure (psia):14.6	
LIQUID INFORMATION:			
34. Avg. daily temperature range of bulk liquid (°F):65	34A. Minimum (°F):55	34B. Maximum (°F):75	
35. Avg. operating pressure range of tank (psig):0	35A. Minimum (psig):0	35B. Maximum (psig):0	
36A. Minimum liquid surface temperature (°F):50		36B. Corresponding vapor pressure (psia): 14.7	
37A. Avg. liquid surface temperature (°F):65		37B. Corresponding vapor pressure (psia):14.7	
38A. Maximum liquid surface temperature (°F):75		38B. Corresponding vapor pressure (psia):14.7	
39. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary.			
39A. Material name and composition:	Rain Water from Comp. Skid		
39B. CAS number:			
39C. Liquid density (lb/gal):	8.3 lb/gal		
39D. Liquid molecular weight (lb/lb-mole):	18		
39E. Vapor molecular weight (lb/lb-mole):	18		
39F. Maximum true vapor pressure (psia):	14.7		
39G. Maxim Reid vapor pressure (psia):	14.7		
39H. Months Storage per year. From: To:	12		

NATURAL GAS FIRED FUEL BURNING UNITS
EMISSION DATA SHEET

Complete the information on this data for each Gas Producing Unit(s), Heater Treater(s), and in-line heater(s) at the production pad. Reboiler information should be entered on the Glycol Dehydration Emission Unit Data Sheet.

Emission Unit ID #[1]	Emission Point ID#[2]	Emission Unit Description (Manufacturer / Model #)	Year Installed/ Modified	Type[3] and Date of Change	Control Device[4]	Design Heat Input (mmBtu/hr)[5]	Fuel Heating Value (Btu/scf)[6]
MT-1	15e	MicroTurbine Generator	2015	New	NA	0.433 MMBtu/hr	1020

[1] Enter the appropriate Emission Unit (or Sources) identification numbers for each fuel burning unit located at the production pad. Gas Producing Unit Burners should be designated GPU-1, GPU-2, etc. Heater Treaters should be designated HT-1, HT-2, etc. Heaters or Line Heaters should be designated LH-1, LH-2, etc. For sources, use 1S, 2S, 3S…or other appropriate designation. Enter glycol dehydration unit Reboiler Vent data on the *Glycol Dehydration Unit Data Sheet*.

[2] Enter the appropriate Emission Point identification numbers for each fuel burning unit located at the production pad. Gas Producing Unit Burners should be designated GPU-1, GPU-2, etc. Heater Treaters should be designated HT-1, HT-2, etc. Heaters or Line Heaters should be designated LH-1, LH-2, etc. For emission points, use 1E, 2E, 3E…or other appropriate designation.

[3] New, modification, removal

[4] Complete appropriate air pollution control device sheet for any control device.

[5] Enter design heat input capacity in mmBtu/hr.

[6] Enter the fuel heating value in Btu/standard cubic foot.

ATTACHMENT N

SUPPORTING EMISSIONS CALCULATIONS

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

Table 1. Annual Potential To Emit (PTE)
CNX Gas LLC - Oxford 11

Criteria PTE

Source	PM	PM10	PM2.5	SO2	NOx	CO [2]	VOC [1]	CO2e
Tanks with VDU 98% DRE (ton/yr)	--	--	--	--	--	--	11.884	-
Gas Processing Units (ton/yr)	0.196	0.196	0.196	0.015	2.576	2.164	0.142	3075.020
Line heaters (ton/yr)	0.082	0.082	0.082	0.006	1.074	0.902	0.059	1281.258
Low Pressure Separator (ton/yr)	0.016	0.016	0.016	0.001	0.215	0.180	0.012	256.252
Engines (ton/yr)	0.026	0.026	0.026	0.016	4.645	4.040	1.692	4281.283
Vapor Destruction Unit (VDU) (tons/yr)	-	-	-	0.158	5.475	29.791	11.272	9385.892
Process Flare (ton/yr)	-	-	-	2.557	8.505	46.278	65.776	14611.250
MicroTurbine (ton/yr)					0.084	0.237	0.030	222.066
Thermoelectic Burner (ton/yr)					0.005	0.002		
Truck Loading (ton/yr)	-	-	-	-	-	-	17.811	-
Piping Fugitives (ton/yr)	-	-	-	-	-	-	32.384	352.339
Total Emissions (ton/yr)	0.32	0.32	0.32	2.75	21.27	80.97	97.41	33465.36
Total Emissions (lb/hr)	0.07	0.07	0.07	0.63	4.86	18.49	22.24	7640.49
DAQ Notice Tons/yr Increase In Emissions					0.084	0.237	0.030	

Notes:

(1) The VOC total here reflects point source emissions under worst case operating scenario of VRU running engine running 8760 hrs/yr.

(2) The CO PTE for the facility does not include emissions from VRU, assumes worst case VDU emissions 8760 hrs/yr

Note: The overall Total Point Source Emission Totals for the site are recalculated for this Class II Update to show the that the site's minor source statue is maintained.

Table 13. MicroTurbine (MT-1) Emissions
CNX Gas LLC - Oxford 11

Pollutant	Emission Factor (lb/MWhe)	Power Rating (kW)	Conversion (MW/kW)	Emissions (lbs/hr)	Emissions (ton/yr)
NOx	0.64	30	(1/1,000)	0.02	0.08
CO	1.80	30	(1/1,000)	0.05	0.24
VOC	0.23	30	(1/1,000)	0.01	0.03
CO2	1690.00	30.00	(1/1,000)	50.70	222.07

Example Formula:

NOx (lb/hr) = Emiss Factor (lb/MWhe) * Power (kW) * Conv Factor (MW/kW)

MWhe = Mega Watt Hour electrical power

Emission factor comes from Capstone Technical Reference for MicroTurbine System at Maximum Exhaust Emissions, Table 1.

ATTACHMENT O

MONITORING/RECORDKEEPING/REPORTING/ TESTING PLANS

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

Monitoring

CNX Gas will monitor the fuel used by the micro turbine generator MT-1

Recordkeeping

CNX Gas will record all turbine maintenance to assure the device is maintenance in accordance with manufacturer's specifications.

Reporting

All equipment malfunctions and/or emission limit exceedances will be reported to the DAQ.

Testing

No testing will be deemed necessary unless at the request of the DAQ.

ATTACHMENT P

PUBLIC NOTICE

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that CNX Gas Company, LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a 45CSR13, Class II Administrative Update for the installation of a micro turbine generator at the Oxford 11 well pad site, off S. Fork of Hughes River near New Milton, Doddridge County, WV. The latitude and longitude coordinates are: 39.17070 and -80.76349.

The applicant estimates the following increase to the site's potential to discharge the following Regulated Air Pollutants:

Pollutant	Tons/yr
NOx	0.09
CO	0.24
VOC	0.03

Startup of operation is planned to begin on or about the 15 day of December, 2015. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of Publication of this notice.

Any questions regarding this permit application should be directed to the DAQ at (304) 926-0499, extension 1250, during normal business hours.

Dated this the 3rd Day of November, 2015.

By: CNX Gas Company, LLC
Patrick Flynn
Air Quality Manager-Env.
1000 Consol Energy Drive
Canonsburg, PA 15317

ATTACHMENT Q

NOT APPLICABLE (SEE NOTE)

Note: No information contained within this application is claimed confidential.

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

ATTACHMENT R

NOT APPLICABLE (SEE NOTE)

Note: No delegation of authority.

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

ATTACHMENT S

NOT APPLICABLE (SEE NOTE)

Note: Not a Title V Permit Revision.

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

ATTACHMENT T

PERMIT APPLICATION FEE

Class II Update R13-3237B

Oxford 11 Well Pad ID 017-00148
New Milton, West Virginia

CNX Gas Company, LLC
PO Box 1248
Jane Lew, West Virginia

November 2015

CNX Gas Company LLC
P. O. Box 305
Canonsburg, PA 15317-0305
Phone: 724-485-4031

WV DEP - DIV OF AIR QUALITY

Vendor No. 867986
Check No. 2780050407

Invoice Number	Invoice Date	Invoice Amount	Discount Amount	Net Amount
102615	10/26/2015	300.00	0.00	300.00
		Check Total.....		**$ 300.00**

OXF 11
Admin Update Fee

THIS CHECK IS TENDERED IN FULL SETTLEMENT OF YOUR INVOICES LISTED HEREON.

PLEASE DETACH REMITTANCE BEFORE CASHING.

CHECK NUMBER
2780050407

CNX Gas Company LLC
P.O. Box 305, Canonsburg, PA 15317-0305

56-503/422
CHECK DATE
10/30/2015

PAY	DOLLARS	CENTS	
	$**300.00**		USD

TO THE ORDER OF

WV DEP - DIV OF AIR QUALITY
601 57TH ST SE
CHARLESTON WV 25304-2345

Michael C. Hondolay

US Bank
Miamisburg, OH

⑈2780050407⑈ ⑆042205038⑆ 130116674227⑈

C30 MicroTurbine
Oil & Gas

33% smaller than equivalent generators. Offers ultra-low emissions and reliable electrical generation from raw natural gas.

- Optimal UL Class 1, Division 2 or ATEX Class 1, Zone 2 certified
- Patented air bearing: No lubricating oil or coolant
- One moving part – minimal maintenance and downtime
- Ultra-low emissions
- Service network available worldwide
- Remote monitoring and diagnostic capabilities
- Multiple units easily synchronized
- Electrical protective relays mean no external switchgear required
- Small, modular design allows for easy, low-cost installation
- Reliable – tens of millions of run hours and counting
- Optional High Humidity protection available

C30 MicroTurbine

Offshore Hazardous Area

Electrical Performance[1]	
Electrical Power Output	30kW
Voltage	400–480 VAC
Electrical Service	3-Phase, 4 wire
Frequency	10–60 Hz, stand alone operation
Maximum Output Current	46A, stand alone operation[2]
Electrical Efficiency LHV	26%

Fuel/Engine Characteristics[1]	Non-Hazardous Area Config.	Hazardous Area Config.
Natural / Wellhead Gas HHV	30.7–99.1 MJ/m³ (825–2,516 BTU/scf)	30.7–99.1 MJ/m³ (825–2,516 BTU/scf)
H_2S Content	< 70, 000 ppmv[3]	< 70,000 ppmv
Inlet Pressure – HHV dependent	310–379 kPa gauge (45–55 psig)	310–379 kPa gauge (45–55 psig)
Fuel Flow HHV	457 MJ/hr (433,000 BTU/hr)	455 MJ/hr (432,000 BTU/hr)
Net Heat Rate LHV	13.8 MJ/kWh (13,100 BTU/kWh)	13.8 MJ/kWh (13,100 BTU/kWh)

Exhaust Characteristics[1]	Raw Natural Gas	Hazardous Area Config.
NOx Emissions @ 15% O_2[4]	< 9 ppmvd (18 mg/m³)	< 9 ppmvd (18 mg/m³)
NOx / Electrical Output [4]	0.22 g/bhp-hr (0.64 lb/MWhe)	0.22 g/bhp-hr (0.64 lb/MWhe)
Exhaust Gas Flow	0.31 kg/s (0.68 lbm/s)	0.32 kg/s (0.70 lbm/s)
Exhaust Gas Temperature	275˚C (530˚F)	275˚C (530˚F)

Reliable power when and where you need it. Clean and simple.

Dimensions & Weight[5][6]	Raw Natural Gas	Hazardous Area Config.
Width x Depth x Height	0.76 x 1.5 x 1.8 m (30 x 60 x 70 in)	0.87 x 2.9 x 2.2 m (35 x 112 x 85 in)
Weight	578 kg (1,271 lb)	1141 kg (2,511 lb)

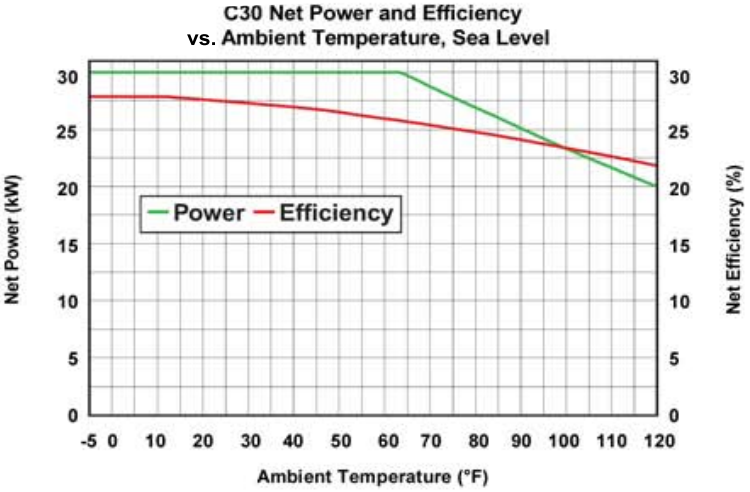
Minimum Clearance Requirements[5]	Raw Natural Gas	Hazardous Area Config.
Vertical Clearance	0.61 m (24 in)	0.61 m (24 in)
Horizontal Clearance		
Left & Right	0.76 m (30 in)	0.89 m (35 in)
Front	0.93 m (37 in)	1.1 m (44 in)
Rear	0.92 m (36 in)	0.92 m (36 in)

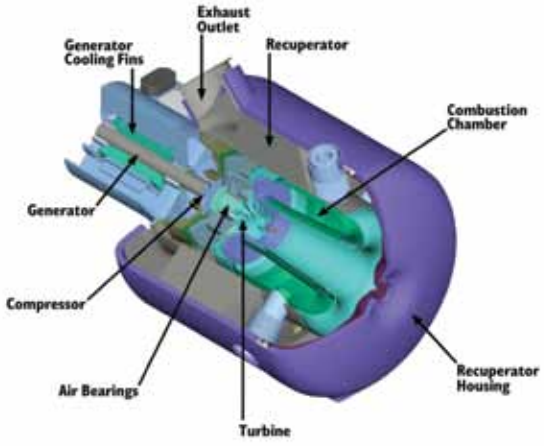
Sound Levels

Acoustic Emissions at Full Load Power	
Nominal at 10 m (33 ft)	65 dBA

Certifications

- Hazardous Area configurations certified to UL 2200 and NFPA 496
- Hazardous Area configurations certified for hazardous locations (UL file E240758) for standard natural gas
- Models available with optional equipment for CE Marking
- Hazardous Area configurations available with ATEX





(1) Nominal full power performance at ISO conditions: 59°F, 14.696 psia, 60% RH
(2) With linear load
(3) Varies with system configuration
(4) Exhaust emissions for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(5) Approximate dimensions and weights
(6) Height dimensions are to the roof line. Exhaust outlet extends at least 7 in above roof line
(7) Clearance requirements may increase due to local code considerations

Specifications are not warranted and are subject to change without notice.

21211 Nordhoff Street • Chatsworth • CA • 91311 • 866.422.7786 • 818.734.5300 • www.capstoneturbine.com

Capstone Turbine Corporation • 21211 Nordhoff Street • Chatsworth • CA 91311 • USA
Phone: (818) 734-5300 • Fax: (818) 734-5320 • Web: www.microturbine.com

Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

Capstone MicroTurbine™ systems are inherently clean and can meet some of the strictest emissions standards in the world. This technical reference is to provide customers with information that may be requested by local air permitting organizations or to compare air quality impacts of different technologies for a specific project. The preferred units of measure are "output based"; meaning that the quantity of a particular exhaust emission is reported relative to the useable output of the microturbine – typically in pounds per megawatt hour for electrical generating equipment. This technical reference also provides volumetric measurements in parts per million and milligrams per normal cubic meter. A conversion between several common units is also provided.

Maximum Exhaust Emissions at ISO Conditions

Table 1 below summarizes the exhaust emissions at full power and ISO conditions for different Capstone microturbine models. Note that the fuel can have a significant impact on certain emissions. For example landfill and digester gas can be made up of a wide variety of fuel elements and impurities, and typically contains some percentage of carbon dioxide (CO_2). This CO_2 dilutes the fuel, makes complete combustion more difficult, and results in higher carbon monoxide emissions (CO) than for pipeline-quality natural gas.

Table 1. Emission for Different Capstone Microturbine Models in [lb/MWhe]

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	0.64	1.8	0.23
CR30 MBTU	Landfill Gas (2)	0.64	22.0	1.00
CR30 MBTU	Digester Gas (3)	0.64	11.0	1.00
C30 Liquid	Diesel #2 (4)	2.60	0.41	0.23
C65 NG Standard	Natural Gas (1)	0.46	1.25	0.10
C65 NG Low NOx	Natural Gas (1)	0.17	1.30	0.10
C65 NG CARB	Natural Gas (1)	0.17	0.24	0.05
CR65 Landfill	Landfill Gas (2)	0.46	4.0	0.10
CR65 Digester	Digester Gas (3)	0.46	4.0	0.10
C200 NG	Natural Gas (1)	0.40	1.10	0.10
C200 NG CARB	Natural Gas (1)	0.14	0.20	0.04
CR200 Digester	Digester Gas (3)	0.40	3.6	0.10

Notes:

(1) Emissions for standard natural gas at 1,000 BTU/scf (HHV) or 39.4 MJ/m3 (HHV)
(2) Emissions for surrogate gas containing 42% natural gas, 39% CO2, and 19% Nitrogen
(3) Emissions for surrogate gas containing 63% natural gas and 37% CO2
(4) Emissions for Diesel #2 according to ASTM D975-07b
(5) Expressed as Methane

Table 2 provides the same output-based information shown in Table 1, but expressed in grams per horsepower hour (g/hp-hr).

Table 2. Emission for Different Capstone Microturbine Models in [g/hp-hr]

Model	Fuel	NOx	CO	VOC [5]
C30 NG	Natural Gas [1]	0.22	0.60	0.078
CR30 MBTU	Landfill Gas [2]	0.22	7.4	0.340
CR30 MBTU	Digester Gas [3]	0.22	3.7	0.340
C30 Liquid	Diesel #2 [4]	0.90	0.14	0.078
C65 NG Standard	Natural Gas [1]	0.16	0.42	0.034
C65 NG Low NOx	Natural Gas [1]	0.06	0.44	0.034
C65 NG CARB	Natural Gas [1]	0.06	0.08	0.017
CR65 Landfill	Landfill Gas [2]	0.16	1.4	0.034
CR65 Digester	Digester Gas [3]	0.16	1.4	0.034
C200 NG	Natural Gas [1]	0.14	0.37	0.034
C200 NG CARB	Natural Gas [1]	0.05	0.07	0.014
CR200 Digester	Digester Gas [3]	0.14	1.3	0.034

Notes: - same as for Table 1

Emissions may also be reported on a volumetric basis, with the most common unit of measurement being parts per million. This is typically a measurement that is corrected to specific oxygen content in the exhaust and without considering moisture content. The abbreviation for this unit of measurement is “ppmvd” (parts per million by volume, dry) and is corrected to 15% oxygen for electrical generating equipment such as microturbines. The relationship between an output based measurement like pounds per MWh and a volumetric measurement like ppmvd depends on the characteristics of the generating equipment and the molecular weight of the criteria pollutant being measured. Table 3 expresses the emissions in ppmvd at 15% oxygen for the Capstone microturbine models shown in Table 1. Note that raw measurements expressed in ppmv will typically be lower than the corrected values shown in Table 3 because the microturbine exhaust has greater than 15% oxygen.

Another volumetric unit of measurement expresses the mass of a specific criteria pollutant per standard unit of volume. Table 4 expresses the emissions in milligrams per normal cubic meter at 15% oxygen. Normal conditions for this purpose are expresses as one atmosphere of pressure and zero degrees Celsius. Note that both the ppmvd and mg/m3 measurements are for specific oxygen content. A conversion can be made to adjust either unit of measurement to other reference oxygen contents, if required. Use the equation below to convert from one reference oxygen content to another:

$$\text{Emissions at New } O_2 = \frac{(20.9 - \text{New } O_2 \text{ Percent})}{(20.9 - \text{Current } O_2 \text{ Percent})} \text{ X Emissions at Current } O_2$$

For example, to express 9 ppmvd of NOx at 15% oxygen to ppmvd at 3% oxygen:

$$\text{Emissions at 3\% } O_2 = \frac{(20.9 - 3.0)}{(20.9 - 15.0)} \text{ X } 9 = 27 \text{ ppmvd}$$

Table 3. Emission for Different Capstone Microturbine Models in [ppmvd] at 15% O_2

Model	Fuel	NOx	CO	VOC
C30 NG	Natural Gas (1)	9	40	9
CR30 MBTU	Landfill Gas (2)	9	500	40
CR30 MBTU	Digester Gas (3)	9	250	40
C30 Liquid	Diesel #2 (4)	35	9	9
C65 NG Standard	Natural Gas (1)	9	40	7
C65 NG Low NOx	Natural Gas (1)	4	40	7
C65 NG CARB	Natural Gas (1)	4	8	3
CR65 Landfill	Landfill Gas (2)	9	130	7
CR65 Digester	Digester Gas (3)	9	130	7
C200 NG	Natural Gas (1)	9	40	7
C200 NG CARB	Natural Gas (1)	4	8	3
CR200 Digester	Digester Gas (3)	9	130	7

Notes: same as Table 1

Table 4. Emission for Different Capstone Microturbine Models in [mg/m3] at 15% O_2

Model	Fuel	NOx	CO	VOC (5)
C30 NG	Natural Gas (1)	18	50	6
CR30 MBTU	Landfill Gas (2)	18	620	30
CR30 MBTU	Digester Gas (3)	18	310	30
C30 Liquid	Diesel #2 (4)	72	11	6
C65 NG Standard	Natural Gas (1)	19	50	5
C65 NG Low NOx	Natural Gas (1)	8	50	5
C65 NG CARB	Natural Gas (1)	8	9	2
CR65 Landfill	Landfill Gas (2)	18	160	5
CR65 Digester	Digester Gas (3)	18	160	5
C200 NG	Natural Gas (1)	18	50	5
C200 NG CARB	Natural Gas (1)	8	9	2
CR200 Digester	Digester Gas (3)	18	160	5

Notes: same as Table 1

The emissions stated in Tables 1, 2, 3 and 4 are guaranteed by Capstone for new microturbines during the standard warranty period. They are also the expected emissions for a properly maintained microturbine according to manufacturer's published maintenance schedule for the useful life of the equipment.

Emissions at Full Power but Not at ISO Conditions

The maximum emissions in Tables 1, 2, 3 and 4 are at full power under ISO conditions. These levels are also the expected values at full power operation over the published allowable ambient temperature and elevation ranges.

Emissions at Part Power

Capstone microturbines are designed to maintain combustion stability and low emissions over a wide operating range. Capstone microturbines utilize multiple fuel injectors, which are switched on or off depending on the power output of the turbine. All injectors are typically on when maximum power is demanded, regardless of the ambient temperature or elevation. As the load requirements of the microturbine are decreased, injectors will be switched off to maintain stability and low emissions. However, the emissions relative to the lower power output may increase. This effect differs for each microturbine model.

Emissions Calculations for Permitting

Air Permitting agencies are normally concerned with the maximum amount of a given pollutant being emitted per unit of time (for example pounds per day of NOx). The simplest way to make this calculation is to use the maximum microturbine full electrical power output (expressed in MW) multiplied by the emissions rate in pounds per MWhe times the number of hours per day. For example, the C65 CARB microturbine operating on natural gas would have a NOx emissions rate of:

NOx = .17 X (65/1000) X 24 = .27 pounds per day

This would be representative of operating the equipment full time, 24 hours per day, at full power output of 65 kWe.

As a general rule, if local permitting is required, use the published agency levels as the stated emissions for the permit and make sure that this permitted level is above the calculated values in this technical reference.

Consideration of Useful Thermal Output

Capstone microturbines are often deployed where their clean exhaust can be used to provide heating or cooling, either directly or using hot water or other heat transfer fluids. In this case, the local permitting or standards agencies will usually consider the emissions from traditional heating sources as being displaced by the useful thermal output of the microturbine exhaust energy. This increases the useful output of the microturbine, and decreases the relative emissions of the combined heat and power system. For example, the CARB version C65 ICHP system with integral heat recovery can achieve a total system efficiency of 70% or more, depending on inlet water temperatures and other installation-specific characteristics. The electric efficiency of the CARB version C65 microturbine is 28% at ISO conditions. This means that the total NOx output based emissions, including the captured thermal value, is the electric-only emissions times the ratio of electric efficiency divided by total system efficiency:

NOx = .17 X 28/70 = .068 pounds per MWh (based on total system output)

This is typically much less than the emissions that would result from providing electric power using traditional central power plants, plus the emissions from a local hot water heater or boiler. In fact microturbine emissions are so low compared with traditional hot water heaters that installing a Capstone microturbine with heat recovery can actually decrease the local emissions of NOx and other criteria pollutants, without even considering the elimination of emissions from a remote power plant.

Greenhouse Gas Emissions

Many gasses are considered "greenhouse gasses", and agencies have ranked them based on their global warming potential (GWP) in the atmosphere compared with carbon dioxide (CO_2), as well as their ability to maintain this effect over time. For example, methane is a greenhouse gas with a GWP of 21. Criteria pollutants like NOx and organic compounds like methane are monitored by local air permitting authorities, and are subject to strong emissions controls. Even though some of these criteria pollutants can be more troublesome for global warming than CO_2, they are released in small quantities – especially from Capstone microturbines. So the major contributor of concern is carbon dioxide, or CO_2. Emission of CO_2 depends on two things:

1. Carbon content in the fuel
2. Efficiency of converting fuel to useful energy

It is for these reasons that many local authorities are focused on using clean fuels (for example natural gas compared with diesel fuel), achieving high efficiency using combined heat and power systems, and displacing emissions from traditional power plants using renewable fuels like waste landfill and digester gasses.

Table 5 shows the typical CO_2 emissions due to combustion for different Capstone microturbine models at full power and ISO conditions. The values do not include CO_2 that may already exist in the fuel itself, which is typical for renewable fuels like landfill and digester gas. These values are expressed on an output basis, as is done for criteria pollutants in Table 1. The table shows the pounds per megawatt hour based on electric power output only, as well as considering total useful output in a CHP system with total 70% efficiency (LHV). As for criteria pollutants, the relative quantity of CO_2 released is substantially less when useful thermal output is also considered in the measurement.

Table 5. CO_2 Emission for Capstone Microturbine Models in [lb/MWh]

Model	Fuel	CO_2	
		Electric Only	70% Total CHP
C30 NG	Natural Gas (1)	1,690	625
CR30 MBTU	Landfill Gas (1)	1,690	625
CR30 MBTU	Digester Gas (1)	1,690	625
C30 Liquid	Diesel #2 (2)	2,400	855
C65 NG Standard	Natural Gas (1)	1,520	625
C65 NG Low NOx	Natural Gas (1)	1,570	625
C65 NG CARB	Natural Gas (1)	1,570	625
CR65 Landfill	Landfill Gas (1)	1,520	625
CR65 Digester	Digester Gas (1)	1,520	625
C200 NG	Natural Gas (1)	1,330	625
C200 NG CARB	Natural Gas (1)	1,330	625
CR200 Digester	Digester Gas (1)	1,330	625

Notes:

(1) Emissions due to combustion, assuming natural gas with CO_2 content of 117 lb/MMBTU (HHV)

(2) Emissions due to combustion, assuming diesel fuel with CO_2 content of 160 lb/MMBTU (HHV)

Useful Conversions

The conversions shown in Table 6 can be used to obtain other units of emissions outputs. These are approximate conversions.

Table 6. Useful Unit Conversions

From	Multiply By	To Get
lb/MWh	0.338	g/bhp-hr
g/bhp-hr	2.96	lb/MWh
lb	0.454	kg
kg	2.20	lb
kg	1,000	g
hp (electric)	.746	kW
kW	1.34	hp (electric)
MW	1,000	kW
kW	0.001	MW

Definitions

- ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and sea level pressure of 101.3 kPa (14.696 psia).
- HHV: Higher Heating Value
- LHV: Lower Heating Value
- kW_{th}: Kilowatt (thermal)
- kW_e : Kilowatt (electric)
- MWh: Megawatt-hour
- hp-hr: horsepower-hour (sometimes referred to as “electric horsepower-hour”)
- Scf: Standard cubic foot (standard references ISO temperature and pressure)
- m3: Normal cubic meter (normal references 0 °C and one atmosphere pressure)

Capstone Contact Information

If questions arise regarding this technical reference, please contact Capstone Turbine Corporation for assistance and information:

Capstone Applications

Toll Free Telephone: (866) 4-CAPSTONE or (866) 422-7786

Fax: (818) 734-5385

E-mail: applications@capstoneturbine.com