November 10, 2015

Assistant Director for Permitting
WV Department of Environmental Protection
Division of Air Quality
601 57th Street, SE
Charleston, WV 25304

RE: Antero Midstream LLC – Underwood Compressor Station
West Virginia Department of Environmental Protection, Division of Air Quality, 45CSR13 Air Permit Application

To Whom it May Concern,

On behalf of Antero Midstream LLC, please find attached the 45CSR13 Air Permit Application for the proposed Underwood Compressor Station located in Tyler County, West Virginia. Underwood Compressor Station is a new source. Enclosed are one hardcopy and two CDs containing the entire permit application including the application form and required attachments. Per 45CSR22, a $4,500 application fee is also enclosed, which covers the base 45CSR13 $1,000 application fee, an additional $1,000 for NSPS requirements, and an additional $2,500 for Hazardous Air Pollutant requirements.

A copy of the Air Quality Permit Notice for the advertisement is included as Attachment P. As the Notice is being submitted simultaneously with the application, the official affidavit of publication will be submitted to the Division of Air Quality separately once it is completed.

Please call if you have any questions or if I can be of further assistance. I can be reached at (719)632-3593 or by email at msteyskal@kleinfelder.com .

Sincerely,
KLEINFELDER

Michele Steyskal
Air Quality Specialist

Enclosures: Underwood Compressor Station Air Permit Application

1801 California Street, Suite 1100 ❖ Denver, CO 80202 ❖ 303.237.6601 ❖ fax 303.237.6602

Antero Midstream LLC

Underwood Compressor Station

NSR Permit Application
West Virginia Department of Environmental Protection
Division of Air Quality
45CSR13

Tyler County, West Virginia

November 2015

Prepared by:

1801 California Street, Suite 1100
Denver, CO 80202
(303) 237-6601
Fax (303) 237-6602
www.kleinfelder.com

DEN15O28447

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):*
Antero Midstream LLC

2. Federal Employer ID No. ***(FEIN):***
46-5517375

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

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

5A. Applicant's mailing address:
1615 Wynkoop Street
Denver, CO 80202

5B. Facility's present physical address:
Wheelers Run Road
Centerville, WV 26320

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: Antero Midstream LLC owns the land for the proposed site
- If **NO,** you are not eligible for a permit for this source.

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

10. North American Industry Classification System **(NAICS)** code for the facility:
221210

11A. DAQ Plant ID No. (for existing facilities only):
–

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

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 Centerville, WV, head west on Wheelers Run Road for approximately 1.6 miles. Turn left into the facility driveway.

12.B. New site address (if applicable):	12C. Nearest city or town:	12D. County:
Wheelers Run Road Centerville, WV 26320	Centerville	Tyler
12.E. UTM Northing (KM): 4364.783	12F. UTM Easting (KM): 511.052	12G. UTM Zone: 17

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

14A. Provide the date of anticipated installation or change: March or April 2016 – 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: September 2016

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: Engines, Dehydrator, Generator, Catalytic Heater

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 : Catalysts, VRU

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 W. McNeilly *(Please use blue ink)* DATE: 11/9/2015 *(Please use blue ink)*

35B. Printed name of signee: Ward McNeilly		35C. Title: Vice President, Reserves Planning and Midstream
35D. E-mail: wmcneilly@anteroresources.com	36E. Phone: (303) 357-6822	36F. FAX: (303)357-7315
36A. Printed name of contact person (if different from above): Barry Schatz		36B. Title: Senior Environmental and Regulatory Manager
36C. E-mail: bschatz@anteroresources.com	36D. Phone: (303) 357-7276	36E. FAX: (303)357-7315

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.

Discussion of Nearby Facilities

Underwood Compressor Station – Closest Antero Facilities

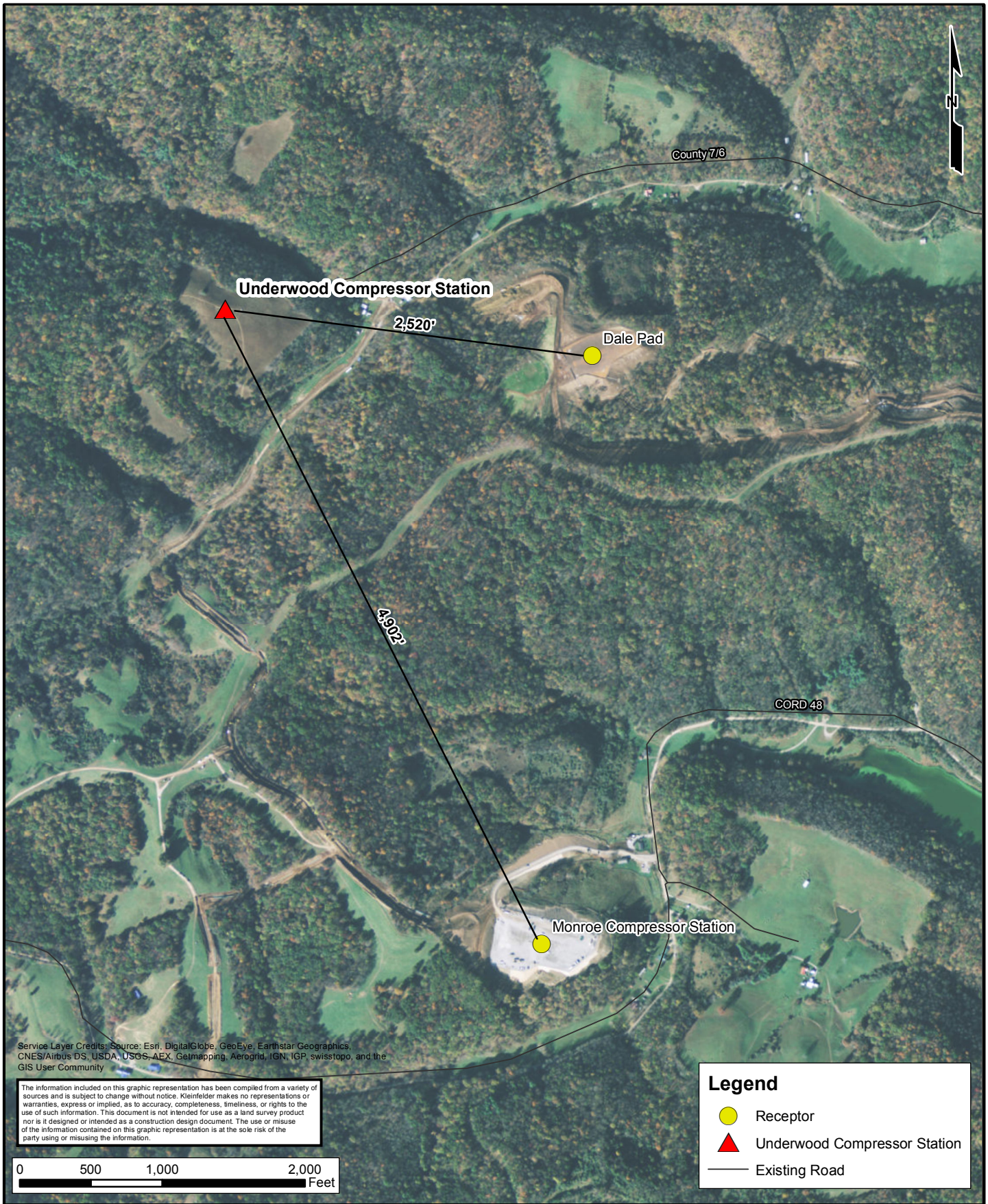
1. Common Control: Only those facilities that are owned and managed by Antero were included in the aggregation discussion. This includes Antero Resources Corporation production facilities in addition to the Antero Midstream LLC midstream facilities.

2. SIC Code: The Underwood Compressor Station will operate under SIC code 4923 (natural gas distribution). The closest facility owned by Antero Midstream LLC with this SIC code is the Monroe Compressor station which is 4,902 feet southeast of the Facility. All Antero Resources Corporation production facilities operate under the SIC code of 1311 (crude petroleum and natural gas extraction). The closest facility operated by Antero Resources Corporation with the SIC code of 1311 is the Dale Pad 2,520 feet to the east.

3. Contiguous or Adjacent: The land between the Underwood Compressor Station and its nearest facility operating under SIC code 4923 is not owned or managed by Antero Midstream LLC or Antero Resources Corporation. Therefore, the two facilities are not contiguous or adjacent. Secondly, although most of the Underwood Compressor Station land parcel border is not adjacent to any parcels operated by Antero, a small portion of the Underwood Compressor Station land parcel is adjacent to the land parcel for the Dale Pad facility operating under 1311. The actual pad locations for the Underwood Compressor Station and the Dale Pad are 2,520 feet apart and thus not contiguous.

Based on this three-pronged evaluation, although the Underwood Compressor Station and Monroe Compressor Station do belong to the same major industrial group, they should not be aggregated because they are not contiguous or adjacent.

Although a small portion of their land parcel borders are adjacent, the Underwood Compressor Station and Dale Pad should not be aggregated because they do not belong to the same major industrial group and do not directly rely on each other nor are they contiguous.



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PROJECT NO.	20161767.001A
DRAWN:	9/30/2015
DRAWN BY:	B. McDavid
CHECKED BY:	M. Steyskal
FILE NAME:	Underwood_ClosestReceptor.mxd

Antero Midstream LLC

Underwood Compressor Station
Tyler County, West Virginia

FIGURE

Attachment A.
Business Certificate

State of West Virginia

Certificate

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

ANTERO MIDSTREAM LLC

Control Number: 9A5E1

a limited liability company, organized under the laws of the State of Delaware

has filed its "Application for Certificate of Authority" in my office according to the provisions of West Virginia Code §31B-10-1002. I hereby declare the organization to be registered as a foreign limited liability company from its effective date of April 29, 2014, until a certificate of cancellation is filed with our office.

Therefore, I hereby issue this

CERTIFICATE OF AUTHORITY OF A FOREIGN LIMITED LIABILITY COMPANY

to the limited liability company authorizing it to transact business in West Virginia

Given under my hand and the Great Seal of the State of West Virginia on this day of April 29, 2014

Natalie E Tennant

Secretary of State

FILED

APR 29 2014

IN THE OFFICE OF
WV SECRETARY OF STATE

Submitted by:
CT Corporation Rep-Terry Stamper
Terry.Stamper@wolterskluwer.com
304-776-1152

1152

Natalie E. Tennant
Secretary of State
1900 Kanawha Blvd E
Bldg 1, Suite 157-K
Charleston, WV 25305

Penney Barker, Manager
Corporations Division
Tel: (304)558-8000
Fax: (304)558-8381
Website: www.wvsos.com
E-mail: business@wvsos.com

Office Hours: Monday – Friday
8:30 a.m. – 5:00 p.m. ET

Control # A45E1

FILE ONE ORIGINAL.
(Two if you want a filed stamped copy returned to you)
FEE: $150

WV APPLICATION FOR CERTIFICATE OF AUTHORITY OF LIMITED LIABILITY COMPANY

1. The **name** of the company as registered in its **home state** is: Antero Midstream LLC

   and the **state or country of organization** is: Delaware

☒ **CHECK HERE to indicate you have obtained and submitted with this application a CERTIFICATE OF EXISTENCE (GOOD STANDING), dated during the current tax year, from your home state of original incorporation as required to process your application. The certificate may be obtained by contacting the Secretary of State's Office in the home state of original incorporation.**

2. The **name** to be used in **West Virginia** will be: [The **name must contain one of the required terms** such as limited liability company" or abbreviations such as "LLC" or "PLLC". See instructions for complete list of acceptable terms and requirements for use of trade name.]
   ☒ **Home State name as listed above,** if available in WV (If name is not available, check DBA Name box below and follow special instructions in **Section 2.** attached.)
   ☐ **DBA name** _____ (See special instructions in **Section 2.** Regarding the **Letter of Resolution** attached to this application.)

3. The company will be a: [See instructions for limitations on professions which may form P.L.L.C. in WV. All members must have WV professional license. In most cases, a **Letter of Authorization/Approval from the appropriate State Licensing Board** is required to process the application.]
   ☒ regular **L.L.C.**
   ☐ **Professional L.L.C.** for the profession of _____

4. The street address of the **principal office** is:
   No. & Street: 1625 17th Street, Suite 300
   City/State/Zip: Denver, Colorado 80202

   and the mailing address (if different) is:
   Street/Box: _____
   City/State/Zip: _____

5. The **address** of the **designated office** of the company in WV, if any, will be:
   No. & Street: 5400 D Big Tyler Road
   City/State/Zip: Charleston, West Virginia 25313

6. **Agent of Process:** Properly designated person to whom notice of legal process may be sent, if any:
   Name: C T Corporation System
   Address: 5400 D Big Tyler Road
   City/State/Zip: Charleston, West Virginia 25313

RECEIVED

APR 29 2014

214913 3/2/2014 8:35:00

7. **E-mail address** where business correspondence may be received: jgiannaula@anteroresources.com

8. **Website address of the business,** if any: N/A

9. The company is:
   - [X] an **at-will** company, for an indefinite period
   - [ ] a **term** company, for the term of _____ years, which will expire on _____.

10. The company is:
   - [X] **member**-managed. [List the names and addresses of all members.]
   - [ ] **manager**-managed. [List the names and addresses of all managers.]

List the **Name(s) and Address(es) of the Member(s)/Manager(s)** of the company (attach additional pages if necessary).

Name	Street Address	City, State, Zip
Antero Resources Corporation	1625 17th Street, Suite 300	Denver, Colorado 80202

11. All or specified members of a limited liability company are liable in their capacity as members for all or specified debts, obligations or liabilities of the company.
   - [X] **No**--All debts, obligations and liabilities are those of the company.
   - [ ] **Yes**--Those persons who are liable in their capacity as members for all debts, obligations or liability of the company have consented in writing to the adoption of the provision or to be bound by the provision.

12. The **purpose** for which this limited liability company is formed are as follows:
(Describe the type(s) of business activity which will be conducted, for example, "real estate," "construction of residential and commercial buildings," "commercial printing," "professional practice of architecture.")

Midstream oil and gas operating company

13. Is the business a **Scrap Metal Dealer**?
   - [ ] **Yes** [If "Yes," you must complete the **Scrap Metal Dealer Registration Form** (Form SMD-1) and proceed to question 14.].
   - [X] **No** [Proceed to question 14.]

14. The number of pages attached and included in this application is: 3

15. The requested **effective date** is: [Requested date *may not be earlier than filing nor later than 90 days after filing in our office.*]
☒ the date & time of filing in the Secretary of State's Office
☐ the following date _____ and time _____

16. **Contact and Signature Information*** (See below ***Important Legal Notice Regarding Signature***):

a.	Alvyn A. Schopp	(313) 357-7310
	Contact Name	Phone Number
b.	Alvyn A. Schopp	Chief Administrative Officer and Regional Vice President
	Print or type name of signer	Title / Capacity of Signer
c.	_____	April 28, 2014
	Signature	**Date**

****Important Legal Notice Regarding Signature:* Per West Virginia Code §31B-2-209, Liability for false statement in filed record.** If a record authorized or required to be filed under this chapter contains a false statement, one who suffers loss by reliance on the statement may recover damages for the loss from a person who signed the record or caused another to sign it on the person's behalf and knew the statement to be false at the time the record was signed.

Delaware

The First State

I, JEFFREY W. BULLOCK, SECRETARY OF STATE OF THE STATE OF DELAWARE, DO HEREBY CERTIFY "ANTERO MIDSTREAM LLC" IS DULY FORMED UNDER THE LAWS OF THE STATE OF DELAWARE AND IS IN GOOD STANDING AND HAS A LEGAL EXISTENCE SO FAR AS THE RECORDS OF THIS OFFICE SHOW, AS OF THE TWENTY-NINTH DAY OF APRIL, A.D. 2014.

AND I DO HEREBY FURTHER CERTIFY THAT THE ANNUAL TAXES HAVE NOT BEEN ASSESSED TO DATE.

Jeffrey W. Bullock, Secretary of State

5466900 8300

AUTHENTICATION: 1328067

140532521

DATE: 04-29-14

You may verify this certificate online at corp.delaware.gov/authver.shtml

Attachment B.
Area Map

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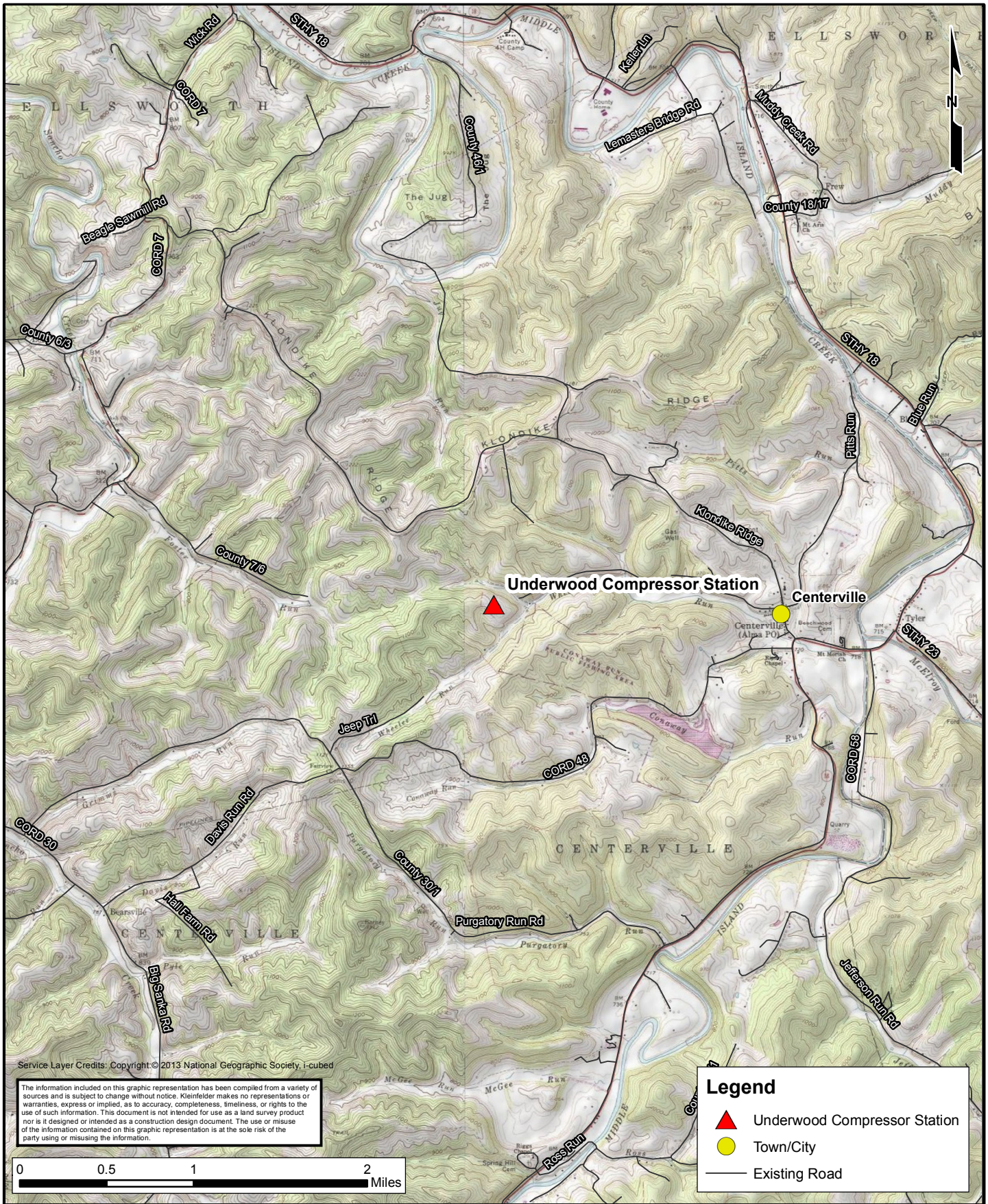
PROJECT NO.	20161767.001A
DRAWN:	9/30/2015
DRAWN BY:	B. McDavid
CHECKED BY:	M. Steyskal
FILE NAME:	Underwood_Receptor_Aerial.mxd

Antero Midstream LLC

Underwood Compressor Station
Tyler County, West Virginia

FIGURE



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PROJECT NO.	20161767.001A
DRAWN:	9/30/2015
DRAWN BY:	B. McDavid
CHECKED BY:	M. Steyskal
FILE NAME:	UnderwoodCompressor_Topo.mxd

Antero Midstream LLC

Underwood Compressor Station
Tyler County, West Virginia

FIGURE

Attachment C.
Installation and Startup Schedule

Underwood Compressor Station – Installation and Startup Schedule

The Underwood Compressor Station will be a new facility located in Tyler County, WV, approximately 1.7 miles west of Centerville, WV. Ground clearing and other site preparation activities are anticipated to occur starting in December 2015. Installation of equipment is anticipated to begin in March or April 2016. Facility operations are scheduled to begin on or around September 2016.

Attachment D.
Regulatory Discussion

Underwood Compressor Station – Regulatory Discussion

Federal Regulations

40 CFR Part 60 – Standards of Performance for New Stationary Sources

I. *Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984.*

Applicability: Subpart Kb applies to volatile organic liquid storage tanks with a capacity greater than or equal to 75 m^3 (§60.110b(a)). Storage vessels with a design capacity less than 1,589.874 m3 do not apply to this subpart if they are used store condensate prior to custody transfer. The condensate and produced water storage tanks at the Underwood Compressor Station will be 64 m^3. The settler tank is 79 m^3, but stores condensate prior to custody transfer. Therefore, Subpart Kb does not apply to the Underwood Compressor Station.

II. *Subpart GG - Standards of Performance for Stationary Gas Turbines*

Applicability: Subpart GG applies to all stationary gas turbines with a heat input at peak load equal to or greater than 10 million BTU per hour based on the lower heating value of the fuel (§60.330(a)). Since the microturbine generators at the Underwood Compressor Station will have a heat input rating less than 10 million Btu per hour, Subpart GG does not apply.

III. *Subpart KKK - Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants for Which Construction, Reconstruction, or Modification Commenced After January 20, 1984, and on or Before August 23, 2011.*

Applicability: Subpart KKK applies to facilities built or modified before August 23, 2011, so Subpart KKK will not apply as the Underwood Compressor Station has not been constructed yet.

IV. *Subpart LLL - Standards of Performance for SO_2 Emissions from Onshore Natural Gas Processing for Which Construction, Reconstruction, or Modification Commenced After January 20, 1984, and on or Before August 23, 2011.*

Applicability: Subpart LLL applies to facilities built or modified before August 23, 2011, so Subpart LLL will not apply as the Underwood Compressor Station has not been constructed yet.

V. *Subpart JJJJ - Standards of Performance for Stationary Spark Ignition Internal Combustion Engines*

Applicability: Subpart JJJJ applies to rich burn engines that were ordered after June 12, 2006 and manufactured on or after July 1, 2007 for engines with maximum power

greater than or equal to 500 hp (§60.4230(a)(4)(i)). Thus, Subpart JJJJ applies to the Underwood Compressor Station as the compressor engines will be installed in 2016 and are new engines manufactured after July 1, 2007.

VI. *Subpart KKKK - Standards of Performance for Stationary Combustion Turbines*

Applicability: Subpart KKKK applies to all stationary combustion turbines with a heat input at peak load equal to or greater than 10 million BTU per hour based on the higher heating value of the fuel (§60.4305(a)). Since the microturbine generators at the Underwood Compressor Station will have a heat input rating less than 10 million Btu per hour, Subpart KKKK does not apply.

VII. *Subpart OOOO - Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution*

Applicability: Subpart OOOO applies to reciprocating compressor facilities that were constructed, modified, or reconstructed after August 23, 2011 (§60.5365(c)). Additionally, Subpart OOOO applies to storage vessel affected facilities with individual tank emissions greater than 6 tons per year (§60.5365(e)). Thus, Subpart OOOO applies to the Underwood Compressor Station as it will be constructed after August 23, 2011 and has reciprocating compressors and a settler tank that has controlled VOC potential to emit greater than six (6) tons per year. The pneumatic controllers installed at Underwood Compressor Station are air-actuated and therefore exempt from the requirements of this subpart.

40 CFR Part 61 – National Emission Standards for Hazardous Air Pollutants

I. *Subpart V – National Emission Standard for Equipment Leaks (Fugitive Emission Sources)*

Applicability: Subpart V applies to components such as compressors, valves, and pumps that are intended to operate in volatile hazardous air pollutant (VHAP) service (§61.240(a)). VHAP service means that a component contains or contacts a fluid that is at least 10 percent by weight a VHAP. Subpart V does not apply to the Underwood Compressor Station because none of the components will have fluid (natural gas, water, or condensate) that is over 10 percent by weight of any VHAP.

40 CFR Part 63 – National Emission Standards for Hazardous Air Pollutants for Source Categories

I. *Subpart HH – National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities*

Applicability: Subpart HH applies to oil and natural gas production facilities that are a major or area source of HAP emissions, and that process, upgrade, or store hydrocarbon liquids or natural gas prior to the transmission and storage source category

(§63.760(a)). Subpart HH does apply to the Underwood Compressor Station, and because it is an area source of HAP emissions, the two (2) TEG dehydrators will be applicable sources under Subpart HH (§63.760(b)(2)). However, actual benzene emissions from the dehydrators at the Underwood Compressor Station will be less than 1 ton per year, so both dehydrators are exempt from all requirements except recordkeeping (§63.764(e)(1)(ii)).

II. *Subpart HHH – National Emission Standards for Hazardous Air Pollutants from Natural Gas Transmission and Storage Facilities*

Applicability: Subpart HHH applies to natural gas transmission and storage facilities that are a major source of HAP emissions (§63.1270(a)). Subpart HHH does not apply to the Underwood Compressor Station as it is not a major source of HAP emissions. Further, the Underwood Compressor Station would be prior to the gas transmission and storage phase.

III. *Subpart EEEE – National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)*

Applicability: Subpart EEEE applies to organic liquids distribution operations that are located at major source of HAP emissions (§63.2334(a)). Subpart EEEE does not apply to the Underwood Compressor Station as it is not a major source of HAP emissions.

IV. *Subpart YYYY – National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines*

Applicability: Subpart YYYY applies to stationary combustion turbines located at major sources of HAP emissions (§63.6085(a)). Since the Underwood Compressor Station is not a major source of HAP emissions, Subpart YYYY does not apply.

V. *Subpart ZZZZ - National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines*

Applicability: Subpart ZZZZ applies to stationary RICE at a major or area source of HAP emissions (§63.6585). Subpart ZZZZ applies to the Underwood Compressor Station as the compressor engines are new RICE. The engines will meet Subpart ZZZZ by meeting 40 CFR Part 60, Subpart JJJJ as the Underwood Compressor Station is an area source of HAP emissions (§63.6590(c)(1)).

VI. *Subpart DDDDD – National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters*

Applicability: Subpart DDDDD applies to process heaters at a major source of HAP emissions (§63.7485). Subpart DDDDD does not apply to the Underwood Compressor Station as it is not a major source of HAP emissions.

West Virginia State Regulations

Title 45 Legislative Rule – Division of Environmental Protection, Office of Air Quality

The following Title 45 Legislative Rules will be applicable to the Underwood Compressor Station:

I. *45CSR2 – To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers*

II. *45CSR2A – Testing, Monitoring, Recordkeeping and Reporting Requirements Under 45CSR2*

III. *45CSR4 – To Prevent and Control the Discharge of Air Pollutants into the Open Air Which Causes or Contributes to an Objectionable Odor or Odors*

IV. *45CSR6 – Control of Air Pollution from Combustion of Refuse*

V. *45CSR8 – Ambient Air Quality Standards*

VI. *45CSR11 – Prevention of Air Pollution Emergency Episodes*

VII. *45CSR13 – Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Administrative Updates, Temporary Permits, General Permits, and Procedures for Evaluation*

VIII. *45CSR16 – Standards of Performance for New Stationary Sources Pursuant to 40 CFR, Part 60*

IX. *45CSR20 – Good Engineering Practice as Applicable to Stack Heights*

X. *45CSR22 – Air Quality Management Fee Program*

XI. *45CSR27 – To Prevent and Control the Emissions of Toxic Air Pollutants*

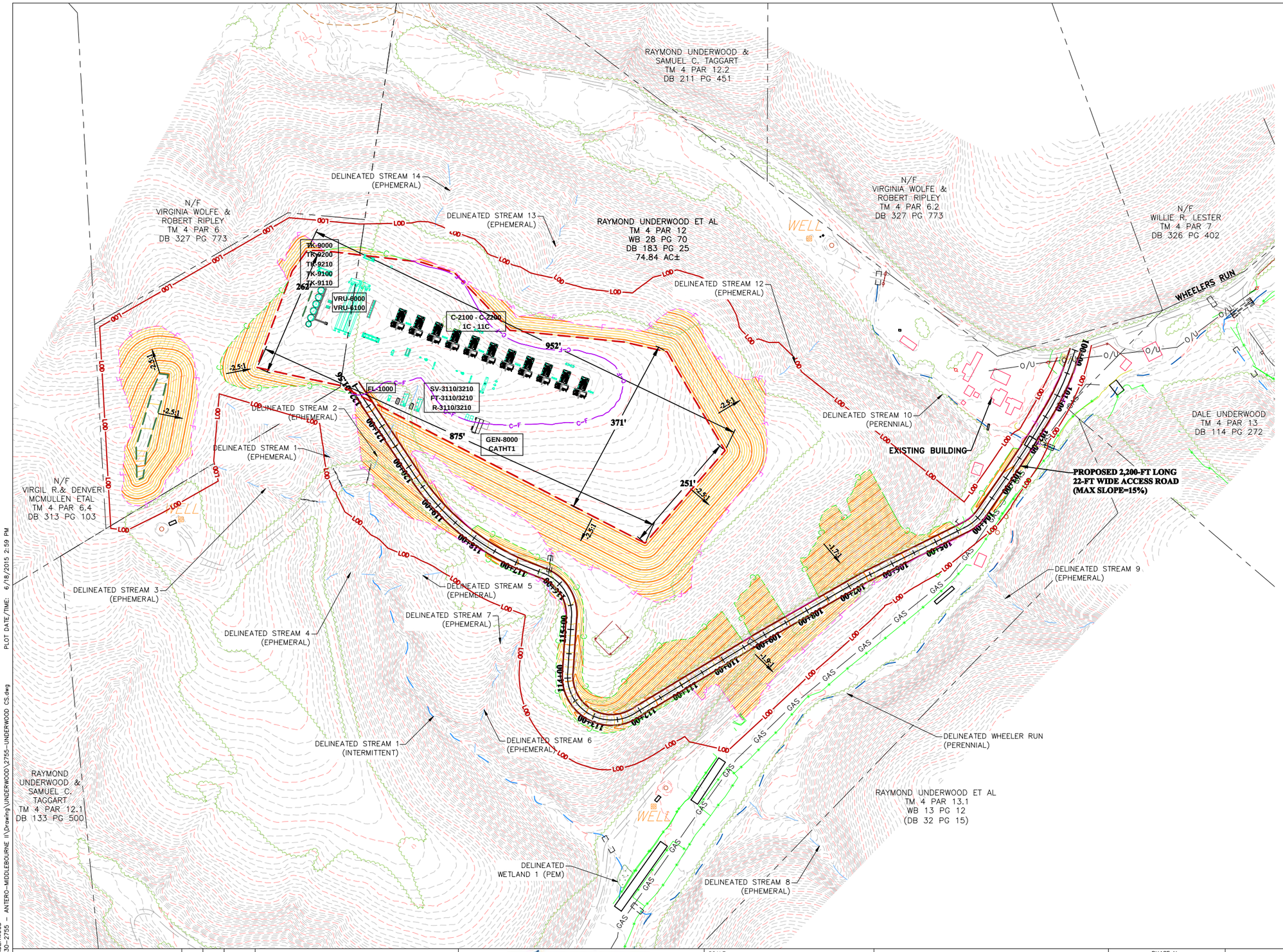
XII. *45CSR33 – Acid Rain Provisions and Permits*

XIII. *45CSR34 – Emission Standards for Hazardous Air Pollutants for Source Categories Pursuant to 40 CFR, Part 63*

XIV. *45CSR38 – Provisions for Determination of Compliance with Air Quality Management Rules*

XV. *45CSR42 – Greenhouse Gas Emissions Inventory*

Attachment E.
Plot Plan



PLAN LEGEND

- EXISTING CONTOURS
- EXISTING ROAD EDGE
- EXISTING DRIVEWAY
- EXISTING TRAIL
- EXISTING BUILDING
- EXISTING TREE LINE
- POTENTIAL EXISTING STREAM
- EXISTING POND
- LIMIT OF DISTURBANCE
- PROPOSED CONTOURS
- PROPOSED CUT LIMIT
- PROPOSED FILL LIMIT
- PROPOSED EDGE OF ACCESS ROAD
- PROPOSED EDGE OF PAD
- PROPERTY LINE

NOTES

1. BASE MAPPING IS BASED ON GIS CONTOURS AND FEATURES AVAILABLE FROM WV GIS DATABASE.
2. PROPOSED SLOPES ARE 2.5H:1V ON THE PAD. SLOPES MAY BE REVISED BASED ON GEOTECHNICAL ENGINEER'S INVESTIGATION AND RECOMMENDATIONS.
3. ALL SLOPES IN EXCESS OF FIFTY (50) VERTICAL FEET WILL REQUIRE BENCHING IN FINAL DESIGN.
4. EROSION AND SEDIMENT CONTROLS WILL BE DESIGNED UPON ACCEPTANCE OF CONCEPTUAL GRADING PLAN.
5. PROPERTY LINES SHOWN ARE BASED ON TYLER COUNTY TAX MAPS. THE SHAPE FILES WERE OBTAINED FROM NATIONAL RIGHT OF WAY.
6. ALL COORDINATES ARE IN NAD-83 WV STATE PLANE NORTH DATUM, UNLESS OTHERWISE NOTED.

EARTHWORK SUMMARY

CS PAD AREA	6.41 AC
CUT (SWELL) FACTOR	110%
FILL (SHRINK) FACTOR	100%
CS PAD TOTAL CUT	90,900 CY
CS PAD TOTAL FILL	94,900 CY
CS PAD NET FILL	4,000 CY
ACCESS ROAD TOTAL CUT	29,900 CY
ACCESS ROAD TOTAL FILL	10,600 CY
ACCESS ROAD NET CUT	19,300 CY
TOTAL CUT	120,800 CY
TOTAL FILL	105,500 CY
TOTAL TOPSOIL	15,300 CY

* THE ASSUMPTION IS MADE THAT ALL MATERIAL IS SUITABLE FOR FILL.
* TOPSOIL DEPTH OF 8" HAS BEEN USED IN DETERMINING TOPSOIL VOLUME.

PLOT DATE/TIME: 6/18/2015 2:59 PM
LAYOUT TAB: UNDERWOOD
CAD FILE: R:\030-2755 - ANTERO-MIDDLEBOURNE II\Drawing\UNDERWOOD\2755-UNDERWOOD CS.dwg

NOT FOR CONSTRUCTION
2015-06-12

NO.	BY	DATE	DESCRIPTION

Antero Midstream Partners LP

SCALE:	
DRAWN:	DATE:
CHECKED:	DATE:
APPROVED:	DATE:
SURVEY DATE:	
SURVEY BY:	
FIELD BOOK No.:	

THRASHER
THE THRASHER GROUP INC.
CIVIL • ENVIRONMENTAL • CONSULTING • FIELD SERVICES
600 WHITE OAKS BOULEVARD, BRIDGEPORT, WV 26330
PHONE (304) 624-4108 • FAX (304) 624-7831

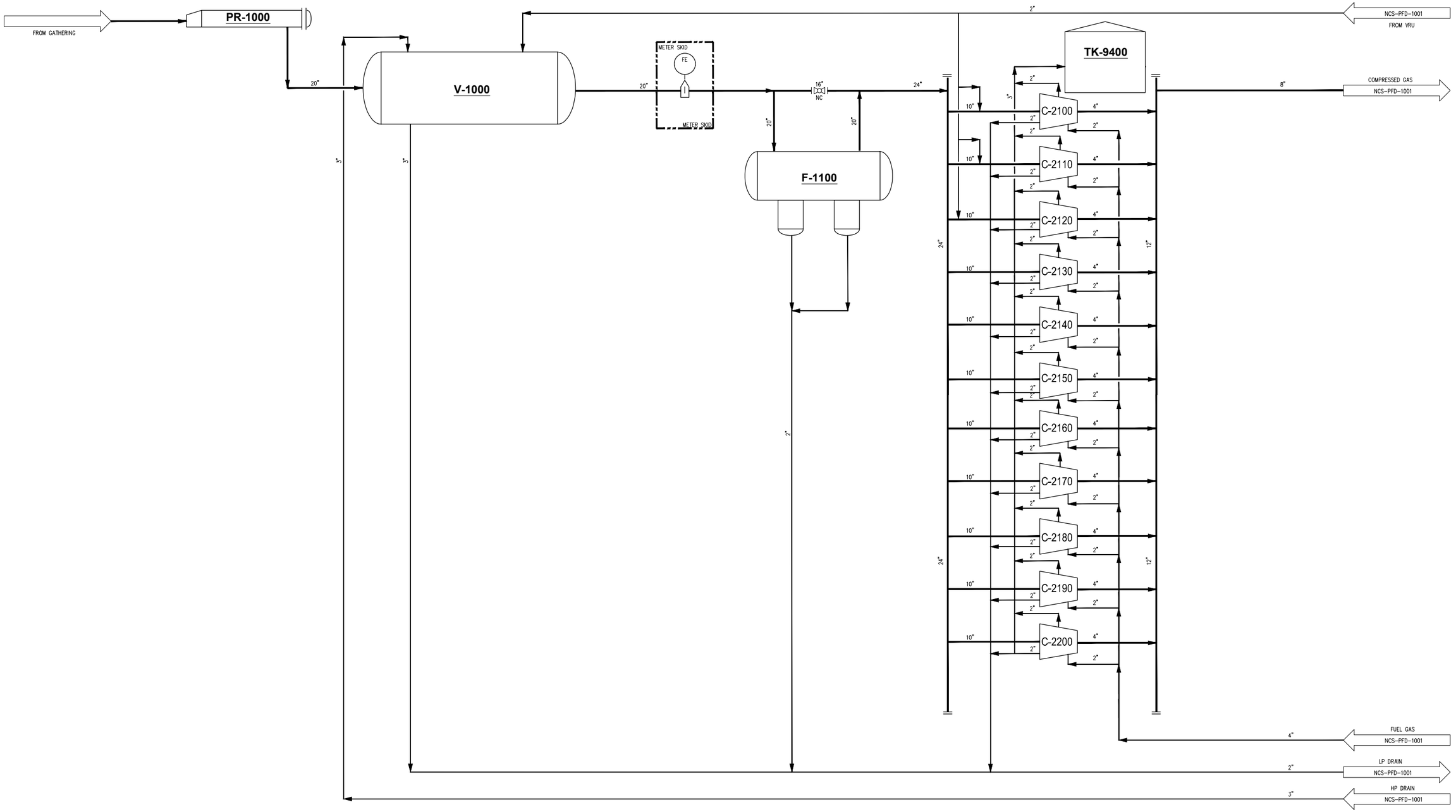
PHASE No.	
CONTRACT No.	
PROJECT No.	101-030-2755

ANTERO MIDSTREAM
MIDDLEBOURNE II COMPRESSOR STATION
CONCEPT PLANS
TYLER COUNTY, WEST VIRGINIA
UNDERWOOD – CS PAD CONCEPT

SHEET No.
14

Attachment F.
Process Flow Diagram

PR-1000 PIG RECIEVER | **V-1000** SLUG CATCHER | **F-1100** INLET FILTER SEPARATOR | **C-2100/2110/2120/2130/2140/2150** COMPRESSORS | **C-2160/2170/2180/2190/2200** COMPRESSORS | **TK-9400** WASTE OIL TANK



NOTES:

REFERENCE DRAWINGS	
DWG. NO.	TITLE

NO.	DESCRIPTION	BY	DATE	CHK.	DATE	APPR.	DATE
B	ISSUED FOR AIR PERMIT	AC	06/19/14	LW	06/19/14	PS	06/19/14
A	ISSUED FOR REVIEW	AC	05/06/14	JW	05/06/14	PS	05/06/14

Antero Resources

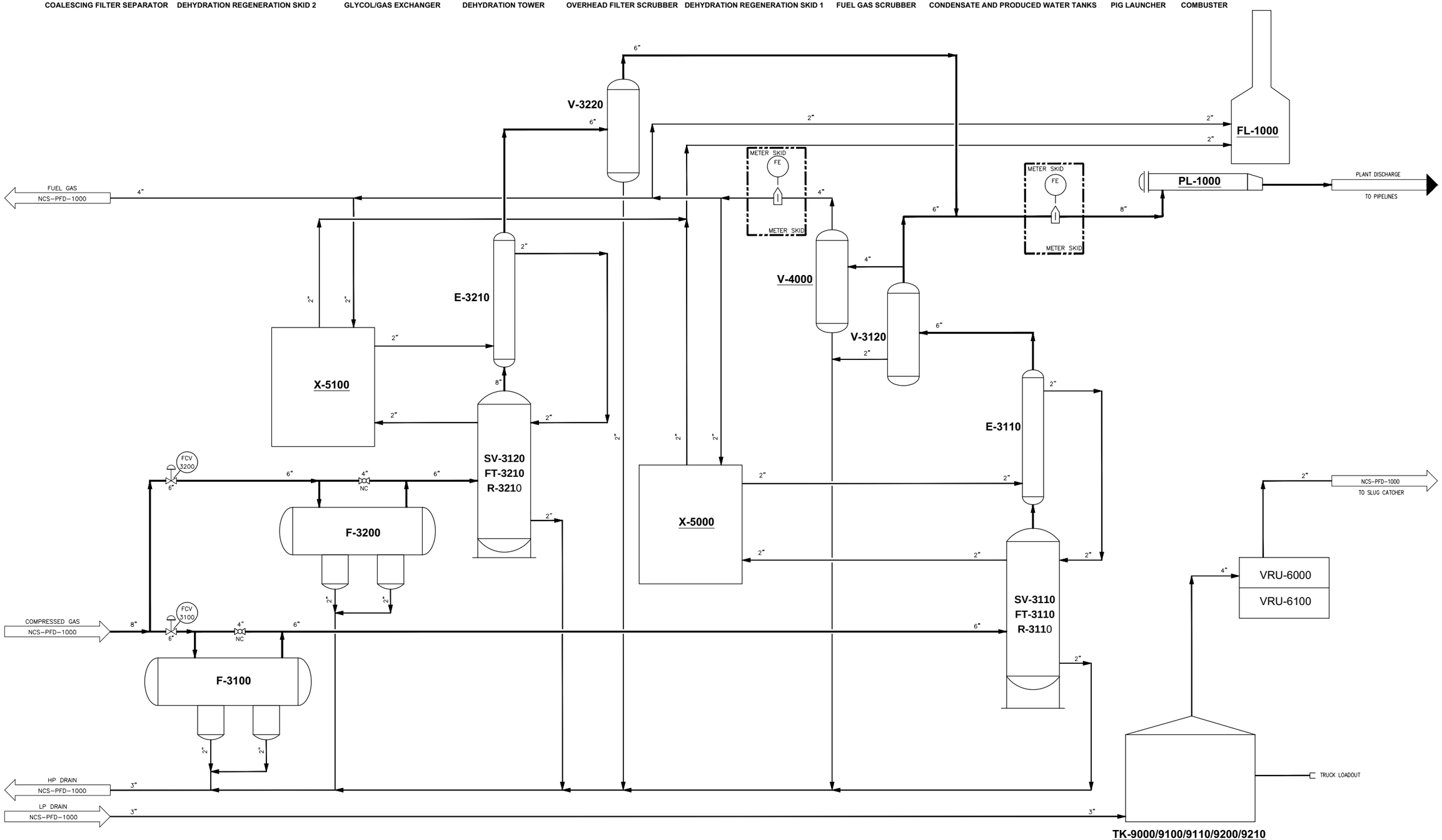
KAHUNA VENTURES LLC
WESTMINSTER, CO 80021
303-451-7374
BY: KAHUNA DESIGN LLC.

PROCESS FLOW DIAGRAM

DRAWN BY: A. COOLEY	CHECKED: J. WARMAN	APPROVED: P. STOCKEBRAND
CREATION DATE: 05/05/14	CHECK DATE: 05/05/14	APPR. DATE: 05/05/14
Proj. No.: 4083.0164.00	DWG. No.: TCS-PFD-1000	SHEET No. 1 OF 2
SCALE: NONE		B

PLOT TIME/DATE: June 19, 2014
LAST SAVED: 06/18/14 BY: Abra Cooley
FILE LOCATION:N:\PROJECTS\ANTERO APPALACHIAN RESOURCES\4083.0164.00 - NICHOLS CS\1000-PFD-PID\NCS-PFD-1000.DWG

F-3100/3200 COALESCING FILTER SEPARATOR | **X-5100** DEHYDRATION REGENERATION SKID 2 | **E-3110/3210** GLYCOL/GAS EXCHANGER | **V-3110/3210** DEHYDRATION TOWER | **V-3120/3220** OVERHEAD FILTER SCRUBBER | **X-5000** DEHYDRATION REGENERATION SKID 1 | **V-4000** FUEL GAS SCRUBBER | **TK-9000/9100/9110/9200/9210** CONDENSATE AND PRODUCED WATER TANKS | **PL-1000** PIG LAUNCHER | **FL-1000** COMBUSTER



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REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

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A	ISSUED FOR REVIEW	AC	05/06/14	JW	05/06/14	PS	05/06-14

Antero Resources

KAHUNA VENTURES LLC
WESTMINSTER, CO 80021
303-451-7374
BY: KAHUNA DESIGN LLC.

PROCESS FLOW DIAGRAM

DRAWN BY: A. COOLEY	CHECKED: J. WARMAN	APPROVED: P. STOCKEBRAND
CREATION DATE: 05/05/14	CHECK DATE: 05/05/14	APPR. DATE: 05/06/14
Proj. No.: 4083.0164.00	DWG. No.: TCS-PFD-1001	SHEET No. 2 OF 2
SCALE: NONE		B

PLOT TIME/DATE: June 19, 2014

LAST SAVED: 06/18/14 BY: Abra Cooley

FILE LOCATION:N:\PROJECTS\ANTERO APPALACHIAN RESOURCES\4083.0164.00 - NICHOLS CS\1000-PFD-PID\NCS-PFD-1001.DWG

Attachment G.
Process Description

Underwood Compressor Station – Process Description

The proposed Underwood Compressor Station will be located in Tyler County, West Virginia. Gas from surrounding pipelines will enter the facility through one (1) receiver and associated slug catcher. From there, the gas is metered and routed through a filter separator. Any produced liquids from the scrubber or separator are sent to the 500 barrel settling tank (TK-9000). Gas from the filter separator is sent to one (1) of eleven (11) 1680 hp compressor engines (C-2100 – C-2200). The eleven (11) compressor engines are controlled with NSCR catalysts and air-fuel ratio controllers (1C – 11C). Produced fluids are routed to the settling tank and high pressure gas is sent to one of the two (2) TEG dehydrators.

Each TEG dehydrator contains a flash gas tank (FT-3110 & FT-3210) and 1.5 MMBtu/hr reboiler (R-3110 & R-3210). Each dehydrator has a design rate of 60 MMscf/day. Within the dehydrator unit, vent gas from the flash gas tank (FT-3110 & FT-3210) is routed to the reboiler (R-3110 & R-3210) and used as fuel, with an assumed 95% efficiency for combusting the gas. Combustion emissions from each reboiler are routed to the atmosphere. The dehydrator still vents (SV-3110 & SV-3210) are controlled by a flare with at least 98% control efficiency (FL-1000). Produced fluids from the dehydrator are routed to the settling tank. The dry gas from the dehydration process is either routed to a fuel gas scrubber, metered, and routed to the compressors as fuel gas or metered and sent to the high pressure facility discharge pipeline.

All produced fluids enter one (1) 500 barrel settling tank (TK-9000) where the fluids settle out as either condensate or produced water. The produced water goes to two (2) 400 barrel produced water tanks (TK-9200 – TK-9210) and the condensate goes to two (2) 400 barrel condensate tanks (TK-9100 – TK-9110). Flashing only occurs at the settling tank as the fluids stabilize in the settling tank before going to the other storage tanks. All five (5) tanks are connected to a primary vapor recovery unit (VRU-6000) where tank vapors are collected and recycled back into the gas system right before the initial filter scrubber. A second vapor recovery unit (VRU-6100) is used as back-up to the primary vapor recovery unit. The produced fluids are trucked out via tanker trucks as needed (LDOUT1). The loading emissions are uncontrolled. The anticipated production is 150 barrels per day of condensate and 45 barrels per day of produced water.

One (1) 600 kWe microturbine generator will be used at the facility. The Capstone C600 unit is comprised of three (3) 200 kWe units that can be operated individually. Likely, all three units will not be operating 8,760 hours per year; however, emissions were calculated as such for maximum flexibility. The fuel line for the generators will be heated by a small catalytic heater (CATHT1) with a burner rating of 24 Btu/hr.

Fugitive emissions from component leaks and emissions from venting or blowdown events will also occur.

There will also be small storage tanks located at the facility. Their ID number, description, and exact size are listed in the table below.

Tag Number	Description	Gallons
TK-9300 & TK-9320	Compressor Skid Oily Water Tanks	1,000 each
TK-9310 & TK-9330	Used Oil Tank	500 each
TK-9410	TEG Make-Up Tank	1,000
TK-9420	Compressor Coolant Tank	2,000
TK-9430	Engine Lube Oil Tank	2,000
TK-9440	Compressor Lube Oil Tank	2,000
TK-9400	Compressor Waste Oil Tank	4,200

Attachment H.
Material Safety Data Sheets

SAFETY DATA SHEET

Material Name: Produced Water **US GHS**

SYNONYMS: **Produced Brine Water, Brine, Brine Water, Formation Water**

* * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Produced Water**
PRODUCT CODES: **Mixture**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
Denver, Colorado 80202

CHEMTREC PHONE: **(800) 424-9300**

* * * Section 2 – HAZARDS IDENTIFICATION * * *

GHS Classification:

Eye Irritant – Category 2A.

GHS LABEL ELEMENTS
Symbol(s)

Signal Word

Warning

Hazard Statements

Causes serious eye irritation

Precautionary Statements

Prevention

Wear protective gloves/protective clothing/eye protection/face protection.

Response

If on SKIN (or hair): Rinse skin with water / shower. Remove / Take off all contaminated clothing immediately.

If in EYES: Rinse cautiously with water for at least fifteen (15) minutes. Remove Contact Lenses, if present and easy to do. Continue rinsing.

If EYE irritation persists, get medical advice / attention.

Storage
Store in a secure area.

Disposal
Dispose of contents/containers in accordance with regulations.

* * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

CAS #	Component	Percent
7732-18-5	Water	80
7647-14-5	Sodium Chloride	20

Because brine water is a natural product, composition can vary greatly.

* * * Section 4 – FIRST AID MEASURES * * *

First Aid: Eyes
Flush eyes with clean running water for at least fifteen (15) minutes. If irritation or redness develops from exposure, following flushing, seek medical attention.

First Aid: Skin
First aid is not required, normally. However, it is a good practice to wash any chemical from the skin.

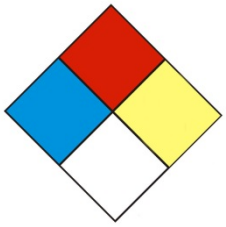
First Aid: Ingestion (Swallowing)
First aid is not required, normally. If spontaneous vomiting occurs, lean the victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. If symptoms develop, seek medical attention.

First Aid: Inhalation (Breathing)
Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

Most important symptoms and effects

None known or anticipated.

* * * Section 5 – FIRE FIGHTING MEASURES * * *



NFPA 704 Hazard Class

Health: 1 Flammability: 0 Instability: 0 (0=Minimal, 1=Slight, 2=Moderate, 3=Serious, 4=Severe)

General Fire Hazards

No fire hazards are expected.

General Fire Hazards

No unusual fire or explosion hazards are expected. If container is not properly cooled, it can rupture in the heat of a fire.

Extinguishing Media

The material is non-flammable. Use extinguishing agent suitable for the type of surrounding fire.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment / Instructions

Small fires in the beginning stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment. Isolate area around container involved in fire and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from the immediate hazard area if it can be done safely. Cool equipment exposed to fire with water, if it can be done safely.

Hazardous Combustion Products

None Anticipated. See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

* * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

Recovery and Neutralization

Contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios of this material. However, local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

Emergency Measures

The material is not considered hazardous. Nevertheless, evacuate nonessential personnel and secure the area. Stay upwind and uphill, if possible.

Personal Precautions and Protective Equipment

Stay upwind and away from the spill/release. Avoid direct contact with the material. For large spillages, notify persons downstream of the spill/release. Isolate the immediate hazard area and keep unauthorized personnel out. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking or absorbents, if possible. Do not flush down sewer or drainage systems. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If a spill occurs on water, notify appropriate authorities and advise shipping of any hazard.

Prevention of Secondary Hazards

None

* * * Section 7 – HANDLING AND STORAGE * * *

Handling Procedures

Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29 CFR 1910.146. Do not wear contaminated clothing or shoes.

Storage Procedures

Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well ventilated areas. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

Incompatibilities

Keep away from excessive heat to prevent rupture of container.

* * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

Component Exposure Limits

Water (7732-18-5)

ACGIH: Not listed

Sodium Chloride (7647-14-5)

ACGIH: Not listed

Engineering Measures

If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

Personal Protective Equipment: Respiratory

Emergencies or conditions that could result in significant airborne exposures may require the use of NIOSH approved respiratory protection. An industrial hygienist or other appropriate health and safety professional should be consulted for specific guidance under these situations.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR

1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use.

Personal Protective Equipment: Skin and Hands

The use of skin protection is not normally required; however, good industrial hygiene practice suggests the use of gloves or other appropriate skin protection whenever working with chemicals.

Personal Protective Equipment: Eyes

Safety glasses or goggles that meet or exceed ANSI Z-87.1 are recommended where there is a possibility of splashing or spraying.

Hygiene Measures

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove contaminated clothing and launder before reuse.

* * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

Appearance:	Clear to Brown	**Odor:**	Salty
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	< 0.36 psia @ 70°F / 21.1°C	**Vapor Density:**	> 1
Boiling Point:	212°F / 100°C	**Melting Point:**	2.4°F / -16.5°C
Solubility (H2O):	Complete	**Specific Gravity:**	1.1 @ 68°F / 20°C
Evaporation Rate:	Variable	**VOC:**	ND
Octanol / H2O Coeff.:	ND	**Flash Point:**	ND
Flash Point Method:	ND		
Lower Flammability Limit: (LFL):	ND	**Upper Flammability Limit: (UFL):**	ND
Auto Ignition:	ND	**Burning Rate:**	ND

* * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will react with alkali and alkaline metals to form flammable hydrogen gas.

Conditions to Avoid

Avoid contact with alkali metals (lithium, sodium, potassium), alkaline metals (beryllium, magnesium, calcium, strontium, and barium), and metallic hydrides like lithium aluminum hydride.

Hazardous Decomposition Products

Not anticipated under normal conditions of use.

Hazardous Polymerization

Not known to occur.

* * * Section 11 – TOXICOLOGICAL INFORMATION * * *

Acute Toxicity

A: General Product Information

Unlikely to be harmful.

B. Component Analysis – D50/LC50

Water (7732-18-5)

Oral LD50 Rat 90 g/kg

Sodium Chloride (7647-14-5)

Oral LD50 Rat 3 g/kg

Potential Health Effects: Skin Corrosion Property / Stimulativeness

May cause skin irritation with prolonged or repeated contact. Not expected to be a skin sensitizer.

Potential Health Effects: Eye Critical Damage / Stimulativeness

Contact with eyes may cause moderate irritation.

Potential Health Effects: Ingestion

Ingestion may result in nausea, vomiting, diarrhea, abdominal cramps, and dehydration (thirst).

Potential Health Effects: Inhalation

No information available on the mixture. However, none of the components have been classified for respiratory sensitization (or are below the concentration threshold for classification).

Generative Cell Mutagenicity

Not expected to cause genetic effects.

Carcinogenicity

General Product Information

Not expected to cause cancer. This substance is not listed as a carcinogen by IARC, NTP or OSHA.

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ general toxicity multiple exposure effects.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

* * * Section 12 – ECOLOGICAL INFORMATION * * *

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

Persistence / Degradability

No information available

Bioaccumulation

No information available

Mobility in Soil

No information available

* * * Section 13 – DISPOSAL CONSIDERATIONS * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

Disposal of Contaminated Containers or Packaging

Recover or recycle if possible. It is the responsibility of the generator to determine the toxicity and physical properties of the material generated so as to properly classify the waste and ensure disposal methods comply with applicable regulations.

This material, if discarded as produced, is not a RCRA "listed" hazardous waste, and is not believed to exhibit characteristics of hazardous waste. Consult state and local regulations regarding the proper disposal of this material. Do not dispose of brine water by draining onto the ground. This will result in soil and groundwater contamination. Waste arising from spillage or tank cleaning should be disposed of in accordance with applicable regulations.

Container contents should be completely used and containers should be emptied prior to discard. Container rinsate should not be considered a RCRA hazardous waste but must be disposed of with care and in full compliance with federal, state and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a qualified drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities.

* * * Section 14 – TRANSPORTATION INFORMATION * * *

DOT Information

Shipping Description: Not Regulated

UN #: Not Regulated

* * * Section 15 – REGULATORY INFORMATION * * *

CERCLA/SARA – Section 302 Extremely Hazardous Substances and TPQs (in pounds):
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372,

CERCLA/SARA – Section 313 and 40 CFR 372):
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

EPA (CERCLA) Reportable Quantity (in pounds):
This material does not contain any chemicals with CERCLA Reportable Quantities.

State Regulations

Component Analysis

The following components appear on one or more of the following state hazardous substances list.

California Proposition 65:
This material does not contain any chemicals that are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

National Chemical Inventories:
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.

U.S. Export control classification Number: EAR99.

* * * Section 16 – OTHER INFORMATION * * *

NFPA® Hazard Rating

Health	1
Fire	0
Reactivity	0

HMIS® Hazard Rating

Health	1	Slight
Fire	0	Minimal
Physical	0	Minimal

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

The information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Date of Preparation: January 28, 2014

Date of Last Revision: March 4, 2014

End of Sheet

SAFETY DATA SHEET

Material Name: Natural Gas Condensate **US GHS**

SYNONYMS: **Drips; Condensate; Field Condensate; Gas Well Condensate; High Pressure Inlet Liquids; Lease Condensate; Natural Gas Liquids; Pipeline Liquids**

* * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Natural Gas Condensate**
PRODUCT CODES: **64741-47-5**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
Denver, Colorado 80202

CHEMTREC PHONE: **(800) 424-9300**

* * * Section 2 – HAZARDS IDENTIFICATION * * *

GHS Classification:

Flammable Liquids – Category 2.
Acute Toxicity Inhalation – Category 3
Germ Cell Mutagenicity – Category 1B
Carcinogenicity – Category 1A
Specific Target Organ Systemic Toxicity (STOT) – Single Exposure Category 3
Specific Target Organ Systemic Toxicity (STOT) – Repeat Exposure Category 1
Aspiration Toxicity – Category 1
Toxic to the Aquatic Environment Acute – Category 3

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

Danger

Hazard Statements

Highly flammable liquid and vapor.
Toxic if inhaled.
May cause genetic defects.
May cause cancer.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May cause damage to organs (liver, kidneys, blood, nervous system, and skin) through prolonged or repeated exposure.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Keep container tightly closed.
Ground/bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Wear protective gloves/protective clothing/eye protection/face protection.
Do not breathe gas/mist/vapors/spray.
Do not handle until all safety precautions have been read and understood.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Use only outdoors or in a well-ventilated area.
Avoid release to the environment.

Response

If on SKIN (or hair): Wash with plenty of soap and water. Remove / Take off all contaminated clothing immediately. Rinse skin with water/shower.
If INHALED: Remove victim to fresh air and keep comfortable for breathing. Call a poison center/doctor if the victim feels unwell.
If SWALLOWED: Immediately call a poison center or doctor / physician. Do not Induce vomiting.
If exposed or concerned: Get medical advice/attention.
In case of fire: Use water spray, fog or fire-fighting foam.

Storage

Store in a well-ventilated place. Keep cool.
Store in a secure area.

Disposal

Dispose of contents/containers in accordance with local/regional/national/international regulations.

* * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

CAS #	Component	Percent
111-65-9	Octanes	25 - 95
142-82-5	Heptanes	25 - 95
110-54-3	Hexanes as n-Hexane	25 - 95
109-66-0	Pentanes as n-Pentane	5 - 70
106-97-8	N-butane	0 - 45
74-98-6	Propane	0 - 15
78-84-0	Ethane	0 - 5
71-43-2	Benzene	< 1
108-88-3	Toluene	< 1
1330-20-7	m-,o-,p-Xylene	< 1

Because natural gas condensate is a natural product, composition can vary greatly.

* * * Section 4 – FIRST AID MEASURES * * *

First Aid: Eyes

Flush eyes with clean running water for at least fifteen (15) minutes. Following flushing, seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops. Wash contaminated clothing before reuse.

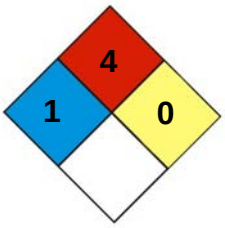
First Aid: Ingestion (swallowing)

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean the victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

First Aid: Inhalation (breathing)

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 – FIRE FIGHTING MEASURES * * *



NFPA 704 Hazard Class

Health: 1 **Flammability:** 4 **Instability:** 0 (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

General Fire Hazards

See Section 9 for Flammability Properties.
Extremely flammable. Vapors may be ignited rapidly when exposed to heat, spark, open flame, or other source of ignition (e.g., static electricity, pilot lights, mechanical / electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers which have not been certified as intrinsically safe). Flammable vapors can burn in the open or explode in confined spaces. Vapors are heavier than air, and may travel distances to an ignition source and flash back. Runoff to sewer systems may cause fire or explosion.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, firefighting foam, water spray, carbon dioxide (CO_2), or other gaseous extinguishing agents. Use caution when applying CO2 in confined spaces.

LARGE FIRES: Water spray, fog or fire-fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment / Instructions

Small fires in the beginning stage may typically be extinguished using handheld portable fire extinguishers and other firefighting equipment. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied firefighting foam.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full face piece and full protective clothing.

* * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

Recovery and Neutralization

Contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken.

Emergency Measures

Evacuate nonessential personnel and secure all ignition sources. No road flares, smoking or flames in hazard area. Consider wind direction. Stay upwind and uphill, if possible. Vapor cloud may be white, but color will dissipate as cloud disperses. Fire and explosion hazard is still present.

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8). Extremely flammable. Spillages of liquid product will create a fire hazard and may form an explosive atmosphere. Keep all sources of

ignition and hot metal surfaces away from spill/release if safe to do so.

The use of explosion-proof electrical equipment is recommended. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons downwind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of firefighting foam may be useful in certain situations to reduce vapors. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

Prevention of Secondary Hazards

None

* * * Section 7 – HANDLING AND STORAGE * * *

Handling Procedures

Keep away from flame, sparks and excessive temperatures. Bond and ground containers. Use non-sparking tools. Use only outdoors or in well ventilated areas. Wear protective gloves / clothing and eye / face protection. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8).

Storage Procedures

Store only in approved containers. Bond and ground containers. Keep away from flame, sparks, excessive temperatures and open flames. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

Incompatibilities

Keep away from strong oxidizers, ignition sources and heat.

* * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

Component Exposure Limits

Octanes (111-65-9)

ACGIH: 300 ppm TWA (listed under Octane, all isomers)

Heptanes (142-82-5)

ACGIH: 400 ppm TWA (listed under n-Heptane)

n-Hexane (110-54-3)

ACGIH: 20 ppm TWA (listed under n-Hexane)

n-Pentane (109-66-0)

ACGIH: 600 ppm TWA (listed under Pentane, all isomers)

n-Butane (106-97-8)

ACGIH: 600 ppm TWA (listed under n-Butane)

Propane (74-98-6)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases C1-C4)

Ethane (74-84-0)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases C1-C4)

Benzene (71-43-2)

ACGIH: 0.5 ppm (TWA); NIOSH: 0.1 ppm (TWA); OSHA 1 ppm (TWA)

Toluene (108-88-3)

ACGIH: 20 ppm TWA (listed under Toluene)

m-, o-, p-Xylene (1330-20-7)

ACGIH: 100 ppm TWA (listed under Xylene o, m & p isomers)

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified / controlled areas.

Personal Protective Equipment: Respiratory

Use a NIOSH-approved positive-pressure, supplied air respirator with escape bottle or self-contained breathing apparatus (SCBA) for gas concentrations above occupational exposure limits, for potential for uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere (oxygen content less than 19.5 percent). A respiratory program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant the use of a respirator.

If benzene concentrations equal or exceed applicable exposure limits, OSHA requirements for personal protective equipment, exposure monitoring, and training may apply (29 CFR 1910.1028 – Benzene).

CAUTION: Flammability limits (i.e., explosion hazard should be considered when assessing the need to expose personnel to concentrations requiring respiratory protection.

Personal Protective Equipment: Hands

Gloves constructed of nitrile or neoprene are recommended.

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying. Eye protection that meets or exceeds ANSI Z.87.1 is recommended. Depending on conditions of use, a face shield may be necessary.

Personal Protective Equipment: Skin and Body

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

Hygiene Measures

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use gasoline or solvents (naphtha, kerosene, etc.) for washing this product from

exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

* * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

Appearance:	Colorless to straw yellow	**Odor:**	Aromatic, Gasoline;
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	110 – 200 psia (Reid VP) @ 100°F/37.8°C	**Vapor Density (air = 1):**	> 1
Boiling Point:	Approx. 85 - 437°F (39 – 200°C)	**Melting Point:**	ND
Solubility (H2O):	Insoluble to slightly soluble	**Specific Gravity:**	AP 0.62-0.76 (varies)
Evaporation Rate:	High	**VOC:**	ND
Octanol / H2O Coeff.:	ND	**Flash Point:**	-40°F -40°C
Flash Point Method:	Tag Closed Cup (TCC)		
Lower Flammability Limit: (LFL):	ND (NFPA Gasoline 1.4)	**Upper Flammability Limit: (UFL):**	ND (NFPA Gasoline 7.6)
Auto Ignition:	AP 480°F (250°C)	**Burning Rate:**	ND

* * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Keep away from ignition sources and high temperatures.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

* * * Section 11 – TOXICOLOGICAL INFORMATION * * *

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B. Component Analysis – LD50/LC50

Octanes (111-65-9)
Inhalation LC50 rat = 118,000 mg/m3 / 4H

Heptanes (142-82-5)
Inhalation LC50 rat = 103,000 mg/m3 / 4H

Hexanes as n-Hexane (110-53-3)
Inhalation LC50 rat = 48,000 ppm / 4H

Pentanes as n-Pentane (109-66-0)
Inhalation LC50 rat = 364,000 mg/m3 / 4H

Butanes as n-Butane (106-97-8)
Inhalation LC50 rat 658,000 mg/l / 4H

Propane (74-98-6)
Inhalation LC50 Rat > 800,000 ppm / 0.25H

Ethane (74-84-0)
Inhalation LC50 Rat 658,000 mg/l / 4H

Benzene (71-43-2)
Inhalation LC50 Rat 44,700 mg/m3 /

Toluene (108-88-3)
Inhalation LD50 Rat 12/5 mg/l / 4H

m-, o-, p-Xylene (1330-20-7)
Inhalation LC50 Rat 5000 ppm / 4H

Potential Health Effects: Skin Corrosion Property / Stimulativeness

May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

Potential Health Effects: Eye Critical Damage / Stimulativeness

Contact with eyes may cause moderate irritation.

Potential Health Effects: Ingestion (swallowing)

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation (breathing)

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

Respiratory Organs Sensitization / Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

May cause genetic defects. Some crude oils and crude oil fractions have been positive in mutagenicity studies.

Carcinogenicity

A: General Product Information

May cause cancer.

This product contains benzene, although at very low concentrations. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

Exposure to light hydrocarbons in the same boiling range as this product have been associated in animal studies with effects to the central nervous system, peripheral nervous system, liver, and kidneys. The significance of these animal models to predict similar human response is uncertain. Observing good work practices and personal hygiene procedures (Sections 7 and 8) can minimize potential risks to humans.

B: Component Carcinogenicity

Benzene (71-43-2)

ACGIH:	A1 - Confirmed Human Carcinogen
OSHA:	5 ppm STEL (Cancer hazard, Flammable, See 29 CFR 1910.1028, 15 min); 0.5 ppm Action Level; 1 ppm TWA
NIOSH:	potential occupational carcinogen
NTP:	Known Human Carcinogen (Select Carcinogen)

IARC: Monograph 100F [in preparation]; Supplement 7 [1987]; Monograph 29 [1982] (Group 1 (carcinogenic to humans))

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

May cause damage to organs (liver, kidneys, blood, nervous system and skin) through prolonged or repeated exposure.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

* * * Section 12 – ECOLOGICAL INFORMATION * * *

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

B: Component Analysis – Ecotoxicity – Aquatic Toxicity

Benzene (71-43-2)

Test and Species	Conditions
96 Hr LC50 Pimephales promelas	10.7-14.7 mg/L [flow-through]
96 Hr LC50 Oncorhynchus mykiss	5.3 mg/L [flow-through]
96 Hr LC50 Lepomis macrochirus	22.49 mg/L [static]
96 Hr LC50 Poecilia reticulata	28.6 mg/L [static]
96 Hr LC50 Pimephales promelas	22330-41160 µg/L [static]
96 Hr LC50 Lepomis macrochirus	70000-142000 µg/L [static]
72 Hr EC50 Pseudokirchneriella subcapitata	29 mg/L
48 Hr EC50 Daphnia magna	8.76 - 15.6 mg/L [static]
48 Hr EC50 Daphnia magna	10 mg/L

Natural Gas condensates (68919-39-1)

Test and Species	Conditions
96 Hr LC50 Alburnus alburnus	119 mg/L [static]
96 Hr LC50 Cyprinodon variegatus	82 mg/L [static]
72 Hr EC50 Pseudokirchneriella subcapitata	56 mg/L
24 Hr EC50 Daphnia magna	170 mg/L

Persistence / Degradability

No information available

Bioaccumulation

No information available

Mobility in Soil

No information available

* * * Section 13 – DISPOSAL CONSIDERATIONS * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

Disposal of Contaminated Containers or Packaging

Recover or recycle if possible. It is the responsibility of the generator to determine the toxicity and physical properties of the material generated so as to properly classify the waste and ensure disposal methods comply with applicable regulations.
This material, if discarded should be fully characterized for ignitability (D001), reactivity (D003) and benzene (D018) prior to disposal (40 CFR261). Use which results in chemical or physical change or contamination may subject it to regulation as a hazardous waste. Along with properly characterizing all waste materials, consult state and local regulations regarding the proper disposal of this material. Do not dispose of by draining onto the ground. This will result in soil and groundwater contamination. Waste arising from spillage or tank cleaning should be disposed of in accordance with applicable regulations.

Container contents should be completely used and containers should be emptied prior to discard. Container rinsate could be considered a RCRA hazardous waste and must be disposed of with care and in full compliance with federal, state and local regulations. Larger empty containers, such as drums, should be returned to the distributor or to a qualified drum reconditioner. To assure proper disposal of smaller empty containers, consult with state and local regulations and disposal authorities.

* * * Section 14 – TRANSPORTATION INFORMATION * * *

DOT Information

Shipping Name: Petroleum Products, n.o.s. (condensate)

UN #: 1268 **Hazard Class:** 3

Additional Info.: Dependent on the product's properties, the shipper may also elect to classify as Gasoline UN1203 or Petroleum Crude Oil UN1267 - reference 49 CFR 172.101 for further description (e.g., packing group determination).

Placard:

* * * Section 15 – REGULATORY INFORMATION * * *

Regulatory Information

Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Benzene (71-43-2)

SARA 313: 0.1% de minimis concentration

CERCLA: 10 lb final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule); 4.54 kg final RQ (received an adjusted RQ of 10 lbs based on potential carcinogenicity in an August 14, 1989 final rule)

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	X	--	--

SARA SECTION 313 – SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION PERCENT BY WEIGHT
Benzene (71-43-2)	<0.1 to 2

Canadian Regulatory Information

DSL/NDSL Inventory	This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the Regulations.
Workplace Hazardous Materials Information System	B2 - Flammable Liquid D1A – Material Causing Immediate and Serious Toxic Effects - Very Toxic Material D2A: Material Causing Other Toxic Effects Very Toxic D2B - Material Causing Other Toxic Effects - Toxic Material

European Union Regulatory Information

Labeling	Product is dangerous as defined by the European Union Dangerous Substances / Preparations Directives. Contains: Low Boiling Point Naphtha
Symbol	**F+** Extremely Flammable **T** Toxic **N** Dangerous for the Environment
Risk Phrases	R12-45-38-65-67-51/53 Extremely flammable. May cause cancer. Irritating to skin. Harmful: may cause lung damage if swallowed. Vapors may cause drowsiness and dizziness. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Safety Phrases	S16-53-45-2-23-24-29-43-62 Keep away from sources of ignition – No smoking. Avoid exposure – obtain special instructions before use. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Keep out of reach of children. Do not breathe vapor. Avoid contact with skin. Do not empty into drains. In case of fire use foam/dry powder/CO2. If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.

State Regulations

Component Analysis – State

The following components appear on one or more of the following state hazardous substances lists

Component	CAS	CA	MA	MN	NJ	PA	RI
Octanes	111-65-9	Yes	No	Yes	Yes	Yes	Yes
Heptanes	142-82-5	Yes	No	Yes	Yes	Yes	Yes
n-Hexane	110-54-3	Yes	Yes	Yes	Yes	Yes	Yes
n-Pentane	109-66-0	Yes	No	Yes	Yes	Yes	Yes
n-Butane	106-97-8	Yes	No	Yes	Yes	Yes	Yes
Propane	74-98-6	No	No	Yes	Yes	Yes	Yes
Ethane	78-84-0	No	No	Yes	Yes	Yes	No
Benzene	71-43-2	Yes	Yes	Yes	Yes	Yes	Yes
Toluene	108-88-3	Yes	Yes	Yes	Yes	Yes	Yes
m-, o-, p-Xylene	1330-20-7	Yes	Yes	Yes	Yes	Yes	Yes

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

WARNING! This product contains a chemical known to the state of California to cause Reproductive / developmental effects.

Component Analysis – WHMIS IDL

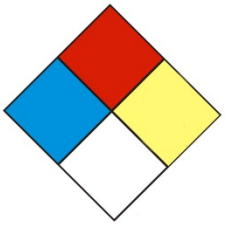
The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

Component	CAS #	Minimum Concentration
Benzene	71-43-2	0.1%

* * * Section 16 – OTHER INFORMATION * * *

NFPA® Hazard Rating

Health	1
Fire	4
Reactivity	0



HMIS® Hazard Rating

Health	1	Slight
Fire	4	Severe
Physical	0	Minimal
		* Chronic

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

The information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Date of Preparation: January 29, 2014

Date of Last Revision: March 4, 2014

End of Sheet

SAFETY DATA SHEET

Material Name: Wet Field Natural Gas

SYNONYMS: **CNG, Natural Gas, Methane.**

* * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Wet Field Natural Gas**
PRODUCT CODES: **CAS Reg. No. 68410-63-9**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
Denver, Colorado 80202

CHEMTREC PHONE: **(800) 424-9300**

* * * Section 2 – HAZARDS IDENTIFICATION * * *

GHS Classification:

Flammable Gas – Category 1.
Gases Under Pressure – Gas.
Specific Target Organ Systemic Toxicity (STOT) – Single Exposure Category 2.

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

Danger

Hazard Statements

Extremely flammable gas.
Contains gas under pressure, may explode if heated.
May cause damage to central nervous and respiratory systems.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Do not breathe fume/gas/mist/vapors/spray.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.

Response

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
If exposed to gas, or concerned about possible exposure: Call a POISON CENTER or doctor/physician.

Storage

Protect from sunlight. Store in a well-ventilated place.
Store in a secure area.

Disposal

Dispose of contents/containers in accordance with local/regional/national/international regulations.

* * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

CAS #	Component	Percent
74-82-8	Methane	72 - 97
78-84-0	Ethane	2.2 - 14
74-98-6	Propane	0.0 – 8.0
106-97-8	Butanes	0.0 – 3.5
109-66-0	Pentanes	0.0 – 1.4
110-54-3	Hexanes	0.0 – 0.5
7727-37-9	Nitrogen	< 0.4
124-38-9	Carbon Dioxide	< 0.2
7782-44-7	Oxygen	< 0.04

Because natural gas is a natural product, composition can vary greatly.

* * * Section 4 – FIRST AID MEASURES * * *

First Aid: Eyes

In case of freeze burn, cover eyes to protect from light. Flush eyes with running water for at least fifteen (15) minutes. Following flushing, seek medical attention.

First Aid: Skin

Remove contaminated clothing. In case of blistering, frostbite or freeze burns, seek immediate medical attention.

Material Name: Wet Field Natural Gas

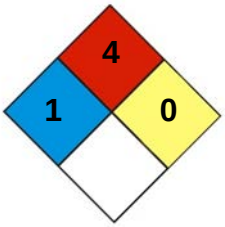
First Aid: Ingestion

Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical assistance.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 – FIRE FIGHTING MEASURES * * *



NFPA 704 Hazard Class

Health: **1** Flammability: **4** Instability: **0** (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

General Fire Hazards

See Section 9 for Flammability Properties.
Forms a flammable mixture with air. If released, the resulting vapors will disperse with the prevailing wind. If a source of ignition is present where the vapor exists at a 5 – 15% concentration in air, the vapor will burn along the flame front toward the source of the fuel.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

Any extinguisher suitable for Class B fires, dry chemical, firefighting foam, CO2, and other gaseous agents. However, fire should not be extinguished unless flow of gas can be immediately stopped.

Unsuitable Extinguishing Media

None.

Fire Fighting Equipment / Instructions

Gas fires should not be extinguished unless flow of gas can be immediately stopped. Shut off gas source and allow gas to burn out. If spill or leak has not ignited, determine

if water spray may assist in dispersing gas or vapor to protect personnel attempting to stop leak. Use water to cool equipment, surfaces and piping exposed to fire and excessive heat. For large fire, the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Isolate area, particularly around piping. Let the fire burn unless leak can be stopped. Concentrate fire-fighting efforts on objects / materials ignited by the initial fire. Withdraw immediately in the event of a rising sound from a venting safety device.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH-approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

* * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

Recovery and Neutralization

Stop the source of the release, if safe to do so.

Materials and Methods for Clean-Up

Consider the use of water spray to disperse gas vapors. Do not use water spray to direct gas vapors toward sewer or drainage systems. Isolate the area until gas has dispersed. Ventilate and gas test area before entering.

Emergency Measures

Evacuate nonessential personnel and secure all ignition sources. No road flares, smoking or flames in hazard area. Consider wind direction. Stay upwind and uphill, if possible. Vapor cloud may be white, but color will dissipate as cloud disperses. Fire and explosion hazard is still present.

Personal Precautions and Protective Equipment

Cooling effect of expanding gas from leak may present frostbite / freeze burn hazard. Wear flame retardant (FR) clothing around un-ignited leak. Wear fire protective clothing around an active fire.

Environmental Precautions

Do not flush gas vapors toward sewer or drainage systems.

Prevention of Secondary Hazards

None.

* * * Section 7 – HANDLING AND STORAGE * * *

Handling Procedures

Keep away from flame, sparks and excessive temperatures. Bond and ground containers. Use only in well ventilated areas.

Storage Procedures

Natural gas will be contained in the pipeline. Keep away from flame, sparks, excessive temperatures and open flames. Empty pipeline segments may contain explosive residues from natural gas liquids. Do not cut, heat, weld or expose containers to sources of ignition sections of pipeline unless the sections have been purged of natural gas residues.

Incompatibilities

Keep away from strong oxidizers, ignition sources and heat.

* * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

Component Exposure Limits

Methane (74-82-8)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Ethane (74-84-0)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Propane (74-98-6)

ACGIH: 2500 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Butane (106-97-8)

ACGIH: 800 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Pentanes (109-66-0)

ACGIH: 600 ppm TWA (listed under Pentane, all isomers)

Hexanes (110-54-3)

ACGIH: 50 ppm TWA (listed under n-Hexane)

Material Name: Wet Field Natural Gas

Nitrogen (7727-37-9)

Simple Asphyxiant

Carbon Dioxide (124-38-9)

ACGIH: 5000 ppm TWA (listed under Carbon Dioxide)

Oxygen (7782-44-7)

N/A – Necessary for life

Engineering Measures

Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified / controlled areas.

Personal Protective Equipment: Respiratory

Use a NIOSH approved positive-pressure, supplied air respirator with escape bottle or self-contained breathing apparatus (SCBA) for gas concentrations above occupational exposure limits, for potential for uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere. CAUTION: Flammability limits (i.e., explosion hazard should be considered when assessing the need to expose personnel to concentrations requiring respiratory protection.

Personal Protective Equipment: Hands

Use cold-impervious, insulating flame-retardant (FR) gloves where contact with pressurized gas may occur.

Personal Protective Equipment: Eyes

Where there is a possibility of pressurized gas contact, wear splash-proof safety goggles and faceshield.

Personal Protective Equipment: Skin and Body

Where contact with pressurized gas may occur, wear flame-retardant (FR) and a faceshield.

* * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

Appearance:	Colorless	**Odor:**	Odorless to slight petroleum odor
Physical State:	Gas	**pH:**	ND
Vapor Pressure:	40 atm @ -187°F (-86°C)	**Vapor Density:**	0.6
Boiling Point:	-259°F (-162°C)	**Melting Point:**	ND
Solubility (H2O):	3.5%	**Specific Gravity:**	0.4 @ -263°F (-164°C)

Material Name: Wet Field Natural Gas

Evaporation Rate:	ND	**VOC:**	ND
Octanol / H2O Coeff.:	ND	**Flash Point:**	Flammable Gas
Flash Point Method:	N/A		
Lower Flammability Limit: (LFL):	3.8 – 6.5	**Upper Flammability Limit: (UFL):**	13-17
Auto Ignition:	900-1170°F (482-632°C)	**Burning Rate:**	ND

* * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Keep away from strong oxidizers, ignition sources and heat.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

* * * Section 11 – TOXICOLOGICAL INFORMATION * * *

Acute Toxicity

A: General Product Information

Methane and ethane, the main components of natural gas, are considered practically inert in terms of physiological effects. At high concentrations these materials act as simple asphyxiants and may cause death due to lack of oxygen.

B. Component Analysis – LD50/LC50

Methane (74-82-8)

Inhalation LC50 Mouse 326 g/m3 2h

Ethane (74-84-0)

Inhalation LC50 Rat 658 mg/l 4h

Propane (74-98-6)

Inhalation LC50 Rat 658 mg/l 4h

Material Name: Wet Field Natural Gas

Butanes (106-97-8)
Inhalation LC50 Rat 658 g/m3 4h

Pentanes (109-66-0)
Inhalation LD50 Rat 364 g/m3 4h

Hexanes (110-54-3)
Inhalation LC50 Rat > 20 mg/l 4h

Nitrogen (7727-37-9)
Simple Asphyxiant

Carbon Dioxide (124-38-9)
Inhalation LC50 Human 100,000 ppm 1minute

Oxygen (7782-44-7)
N/A – Necessary for life

Potential Health Effects: Skin Corrosion Property / Stimulativeness
This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity
This product is not reported to have any mutagenic effects.

Carcinogenicity

A: General Product Information
This product is not reported to have any carcinogenic effects.

B: Component Carcinogenicity
None of this product's components are listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Reproductive Toxicity
This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure
This product may cause damage to the heart.

Specified Target Organ General Toxicity: Repeated Exposure
This product is not reported to have any specific target organ repeat effects.

Aspiration Respiratory Organs Hazard
This product is not reported to have any aspiration hazard effects.

* * * Section 12 – ECOLOGICAL INFORMATION * * *

Ecotoxicity

A: General Product Information

Keep gas and vapors out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

B: Component Analysis – Ecotoxicity – Aquatic Toxicity

No ecotoxicity data are available for this product's components.

Persistance / Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * * Section 13 – DISPOSAL CONSIDERATIONS * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents / container in accordance with local / regional / national / international regulations.

* * * Section 14 – TRANSPORTATION INFORMATION * * *

DOT Information

Shipping Name: Natural Gas, Compressed

UN #: 1971 **Hazard Class:** 2.1

Placard:

* * * Section 15 – REGULATORY INFORMATION * * *

Regulatory Information

Component Analysis

None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A.
n-hexane is listed under SARA Section 313 (40 CFR 372.65). However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

n-hexane is listed under CERCLA (40 CFR 302.4). However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
---	---	X	X	---

SARA Section 313 – Supplier Notification

This product contains one chemical (n-Hexane) that is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-to-know act (EPCRA) of 1986 and of 40 CFR 372. However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

State Regulations

Component Analysis – State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Methane	74-82-8	No	No	Yes	Yes	Yes	No
Ethane	78-84-0	No	No	Yes	Yes	Yes	No
Propane	74-98-6	No	No	Yes	Yes	Yes	Yes
Butane	106-97-8	Yes	No	Yes	Yes	Yes	Yes
Pentanes	109-66-0	Yes	No	Yes	Yes	Yes	Yes
Hexanes	110-54-3	Yes	Yes	Yes	Yes	Yes	Yes
Nitrogen	7727-37-9	No	No	No	No	No	No
Carbon Dioxide	124-38-9	Yes	No	Yes	Yes	Yes	Yes
Oxygen	7782-44-7	No	No	No	No	No	No

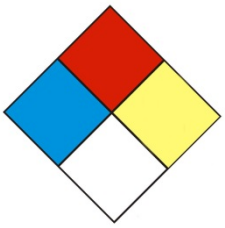
SAFETY DATA SHEET

Material Name: Wet Field Natural Gas

* * * Section 16 – OTHER INFORMATION * * *

NFPA® Hazard Rating

Health	1
Fire	4
Reactivity	0



HMIS® Hazard Rating

Health	1	Moderate
Fire	4	Severe
Physical	0	Minimal
		* Chronic

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

The information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Date of Preparation: February 7, 2014

Date of Last Revision: March 4,, 2014

End of Sheet

SAFETY DATA SHEET

Material Name: Dry Field Natural Gas **US GHS**

SYNONYMS: **CNG, Natural Gas, Methane.**

* * * Section 1 – PRODUCT AND COMPANY IDENTIFICATION * * *

PRODUCT NAME: **Dry Field Natural Gas**
PRODUCT CODES: **CAS Reg. No. 68410-63-9**

EMERGENCY PHONE: **(800) 878-1373**
AFTER HOURS: **(800) 878-1373**

PRODUCER: **Antero Resources**
ADDRESS: **1615 Wynkoop Street**
Denver, Colorado 80202

CHEMTREC PHONE: **(800) 424-9300**

* * * Section 2 – HAZARDS IDENTIFICATION * * *

GHS Classification:

Flammable Gas – Category 1.
Gases Under Pressure – Gas.
Specific Target Organ Systemic Toxicity (STOT) – Single Exposure Category 2.

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

Danger

Hazard Statements

Extremely flammable gas.
Contains gas under pressure, may explode if heated.
May cause damage to central nervous and respiratory systems.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Do not breathe fume/gas/mist/vapors/spray.
Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.

Response

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
If exposed to gas, or concerned about possible exposure: Call a POISON CENTER or doctor/physician.

Storage

Protect from sunlight. Store in a well-ventilated place.
Store in a secure area.

Disposal

Dispose of contents/containers in accordance with local/regional/national/international regulations.

* * * Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS * * *

CAS #	Component	Percent
74-82-8	Methane	95.01
78-84-0	Ethane	3.99
74-98-6	Propane	0.32
106-97-8	Butanes	0.07
109-66-0	Pentanes	0.02
110-54-3	Hexanes	0.01
7727-37-9	Nitrogen	0.35
124-38-9	Carbon Dioxide	0.19
7782-44-7	Oxygen	0.03

Because natural gas is a natural product, composition can vary greatly.

* * * Section 4 – FIRST AID MEASURES * * *

First Aid: Eyes

In case of freeze burn, cover eyes to protect from light. Flush eyes with running water for at least fifteen (15) minutes. Following flushing, seek medical attention.

First Aid: Skin

Remove contaminated clothing. In case of blistering, frostbite or freeze burns, seek immediate medical attention.

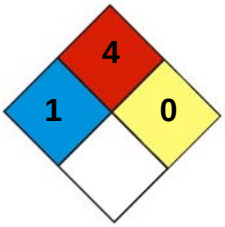
First Aid: Ingestion

Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical assistance.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 – FIRE FIGHTING MEASURES * * *



NFPA 704 Hazard Class

Health: **1** Flammability: **4** Instability: **0** (0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)

General Fire Hazards

See Section 9 for Flammability Properties.
Forms a flammable mixture with air. If released, the resulting vapors will disperse with the prevailing wind. If a source of ignition is present where the vapor exists at a 5 – 15% concentration in air, the vapor will burn along the flame front toward the source of the fuel.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

Any extinguisher suitable for Class B fires, dry chemical, fire fighting foam, CO2, and other gaseous agents. However, fire should not be extinguished unless flow of gas can be immediately stopped.

Unsuitable Extinguishing Media

None.

Fire Fighting Equipment / Instructions

Gas fires should not be extinguished unless flow of gas can be immediately stopped. Shut off gas source and allow gas to burn out. If spill or leak has not ignited, determine

if water spray may assist in dispersing gas or vapor to protect personnel attempting to stop leak. Use water to cool equipment, surfaces and piping exposed to fire and excessive heat. For large fire, the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Isolate area, particularly around piping. Let the fire burn unless leak can be stopped. Concentrate fire-fighting efforts on objects / materials ignited by the initial fire. Withdraw immediately in the event of a rising sound from a venting safety device.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH-approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

* * * Section 6 – ACCIDENTAL RELEASE MEASURES * * *

Recovery and Neutralization

Stop the source of the release, if safe to do so.

Materials and Methods for Clean-Up

Consider the use of water spray to disperse gas vapors. Do not use water spray to direct gas vapors toward sewer or drainage systems. Isolate the area until gas has dispersed. Ventilate and gas test area before entering.

Emergency Measures

Evacuate nonessential personnel and secure all ignition sources. No road flares, smoking or flames in hazard area. Consider wind direction. Stay upwind and uphill, if possible. Vapor cloud may be white, but color will dissipate as cloud disperses. Fire and explosion hazard is still present.

Personal Precautions and Protective Equipment

Cooling effect of expanding gas from leak may present frostbite / freeze burn hazard. Wear flame retardant (FR) clothing around un-ignited leak. Wear fire protective clothing around an active fire.

Environmental Precautions

Do not flush gas vapors toward sewer or drainage systems.

Prevention of Secondary Hazards

None.

* * * Section 7 – HANDLING AND STORAGE * * *

Handling Procedures

Keep away from flame, sparks and excessive temperatures. Bond and ground containers. Use only in well ventilated areas.

Storage Procedures

Natural gas will be contained in the pipeline. Keep away from flame, sparks, excessive temperatures and open flames. Empty pipeline segments may contain explosive residues from natural gas liquids. Do not cut, heat, weld or expose containers to sources of ignition sections of pipeline unless the sections have been purged of natural gas residues.

Incompatibilities

Keep away from strong oxidizers, ignition sources and heat.

* * * Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION * * *

Component Exposure Limits

Methane (74-82-8)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Ethane (74-84-0)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Propane (74-98-6)

ACGIH: 2500 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Butane (106-97-8)

ACGIH: 800 ppm TWA (listed under Aliphatic hydrocarbon gases : Alkane C1-4)

Pentanes (109-66-0)

ACGIH: 600 ppm TWA (listed under Pentane, all isomers)

Hexanes (110-54-3)

ACGIH: 50 ppm TWA (listed under n-Hexane)

Nitrogen (7727-37-9)

Simple Asphyxiant

Carbon Dioxide (124-38-9)

ACGIH: 5000 ppm TWA (listed under Carbon Dioxide)

Oxygen (7782-44-7)

N/A – Necessary for life

Engineering Measures

Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified / controlled areas.

Personal Protective Equipment: Respiratory

Use a NIOSH approved positive-pressure, supplied air respirator with escape bottle or self-contained breathing apparatus (SCBA) for gas concentrations above occupational exposure limits, for potential for uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere. CAUTION: Flammability limits (i.e., explosion hazard should be considered when assessing the need to expose personnel to concentrations requiring respiratory protection.

Personal Protective Equipment: Hands

Use cold-impervious, insulating flame-retardant (FR) gloves where contact with pressurized gas may occur.

Personal Protective Equipment: Eyes

Where there is a possibility of pressurized gas contact, wear splash-proof safety goggles and faceshield.

Personal Protective Equipment: Skin and Body

Where contact with pressurized gas may occur, wear flame-retardant (FR) and a faceshield.

* * * Section 9 – PHYSICAL AND CHEMICAL PROPERTIES * * *

Appearance:	Colorless	**Odor:**	Odorless to slight petroleum odor
Physical State:	Gas	**pH:**	ND
Vapor Pressure:	40 atm @ -187°F (-86°C)	**Vapor Density:**	0.6
Boiling Point:	-259°F (-162°C)	**Melting Point:**	ND
Solubility (H2O):	3.5%	**Specific Gravity:**	0.4 @ -263°F (-164°C)

Evaporation Rate:	ND	**VOC:**	ND
Octanol / H2O Coeff.:	ND	**Flash Point:**	Flammable Gas
Flash Point Method:	N/A		
Lower Flammability Limit: (LFL):	3.8 – 6.5	**Upper Flammability Limit: (UFL):**	13-17
Auto Ignition:	900-1170°F (482-632°C)	**Burning Rate:**	ND

* * * Section 10 – CHEMICAL STABILITY & REACTIVITY INFORMATION * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Keep away from strong oxidizers, ignition sources and heat.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

* * * Section 11 – TOXICOLOGICAL INFORMATION * * *

Acute Toxicity

A: General Product Information

Methane and ethane, the main components of natural gas, are considered practically inert in terms of physiological effects. At high concentrations these materials act as simple asphyxiants and may cause death due to lack of oxygen.

B. Component Analysis – LD50/LC50

Methane (74-82-8)

Inhalation LC50 Mouse 326 g/m3 2h

Ethane (74-84-0)

Inhalation LC50 Rat 658 mg/l 4h

Propane (74-98-6)

Inhalation LC50 Rat 658 mg/l 4h

Butanes (106-97-8)
Inhalation LC50 Rat 658 g/m3 4h

Pentanes (109-66-0)
Inhalation LD50 Rat 364 g/m3 4h

Hexanes (110-54-3)
Inhalation LC50 Rat > 20 mg/l 4h

Nitrogen (7727-37-9)
Simple Asphyxiant

Carbon Dioxide (124-38-9)
Inhalation LC50 Human 100,000 ppm 1minute

Oxygen (7782-44-7)
N/A – Necessary for life

Potential Health Effects: Skin Corrosion Property / Stimulativeness
This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity
This product is not reported to have any mutagenic effects.

Carcinogenicity

A: General Product Information
This product is not reported to have any carcinogenic effects.

B: Component Carcinogenicity
None of this product's components are listed by ACGIH, IARC, OSHA, NIOSH, or NTP.

Reproductive Toxicity
This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure
This product may cause damage to the heart.

Specified Target Organ General Toxicity: Repeated Exposure
This product is not reported to have any specific target organ repeat effects.

Aspiration Respiratory Organs Hazard
This product is not reported to have any aspiration hazard effects.

* * * Section 12 – ECOLOGICAL INFORMATION * * *

Ecotoxicity

A: General Product Information

Keep gas and vapors out of sewers, drainage areas, and waterways. Report spills and releases, as applicable under Federal and State regulations.

B: Component Analysis – Ecotoxicity – Aquatic Toxicity

No ecotoxicity data are available for this product's components.

Persistance / Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * * Section 13 – DISPOSAL CONSIDERATIONS * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment Recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents / container in accordance with local / regional / national / international regulations.

* * * Section 14 – TRANSPORTATION INFORMATION * * *

DOT Information

Shipping Name: Natural Gas, Compressed

UN #: 1971 **Hazard Class:** 2.1

Placard:

* * * Section 15 – REGULATORY INFORMATION * * *

Regulatory Information

Component Analysis

None of this products components are listed under SARA Section 302 (40 CFR 355 Appendix A.
n-hexane is listed under SARA Section 313 (40 CFR 372.65). However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

n-hexane is listed under CERCLA (40 CFR 302.4). However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
---	---	X	X	---

SARA Section 313 – Supplier Notification

This product contains one chemical (n-Hexane) that is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-to-know act (EPCRA) of 1986 and of 40 CFR 372. However the concentration of this component is approximately 0.01 % in compressed natural gas and is therefore far under the reporting threshold for the chemical.

State Regulations

Component Analysis – State

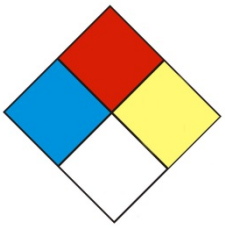
The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Methane	74-82-8	No	No	Yes	Yes	Yes	No
Ethane	78-84-0	No	No	Yes	Yes	Yes	No
Propane	74-98-6	No	No	Yes	Yes	Yes	Yes
Butane	106-97-8	Yes	No	Yes	Yes	Yes	Yes
Pentanes	109-66-0	Yes	No	Yes	Yes	Yes	Yes
Hexanes	110-54-3	Yes	Yes	Yes	Yes	Yes	Yes
Nitrogen	7727-37-9	No	No	No	No	No	No
Carbon Dioxide	124-38-9	Yes	No	Yes	Yes	Yes	Yes
Oxygen	7782-44-7	No	No	No	No	No	No

* * * Section 16 – OTHER INFORMATION * * *

NFPA® Hazard Rating

Health	1
Fire	4
Reactivity	0



HMIS® Hazard Rating

Health	1	Moderate
Fire	4	Severe
Physical	0	Minimal
		* Chronic

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act: ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; NJTSR = New Jersey Trade Secret Registry.

Literature References

None

Other Information

The information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Date of Preparation: January 30, 2014

Date of Last Revision: March 4, 2014

End of Sheet

Material Safety Data Sheet
(TRIETHYLENE GLYCOL (TEG))

JMN Specialties, Inc.
1100 Victory Drive
Westwego, LA 70094
(504) 341-3749
ISO 9001 Registered

HMIS HEALTH:.....2
HMIS FLAMMABILITY: 1
HMIS REACTIVITY:.....0
PERSONAL PROTECTION: C

EMERGENCY NUMBER: 800-255-3924

SECTION 1 – IDENTIFICATION OF CHEMICAL PRODUCT

PRODUCT NAME:..... TRIETHYLENE GLYCOL (TEG)
EFFECTIVE DATE:..... October 1, 2007
CHEMICAL FAMILY:..... Glycol
FORMULA: $C_6H_{14}O_4$
CAS NUMBER:..... 112-27-6

SECTION 2 – COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENT	PERCENT	CAS NUMBER	PEL
TRIETHYLENE GLYCOL	> 99	112-27-6	None Established by ACGIH or OSHA.

The criteria for listing components in the composition section are as follows: Carcinogens are listed when present at 0.1% or greater; components which are otherwise hazardous according to OSHA are listed when present at 1.0% or greater. Non-hazardous components may be listed at 3.0% or greater if not proprietary in nature. This is not intended to be complete compositional disclosure. Refer to section 14 for applicable states right to know and other regulatory information.

SECTION 3 – HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE / ODOR:..... Clear Liquid / Mild Odor

SHORT TERM EXPOSURE: **Inhalation:** No adverse health effects expected from inhalation. **Ingestion:** No adverse effects expected. **Skin Contact:** Prolonged exposure may cause skin irritation. **Eye Contact:** Splashing in eye causes irritation with transitory disturbances of corneal epithelium. However, these effects diminish and no permanent injury is expected. Vapors are non-irritating. **Chronic Exposure:** Possible skin irritation. **Aggravation of Pre-existing Conditions:** No information found.

OSHA REGULATED:..... No

LISTED CARCINOGEN: ..... **NTP:** No **IARC MONOGRAPHS:** No

POTENTIAL HEALTH EFFECTS

INHALATION: ..... Unlikely
INGESTION:..... Irritant
SKIN (DERMAL): ..... Slight Irritant After Prolonged Contact

OVER EXPOSURE EFFECTS: **Inhalation:** No adverse health effects expected from inhalation. **Ingestion:** No adverse effects expected. **Skin Contact:** Prolonged exposure may cause skin irritation. **Eye Contact:** Splashing in eye causes irritation with transitory disturbances of corneal epithelium. However, these effects diminish and no permanent injury is expected. Vapors are non-irritating. **Chronic Exposure:** Possible skin irritation. **Aggravation of Pre-existing Conditions:** No information found.

SECTION 4 – FIRST AID MEASURES

FIRST AID: **SKIN CONTACT:** Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately. **EYE CONTACT:** Flush eyes immediately with large amounts of water or normal saline solution, occasionally lifting upper and lower lids until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately. **INGESTION:** Give large amounts of fresh water or milk immediately. Do not give anything by mouth if person is unconscious or otherwise unable to swallow. If vomiting occurs, keep head below hips to prevent aspiration. Treat symptomatically and supportively. Seek medical attention immediately. **INHALATION:** Remove from exposure area to fresh air immediately. If breathing has stopped, perform artificial resuscitation. Keep person warm and at rest. Treat symptomatically and supportively. Seek medical attention immediately. Qualified medical personnel should consider administering oxygen.

NOTE TO PHYSICIAN: ..... Ethylene Glycol (EG) and diethylene glycol (DEG) intoxication may initially produce behavioral changes, drowsiness, vomiting, diarrhea, thirst, and convulsions. EG and DEG are nephrotoxic. End stages of poisoning may include renal damage or failure with acidosis. Supportive measures, supplemented with hemodialysis if indicated, may limit the progression and severity of toxic effects. Primary toxic effects of EG when swallowed are kidney damage and metabolic acidosis. This product may contain trace amounts of Ethylene Glycol (EG) or Diethylene Glycol (DEG).

SECTION 5 - FIRE FIGHTING MEASURES

FLASHPOINT:..... 350°F

EXTINGUISHING MEDIA: Water fog or spray, Foam, Dry Powder, Carbon Dioxide (CO_2).

DECOMPOSITION PRODUCTS:..... From fire; Smoke, Carbon dioxide, & Carbon Monoxide

LOWER FLAME LIMIT:..... < 0.9

HIGHER FLAME LIMIT:..... > 9

UNUSUAL FIRE AND EXPLOSION HAZARDS:..... Toxic levels of carbon monoxide, carbon dioxide, irritation aldehydes and ketones may be formed on burning. Heating in air may produce irritating aldehydes, acids, and ketones.

FIRE FIGHTING

EQUIPMENT: ..... Fire fighters and others exposed to products of combustion should wear self-contained breathing apparatus. Equipment should be thoroughly decontaminated after use.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

CHEMTEL EMERGENCY NUMBER (24 Hour): **1-800-255-3924**

SPILL: ..... Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer!

RCRA STATUS: ..... None

SECTION 7 – HANDLING AND STORAGE

HANDLE IN ACCORDANCE WITH GOOD INDUSTRIAL HYGIENE AND SAFETY PRACTICES. THESE PRACTICES INCLUDE AVOIDING UNNECESSARY EXPOSURE AND PROMPT REMOVAL OF MATERIAL FROM EYES, SKIN, AND CLOTHING.

HANDLING AND STORAGE: .. No special storage requirements. Do not store above 120°F.

PRECAUTIONARY MEASURES: ..... Provide fresh air ventilation during and after application. Close container after each use. Avoid prolonged or repeated contact with skin. Avoid contact with skin, eyes, and clothing. After handling this product, wash hands before eating, drinking, or smoking. If needed, take first aid action shown in Section 4.

SECTION 8 – EXPOSURE CONTROL / PERSONAL PROTECTION

GENERAL CONSIDERATIONS:

Consider the potential hazards of this material (see section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment.

EYE PROTECTION: ..... Chemical safety goggles meeting the specifications of OSHA 29CFR 1910.133 / ANSI Standard Z87.1 should be worn whenever there is the possibility of splashing or other contact with the eyes. Wear safety glasses meeting the specifications of OSHA 29CFR 1910.133 / ANSI Standard Z87.1 where no contact with the eye is anticipated.

RESPIRATORY PROTECTION: ..... Not normally needed. Use NIOSH approved vapor respirator if exposure is unknown or exceeds permissible limits. A respiratory protection program that meets OSHA's 29 CFR 1910.134 or ANSI Z88.2 requirements must be followed whenever workplace conditions warrant respirator use.

Use NIOSH / MSHA approved respiratory protection equipment when airborne exposure limits are exceeded (see below). Consult the respirator manufacturer to determine appropriate type of

equipment for a given application. Observe respirator use limitations specified by NIOSH / MSHA or the manufacturer. Respiratory protection programs must comply with 29 CFR 1910.134.
WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.
PROTECTIVE GLOVES:..... Wear impervious gloves
VENTILATION: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
MECHANICAL EXHAUST: ..... Desired in closed places
LOCAL EXHAUST: ..... Recommended

VENTILATION NOTES: Provide natural or mechanical ventilation to control exposure levels below Airborne exposure limits (see below). The use of local mechanical exhaust ventilation is preferred at sources of air contamination such as open process equipment. Consult NFPA Standard 91 for design of exhaust systems.

THRESHOLD LIMIT VALUE: . None Established
PROTECTIVE EQUIPMENT:... HMIS PERSONAL PROTECTION: C: Safety Glasses, Gloves, Apron
The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE / ODOR: ..... Clear Liquid / Mild Odor
BOILING POINT: ..... > 500°F
FREEZING POINT: ..... < 32°F
VAPOR PRESSURE:..... > 1
VAPOR DENSITY (AIR=1): 5.1
SPECIFIC GRAVITY: 1.1
pH: 8.2
SOLUBILITY IN WATER: ..... Complete

SECTION 10 – STABILITY AND REACTIVITY

STABILITY:..... Stable
HAZARDOUS
POLYMERIZATION:..... Will Not Occur
POLYMERIZATION AVOID:... None
INCOMPATIBILITY:..... Explosive decomposition may occur if combined with strong acids or strong bases and subjected to elevated temperatures. Therefore, avoid strong acids and strong bases at elevated temperatures. Avoid contamination with strong oxidizing agentsand materials reactive with hydroxyl compounds. Avoid burning or heating in air. This may produce irritating aldehydes, acids, and ketones.
CONDITIONS TO AVOID:..... Excessive heat. Will ignite in air at 700°F

Material Safety Data Sheet
(TRIETHYLENE GLYCOL (TEG))

SECTION 11 – TOXICOLOGICAL INFORMATION

EYE EFFECTS:
The eye irritation hazard is based on data from information supplied by raw material(s) supplier(s).
SKIN EFFECTS:
The skin irritation hazard is based on data from information supplied by raw material(s) supplier(s).
ACUTE ORAL EFFECTS:
The acute oral toxicity is based on data from information supplied by raw material(s) supplier(s).
ACUTE INHALATION EFFECTS:
The acute respiratory toxicity is based on data from information supplied by raw material(s) supplier(s).

SECTION 12 – ECOLOGICAL INFORMATION

Data from laboratory studies and from scientific literature is noted below if available.

SECTION 13 DISPOSAL CONSIDERATIONS

WASTE DISPOSAL: ..... Treatment, storage, transportation and disposal must be in accordance with Federal, State/Provincial and Local Regulations. Regulations may vary in different locations. Characterization and compliance with applicable laws are the responsibility solely of the generator. Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

SECTION 14- TRANSPORTATION INFORMATION

The data provided in this section is for information only. The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate regulations to properly classify your shipment for transportation.

PROPER SHIPPING NAME:..... DOT NON-REGULATED - TRIETHYLENE GLYCOL (TEG)
REPORTABLE QUANTITY:..... None
HAZARD CLASS AND LABEL: NON-REGULATED
UN NUMBER: ..... None
NA NUMBER: ..... None
PACKAGING SIZE:..... Pail, Drum & Bulk

SECTION 15 - REGULATORY INFORMATION

SARA 311 CATEGORIES:
EPA ACUTE:..... Yes (Eyes)

EPA CHRONIC: ..... No
EPA IGNITABILITY: ..... No
EPA REACTIVITY: ..... No
EPA SUDDEN RELEASE
OF PRESSURE: ..... No

CERCLA RQ VALUE: ..... None
SARA TPQ: ..... None
SARA RQ: ..... None
EPA HAZARD WASTE #: ..... None
CLEAN AIR: ..... NA
CLEAN WATER: ..... NA
SARA SECTION 313: ..... No
NFPA HEALTH: 2
NFPA FLAMMABILITY: 1
NFPA REACTIVITY: 0
DEA Chemical Trafficking Act:.. No
TSCA STATUS: ..... All ingredients in this product are on the TSCA Inventory List.

SECTION 16 - ADDITIONAL INFORMATION

FOOT NOTES: NA - NOT APPLICABLE ND - NO DATA AVAILABLE > = GREATER THAN < = LESS THAN

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Company Health and Risk Assessment Unit, PO Box 1519, Gretna, LA 70054-1519.

REVISION STATEMENT: Changes have been made throughout this Material Safety Data Sheet. Please read the entire document.

DISCLAIMER:
Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, the Company makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving this MSDS will make their own determination as to its suitability for their intended purposes prior to use. Since the product is within the exclusive control of the user, it is the user's obligation to determine the conditions of safe use of this product. Such conditions should comply with all Federal Regulations concerning the Product. It must be recognized that the physical and chemical properties of any product may not be fully understood and that new, possibly hazardous products may arise from reactions between chemicals. The information given in this data sheet is based on our present knowledge and shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

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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]
C-2100	1E	Compressor Engine #1	2016	1,680 hp	New	NSCR (1C)
C-2110	2E	Compressor Engine #2	2016	1,680 hp	New	NSCR (2C)
C-2120	3E	Compressor Engine #3	2016	1,680 hp	New	NSCR (3C)
C-2130	4E	Compressor Engine #4	2016	1,680 hp	New	NSCR (4C)
C-2140	5E	Compressor Engine #5	2016	1,680 hp	New	NSCR (5C)
C-2150	6E	Compressor Engine #6	2016	1,680 hp	New	NSCR (6C)
C-2160	7E	Compressor Engine #7	2016	1,680 hp	New	NSCR (7C)
C-2170	8E	Compressor Engine #8	2016	1,680 hp	New	NSCR (8C)
C-2180	9E	Compressor Engine #9	2016	1,680 hp	New	NSCR (9C)
C-2190	10E	Compressor Engine #10	2016	1,680 hp	New	NSCR(10C)
C-2200	11E	Compressor Engine #11	2016	1,680 hp	New	NSCR(11C)
G-8000	12E	Microturbine Generator #1	2016	600 kWe	New	None
SV-3110	13E	Dehydrator Still Vent #1	2016	60 MMscfd	New	FL-1000 (12C)
FT-3110	14E	Dehydrator Flash Tank #1	2016	60 MMscfd	New	R-3110 (15E)
R-3110	15E	Dehydrator Reboiler #1	2016	1.5 mmbtu/hr	New	None
SV-3210	16E	Dehydrator Still Vent #2	2016	60 MMscfd	New	FL-1000 (12C)
FT-3210	17E	Dehydrator Flash Tank #2	2016	60 MMscfd	New	R-3210 (18E)
R-3210	18E	Dehydrator Reboiler #2	2016	1.5 mmbtu/hr	New	None
TK-9000	19E	Settling Tank 1	2016	500 barrel	New	VRU-6000 & VRU-6100 (13C & 14C)
TK-9200	20E	Condensate Tank 1	2016	400 barrel	New	VRU-6000 & VRU-6100 (13C & 14C)
TK-9210	21E	Condensate Tank 2	2016	400 barrel	New	VRU-6000 & VRU-6100 (13C & 14C)
TK-9100	22E	Produced Water Tank 1	2016	400 barrel	New	VRU-6000 & VRU-6100 (13C & 14C)
TK-9110	23E	Produced Water Tank 2	2016	400 barrel	New	VRU-6000 & VRU-6100 (13C & 14C)

CATHT1	24E	Catalytic Heater for Generator Fuel	2016	0.024 MMBtu/hr	New	None
-----	-----	NSCR Catalyst for Compressor #1	2016	-----	New	1C
-----	-----	NSCR Catalyst for Compressor #2	2016	-----	New	2C
-----	-----	NSCR Catalyst for Compressor #3	2016	-----	New	3C
-----	-----	NSCR Catalyst for Compressor #4	2016	-----	New	4C
-----	-----	NSCR Catalyst for Compressor #5	2016	-----	New	5C
----	----	NSCR Catalyst for Compressor #6	2016	----	New	6C
----	----	NSCR Catalyst for Compressor #7	2016	----	New	7C
----	----	NSCR Catalyst for Compressor #8	2016	----	New	8C
----	----	NSCR Catalyst for Compressor #9	2016	----	New	9C
----	----	NSCR Catalyst for Compressor #10	2016	----	New	10C
----	----	NSCR Catalyst for Compressor #11	2016	----	New	11C
FL-1000	25E	Flare Combustion Device 1	2016	9.21 MMBtu/hr	New	12C
VRU-6000	-----	Vapor Recovery Unit 1	2016	TBD	New	13C
VRU-6100	----	Vapor Recovery Unit 2	2016	TBD	New	14C

[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

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			
1E	Upward Vertical Stack	C-2100	Com-pressor engine 1	1C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
2E	Upward Vertical Stack	C-2110	Com-pressor engine 2	2C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
3E	Upward Vertical Stack	C-2120	Com-pressor engine 3	3C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	

4E	Upward Vertical Stack	C-2130	Com-pressor engine 4	4C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
5E	Upward Vertical Stack	C-2140	Com-pressor engine 5	5C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
6E	Upward Vertical Stack	C-2150	Com-pressor engine 6	6C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
7E	Upward Vertical Stack	C-2160	Com-pressor engine 7	7C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	

8E	Upward Vertical Stack	C-2170	Com-pressor engine 8	8C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
9E	Upward Vertical Stack	C-2180	Com-pressor engine 9	9C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
10E	Upward Vertical Stack	C-2190	Com-pressor engine 10	10C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	
11E	Upward Vertical Stack	C-2200	Com-pressor engine 11	11C	NSCR catalyst	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	50.74 47.04 1.74 0.27 0.008 0.35 0.19 2081	199.39 184.84 6.84 1.06 0.03 1.38 0.73 8176	1.74 1.65 0.87 0.27 0.008 0.21 0.04 1996	6.98 6.47 3.42 1.06 0.03 0.83 0.17 7845	Gas/Vapor	EE	

12E	Upward Vertical Stack	G8000	Microturbine Generator	----	----	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	0.24 0.66 0.06 0.04 0.02 0.006 0.004 799	1.05 2.89 0.26 0.18 0.09 0.03 0.02 3499	0.24 0.66 0.06 0.04 0.02 0.006 0.004 799	1.05 2.89 0.26 0.18 0.09 0.03 0.02 3499	Gas/Vapor	EE	
13E	Upward Vertical Stack	SV-3110	Dehydrator Still Vent 1	12C	Flare-98% Control	C	8,760	VOC Total HAPs Benzene Toluene Ethylbenzene Xylenes n-Hexane CO2e	16.24 7.38 0.27 1.21 1.07 4.57 0.25 436	71.12 32.30 1.19 5.29 4.68 20.04 1.10 1910	See 25E emissions		Gas/Vapor	EE	
14E	Used for fuel in 15E	FT-3110	Dehydrator Flash Gas 1	Used for Fuel in 15E	95% Combustion	C	8,760	VOC Total HAPs Benzene Toluene Ethylbenzene Xylenes n-Hexane CO2e	32.26 0.67 0.021 0.053 0.024 0.065 0.51 1354	141.31 2.93 0.091 0.23 0.11 0.29 2.21 5929	See 15E emissions		Gas/Vapor	EE	
15E	Upward Vertical Stack	R-3110	Dehydrator Reboiler 1	---	----	C	8,760	NOx CO VOC PM10 SO2 Total HAPs CO2e	0.18 0.15 0.01 0.01 0.001 0.003 176.1	0.81 0.68 0.04 0.06 0.005 0.02 771	0.18 0.15 1.62 0.01 0.001 0.036 245.1	0.81 0.68 7.11 0.06 0.005 0.17 1072	Gas/Vapor	EE	

16E	Upward Vertical Stack	SV-3210	Dehydrator Still Vent 2	12C	Flare-98% Control	C	8,760	VOC Total HAPs Benzene Toluene Ethylbenzene Xylenes n-Hexane CO2e	16.24 7.38 0.27 1.21 1.07 4.57 0.25 436	71.12 32.30 1.19 5.29 4.68 20.04 1.10 1910	See 25E emissions		Gas/Vapor	EE	
17E	Used for fuel in 18E	FT-3210	Dehydrator Flash Gas 2	Used for Fuel in 18E	95% Combustion	C	8,760	VOC Total HAPs Benzene Toluene Ethylbenzene Xylenes n-Hexane CO2e	32.26 0.67 0.021 0.053 0.024 0.065 0.51 1354	141.31 2.93 0.091 0.23 0.11 0.29 2.21 5929	See 18E emissions		Gas/Vapor	EE	
18E	Upward Vertical Stack	R-3210	Dehydrator Reboiler 2	---	----	C	8,760	NOx CO VOC PM10 SO2 Total HAPs CO2e	0.18 0.15 0.01 0.01 0.001 0.003 176.1	0.81 0.68 0.04 0.06 0.005 0.02 771	0.18 0.15 1.62 0.01 0.001 0.036 245.1	0.81 0.68 7.11 0.06 0.005 0.17 1072	Gas/Vapor	EE	
19E	Upward Vertical Stack	TK-9000	Settler Tank	13C	VRU-98% capture	C	8,760	VOC Total HAPs CO2e	128.9 3.94 325.8	564.6 17.25 1427	2.58 0.079 6.62	11.29 0.35 29	Gas/Vapor	EE	
20E	Upward Vertical Stack	TK-9200	Condensate Tank 1	13C	VRU-98% capture	C	8,760	VOC Total HAPs CO2e	1.56 0.004 0.046	6.82 0.017 2.01	0.032 7.8e-5 0.011	0.14 3.4e-4 0.047	Gas/Vapor	EE	
21E	Upward Vertical Stack	TK-9210	Condensate Tank 2	13C	VRU-98% capture	C	8,760	VOC Total HAPs CO2e	1.56 0.004 0.046	6.82 0.017 2.01	0.032 7.8e-5 0.011	0.14 3.4e-4 0.047	Gas/Vapor	EE	

22E	Upward Vertical Stack	TK-9100	Produced Water Tank 1	13C	VRU-98% capture	C	8,760	VOC Total HAPs CO2e	8.7e-5 3.4e-8 0.002	3.8e-4 1.5e-7 0.009	1.8e-6 6.9e-10 7.5e-5	7.7e-6 3.0e-9 3.3e-4	Gas/Vapor	EE	
23E	Upward Vertical Stack	TK-9110	Produced Water Tank 2	13C	VRU-98% capture	C	8,760	VOC Total HAPs CO2e	8.7e-5 3.4e-8 0.002	3.8e-4 1.5e-7 0.009	1.8e-6 6.9e-10 7.5e-5	7.7e-6 3.0e-9 3.3e-4	Gas/Vapor	EE	
24E	Upward Vertical Stack	CATHT 1	Catalytic Heater for Generator Fuel	---	---	C	8,760	NOx CO VOC PM10 SO2 Total HAPs Formaldehyde CO2e	0.0029 0.0025 1.6 E-4 2.2 E-4 1.8 E-5 6 E-5 2 E-6 2.82	0.013 0.011 7.1 E-4 0.001 7.7 E-5 2.4 E-4 1 E-5 12	0.0029 0.0025 1.6 E-4 2.2 E-4 1.8 E-5 6 E-5 2 E-6 2.82	0.013 0.011 7.1 E-4 0.001 7.7 E-5 2.4 E-4 1 E-5 12	Gas/Vapor	EE	
25E	Upward Vertical Stack	FL-1000	Flare combustion device 1	---	---	C	8,760	NOx CO VOC PM10 Total HAPs CO2e	--- --- --- --- --- ---	--- --- --- --- --- ---	0.63 2.86 0.64 1.3e-4 0.30 1101	2.75 12.51 2.84 5.5e-4 1.30 4822	Gas/Vapor	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.	Inner Diameter (ft.)	Exit Gas			Emission Point Elevation (ft)		UTM Coordinates (km)	
		Temp. (ºF)	Volumetric Flow [1] (acfm) *at operating conditions*	Velocity (fps)	Ground Level *(Height above mean sea level)*	Stack Height [2]	Northing	Easting
1E/1C	1.1	1223	8813	155	980	TBD	4,364.863	510.979
2E/2C	1.1	1223	8813	155	980	TBD	4,364.858	510.991
3E/3C	1.1	1223	8813	155	980	TBD	4,364.854	511.002
4E/4C	1.1	1223	8813	155	980	TBD	4,364.851	511.013
5E/5C	1.1	1223	8813	155	980	TBD	4,364.848	511.025
6E/6C	1.1	1223	8813	155	980	TBD	4,364.843	511.036
7E/7C	1.1	1223	8813	155	980	TBD	4,364.839	511.048
8E/8C	1.1	1223	8813	155	980	TBD	4,364.834	511.059
9E/9C	1.1	1223	8813	155	980	TBD	4,364.829	511.071
10E/10C	1.1	1223	8813	155	980	TBD	4,364.825	511.082
11E/11C	1.1	1223	8813	155	980	TBD	4,364.820	511.093
12E	0.5	535	4.0 kg/s mass flow	'---	980	~11	4364.802	511.026
15E	0.75	350	530	20	980	~18	4364.801	510.984
18E	0.75	350	530	20	980	~18	4364.814	510.993
24E	0.5	225	47	4	980	~10	4364.802	511.026
25E	3	1030	2545	6	980	20	4364.819	510.975
Note: Points 13E and 16E are grouped into 25E. Points 14E and 17E are grouped into 15E and 18E respectively. Points 19E-23E are sent to the VRUs in a closed loop.								

[1] Give at operating conditions. Include inerts. [2] Release height of emissions above ground level.

Attachment K.
Fugitive Emissions Data Summary Sheet

Attachment K

FUGITIVE EMISSIONS DATA SUMMARY SHEET

The FUGITIVE EMISSIONS SUMMARY SHEET provides a summation of fugitive emissions. Fugitive emissions are those emissions which could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening. Note that uncaptured process emissions are not typically considered to be fugitive, and must be accounted for on the appropriate EMISSIONS UNIT DATA SHEET and on the EMISSION POINTS DATA SUMMARY SHEET.

Please note that total emissions from the source are equal to all vented emissions, all fugitive emissions, plus all other emissions (e.g. uncaptured emissions).

APPLICATION FORMS CHECKLIST - FUGITIVE EMISSIONS
1.) Will there be haul road activities? ☒ Yes ☐ No ☒ If YES, then complete the HAUL ROAD EMISSIONS UNIT DATA SHEET.
2.) Will there be Storage Piles? ☐ Yes ☒ No ☐ If YES, complete Table 1 of the NONMETALLIC MINERALS PROCESSING EMISSIONS UNIT DATA SHEET.
3.) Will there be Liquid Loading/Unloading Operations? ☒ Yes ☐ No ☒ If YES, complete the BULK LIQUID TRANSFER OPERATIONS EMISSIONS UNIT DATA SHEET.
4.) Will there be emissions of air pollutants from Wastewater Treatment Evaporation? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
5.) Will there be Equipment Leaks (e.g. leaks from pumps, compressors, in-line process valves, pressure relief devices, open-ended valves, sampling connections, flanges, agitators, cooling towers, etc.)? ☒ Yes ☐ No ☒ If YES, complete the LEAK SOURCE DATA SHEET section of the CHEMICAL PROCESSES EMISSIONS UNIT DATA SHEET.
6.) Will there be General Clean-up VOC Operations? ☐ Yes ☒ No ☐ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET.
7.) Will there be any other activities that generate fugitive emissions? ☒ Yes ☐ No ☒ If YES, complete the GENERAL EMISSIONS UNIT DATA SHEET or the most appropriate form.
If you answered "NO" to all of the items above, it is not necessary to complete the following table, "Fugitive Emissions Summary."

FUGITIVE EMISSIONS SUMMARY	All Regulated Pollutants - Chemical Name/CAS [1]	Maximum Potential Uncontrolled Emissions [2]		Maximum Potential Controlled Emissions [3]		Est. Method Used [4]
		lb/hr	ton/yr	lb/hr	ton/yr	
Haul Road/Road Dust Emissions Paved Haul Roads						
Unpaved Haul Roads	PM-10 PM-2.5	0.15 0.015	0.67 0.067	0.15 0.015	0.67 0.067	EE
Storage Pile Emissions						
Loading/Unloading Operations	VOCs Total HAPs CO2e	52.65 0.13 30.7	7.94 0.02 3.03	52.65 0.13 30.7	7.94 0.02 3.03	EE
Wastewater Treatment Evaporation & Operations						
Equipment Leaks	VOCs Total HAPs CO2e	1.01 0.02 22.6	4.42 0.09 99	1.01 0.02 22.6	4.42 0.09 99	EE
General Clean-up VOC Emissions						
Other – Venting Episodes	VOCs Total HAPs CO2e	Does not apply	9.90 0.16 672	Does not apply	9.90 0.16 672	EE

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

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

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

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

Attachment L.
Emission Unit Data Sheets

Compressor Engines

NATURAL GAS COMPRESSOR/GENERATOR ENGINE DATA SHEET

Source Identification Number[1]		1E		2E		3E	
Engine Manufacturer and Model		Waukesha, 7044 GSI		Waukesha, 7044 GSI		Waukesha, 7044 GSI	
Manufacturer's Rated bhp/rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm	
Source Status[2]		NS		NS		NS	
Date Installed/Modified/Removed[3]		March 2016		March 2016		March 2016	
Engine Manufactured/Reconstruction Date[4]		TBD		TBD		TBD	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60 Subpart JJJJ? (Yes or No)[5]		No		No		No	
Engine, Fuel and Combustion Data	Engine Type[6]	RB4S		RB4S		RB4S	
	APCD Type[7]	NSCR		NSCR		NSCR	
	Fuel Type[8]	PQ		PQ		PQ	
	H_2S (gr/100 scf)	0		0		0	
	Operating bhp/rpm	1674 bhp/1200 rpm		1674 bhp/1200 rpm		1674 bhp/1200 rpm	
	BSFC (Btu/bhp-hr)	8,267		8,267		8,267	
	Fuel throughput (ft^3/hr)	11,820		11,820		11,820	
	Fuel throughput ($MMft^3$/yr)	93.19		93.19		93.19	
	Operation (hrs/yr)	8,760		8,760		8,760	
Reference[9]	Potential Emissions[10]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
MD	NO_X	1.78	6.98	1.78	6.98	1.78	6.98
MD	CO	1.65	6.47	1.65	6.47	1.65	6.47
MD	VOC	0.87	3.42	0.87	3.42	0.87	3.42
AP	SO_2	0.008	0.03	0.008	0.03	0.008	0.03
AP	PM_{10}	0.27	1.06	0.27	1.06	0.27	1.06
MD	Formaldehyde	0.04	0.17	0.04	0.17	0.04	0.17

Source Identification Number[1]		4E		5E		6E	
Engine Manufacturer and Model		Waukesha, 7044 GSI		Waukesha, 7044 GSI		Waukesha, 7044 GSI	
Manufacturer's Rated bhp/rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm	
Source Status[2]		NS		NS		NS	
Date Installed/Modified/Removed[3]		March 2016		March 2016		March 2016	
Engine Manufactured/Reconstruction Date[4]		TBD		TBD		TBD	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60 Subpart JJJJ? (Yes or No)[5]		No		No		No	
Engine, Fuel and Combustion Data	Engine Type[6]	RB4S		RB4S		RB4S	
	APCD Type[7]	NSCR		NSCR		NSCR	
	Fuel Type[8]	PQ		PQ		PQ	
	H_2S (gr/100 scf)	0		0		0	
	Operating bhp/rpm	1674 bhp/1200 rpm		1674 bhp/1200 rpm		1674 bhp/1200 rpm	
	BSFC (Btu/bhp-hr)	8,267		8,267		8,267	
	Fuel throughput (ft^3/hr)	11,820		11,820		11,820	
	Fuel throughput ($MMft^3$/yr)	93.19		93.19		93.19	
	Operation (hrs/yr)	8,760		8,760		8,760	
Reference[9]	Potential Emissions[10]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
MD	NO_X	1.78	6.98	1.78	6.98	1.78	6.98
MD	CO	1.65	6.47	1.65	6.47	1.65	6.47
MD	VOC	0.87	3.42	0.87	3.42	0.87	3.42
AP	SO_2	0.008	0.03	0.008	0.03	0.008	0.03
AP	PM_{10}	0.27	1.06	0.27	1.06	0.27	1.06
MD	Formaldehyde	0.04	0.17	0.04	0.17	0.04	0.17

Source Identification Number[1]		7E		8E		9E	
Engine Manufacturer and Model		Waukesha, 7044 GSI		Waukesha, 7044 GSI		Waukesha, 7044 GSI	
Manufacturer's Rated bhp/rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm	
Source Status[2]		NS		NS		NS	
Date Installed/Modified/Removed[3]		March 2016		March 2016		March 2016	
Engine Manufactured/Reconstruction Date[4]		TBD		TBD		TBD	
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60 Subpart JJJJ? (Yes or No)[5]		No		No		No	
Engine, Fuel and Combustion Data	Engine Type[6]	RB4S		RB4S		RB4S	
	APCD Type[7]	NSCR		NSCR		NSCR	
	Fuel Type[8]	PQ		PQ		PQ	
	H_2S (gr/100 scf)	0		0		0	
	Operating bhp/rpm	1674 bhp/1200 rpm		1674 bhp/1200 rpm		1674 bhp/1200 rpm	
	BSFC (Btu/bhp-hr)	8,267		8,267		8,267	
	Fuel throughput (ft^3/hr)	11,820		11,820		11,820	
	Fuel throughput ($MMft^3$/yr)	93.19		93.19		93.19	
	Operation (hrs/yr)	8,760		8,760		8,760	
Reference[9]	Potential Emissions[10]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
MD	NO_X	1.78	6.98	1.78	6.98	1.78	6.98
MD	CO	1.65	6.47	1.65	6.47	1.65	6.47
MD	VOC	0.87	3.42	0.87	3.42	0.87	3.42
AP	SO_2	0.008	0.03	0.008	0.03	0.008	0.03
AP	PM_{10}	0.27	1.06	0.27	1.06	0.27	1.06
MD	Formaldehyde	0.04	0.17	0.04	0.17	0.04	0.17

Source Identification Number[1]		10E		11E			
Engine Manufacturer and Model		Waukesha, 7044 GSI		Waukesha, 7044 GSI			
Manufacturer's Rated bhp/rpm		1680 bhp/1200 rpm		1680 bhp/1200 rpm			
Source Status[2]		NS		NS			
Date Installed/Modified/Removed[3]		March 2016		March 2016			
Engine Manufactured/Reconstruction Date[4]		TBD		TBD			
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60 Subpart JJJJ? (Yes or No)[5]		No		No			
Engine, Fuel and Combustion Data	Engine Type[6]	RB4S		RB4S			
	APCD Type[7]	NSCR		NSCR			
	Fuel Type[8]	PQ		PQ			
	H_2S (gr/100 scf)	0		0			
	Operating bhp/rpm	1674 bhp/1200 rpm		1674 bhp/1200 rpm			
	BSFC (Btu/bhp-hr)	8,267		8,267			
	Fuel throughput (ft^3/hr)	11,820		11,820			
	Fuel throughput ($MMft^3$/yr)	93.19		93.19			
	Operation (hrs/yr)	8,760		8,760			
Reference[9]	Potential Emissions[10]	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
MD	NO_X	1.78	6.98	1.78	6.98		
MD	CO	1.65	6.47	1.65	6.47		
MD	VOC	0.87	3.42	0.87	3.42		
AP	SO_2	0.008	0.03	0.008	0.03		
AP	PM_{10}	0.27	1.06	0.27	1.06		
MD	Formaldehyde	0.04	0.17	0.04	0.17		

1. Enter the appropriate Source Identification Number for each natural gas-fueled reciprocating internal combustion compressor/generator engine located at the compressor station. Multiple compressor engines should be designated CE-1, CE-2, CE-3 etc. Generator engines should be designated GE-1, GE-2, GE-3 etc. If more than three (3) engines exist, please use additional sheets.

2. Enter the Source Status using the following codes:

NS	Construction of New Source (installation)	ES	Existing Source
MS	Modification of Existing Source	RS	Removal of Source

3. Enter the date (or anticipated date) of the engine's installation (construction of source), modification or removal.

4. Enter the date that the engine was manufactured, modified or reconstructed.

5. Is the engine a certified stationary spark ignition internal combustion engine according to 40CFR60 Subpart JJJJ. If so, the engine and control device must be operated and maintained in accordance with the manufacturer's emission-related written instructions. You must keep records of conducted maintenance to demonstrate compliance, but no performance testing is required. If the certified engine is not operated and maintained in accordance with the manufacturer's emission-related written instructions, the engine will be considered a non-certified engine and you must demonstrate compliance according to 40CFR§60.4243a(2)(i) through (iii), as appropriate.

   Provide a manufacturer's data sheet for all engines being registered.

6. Enter the Engine Type designation(s) using the following codes:

LB2S	Lean Burn Two Stroke	RB4S	Rich Burn Four Stroke
LB4S	Lean Burn Four Stroke		

7. Enter the Air Pollution Control Device (APCD) type designation(s) using the following codes:

A/F	Air/Fuel Ratio	IR	Ignition Retard
HEIS	High Energy Ignition System	SIPC	Screw-in Precombustion Chambers
PSC	Prestratified Charge	LEC	Low Emission Combustion
NSCR	Rich Burn & Non-Selective Catalytic Reduction	SCR	Lean Burn & Selective Catalytic Reduction

8. Enter the Fuel Type using the following codes:

PQ	Pipeline Quality Natural Gas	RG	Raw Natural Gas

9. Enter the Potential Emissions Data Reference designation using the following codes. Attach all referenced data to this *Compressor/Generator Data Sheet(s).*

MD	Manufacturer's Data	AP	AP-42	
GR	GRI-HAPCalc™	OT	Other _____	(please list)

10. Enter each engine's Potential to Emit (PTE) for the listed regulated pollutants in pounds per hour and tons per year. PTE shall be calculated at manufacturer's rated brake horsepower and may reflect reduction efficiencies of listed Air Pollution Control Devices. Emergency generator engines may use 500 hours of operation when calculating PTE. PTE data from this data sheet shall be incorporated in the *Emissions Summary Sheet*.

GE Power & Water

Underwood Compressor Station - Tyler County, West Virginia

VHP - L7044GSI

Gas Compression

ENGINE SPEED (rpm):	1200	NOx SELECTION (g/bhp-hr):	Customer Catalyst
DISPLACEMENT (in3):	7040	COOLING SYSTEM:	JW, IC + OC
COMPRESSION RATIO:	8:1	INTERCOOLER WATER INLET (°F):	130
IGNITION SYSTEM:	ESM	JACKET WATER OUTLET (°F):	180
EXHAUST MANIFOLD:	Water Cooled	JACKET WATER CAPACITY (gal):	100
COMBUSTION:	Rich Burn, Turbocharged	AUXILIARY WATER CAPACITY (gal):	11
ENGINE DRY WEIGHT (lbs):	24250	LUBE OIL CAPACITY (gal):	190
AIR/FUEL RATIO SETTING:	0.38% CO	MAX. EXHAUST BACKPRESSURE (in. H2O):	18
ENGINE SOUND LEVEL (dBA)	104	MAX. AIR INLET RESTRICTION (in. H2O):	15
		EXHAUST SOUND LEVEL (dBA)	111

SITE CONDITIONS:

FUEL:	Commercial Quality Natural Gas	ALTITUDE (ft):	980
FUEL PRESSURE RANGE (psig):	30 - 60	MAXIMUM INLET AIR TEMPERATURE (°F):	100
FUEL HHV (BTU/ft3):	1,295.7	FUEL WKI:	58.9
FUEL LHV (BTU/ft3):	1,171.3		

SITE SPECIFIC TECHNICAL DATA

POWER RATING	UNITS	MAX RATING AT 100 °F AIR TEMP	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE OF 100 °F		
			100%	75%	50%
CONTINUOUS ENGINE POWER	BHP	1674	1674	1260	843
OVERLOAD	% 2/24 hr	0	0	-	-
MECHANICAL EFFICIENCY (LHV)	%	30.8	30.8	29.3	28.6
CONTINUOUS POWER AT FLYWHEEL	BHP	1674	1674	1260	843
based on no auxiliary engine driven equipment					
FUEL CONSUMPTION					
FUEL CONSUMPTION (LHV)	BTU/BHP-hr	8267	8267	8686	8896
FUEL CONSUMPTION (HHV)	BTU/BHP-hr	9145	9145	9609	9841
FUEL FLOW *based on fuel analysis LHV*	SCFM	197	197	156	107
HEAT REJECTION					
JACKET WATER (JW)	BTU/hr x 1000	4131	4131	3428	2505
LUBE OIL (OC)	BTU/hr x 1000	570	570	521	430
INTERCOOLER (IC)	BTU/hr x 1000	266	266	185	92
EXHAUST	BTU/hr x 1000	4173	4173	3160	1928
RADIATION	BTU/hr x 1000	705	705	655	543
EMISSIONS (ENGINE OUT):					
NOx (NO + NO2)	g/bhp-hr	13.7	13.7	14.9	16.5
CO	g/bhp-hr	12.7	12.7	12.7	11.4
THC	g/bhp-hr	2.3	2.3	2.3	2.3
NMHC	g/bhp-hr	0.98	0.98	0.94	0.76
NM, NEHC	g/bhp-hr	0.47	0.47	0.45	0.37
CO2	g/bhp-hr	529	529	556	569
CO2e	g/bhp-hr	561	561	587	594
CH2O	g/bhp-hr	0.05	0.05	0.05	0.05
CH4	g/bhp-hr	1.30	1.30	1.25	1.01
AIR INTAKE / EXHAUST GAS					
INDUCTION AIR FLOW	SCFM	2534	2534	2004	1373
EXHAUST GAS MASS FLOW	lb/hr	11782	11782	9320	6384
EXHAUST GAS FLOW *at exhaust temp, 14.5 psia*	ACFM	8813	8813	6797	4358
EXHAUST TEMPERATURE	°F	1223	1223	1181	1076

HEAT EXCHANGER SIZING		
TOTAL JACKET WATER CIRCUIT (JW)	BTU/hr x 1000	4685
TOTAL AUXILIARY WATER CIRCUIT (IC + OC)	BTU/hr x 1000	947

COOLING SYSTEM WITH ENGINE MOUNTED WATER PUMPS		
JACKET WATER PUMP MIN. DESIGN FLOW	GPM	450
JACKET WATER PUMP MAX. EXTERNAL RESTRICTION	psig	16
AUX WATER PUMP MIN. DESIGN FLOW	GPM	79
AUX WATER PUMP MAX. EXTERNAL RESTRICTION	psig	44

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

Data Generated by EngCalc Program Version 3.5.1 Dresser Inc.

10/8/2015 3:54 PM

Underwood Compressor Station - Tyler County, West Virginia

VHP - L7044GSI

Gas Compression

FUEL COMPOSITION

HYDROCARBONS:		Mole or Volume %
Methane	CH4	75.469
Ethane	C2H6	15.543
Propane	C3H8	5.177
Iso-Butane	I-C4H10	0.676
Normal Butane	N-C4H10	1.475
Iso-Pentane	I-C5H12	0.348
Normal Pentane	N-C5H12	0.358
Hexane	C6H14	0.415
Heptane	C7H16	0
Ethene	C2H4	0
Propene	C3H6	0
	SUM HYDROCARBONS	99.461
NON-HYDROCARBONS:		
Nitrogen	N2	0.363
Oxygen	O2	0
Helium	He	0
Carbon Dioxide	CO2	0.162
Carbon Monoxide	CO	0
Hydrogen	H2	0
Water Vapor	H2O	0
	TOTAL FUEL	99.986

FUEL:	Commercial Quality Natural Gas
FUEL PRESSURE RANGE (psig):	30 - 60
FUEL WKI:	58.9
FUEL SLHV (BTU/ft3):	1150.92
FUEL SLHV (MJ/Nm3):	45.26
FUEL LHV (BTU/ft3):	1171.30
FUEL LHV (MJ/Nm3):	46.06
FUEL HHV (BTU/ft3):	1295.69
FUEL HHV (MJ/Nm3):	50.95
FUEL DENSITY (SG):	0.74

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.

No water or hydrocarbon condensates are allowed in the engine. Requires liquids removal.

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 for engines with GE supplied 3-way catalyst are given at catalyst outlet flange. For all other engine models, 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. Catalyst out emission levels represent emission levels the catalyst is sized to achieve. Manual adjustment may be necessary to achieve compliance as catalyst/engine age. Catalyst-out emission levels are valid for the duration of the engine warranty. 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 158 PSI BMEP and 1200 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.
18. Continuous Power Rating: The highest load and speed that can be applied 24 hours per day, seven days per week, 365 days per year except for normal maintenance at indicated ambient reference conditions and fuel. No engine overload power rating is available.
19. emPact emission compliance available for entire range of operable fuels; however, fuel system and/or O2 set point may need to be adjusted in order to maintain compliance.
20. In cold ambient temperatures, heating of the engine jacket water, lube oil and combustion air may be required. See Waukesha Technical Data.

SPECIAL REQUIREMENTS

Microturbine Generators

NATURAL GAS COMPRESSOR/GENERATOR ENGINE DATA SHEET

Source Identification Number[1]		12E					
Engine Manufacturer and Model		Capstone C600 Standard					
Manufacturer's Rated bhp/rpm		600 kWe					
Source Status[2]		NS					
Date Installed/Modified/Removed[3]		March 2016					
Engine Manufactured/Reconstruction Date[4]		TBD					
Is this a Certified Stationary Spark Ignition Engine according to 40CFR60 Subpart JJJJ? (Yes or No)[5]		N/A					
Engine, Fuel and Combustion Data	Engine Type[6]	N/A					
	APCD Type[7]	N/A					
	Fuel Type[8]	PQ					
	H_2S (gr/100 scf)	0					
	Operating kWe	600					
	BSFC (Btu/kWe)	10,300					
	Fuel throughput (ft^3/hr)	6,059					
	Fuel throughput ($MMft^3$/yr)	53.08					
	Operation (hrs/yr)	8,760					
Reference[9]	Potential Emissions[10]	lbs/hr	tons/yr			lbs/hr	tons/yr
MD	NO_X	0.24	1.05				
MD	CO	0.66	2.89				
MD	VOC	0.06	0.26				
AP	SO_2	0.02	0.09				
AP	PM_{10}	0.04	0.018				
AP	Formaldehyde	4.4e-4	0.02				

1. Enter the appropriate Source Identification Number for each natural gas-fueled reciprocating internal combustion compressor/generator engine located at the compressor station. Multiple compressor engines should be designated CE-1, CE-2, CE-3 etc. Generator engines should be designated GE-1, GE-2, GE-3 etc. If more than three (3) engines exist, please use additional sheets.

2. Enter the Source Status using the following codes:

NS	Construction of New Source (installation)	ES	Existing Source
MS	Modification of Existing Source	RS	Removal of Source

3. Enter the date (or anticipated date) of the engine's installation (construction of source), modification or removal.

4. Enter the date that the engine was manufactured, modified or reconstructed.

5. Is the engine a certified stationary spark ignition internal combustion engine according to 40CFR60 Subpart JJJJ. If so, the engine and control device must be operated and maintained in accordance with the manufacturer's emission-related written instructions. You must keep records of conducted maintenance to demonstrate compliance, but no performance testing is required. If the certified engine is not operated and maintained in accordance with the manufacturer's emission-related written instructions, the engine will be considered a non-certified engine and you must demonstrate compliance according to 40CFR§60.4243a(2)(i) through (iii), as appropriate.

   Provide a manufacturer's data sheet for all engines being registered.

6. Enter the Engine Type designation(s) using the following codes:

LB2S	Lean Burn Two Stroke	RB4S	Rich Burn Four Stroke
LB4S	Lean Burn Four Stroke		

7. Enter the Air Pollution Control Device (APCD) type designation(s) using the following codes:

A/F	Air/Fuel Ratio	IR	Ignition Retard
HEIS	High Energy Ignition System	SIPC	Screw-in Precombustion Chambers
PSC	Prestratified Charge	LEC	Low Emission Combustion
NSCR	Rich Burn & Non-Selective Catalytic Reduction	SCR	Lean Burn & Selective Catalytic Reduction

8. Enter the Fuel Type using the following codes:

PQ	Pipeline Quality Natural Gas	RG	Raw Natural Gas

9. Enter the Potential Emissions Data Reference designation using the following codes. Attach all referenced data to this *Compressor/Generator Data Sheet(s)*.

MD	Manufacturer's Data	AP	AP-42	
GR	GRI-HAPCalc™	OT	Other _____	(please list)

10. Enter each engine's Potential to Emit (PTE) for the listed regulated pollutants in pounds per hour and tons per year. PTE shall be calculated at manufacturer's rated brake horsepower and may reflect reduction efficiencies of listed Air Pollution Control Devices. Emergency generator engines may use 500 hours of operation when calculating PTE. PTE data from this data sheet shall be incorporated in the *Emissions Summary Sheet*.

C600 600kW Power Package
High-pressure Natural Gas

World's largest air-bearing microturbine produces 600kW of clean, green and reliable power.

- High electrical efficiency over a very wide operating range
- Low maintenance air bearings require no lube oil or coolant
- Ultra-low emissions
- High availability – part load redundancy
- Proven technology with tens of millions of operating hours
- Integrated utility synchronization and protection with a modular design
- 5 and 9 year Factory Protection Plans available
- Remote monitoring and diagnostic capabilities
- Upgradable to 800kW or 1MW with field installed Capstone 200kW power modules
- Internal fuel gas compressor available for low fuel pressure Natural Gas applications

C600 600kW Power Package

Electrical Performance[1]

Electrical Power Output	600kW
Voltage	400–480 VAC
Electrical Service	3-Phase, 4 wire
Frequency	50/60 Hz, grid connect operation
	10–60 Hz, stand alone operation
Maximum Output Current	870A RMS @ 400V, grid connect operation
	720A RMS @ 480V, grid connect operation
	930A RMS, stand alone operation[2]
Electrical Efficiency LHV	33%

Fuel/Engine Characteristics[1]

Natural Gas HHV	30.7–47.5 MJ/m^3 (825–1,275 BTU/scf)
Inlet Pressure[3]	517–552 kPa gauge (75–80 psig)
Fuel Flow HHV	7,200 MJ/hr (6,840,000 BTU/hr)
Net Heat Rate LHV	10.9 MJ/kWh (10,300 BTU/kWh)

Exhaust Characteristics[1]	Standard	CARB Version
NOx Emissions @ 15% O_2[4]	< 9 ppmvd (18 mg/m^3)	< 4 ppmvd (8 mg/m^3)
NOx / Electrical Output[4]	0.14 g/bhp-hr (0.4 lb/MWhe)	0.05 g/bhp-hr (0.14 lb/MWhe)
Exhaust Gas Flow	4.0 kg/s (8.8 lbm/s)	4.0 kg/s (8.8 lbm/s)
Exhaust Gas Temperature	280°C (535°F)	280°C (535°F)
Exhaust Energy	4,260 MJ/hr (4,050,000 BTU/hr)	4,260 MJ/hr (4,050,000 BTU/hr)

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

Dimensions & Weight[5]

Width x Depth x Height	2.4 x 9.1 x 2.9 m (96 x 360 x 114 in)
Weight - Grid Connect Model	12565 kg (27,700 lbs)
Weight - Dual Mode Model	15014 kg (33,100 lbs)

Minimum Clearance Requirements[6]

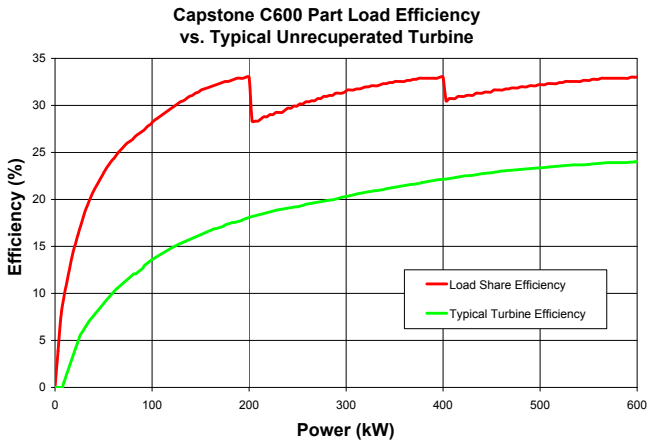
Vertical Clearance	0.6 m (24 in)
Horizontal Clearance	
Left & Right	1.5 m (60 in)
Front	1.5 m (60 in)
Rear	1.8 m (72 in)

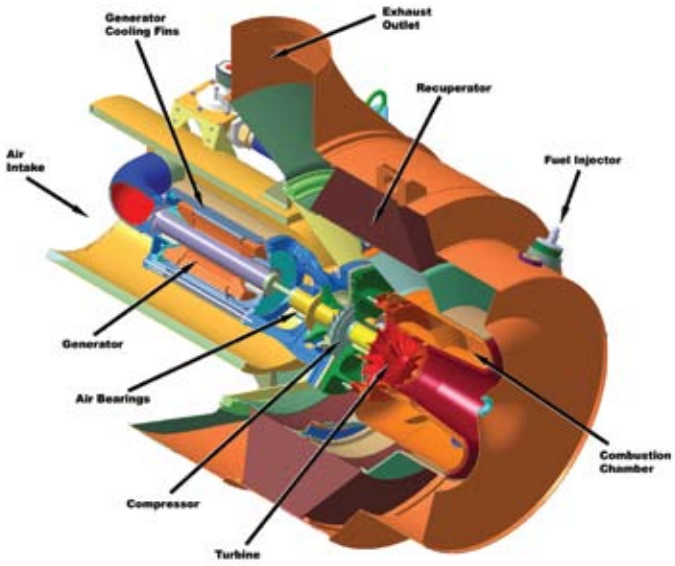
Sound Levels

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

Planned Certifications

- UL 2200 and UL 1741 for natural gas operation under existing UL files[7]
- Will comply with IEEE 1547 and will meet statewide utility interconnection requirements for California Rule 21 and the New York State Public Service Commission
- Models will be available with optional equipment for CE marking





C200 Engine

(1) Nominal full power performance at ISO conditions: 59°F, 14.696 psia, 60% RH
(2) With linear load
(3) Inlet pressure for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(4) Emissions for standard natural gas at 39.4 MJ/Nm³ (1,000 BTU/scf) (HHV)
(5) Approximate dimensions and weights
(6) Clearance requirements may increase due to local code considerations
(7) All models are planned to be UL Listed or available with optional equipment for CE marking

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

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Technical Reference

Capstone MicroTurbine™ Systems Emissions

Summary

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

Maximum Exhaust Emissions at ISO Conditions

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

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

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

Notes:

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

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

Catalytic Heater

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*):

1. Name or type and model of proposed affected source: Bruest HotCat Heater. Model 8000 24,000 Btu/hr
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: Natural Gas as fuel - 30 scf/hr
4. Name(s) and maximum amount of proposed material(s) produced per hour: Heater is used to increase temperature of fuel gas to generators. Heater will be used to raise the temperature of the fuel gas by approximately 30 F (average from 45F to 75F).
5. Give chemical reactions, if applicable, that will be involved in the generation of air pollutants: Combustion process

* 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 as fuel - 30 scf/hr

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

Same as fuel gas analysis - see attached sheet

(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:

24,000 Btu/hr heater. Natural gas

(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:

(g) Proposed maximum design heat input: $\times 10^6$ BTU/hr.

7. Projected operating schedule:

24 Hours/Day	7 Days/Week	Weeks/Year 52

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

@ 75 °F and 164 psia

a.	NO_X	0.0029	lb/hr	grains/ACF
b.	SO_2	0.000018	lb/hr	grains/ACF
c.	CO	0.0025	lb/hr	grains/ACF
d.	PM_{10}	0.00022	lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs	0.00016	lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
	Total HAP (including formaldehyde	0.00006	lb/hr	grains/ACF
	CO2e	2.82	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
see Attachment O	see Attachment O
REPORTING	TESTING
see Attachment O	see Attachment O

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

Infrared Radiant Heaters

The Safest, Most Efficient Alternative Wherever Flameless Heat is Required

Catalytic heating is the product of intensive research efforts to quantify the effectiveness of catalysts in promoting the reaction of combustive gases with oxygen or air to produce heat. There is no flame to create a hazard, and catalytic heat can operate efficiently on low-cost natural gas, butane or propane.

The use of catalytic heaters has been approved and accepted for dozens of industrial and petrochemical applications.

How the Catalytic Principle Works

The normal ignition temperature of natural gas (80%) in air (20%) at atmosphere pressure is given as 1260˚F. In the presence of the catalyst, the reaction occurs with sufficient velocity to begin a chain reaction at 225˚F. Thus, if natural gas is brought into contact with the catalyst at 225˚F in the presence of oxygen, it is oxidized to carbon dioxide and water vapor. Sufficient heat is, therefore, evolved to raise the temperature of the bed of the heater and oxidation will continue as long as gas and oxygen are supplied.

No flame is produced under these conditions, since the gases are well below ignition temperature (1260˚F). However, approximately the same amount of heat is produced as if the gas had been burned in the normal manner.

The thermal efficiency of a catalytic heater is substantially higher than a conventional heater. In the catalytic heating principle, a considerably larger proportion of the heat produced is radiant heat of wavelengths of 2–16 microns, and much less heat is required to heat the evolved gases.

Practically no heat is utilized to heat the large volume of nitrogen associated with the oxygen as in a conventional heater because most of the heat content of the carbon dioxide and water is recovered as radiant heat.

In a catalytic heater, the temperature attained in the catalyst bed is determined by two factors: the flow of the gas to the catalyst bed, and the rate at which oxygen diffuses through the bed to replace what was consumed in the reaction.

If the rate of gas flow is too high, not enough oxygen can enter to completely burn the gas. If the rate is too low, the gas is burned deeper in the bed and the surface cools. Therefore, the temperature of a catalytic heater is self-limiting and the system will operate stably for long periods of time without intervention as long as gas and air are supplied.

The Catalytic Principle

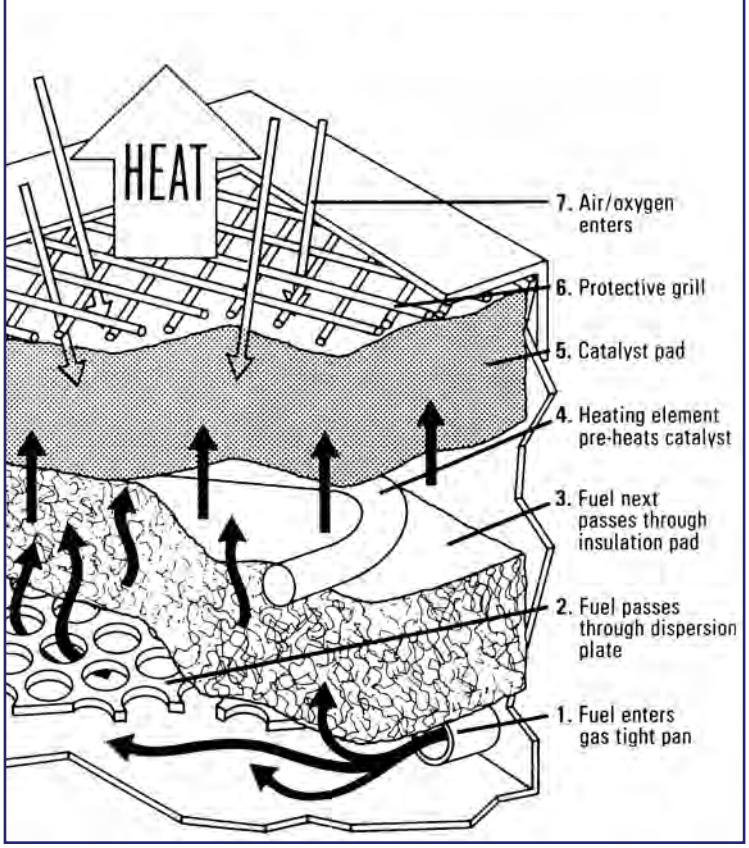
Catalytic heat is radiant heat. Radiant heat, like light, is electromagnetic wave energy that travels in straight lines at 186,000 miles per second, casts shadows, may be transmitted, absorbed or reflected by matter, and may be focused or dispersed by lenses or prisms of the proper material.

A source of radiant energy – such as a catalytic heater – floods the area around it with heat energy in the same way that light floods the area around it. The intensity of the heat energy varies with the square of the distance (as does light) and travels any distance without loss as long as it does not contact matter which absorbs it.

The absorption of radiant energy by various materials is a property specific to each material. Certain wavelengths will be absorbed to a considerable extent, others less, and some very little or not at all. Thus, each molecular substance has an infrared absorption spectrum which is a fingerprint of that substance. The absorption data for many substances can be found in an atlas of infrared absorption spectra.

Since the absorption of radiant heat is highly selective, there are many excellent application opportunities. By selecting proper substances to act as a filter between the source and object to be heated, all but the desired wavelengths can be filtered out.

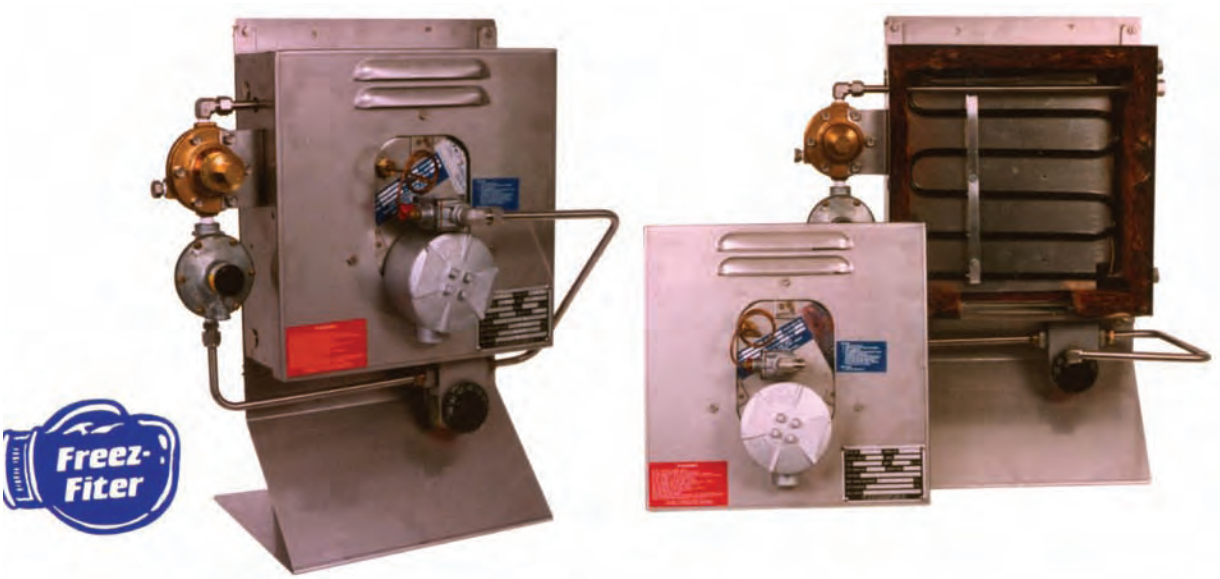
SIMPLIFIED CATALYTIC HEATER DIAGRAM



Sample Applications for Bruest Catalytic Heaters

- **Compressor Gas Preheat**
- **Regulators and Control Valves**
- **Gas Wellhead Heaters**
- **Peak Shaving Vaporizer Valves**
- **Enclosures of all Types**
- **Oil Production Well Injection, Offshore Platform Approved**
- **Personnel, Fixed or Portable**
- **Space Heaters, Compressor Stations**
- **Pipeline Heaters**

Bruest Catalytic Heaters are approved for use by
THE CANADIAN STANDARDS ASSOCIATION and FACTORY MUTUAL SYSTEM
for hazardous locations Class 1, Group D, Division 2.



FREEZ-FITER PILOT-REGULATOR HEATER PREVENTS FREEZE-UPS

- Heats gas supply to controllers, pilots and instrument regulators
- Heat source - Bruest flameless catalytic heater
- Fuel: natural gas, L.P. (propane) or butane gas
- Low fuel consumption
- FM models suitable for use in Class 1, Division 2, Group D locations
- CSA models suitable for use in Class 1, Division 1 and 2, Group D locations
- Single coil standard - dual coil model available (use with 2 regulators)
- Low pressure fuel gas regulator comes with unit (maximum 50 PSI inlet pressure)
- Preheat fuel gas tube

FREEZ-FILTER SPECIFICATIONS

MODEL NO.	EXCHANGER COIL	HEATER	CASE DIMENSION
1800	3/8" OD - Type 304 Stainless Steel • Operating Pressure • 2500 PSI-Max. Test Pressure - 5000 PSI • Exchanger Coil Pipe Fittings - 1/4" NPT	Bruest-SR-8 Catalytic Heater• Start-up Voltage - 12 Volt or 120 Volt • Stainless Steel Case • 2500 BTU Input • Fuel - Natural Gas at 3 1/2" W.C. • LP Gas at 11" W.C.	Size 12" x 12" x 4" with 1" Fiberglass Insulation • Stainless Steel Case
4000	Same as Above	Bruest-SR-12 Catalytic Heater • Start-up Voltage 12 Volt or 120 Volt • Stainless Steel Case • 5000 BTU Input • Fuel-Natural Gas at 3 1/2" W.C. • LP Gas at 11" W.C.	Size 16" x 16" x 4" with 1" Fiberglass insulation • Stainless Steel Case

ACCESSORY OPTIONS

- High pressure fuel gas regulator; 6000 PSI max; 10-75 PSI outlet; Fisher 1301F
- Thermostat: 100° - 200°F range (Invensys)
- Explosion-proof junction box is standard on CSA models and optional on FM models
- 16 ft. - 12V electrical pigtail with battery clips for a standard or explosion-proof junction box
- 25 ft. - 12V electrical pigtail with battery clips for a standard or explosion-proof junction box
- Nupro relief valve (set @ 45 PSI) 1/4˝ npt

Dehydrators

NATURAL GAS GLYCOL DEHYDRATION UNIT DATA SHEET

General Glycol Dehydration Unit Data		Manufacturer and Model		TBD	
		Max Dry Gas Flow Rate (MMscf/day)		60	
		Design Heat Input (MMBtu/hr)		1.5	
		Design Type (DEG or TEG)		TEG	
		Source Status[2]		NS	
		Date Installed/Modified/Removed[3]		March 2016	
		Regenerator Still Vent APCD[4]		FL	
		Fuel HV (Btu/scf)		1,174	
		H_2S Content (gr/100 scf)		0	
		Operation (hrs/yr)		8,760	
Source ID #[1]	Vent	Reference[5]	Potential Emissions[6]	lbs/hr	tons/yr
15E	Reboiler Vent	AP	NO_X	0.18	0.81
		AP	CO	0.15	0.68
		AP	VOC	0.01	0.04
		AP	SO_2	0.001	0.005
		AP	PM_{10}	0.01	0.06
13E	Glycol Regenerator Still Vent	GRI-GLYCalc™	VOC	0.32	1.42
		GRI-GLYCalc™	Benzene	0.0054	0.024
		GRI-GLYCalc™	Ethylbenzene	0.021	0.094
		GRI-GLYCalc™	Toluene	0.024	0.11
		GRI-GLYCalc™	Xylenes	0.092	0.40
		GRI-GLYCalc™	n-Hexane	0.0050	0.022
14E	Flash Gas Tank Vent	GRI-GLYCalc™	VOC	1.61	7.07
		GRI-GLYCalc™	Benzene	0.0010	0.0046
		GRI-GLYCalc™	Ethylbenzene	0.0012	0.0053
		GRI-GLYCalc™	Toluene	0.0027	0.012
		GRI-GLYCalc™	Xylenes	0.0033	0.014
		GRI-GLYCalc™	n-Hexane	0.025	0.11

General Glycol Dehydration Unit Data		Manufacturer and Model		TBD	
		Max Dry Gas Flow Rate (mmscf/day)		60	
		Design Heat Input (mmBtu/hr)		1.5	
		Design Type (DEG or TEG)		TEG	
		Source Status[2]		NS	
		Date Installed/Modified/Removed[3]		March 2016	
		Regenerator Still Vent APCD[4]		FL	
		Fuel HV (Btu/scf)		1,174	
		H_2S Content (gr/100 scf)		0	
		Operation (hrs/yr)		8,760	
Source ID #[1]	Vent	Reference[5]	Potential Emissions[6]	lbs/hr	tons/yr
18E	Reboiler Vent	AP	NO_X	0.18	0.81
		AP	CO	0.15	0.68
		AP	VOC	0.01	0.04
		AP	SO_2	0.001	0.005
		AP	PM_{10}	0.01	0.06
16E	Glycol Regenerator Still Vent	GRI-GLYCalc™	VOC	0.32	1.42
		GRI-GLYCalc™	Benzene	0.0054	0.024
		GRI-GLYCalc™	Ethylbenzene	0.021	0.094
		GRI-GLYCalc™	Toluene	0.024	0.11
		GRI-GLYCalc™	Xylenes	0.092	0.40
		GRI-GLYCalc™	n-Hexane	0.0050	0.022
17E	Flash Gas Tank Vent	GRI-GLYCalc™	VOC	1.61	7.07
		GRI-GLYCalc™	Benzene	0.0010	0.0046
		GRI-GLYCalc™	Ethylbenzene	0.0012	0.0053
		GRI-GLYCalc™	Toluene	0.0027	0.012
		GRI-GLYCalc™	Xylenes	0.0033	0.014
		GRI-GLYCalc™	n-Hexane	0.025	0.11

1. Enter the appropriate Source Identification Numbers for the glycol dehydration unit Reboiler Vent and glycol Regenerator Still Vent. The glycol dehydration unit Reboiler Vent and glycol Regenerator Still Vent should be designated RBV-1 and RSV-1, respectively. If the compressor station incorporates multiple glycol dehydration units, a *Glycol Dehydration Unit Data Sheet* shall be completed for each, using Source Identification #s RBV-2 and RSV-2, RBV-3 and RSV-3, etc.

2. Enter the Source Status using the following codes:

NS	Construction of New Source	ES	Existing Source
MS	Modification of Existing Source	RS	Removal of Source

3. Enter the date (or anticipated date) of the glycol dehydration unit's installation (construction of source), modification or removal.

4. Enter the Air Pollution Control Device (APCD) type designation using the following codes:

NA	None	CD	Condenser
FL	Flare	CC	Condenser/Combustion Combination
TO	Thermal Oxidizer		

5. Enter the Potential Emissions Data Reference designation using the following codes:

MD	Manufacturer's Data	AP	AP-42	
GR	GRI-GLYCalc™	OT	Other _____	(please list)

6. Enter the Reboiler Vent and glycol Regenerator Still Vent Potential to Emit (PTE) for the listed regulated pollutants in lbs per hour and tons per year. The glycol Regenerator Still Vent potential emissions may be determined using the most recent version of the thermodynamic software model GRI-GLYCalc™ (Radian International LLC & Gas Research Institute). Attach all referenced Potential Emissions Data (or calculations) and the GRI-GLYCalc *Aggregate Calculations Report* to this *Glycol Dehydration Unit Data Sheet(s)*. This PTE data shall be incorporated in the *Emissions Summary Sheet*.

Include a copy of the GRI-GLYCalc™ analysis. This includes a printout of the aggregate calculations report, which shall include emissions reports, equipment reports, and stream reports.

***An explanation of input parameters and examples, when using GRI-GLYCalc™ is available on our website.**

West Virginia Department of Environmental Protection

Division of Air Quality

40 CFR Part 63; Subpart HH & HHH Registration Form

DIVISION OF AIR QUALITY : (304) 926-0475
WEB PAGE: http:\\www.wvdep.org

Complete this form for any oil and natural gas production or natural gas transmission and storage facility that uses an affected unit under HH/HHH, whether subject or not.

Section A: Facility Description		
Affected facility actual annual average natural gas throughput (scf/day):	120,000,000	
Affected facility actual annual average hydrocarbon liquid throughput: (bbl/day):	195	
The affected facility processes, upgrades, or stores hydrocarbon liquids prior to custody transfer.	(Yes)	No
The affected facility processes, upgrades, or stores natural gas prior to the point at which natural gas (NG) enters the NG transmission and storage source category or is delivered to the end user.	(Yes)	No
The affected facility is: ☒ prior to a NG processing plant ☐ a NG processing plant ☐ prior to the point of custody transfer and there is no NG processing plant		
The affected facility transports or stores natural gas prior to entering the pipeline to a local distribution company or to a final end user (if there is no local distribution company).	(Yes)	No
The affected facility exclusively processes, stores, or transfers black oil.	Yes	(No)
Initial producing gas-to-oil ratio (GOR): _____scf/bbl API gravity: _____degrees		

Section B: Dehydration Unit (if applicable) [1]			
Description:	Underwood Compressor Station Dehydrators (SV-3110 & SV-3210; FT-3110 & FT-3210; R-3110 & R-3210)		
Date of Installation:	March 2016	Annual Operating Hours: 8,760	Burner rating (MMbtu/hr): 1.5
Exhaust Stack Height (ft):	TBD	Stack Diameter (ft): TBD	Stack Temp. (°F): TBD
Glycol Type:	☒ TEG ☐ EG ☐ Other:		
Glycol Pump Type:	☐ Electric ☒ Gas	If gas, what is the volume ratio? __0.032__ACFM/gpm	
Condenser installed?	☒ Yes ☐ No	Exit Temp. 200_ °F Condenser Pressure _0__psig	
Incinerator/flare installed?	☒ Yes ☐ No	Destruction Eff. __98___%	
Other controls installed?	☐ Yes ☒ No	Describe:	
Wet Gas[2]: (Upstream of Contact Tower)	Gas Temp.: _120_°F Gas Pressure _1,100 psig Saturated Gas? ☒ Yes ☐ No	If no, water content _____ lb/MMSCF	
Dry Gas: (Downstream of Contact Tower)	Gas Flowrate(MMSCFD) Actual _____ Design ___60 each ____ Water Content ___5.0____ lb/MMSCF		
Lean Glycol:	Circulation rate (gpm) Actual[3] __TBD_____ Maximum[4] ___7.9____ Pump make/model: Kimray 45015PV		
Glycol Flash Tank (if applicable):	Temp.: __80__°F Pressure __5___ psig Vented? Yes ☐ No ☒ If no, describe vapor control: Vent gas used in reboiler as fuel		
Stripping Gas (if applicable):	Source of gas: Dry gas, if used	Rate _9__ scfm	

Please attach the following required dehydration unit information:

1. System map indicating the chain of custody information. See Page 43 of this document for an example of a gas flow schematic. It is not intended that the applicant provide this level of detail for all sources. The level of detail that is necessary is to establish where the custody transfer points are located. This can be accomplished by submitting a process flow diagram indicating custody transfer points and the natural gas flow. However, the DAQ reserves the right to request more detailed information in order to make the necessary decisions.
2. Extended gas analysis from the Wet Gas Stream including mole percents of C_1-C_8, benzene, ethylbenzene, toluene, xylene and n-Hexane, using Gas Processors Association (GPA) 2286 (or similar). A sample should be taken from the inlet gas line, downstream from any inlet separator, and using a manifold to remove entrained liquids from the sample and a probe to collect the sample from the center of the gas line. GPA standard 2166 reference method or a modified version of EPA Method TO-14, (or similar) should be used.
3. GRI-GLYCalc Ver. 3.0 aggregate report based on maximum Lean Glycol circulation rate and maximum throughput.
4. Detailed calculations of gas or hydrocarbon flow rate.

Section C: Facility NESHAPS Subpart HH/HHH status

Affected facility status: (choose only one)

- ☒ Subject to Subpart HH - applies, but is exempt through < 1 tpy benzene exemption
- ☐ Subject to Subpart HHH
- ☒ Not Subject because:
  - ☒ < 10/25 TPY
  - ☐ Affected facility exclusively handles black oil
  - ☐ The facility wide actual annual average NG throughput is < 650 thousand scf/day and facility wide actual annual average hydrocarbon liquid is < 250 bpd
  - ☐ No affected source is present

Storage Tanks

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Production Storage Tanks	2. Tank Name Settling Tank
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) TK-9000	4. Emission Point Identification No. (as assigned on *Equipment List Form*) 19E
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable)	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 500 barrel	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 25
10A. Maximum Liquid Height (ft) 24	10B. Average Liquid Height (ft) 12.5
11A. Maximum Vapor Space Height (ft) 1	11B. Average Vapor Space Height (ft) 12.5
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 480 barrel	

13A. Maximum annual throughput (gal/yr) 2,989,350	13B. Maximum daily throughput (gal/day) 8,190

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume) 148

15. Maximum tank fill rate (gal/min) TBD

16. Tank fill method ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☒ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year

18. Type of tank (check all that apply):
- ☒ Fixed Roof X vertical ___ horizontal ___ flat roof ___ cone roof X dome roof
  ___ other (describe)
- ☐ External Floating Roof ___ pontoon roof ___ double deck roof
- ☐ Domed External (or Covered) Floating Roof
- ☐ Internal Floating Roof ___ vertical column support ___ self-supporting
- ☐ Variable Vapor Space ___ lifter roof ___ diaphragm
- ☐ Pressurized ___ spherical ___ cylindrical
- ☐ Underground
- ☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

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

20A. Shell Color Green	20B. Roof Color Green	20C. Year Last Painted

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

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): to ambient

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft) 12

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☐ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one)
☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal
☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

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

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL	
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT	
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER	
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT	
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)	
OPEN:	90% CLOSED:

STUB DRAIN
1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☐ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV
28. Daily Average Ambient Temperature (°F) 65.08
29. Annual Average Maximum Temperature (°F) 75.94
30. Annual Average Minimum Temperature (°F) 54.2
31. Average Wind Speed (miles/hr) 6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day)) 1,250.6
33. Atmospheric Pressure (psia) 14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: ProMax 3.2 Calculation	
34A. Minimum (°F)	34B. Maximum (°F)
35. Average operating pressure range of tank:	
35A. Minimum (psig)	35B. Maximum (psig)
36A. Minimum Liquid Surface Temperature (°F)	36B. Corresponding Vapor Pressure (psia)
37A. Average Liquid Surface Temperature (°F) 65.08	37B. Corresponding Vapor Pressure (psia) 11.76
38A. Maximum Liquid Surface Temperature (°F)	38B. Corresponding Vapor Pressure (psia)

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.

39A.	Material Name or Composition	Condensate/water mix		
39B.	CAS Number			
39C.	Liquid Density (lb/gal)	6		
39D.	Liquid Molecular Weight (lb/lb-mole)	42.9		
39E.	Vapor Molecular Weight (lb/lb-mole)	41.1		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)			
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☒ Other[1] (describe): Vapor Recovery Unit and vapors recycled back into system

[1] Complete appropriate Air Pollution Control Device Sheet.

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

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss Amount	Working Loss Units	Annual Loss (lb/yr)	Estimation Method[1]
VOC	0.017	0.024	lb/hr	22,580	O-ProMax 3.2
Emissions are controlled values				*Annual Loss includes flash emissions	

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Production Storage Tanks	2. Tank Name Produced Water Tank 1
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) TK-9100	4. Emission Point Identification No. (as assigned on *Equipment List Form*) 22E
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable)	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 400 barrel	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 20
10A. Maximum Liquid Height (ft) 19	10B. Average Liquid Height (ft) 10
11A. Maximum Vapor Space Height (ft) 1	11B. Average Vapor Space Height (ft) 10
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 380 barrel	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
344,925	945

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 21.6

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☒ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year

18. Type of tank (check all that apply):

☒ Fixed Roof X vertical ___ horizontal ___ flat roof ___ cone roof X dome roof
___ other (describe)

☐ External Floating Roof ___ pontoon roof ___ double deck roof

☐ Domed External (or Covered) Floating Roof

☐ Internal Floating Roof ___ vertical column support ___ self-supporting

☐ Variable Vapor Space ___ lifter roof ___ diaphragm

☐ Pressurized ___ spherical ___ cylindrical

☐ Underground

☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)

20A. Shell Color Green	20B. Roof Color Greeen	20C. Year Last Painted

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): to ambient

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft) 12

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☐ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

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

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL	
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT	
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER	
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT	
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)	
OPEN:	90% CLOSED:

STUB DRAIN
1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☐ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F)	65.08
29. Annual Average Maximum Temperature (°F)	75.94
30. Annual Average Minimum Temperature (°F)	54.2
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,250.6
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: ProMax 3.2 Calculation	
34A. Minimum (°F)	34B. Maximum (°F)
35. Average operating pressure range of tank:	
35A. Minimum (psig)	35B. Maximum (psig)
36A. Minimum Liquid Surface Temperature (°F)	36B. Corresponding Vapor Pressure (psia)
37A. Average Liquid Surface Temperature (°F) 65.08	37B. Corresponding Vapor Pressure (psia) .31
38A. Maximum Liquid Surface Temperature (°F)	38B. Corresponding Vapor Pressure (psia)

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.

39A.	Material Name or Composition	Produced Water		
39B.	CAS Number			
39C.	Liquid Density (lb/gal)	8.36		
39D.	Liquid Molecular Weight (lb/lb-mole)	18.02		
39E.	Vapor Molecular Weight (lb/lb-mole)	18.54		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)			
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☒ Other[1] (describe): Vapor Recovery Unit and vapors recycled back into system

[1] Complete appropriate Air Pollution Control Device Sheet.

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

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss		Annual Loss (lb/yr)	Estimation Method[1]
		Amount	Units		
VOC	8.6e-7	8.8e-7	lb/hr	0.015	O - ProMax 3.2
Emissions are controlled values					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Production Storage Tanks	2. Tank Name Produced Water Tank 2
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) TK-9110	4. Emission Point Identification No. (as assigned on *Equipment List Form*) 23E
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable)	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 400 barrel	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 20
10A. Maximum Liquid Height (ft) 19	10B. Average Liquid Height (ft) 10
11A. Maximum Vapor Space Height (ft) 1	11B. Average Vapor Space Height (ft) 10
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 380 barrel	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
344,925	945

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 21.6

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☒ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year

18. Type of tank (check all that apply):

☒ Fixed Roof X vertical ___ horizontal ___ flat roof ___ cone roof X dome roof
___ other (describe)

☐ External Floating Roof ___ pontoon roof ___ double deck roof

☐ Domed External (or Covered) Floating Roof

☐ Internal Floating Roof ___ vertical column support ___ self-supporting

☐ Variable Vapor Space ___ lifter roof ___ diaphragm

☐ Pressurized ___ spherical ___ cylindrical

☐ Underground

☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)

20A. Shell Color Green	20B. Roof Color Greeen	20C. Year Last Painted

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): to ambient

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft) 12

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☐ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

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

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL	
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT	
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER	
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT	
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)	
OPEN:	90% CLOSED:

STUB DRAIN
1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☐ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F)	65.08
29. Annual Average Maximum Temperature (°F)	75.94
30. Annual Average Minimum Temperature (°F)	54.2
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,250.6
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: ProMax 3.2 Calculation	
34A. Minimum (°F)	34B. Maximum (°F)
35. Average operating pressure range of tank:	
35A. Minimum (psig)	35B. Maximum (psig)
36A. Minimum Liquid Surface Temperature (°F)	36B. Corresponding Vapor Pressure (psia)
37A. Average Liquid Surface Temperature (°F) 65.08	37B. Corresponding Vapor Pressure (psia) .31
38A. Maximum Liquid Surface Temperature (°F)	38B. Corresponding Vapor Pressure (psia)

39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.

39A.	Material Name or Composition	Produced Water		
39B.	CAS Number			
39C.	Liquid Density (lb/gal)	8.36		
39D.	Liquid Molecular Weight (lb/lb-mole)	18.02		
39E.	Vapor Molecular Weight (lb/lb-mole)	18.54		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)			
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☒ Other[1] (describe): Vapor Recovery Unit and vapors recycled back into system

[1] Complete appropriate Air Pollution Control Device Sheet.

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

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss		Annual Loss (lb/yr)	Estimation Method[1]
		Amount	Units		
VOC	8.6e-7	8.8e-7	lb/hr	0.015	O - ProMax 3.2
Emissions are controlled values					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Production Storage Tanks	2. Tank Name Condensate Tank 1
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) TK-9200	4. Emission Point Identification No. (as assigned on *Equipment List Form*) 20E
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable)	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 400 barrel	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 20
10A. Maximum Liquid Height (ft) 19	10B. Average Liquid Height (ft) 10
11A. Maximum Vapor Space Height (ft) 1	11B. Average Vapor Space Height (ft) 10
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 380 barrel	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
1,149,750	3,150

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 72

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☒ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year

18. Type of tank (check all that apply):

☒ Fixed Roof X vertical ___ horizontal ___ flat roof ___ cone roof X dome roof
___ other (describe)

☐ External Floating Roof ___ pontoon roof ___ double deck roof

☐ Domed External (or Covered) Floating Roof

☐ Internal Floating Roof ___ vertical column support ___ self-supporting

☐ Variable Vapor Space ___ lifter roof ___ diaphragm

☐ Pressurized ___ spherical ___ cylindrical

☐ Underground

☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)

20A. Shell Color Green	20B. Roof Color Green	20C. Year Last Painted

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): to ambient

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft) 12

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☐ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

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

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL	
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT	
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER	
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT	
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)	
OPEN:	90% CLOSED:

STUB DRAIN
1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☐ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F)	65.08
29. Annual Average Maximum Temperature (°F)	75.94
30. Annual Average Minimum Temperature (°F)	54.2
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,250.6
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: ProMax 3.2 Calculation			
34A. Minimum (°F)		34B. Maximum (°F)	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F) 65.08		37B. Corresponding Vapor Pressure (psia) 11.76	
38A. Maximum Liquid Surface Temperature (°F)		38B. Corresponding Vapor Pressure (psia)	
39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Condensate		
39B. CAS Number			
39C. Liquid Density (lb/gal)	5.9		
39D. Liquid Molecular Weight (lb/lb-mole)	105.8		
39E. Vapor Molecular Weight (lb/lb-mole)	41.1		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)			
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting — Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☒ Other[1] (describe): Vapor Recovery Unit and vapors recycled back into system

[1] Complete appropriate Air Pollution Control Device Sheet.

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

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss		Annual Loss (lb/yr)	Estimation Method[1]
		Amount	Units		
VOC	0.016	0.015	lb/hr	280	ProMax 3.2
Emissions are controlled value					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Attachment L
EMISSIONS UNIT DATA SHEET
STORAGE TANKS

Provide the following information for each new or modified bulk liquid storage tank as shown on the *Equipment List Form* and other parts of this application. A tank is considered modified if the material to be stored in the tank is different from the existing stored liquid.

IF USING US EPA'S TANKS EMISSION ESTIMATION PROGRAM (AVAILABLE AT **www.epa.gov/tnn/tanks.html**), APPLICANT MAY ATTACH THE SUMMARY SHEETS IN LIEU OF COMPLETING SECTIONS III, IV, & V OF THIS FORM. HOWEVER, SECTIONS I, II, AND VI OF THIS FORM MUST BE COMPLETED. US EPA'S AP-42, SECTION 7.1, "ORGANIC LIQUID STORAGE TANKS," MAY ALSO BE USED TO ESTIMATE VOC AND HAP EMISSIONS (**http://www.epa.gov/tnn/chief/**).

I. GENERAL INFORMATION (required)

1. Bulk Storage Area Name Production Storage Tanks	2. Tank Name Condensate Tank 2
3. Tank Equipment Identification No. (as assigned on *Equipment List Form*) TK-9210	4. Emission Point Identification No. (as assigned on *Equipment List Form*) 21E
5. Date of Commencement of Construction (for existing tanks)	
6. Type of change ☒ New Construction ☐ New Stored Material ☐ Other Tank Modification	
7. Description of Tank Modification (if applicable)	
7A. Does the tank have more than one mode of operation? (e.g. Is there more than one product stored in the tank?) ☐ Yes ☒ No	
7B. If YES, explain and identify which mode is covered by this application (Note: A separate form must be completed for each mode).	
7C. Provide any limitations on source operation affecting emissions, any work practice standards (e.g. production variation, etc.): None	

II. TANK INFORMATION (required)

8. Design Capacity (specify barrels or gallons). Use the internal cross-sectional area multiplied by internal height. 400 barrel	
9A. Tank Internal Diameter (ft) 12	9B. Tank Internal Height (or Length) (ft) 20
10A. Maximum Liquid Height (ft) 19	10B. Average Liquid Height (ft) 10
11A. Maximum Vapor Space Height (ft) 1	11B. Average Vapor Space Height (ft) 10
12. Nominal Capacity (specify barrels or gallons). This is also known as "working volume" and considers design liquid levels and overflow valve heights. 380 barrel	

13A. Maximum annual throughput (gal/yr)	13B. Maximum daily throughput (gal/day)
1,149,750	3,150

14. Number of Turnovers per year (annual net throughput/maximum tank liquid volume): 72

15. Maximum tank fill rate (gal/min): TBD

16. Tank fill method: ☐ Submerged ☒ Splash ☐ Bottom Loading

17. Complete 17A and 17B for Variable Vapor Space Tank Systems ☒ Does Not Apply

17A. Volume Expansion Capacity of System (gal)	17B. Number of transfers into system per year

18. Type of tank (check all that apply):

☒ Fixed Roof X vertical ___ horizontal ___ flat roof ___ cone roof X dome roof
___ other (describe)

☐ External Floating Roof ___ pontoon roof ___ double deck roof

☐ Domed External (or Covered) Floating Roof

☐ Internal Floating Roof ___ vertical column support ___ self-supporting

☐ Variable Vapor Space ___ lifter roof ___ diaphragm

☐ Pressurized ___ spherical ___ cylindrical

☐ Underground

☐ Other (describe)

III. TANK CONSTRUCTION & OPERATION INFORMATION (optional if providing TANKS Summary Sheets)

19. Tank Shell Construction:

☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☐ Other (describe)

20A. Shell Color Green	20B. Roof Color Green	20C. Year Last Painted

21. Shell Condition (if metal and unlined):

☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable

22A. Is the tank heated? ☐ YES ☒ NO

22B. If YES, provide the operating temperature (°F)

22C. If YES, please describe how heat is provided to tank.

23. Operating Pressure Range (psig): to ambient

24. Complete the following section for **Vertical Fixed Roof Tanks** ☐ Does Not Apply

24A. For dome roof, provide roof radius (ft) 12

24B. For cone roof, provide slope (ft/ft)

25. Complete the following section for **Floating Roof Tanks** ☐ Does Not Apply

25A. Year Internal Floaters Installed:

25B. Primary Seal Type: (check one) ☐ Metallic (Mechanical) Shoe Seal ☐ Liquid Mounted Resilient Seal ☐ Vapor Mounted Resilient Seal ☐ Other (describe):

25C. Is the Floating Roof equipped with a Secondary Seal? ☐ YES ☐ NO

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

25E. Is the Floating Roof equipped with a weather shield? ☐ YES ☐ NO

25F. Describe deck fittings; indicate the number of each type of fitting:

ACCESS HATCH		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

AUTOMATIC GAUGE FLOAT WELL		
BOLT COVER, GASKETED:	UNBOLTED COVER, GASKETED:	UNBOLTED COVER, UNGASKETED:

COLUMN WELL		
BUILT-UP COLUMN – SLIDING COVER, GASKETED:	BUILT-UP COLUMN – SLIDING COVER, UNGASKETED:	PIPE COLUMN – FLEXIBLE FABRIC SLEEVE SEAL:

LADDER WELL	
PIP COLUMN – SLIDING COVER, GASKETED:	PIPE COLUMN – SLIDING COVER, UNGASKETED:

GAUGE-HATCH/SAMPLE PORT	
SLIDING COVER, GASKETED:	SLIDING COVER, UNGASKETED:

ROOF LEG OR HANGER WELL		
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:	SAMPLE WELL-SLIT FABRIC SEAL (10% OPEN AREA)

VACUUM BREAKER	
WEIGHTED MECHANICAL ACTUATION, GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

RIM VENT	
WEIGHTED MECHANICAL ACTUATION GASKETED:	WEIGHTED MECHANICAL ACTUATION, UNGASKETED:

DECK DRAIN (3-INCH DIAMETER)	
OPEN:	90% CLOSED:

STUB DRAIN
1-INCH DIAMETER:

OTHER (DESCRIBE, ATTACH ADDITIONAL PAGES IF NECESSARY)

26. Complete the following section for Internal Floating Roof Tanks ☐ Does Not Apply	
26A. Deck Type: ☐ Bolted ☐ Welded	
26B. For Bolted decks, provide deck construction:	
26C. Deck seam: ☐ Continuous sheet construction 5 feet wide ☐ Continuous sheet construction 6 feet wide ☐ Continuous sheet construction 7 feet wide ☐ Continuous sheet construction 5 × 7.5 feet wide ☐ Continuous sheet construction 5 × 12 feet wide ☐ Other (describe)	
26D. Deck seam length (ft)	26E. Area of deck (ft^2)
For column supported tanks: 26F. Number of columns:	26G. Diameter of each column:

IV. SITE INFORMANTION (optional if providing TANKS Summary Sheets)

27. Provide the city and state on which the data in this section are based. Charleston, WV	
28. Daily Average Ambient Temperature (°F)	65.08
29. Annual Average Maximum Temperature (°F)	75.94
30. Annual Average Minimum Temperature (°F)	54.2
31. Average Wind Speed (miles/hr)	6.05
32. Annual Average Solar Insulation Factor (BTU/(ft^2·day))	1,250.6
33. Atmospheric Pressure (psia)	14.25

V. LIQUID INFORMATION (optional if providing TANKS Summary Sheets)

34. Average daily temperature range of bulk liquid: ProMax 3.2 Calculation			
34A. Minimum (°F)		34B. Maximum (°F)	
35. Average operating pressure range of tank:			
35A. Minimum (psig)		35B. Maximum (psig)	
36A. Minimum Liquid Surface Temperature (°F)		36B. Corresponding Vapor Pressure (psia)	
37A. Average Liquid Surface Temperature (°F) 65.08		37B. Corresponding Vapor Pressure (psia) 11.76	
38A. Maximum Liquid Surface Temperature (°F)		38B. Corresponding Vapor Pressure (psia)	
39. Provide the following for <u>each</u> liquid or gas to be stored in tank. Add additional pages if necessary.			
39A. Material Name or Composition	Condensate		
39B. CAS Number			
39C. Liquid Density (lb/gal)	5.9		
39D. Liquid Molecular Weight (lb/lb-mole)	105.8		
39E. Vapor Molecular Weight (lb/lb-mole)	41.1		

Maximum Vapor Pressure 39F. True (psia) 39G. Reid (psia)			
Months Storage per Year 39H. From 39I. To			

VI. EMISSIONS AND CONTROL DEVICE DATA (required)

40. Emission Control Devices (check as many as apply): ☐ Does Not Apply

- ☐ Carbon Adsorption[1]
- ☐ Condenser[1]
- ☐ Conservation Vent (psig)
  - Vacuum Setting — Pressure Setting
- ☐ Emergency Relief Valve (psig)
- ☐ Inert Gas Blanket of
- ☐ Insulation of Tank with
- ☐ Liquid Absorption (scrubber)[1]
- ☐ Refrigeration of Tank
- ☐ Rupture Disc (psig)
- ☐ Vent to Incinerator[1]
- ☒ Other[1] (describe): Vapor Recovery Unit and vapors recycled back into system

[1] Complete appropriate Air Pollution Control Device Sheet.

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

Material Name & CAS No.	Breathing Loss (lb/hr)	Working Loss		Annual Loss (lb/yr)	Estimation Method[1]
		Amount	Units		
VOC	0.016	0.015	lb/hr	280	ProMax 3.2
Emissions are controlled value					

[1] EPA = EPA Emission Factor, MB = Material Balance, SS = Similar Source, ST = Similar Source Test, Throughput Data, O = Other (specify)

☒ Remember to attach emissions calculations, including TANKS Summary Sheets if applicable.

Bulk Loading and Fugitives

Attachment L
FUGITIVE EMISSIONS FROM UNPAVED HAULROADS

UNPAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

		PM	PM-10
k =	Particle size multiplier	0.80	0.36
s =	Silt content of road surface material (%)	4.8	4.8
p =	Number of days per year with precipitation >0.01 in.	160	160

Item Number	Description	Number of Wheels	Mean Vehicle Weight (tons)	Mean Vehicle Speed (mph)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1	Condensate Tank Truck	4	40	--	0.89	1	365	NA	NA
2	Produced Water Tank Truck	4	40	--	0.89	1	365	NA	NA
3	Passenger Vehicles	4	3	--	0.89	1	975	NA	NA
4									
5									
6									
7									
8									

Source: *AP-42 Fifth Edition – 13.2.2 Unpaved Roads*

$E = k \times 5.9 \times (s \div 12) \times (S \div 30) \times (W \div 3)^{0.7} \times (w \div 4)^{0.5} \times ((365 - p) \div 365) =$ lb/Vehicle Mile Traveled (VMT)

Where:

		PM	PM-10
k =	Particle size multiplier	0.80	0.36
s =	Silt content of road surface material (%)	4.8	4.8
S =	Mean vehicle speed (mph)	---	---
W =	Mean vehicle weight (tons)	17.8	17.8
w =	Mean number of wheels per vehicle	4	4
p =	Number of days per year with precipitation >0.01 in.	160	160

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF UNPAVED HAULROAD EMISSIONS

Item No.	PM				PM-10			
	Uncontrolled		Controlled		Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY
1	0.12	0.52	0.12	0.52	0.031	0.13	0.031	0.13
2	0.12	0.52	0.12	0.52	0.031	0.13	0.031	0.13
3	0.36	1.57	0.36	1.57	0.092	0.40	0.92	0.40
4								
5								
6								
7								
8								
TOTALS	0.60	2.62	0.60	2.62	0.15	0.67	0.15	0.67

FUGITIVE EMISSIONS FROM PAVED HAULROADS

INDUSTRIAL PAVED HAULROADS (including all equipment traffic involved in process, haul trucks, endloaders, etc.)

I =	Industrial augmentation factor (dimensionless)	
n =	Number of traffic lanes	
s =	Surface material silt content (%)	
L =	Surface dust loading (lb/mile)	

Item Number	Description	Mean Vehicle Weight (tons)	Miles per Trip	Maximum Trips per Hour	Maximum Trips per Year	Control Device ID Number	Control Efficiency (%)
1							
2							
3							
4							
5							
6							
7							
8							

Source: *AP-42 Fifth Edition – 11.2.6 Industrial Paved Roads*

$E = 0.077 \times I \times (4 \div n) \times (s \div 10) \times (L \div 1000) \times (W \div 3)^{0.7}$ = lb/Vehicle Mile Traveled (VMT)

Where:

I =	Industrial augmentation factor (dimensionless)	
n =	Number of traffic lanes	
s =	Surface meterial silt content (%)	
L =	Surface dust loading (lb/mile)	
W =	Average vehicle weight (tons)	

For lb/hr: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] = lb/hr

For TPY: [lb ÷ VMT] × [VMT ÷ trip] × [Trips ÷ Hour] × [Ton ÷ 2000 lb] = Tons/year

SUMMARY OF PAVED HAULROAD EMISSIONS

Item No.	Uncontrolled		Controlled	
	lb/hr	TPY	lb/hr	TPY
1				
2				
3				
4				
5				
6				
7				
8				
TOTALS				

Attachment L
EMISSIONS UNIT DATA SHEET
BULK LIQUID TRANSFER OPERATIONS

Furnish the following information for each new or modified bulk liquid transfer area or loading rack, as shown on the *Equipment List Form* and other parts of this application. This form is to be used for bulk liquid transfer operations such as to and from drums, marine vessels, rail tank cars, and tank trucks.

Identification Number (as assigned on *Equipment List Form*): LDOUT1	
1. Loading Area Name: Produced Fluids Loadout	
2. Type of cargo vessels accommodated at this rack or transfer point (check as many as apply): □ Drums □ Marine Vessels □ Rail Tank Cars X Tank Trucks	
3. Loading Rack or Transfer Point Data:	
Number of pumps	None – use truck pumps
Number of liquids loaded	Two – Condensate & Produced Water
Maximum number of marine vessels, tank trucks, tank cars, and/or drums loading at one time	Four as each tank has a connection, but not likely that there will be four at one time. TK-9000 does not have a loading connection.
4. Does ballasting of marine vessels occur at this loading area? □ Yes □ No X Does not apply	
5. Describe cleaning location, compounds and procedure for cargo vessels using this transfer point: N/A	
6. Are cargo vessels pressure tested for leaks at this or any other location? □ Yes X No If YES, describe:	

7. Projected Maximum Operating Schedule (for rack or transfer point as a whole):				
Maximum	Jan. - Mar.	Apr. - June	July - Sept.	Oct. - Dec.
hours/day	10	10	10	10
days/week	5	5	5	5
weeks/quarter	all	all	all	all

8. Bulk Liquid Data *(add pages as necessary):*							
Pump ID No.		N/A	N/A				
Liquid Name		Conden-sate	Produced Water				
Max. daily throughput (1000 gal/day)		6.30	1.89				
Max. annual throughput (1000 gal/yr)		2,299.5	689.85				
Loading Method [1]		SUB	SUB				
Max. Fill Rate (gal/min)		TBD	TBD				
Average Fill Time (min/loading)		TBD	TBD				
Max. Bulk Liquid Temperature (^{o}F)		76	76				
True Vapor Pressure [2]		11.76	0.31				
Cargo Vessel Condition [3]		U	U				
Control Equipment or Method [4]		None	None				
Minimum control efficiency (%)		0	0				
Maximum Emission Rate	Loading (lb/hr)	52.02	0.63				
	Annual (lb/yr)	15,820	60				
Estimation Method [5]		EPA	EPA				

[1] BF = Bottom Fill SP = Splash Fill SUB = Submerged Fill

[2] At maximum bulk liquid temperature

[3] B = Ballasted Vessel, C = Cleaned, U = Uncleaned (dedicated service), O = other (describe)

[4] List as many as apply (complete and submit appropriate *Air Pollution Control Device Sheets*):CA = Carbon Adsorption LOA = Lean Oil AdsorptionCO = Condensation SC = Scrubber (Absorption)CRA = Compressor-Refrigeration-Absorption TO = Thermal Oxidation or Incineration
CRC = Compression-Refrigeration-Condensation VB = Dedicated Vapor Balance (closed system)
O = other (descibe)

[5] EPA = EPA Emission Factor as stated in AP-42
MB = Material Balance
TM = Test Measurement based upon test data submittal
O = other (describe)

9. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**

Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
see Attachment O	**see Attachment O**
REPORTING	TESTING
see Attachment O	**see Attachment O**

MONITORING. PLEASE LIST AND DESCRIBE THE PROCESS PARAMETERS AND RANGES THAT ARE PROPOSED TO BE MONITORED IN ORDER TO DEMONSTRATE COMPLIANCE WITH THE OPERATION OF THIS

RECORDKEEPING. PLEASE DESCRIBE THE PROPOSED RECORDKEEPING THAT WILL ACCOMPANY THE MONITORING.
REPORTING. PLEASE DESCRIBE THE PROPOSED FREQUENCY OF REPORTING OF THE RECORDKEEPING.
TESTING. PLEASE DESCRIBE ANY PROPOSED EMISSIONS TESTING FOR THIS PROCESS EQUIPMENT/AIR POLLUTION CONTROL DEVICE.

10. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

Attachment L
EMISSIONS UNIT DATA SHEET
CHEMICAL PROCESS

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

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

1. Chemical process area name and equipment ID number (as shown in *Equipment List Form*)
   Piping for Entire Facility. Piping not contained in equipment form.

2. Standard Industrial Classification Codes (SICs) for process(es)
   4923

3. List raw materials and ☐ attach MSDSs
   Wet Natural Gas

4. List Products and Maximum Production and ☐ attach MSDSs

Description and CAS Number	Maximum Hourly (lb/hr)	Maximum Annual (ton/year)
Dry Natural Gas	5 MMscf/hour	43,800 MMscf/year
Condensate	6.25 barrels/hour	54,750 barrels/year
Produced Water	1.875 barrels/hour	16,425 barrels/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.

   Leak Detection Plan yet to be determined. Not subject to any federal regulations.

7. Clearly describe below or attach to application Accident Procedures to be followed in the event of an accidental spill or release.
   TBD – Will reference Spill Prevention, Control and Countermeasure (SPCC) plan once developed and approved.

8A. Complete the *Toxicology Data Sheet* or attach to application a toxicology report (an up-to-date material safety data sheets (MSDS) may be used) outlining the currently known acute and chronic health effects of each compound or chemical entity emitted to the air. If these compounds have already been listed in Item 3, then a duplicate MSDS sheet is not required. Include data such as the OSHA time weighted average (TWA) or mutagenicity, teratogenicity, irritation, and other known or suspected effects should be addressed. Indicate where these are unknown, and provide references.

8B. Describe any health effects testing or epidemiological studies on these compounds that are being or may be conducted by the company or required under TSCA, RCRA or other federal regulations. Discuss the persistence in the environment of any emission (e.g. pesticides, etc.).

9. **Waste Products** - Waste products status: (If source is subject to RCRA or 45CSR25, please contact the Hazardous Waste Section of WVDEP, OAQ at (304) 926-3647.)

9A. Types and amounts of wastes to be disposed:

9B. Method of disposal and location of waste disposal facilities:

Carrier: Phone:

9C. Check here if approved USEPA/State Hazardous Waste Landfill will be used ☐

10. Maximum and Projected Typical Operating Schedule for process or project as a whole (circle appropriate units).

circle units:	(hrs/day) (hr/batch)	(days), (batches/day), (batches/week)	(days/yr), (weeks/year)
10A. Maximum	24	7	52
10B. Typical	24	7	52

11. Complete a *Reactor Data Sheet* for each reactor in this chemical process.

12. Complete a *Distillation Column Data Sheet* for each distillation column in this chemical process.

13. **Proposed Monitoring, Recordkeeping, Reporting, and Testing**

Please propose monitoring, recordkeeping, and reporting in order to demonstrate compliance with the proposed operating parameters. Please propose testing in order to demonstrate compliance with the proposed emissions limits.

MONITORING	RECORDKEEPING
see Attachment O	**see Attachment O**
REPORTING	TESTING
see Attachment O	**see Attachment O**

MONITORING. Please list and describe the process parameters and ranges that are proposed to be monitored in order to demonstrate compliance with the operation of this process equipment operation or air pollution control device.

RECORDKEEPING. Please describe the proposed recordkeeping that will accompany the monitoring.

REPORTING. Please describe the proposed frequency of reporting of the recordkeeping.

TESTING. Please describe any proposed emissions testing for this process equipment or air pollution control device.

14. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty

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	250	TBD	1	4,580 – EE
	Light Liquid VOC	42	TBD	1	1,480 – EE
	Heavy Liquid VOC				
	Non-VOC				
Safety Relief Valves[11]	Gas VOC				
	Non VOC				
Open-ended Lines[12]	VOC				
	Non-VOC				
Sampling Connections[13]	VOC				
	Non-VOC				
Compressors	VOC	33	TBD	1	1,180 – EE
	Non-VOC				
Flanges	Gas VOC	836	TBD	1	1,320 – EE
	Light Liquid VOC	175	TBD	1	280 – EE
	Non-VOC				
Other	VOC				
	Non-VOC				

[1 - 13] See notes on the following page.

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*): Fugitive so no number assigned

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

Fugitive emissions from venting episodes such as plant shutdowns and compressor start ups/shut downs.

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:

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

- compressor blowdown - 0.059 tons VOC per event, 3.99 tons CO2e per event
- compressor startup - 0.006 tons VOC per event, 0.42 tons CO2e per event
- plant shutdown - 0.59 tons VOC per event, 39.88 tons CO2e per event
- pigging venting - 0.006 tons VOC per event, 0.40 tons CO2e per event

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

none

* 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:

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

(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:

(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:

(g) Proposed maximum design heat input: $\times 10^6$ BTU/hr.

7. Projected operating schedule:

Hours/Day	not a regular schedule	Days/Week	not a regular schedule	Weeks/Year	not a regular schedule

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

@ venting events are uncontrolled °F and psia

a.	NO_X		lb/hr	grains/ACF
b.	SO_2		lb/hr	grains/ACF
c.	CO		lb/hr	grains/ACF
d.	PM_{10}		lb/hr	grains/ACF
e.	Hydrocarbons		lb/hr	grains/ACF
f.	VOCs	variable based on event	lb/hr	grains/ACF
g.	Pb		lb/hr	grains/ACF
h.	Specify other(s)			
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF
			lb/hr	grains/ACF

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

(2) Complete the Emission Points Data Sheet.

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

MONITORING	RECORDKEEPING
see Attachment O	see Attachment O
REPORTING	TESTING
see Attachment O	see Attachment O

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 M.
Air Pollution Control Device Sheets

NSCR Catalysts

Attachment M
Air Pollution Control Device Sheet
(OTHER COLLECTORS)

Control Device ID No. (must match Emission Units Table): 1C – 11C

Equipment Information

1. Manufacturer: EMIT Technologies Model No. RT-2415-T	2. Control Device Name: 1C – 11C – Catalysts for C-2100 through C-2200 Type: NSCR Catalyst
3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.	
4. On a separate sheet(s) supply all data and calculations used in selecting or designing this collection device.	
5. Provide a scale diagram of the control device showing internal construction.	
6. Submit a schematic and diagram with dimensions and flow rates.	
7. Guaranteed minimum collection efficiency for each pollutant collected: N/A – no capture of pollutants	
8. Attached efficiency curve and/or other efficiency information.	
9. Design inlet volume: 8,813 ACFM	10. Capacity:
11. Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any. N/A	
12. Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.	
13. Description of method of handling the collected material(s) for reuse of disposal. Replace Catalyst elements when necessary	

Gas Stream Characteristics

14. Are halogenated organics present?	☐ Yes	☒ No
Are particulates present?	☒ Yes	☐ No
Are metals present?	☐ Yes	☒ No

15. Inlet Emission stream parameters:	**Maximum**	**Typical**
Pressure (mmHg):	Not specified	
Heat Content (BTU/scf):	1,400	1,175
Oxygen Content (%):	Not specified	
Moisture Content (%):	Not specified	
Relative Humidity (%):	Not specified	

16. Type of pollutant(s) controlled: ☐ SO_x ☐ Odor
☐ Particulate (type): ☒ Other NOx, CO, VOC, HCHO, CH4

17. Inlet gas velocity: 155 ft/sec

18. Pollutant specific gravity:

19. Gas flow into the collector:
8,813 ACF @ 1,223°F and PSIA

20. Gas stream temperature:
Inlet: 1,223 °F
Outlet: 1,223 °F

21. Gas flow rate:
Design Maximum: 8,813 ACFM
Average Expected: TBD ACFM

22. Particulate Grain Loading in grains/scf: N/A
Inlet:
Outlet:

23. Emission rate of each pollutant (specify) into and out of collector:

Pollutant	IN Pollutant		Emission Capture Efficiency %	OUT Pollutant		Control Efficiency %
	lb/hr	grains/acf		lb/hr	grains/acf	
A NOx	50.74		--	1.78		96.5
B CO	47.04		--	1.65		96.5
C VOC	1.74		--	0.87		50
D HCHO	0.19		--	0.04		76
E CH4	4.81		--	1.44		70

24. Dimensions of stack: Height TBD ft. Diameter 1.10 ft.

25. Supply a curve showing proposed collection efficiency versus gas volume from 25 to 130 percent of design rating of collector.

Particulate Distribution

26. Complete the table:	Particle Size Distribution at Inlet to Collector	Fraction Efficiency of Collector
Particulate Size Range (microns)	Weight % for Size Range	Weight % for Size Range
0 – 2		
2 – 4		
4 – 6		
6 – 8		
8 – 10		
10 – 12		
12 – 16		
16 – 20		
20 – 30		
30 – 40		
40 – 50		
50 – 60		
60 – 70		
70 – 80		
80 – 90		
90 – 100		
>100		

27. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification): None

28. Describe the collection material disposal system: Catalyst elements can be cleaned and/or replaced; materials are not disposed on site.

29. Have you included ***Other Collectores Control Device*** in the Emissions Points Data Summary Sheet? yes

30. **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: **see Attachment O**	RECORDKEEPING: **see Attachment O**
REPORTING: **see Attachment O**	TESTING: **see Attachment O**

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 or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

31. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
NOx: 96.5%, CO: 96.5%, VOC: 50%, HCHO: 76%, CH4: 70%.
Due to variable load conditions, the catalyst efficiency may vary. The catalyst efficiencies listed above are typical based on expected operating conditions. Manufacturer data is for 96% for both NOx and CO; however, 96.5% is being used for permitting based on similar facilities in operation.

32. Manufacturer's Guaranteed Control Efficiency for each air pollutant.

33. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.
Inlet temperature range is 750 F – 1250 F. Engine must be operated between 50 – 100 % load. A/F ratio controller must be set properly with fuel heating value of around 1400 Btu/scf. Engine lube oil shall contain less than 0.5 wt% sulfated ash. Catalyst must not be exposed to the following: antimony, arsenic, chromium, copper, iron, lead, lithium, magnesium, mercury, nickel, phosphorous, potassium, silicon, sodium, sulfur, tin, zinc.

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Prepared For:
Michele Steyskal
KLEINFELDER

QUOTE: QUO-17092-J5Q4

INFORMATION PROVIDED BY WAUKESHA

Engine:	L7044GSI
Horsepower:	1680
RPM:	1200
Compression Ratio:	8.0
Exhaust Flow Rate:	8813 CFM
Exhaust Temperature:	1223 °F
Reference:	N/A
Fuel:	Natural Gas
Annual Operating Hours:	8760

Uncontrolled Emissions

	g/bhp-hr	Lb/Hr	Tons/Year
NOx:	13.70	50.74	222.25
CO:	12.70	47.04	206.03
THC:	2.30	8.52	37.31
NMHC	0.98	3.63	15.90
NMNEHC:	0.47	1.74	7.62
HCHO:	0.05	0.19	0.81
O2:	0.30 %		

POST CATALYST EMISSIONS

	% Reduction	g/bhp-hr
NOx:	>96 %	<0.55
CO:	>96 %	<0.51
VOC:	>50 %	<0.23
HCHO:	>76 %	<0.01
CH4:	>70%	<0.40

CONTROL EQUIPMENT

Catalyst Element

Model:	RT-2415-T
Catalyst Type:	NSCR, Standard Precious Group Metals
Substrate Type:	BRAZED
Manufacturer:	EMIT Technologies, Inc
Element Quantity:	4
Element Size:	Rectangle 24" x 15" x 3.5"

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WARRANTY

EMIT Technologies, Inc. warrants that the goods supplied will be free from defects in workmanship by EMIT Technologies, Inc. for a period of two (2) years from date of shipment. EMIT Technologies, Inc. will not be responsible for any defects which result from improper use, neglect, failure to properly maintain or which are attributable to defects, errors or omissions in any drawings, specifications, plans or descriptions, whether written or oral, supplied to EMIT Technologies, Inc. by Buyer.

Catalyst performance using an EMIT Air/Fuel ratio controller is dependent upon properly defined set-points, variable with engine and fuel gas composition. Air/fuel ratio controller performance is guaranteed, but not limited, to fuel gas with a HHV content of 1400 BTU/SCF.

Catalyst performance will be guaranteed for a period of 1 year from installation, or 8760 operating hours, whichever comes first. The catalyst shall be operated with an automatic air/fuel ratio controller. The performance guarantee shall not cover the effects of excessive ash masking due to operation at low load, improper engine maintenance, or inappropriate lubrication oil. The performance guarantee shall not cover the effects of continuous engine misfires (cylinder or ignition) exposing the catalyst to excessive exothermic reaction temperatures. In most cases, excluding thermal deactivation, catalyst performance is redeemable by means of proper washing (refer to EMIT Catalyst/Silencer Housing Manual for element wash information, or contact a local EMIT Sales representative).

The exhaust temperature operating range at the converter inlet is a minimum of 600°F for oxidation catalyst and 750 ˚F for NSCR catalyst, and a maximum of 1250°F.

If a properly functioning, high temperature shut down switch is not installed, thermal deactivation of catalyst at sustained temperatures above 1250˚F is not covered. If excessive exposure to over oxygenation of NSCR catalyst occurs due to improperly functioning or non-existent Air/Fuel ratio control, then deactivation of catalyst is not warranted.

The catalyst conversion efficiencies (% reduction) will be guaranteed for engine loads of 50 to 100 percent. Standard Oxidation Catalyst conversion efficiencies (% reduction) will be guaranteed for fuel gas containing less than 1.5% mole fraction of non-methane, non-ethane hydrocarbons. Applications where fuel gas exceeds this level will require a Premium Oxidation Catalyst to maintain guaranteed VOC conversion efficiencies.

Engine lubrication oil shall contain less than 0.5 wt% Sulfated Ash with a maximum allowable specific oil consumption of 0.7 g/bhp-hr. The catalyst shall be limited to a maximum ash loading of 0.022 lb/ft3. Phosphorous and zinc additives are limited to 0.03 wt%. New or Reconstructed engines must operate for a minimum of 50 hours prior to catalyst installation, otherwise the warranty is void.

The catalyst must not be exposed to the following know poisoning agents, including: antimony, arsenic, chromium, copper, iron, lead, lithium, magnesium, mercury, nickel, phosphorous, potassium, silicon, sodium, sulfur, tin, and zinc. Total poison concentrations in the fuel gas must be limited to 0.25 ppm or less for catalyst to function properly.

Shipment - Promised shipping dates are approximate lead times from the point of manufacture and are not guaranteed. EMIT Technologies, Inc. will not be liable for any loss, damage or delay in manufacture or delivery resulting from any cause beyond its control including, but not limited to a period equal to the time lost by reason of that delay. All products will be crated as per best practice to prevent any damage during shipment. Unless otherwise specified, Buyer will pay for any special packing and shipping requirements. Acceptance of goods by common carrier constitutes delivery to Buyer. EMIT Technologies, Inc. shall not be responsible for goods damaged or lost in transit.

Terms: Credit is extended to purchaser for net 30 time period. If payment is not received in the net 30 timeframe, interest on the unpaid balance will accrue at a rate of 1.5% per month from the invoice date.

Order Cancellation Terms: Upon cancellation of an order once submittal of a Purchase Order has occurred, the customer will pay a 25% restocking fee for Catalyst Housings, Catalyst Elements, and Air/Fuel Ratio Controllers; 50% restocking fee for Cooler Top Solutions Exhaust System Accessories, and other Custom Built Products; 100% of all associated shipping costs incurred by EMIT; 100% of all project expenses incurred by EMIT for Field Services.

Flare

Attachment M
Air Pollution Control Device Sheet
(FLARE SYSTEM)

Control Device ID No. (must match Emission Units Table): 12C

Equipment Information

1. Manufacturer: Abutec

   Model No. 100

   9.2 MMBtu/hr

2. Method: ☒ Elevated flare ☐ Ground flare ☐ Other Describe

3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.

4. Method of system used:
   ☐ Steam-assisted ☐ Air-assisted ☐ Pressure-assisted ☒ Non-assisted

5. Maximum capacity of flare:
   9.2 MMBtu/hr

6. Dimensions of stack:
   Diameter 3 ft.
   Height 20 ft.

7. Estimated combustion efficiency:
   (Waste gas destruction efficiency)
   Estimated: 98 %
   Minimum guaranteed: 98 %

8. Fuel used in burners:
   ☒ Natural Gas
   ☐ Fuel Oil, Number
   ☐ Other, Specify:

9. Number of burners:
   Rating: 9,200,000 BTU/hr

10. Will preheat be used? ☐ Yes ☒ No

11. Describe method of controlling flame:
    Enclosed flare

12. Flare height: 20 ft

13. Flare tip inside diameter: 3 ft

14. Natural gas flow rate to flare pilot flame per pilot light: 0.27 scf/min
    16.4 scf/hr

15. Number of pilot lights: 1
    Total 16,728 BTU/hr

16. Will automatic re-ignition be used?
    ☐ Yes ☒ No

17. If automatic re-ignition will be used, describe the method:

18. Is pilot flame equipped with a monitor? ☒ Yes ☐ No
    If yes, what type? ☒ Thermocouple ☐ Infra-Red
    ☐ Ultra Violet ☐ Camera with monitoring control room
    ☐ Other, Describe:

19. Hours of unit operation per year: **8,760**

Steam Injection

20. Will steam injection be used? ☐ Yes ☒ No	21. Steam pressure PSIG Minimum Expected: Design Maximum:
22. Total Steam flow rate: LB/hr	23. Temperature: °F
24. Velocity ft/sec	25. Number of jet streams
26. Diameter of steam jets: in	27. Design basis for steam injected: LB steam/LB hydrocarbon
28. How will steam flow be controlled if steam injection is used?	

Characteristics of the Waste Gas Stream to be Burned

29.

Name	Quantity Grains of H_2S/100 ft^3	Quantity (LB/hr, ft^3/hr, etc)	Source of Material
SV-3110	0	2760 scfh	Dehy Still Vent
SV-3210	0	2760 scfh	Dehy Still Vent

30. Estimate total combustible to flare: 5520 LB/hr or ACF/hr
(Maximum mass flow rate of waste gas) 92 scfm

31. Estimated total flow rate to flare including materials to be burned, carrier gases, auxiliary fuel, etc.:
LB/hr or ACF/hr

32. Give composition of carrier gases:

33. Temperature of emission stream: °F Heating value of emission stream: ~300 BTU/ft^3 Mean molecular weight of emission stream: MW =	34. Identify and describe all auxiliary fuels to be burned. BTU/scf BTU/scf BTU/scf BTU/scf
35. Temperature of flare gas: > 1030 °F	36. Flare gas flow rate: scf/min
37. Flare gas heat content: BTU/ft^3	38. Flare gas exit velocity: scf/min

39. Maximum rate during emergency for one major piece of equipment or process unit: N/A scf/min

40. Maximum rate during emergency for one major piece of equipment or process unit: N/A BTU/min

41. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification):

42. Describe the collection material disposal system:

43. Have you included ***Flare Control Device*** in the Emissions Points Data Summary Sheet? **Yes**

44. **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:
see Attachment O	**see Attachment O**
REPORTING:	TESTING:
see Attachment O	**see Attachment O**

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 or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

45. Manufacturer's Guaranteed Capture Efficiency for each air pollutant.
N/A – no capture efficiency

46. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
98% control efficiency for VOCs, HAPs, C1, C2

47. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.
Inlet Pressure must range between 2 oz/in^2 and 120 psig

QUAD O COMPLIANCE INFORMATION & QUESTIONS

ABUTEC 100

Don't combust – ABUTEC 100 is Quad O Approved

The ABUTEC 100 (SCUF MTF 2.7), has been approved by the Environmental Protection Agency (EPA) as having achieved specific performance requirements related to emissions. Read the full report here.

The announcement relieves owners and operators from the burden of performing third-party testing on approved combustion devices. Because the ABUTEC 20 and ABUTEC 100 have been approved,these owners and operators will save time and expense.

For larger sites that need a customizable solution for emission control, the ABUTEC 100 is an ideal addition. Because it meets all government regulations for vapor combustion, the ABUTEC 100 lets your facility remain compliant and in control of your emissions.

The reliability of the ABUTEC 100 is second to none, especially for remote locations without available electricity. It is able to be paired with other systems, giving your facility exactly the combustion you require. Additionally, the ABUTEC 100 is easy to install, and works in even the toughest environmental conditions.

View Oil and Gas Brochure

Read about the ABUTEC 100 in action

Key Features of the ABUTEC 100:

- Quad O Compliant Ready
- Local Service Team availability
- Low Capital and Operating Costs
- Meets 40 CFR 60.18 regulations
- Flexible & Scalable System
- Continuous pilot
- 99%+ Destruction Efficiency (Independent 3rd party tested)
- Very High Turndown Ratio
- Scalable flow rates – from 20-100 MSCFD
- Inlet pressure as low as 2oz/in² and up to 120psig
- Capable of 9,212,400 BTU/hour
- TERO License from Three Affiliated Tribes
- Solar Panel functionality
- SCADA integration with control panel for remote monitoring
- Stainless steel construction

Customizing the ABUTEC 100

The ABUTEC 100 can be paired with the ABUTEC High Pressure (HP) units to give your site the high/low pressure solution it needs.

The HP 1500 and HP 3000 can be installed as a stand-alone unit, or paired with the ABUTEC 100 on the same skid or included on the same site on a different skid.

Learn more about HP + ABUTEC Integrated Systems

Vapor Recovery Unit

Attachment M
Air Pollution Control Device Sheet
(OTHER COLLECTORS)

Control Device ID No. (must match Emission Units Table): 13C (VRU-6000)

Equipment Information

1. Manufacturer: TBD	2. Control Device Name: 13C (VRU-6000) Type: Vapor Recovery Unit for Storage Tanks
3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.	
4. On a separate sheet(s) supply all data and calculations used in selecting or designing this collection device.	
5. Provide a scale diagram of the control device showing internal construction.	
6. Submit a schematic and diagram with dimensions and flow rates.	
7. Guaranteed minimum collection efficiency for each pollutant collected: **closed loop system, however claiming 98% efficiency.** **VRU-6000 is the primary VRU to collect storage tank vapors and VRU-6100 is the backup VRU in times when the primary VRU is undergoing maintenance or shutdown. In the unlikely event that both VRU-6000 and VRU-6100 are under maintenance or are shutdown, a bypass system is in place to route tank vapors to the facility inlet.**	
8. Attached efficiency curve and/or other efficiency information.	
9. Design inlet volume: 40 Mscfd	10. Capacity: 40 Mscfd
11. Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any. N/A	
12. Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.	
13. Description of method of handling the collected material(s) for reuse of disposal. **Collected materials get recycled back into gas system – closed loop**	

Gas Stream Characteristics

14. Are halogenated organics present?	☐ Yes	☒ No
Are particulates present?	☐ Yes	☒ No
Are metals present?	☐ Yes	☒ No

15. Inlet Emission stream parameters:	**Maximum**	**Typical**
Pressure (mmHg):	0.01 psig	
Heat Content (BTU/scf):	Not specified	
Oxygen Content (%):	Not specified	
Moisture Content (%):	Not specified	
Relative Humidity (%):	Not specified	

16. Type of pollutant(s) controlled: ☐ SO_x ☐ Odor
☐ Particulate (type): ☒ Other VOC, HAPs, C1, C2

17. Inlet gas velocity: N/A ft/sec

18. Pollutant specific gravity:

19. Gas flow into the collector:
TBD ACF @ ambient and TBD PSIA

20. Gas stream temperature:
Inlet: ambient °F
Outlet: ambient °F

21. Gas flow rate:
Design Maximum: ACFM
Average Expected: 20.32 ACFM

22. Particulate Grain Loading in grains/scf: N/A
Inlet:
Outlet:

23. Emission rate of each pollutant (specify) into and out of collector:

Pollutant	IN Pollutant		Emission Capture Efficiency %	OUT Pollutant		Control Efficiency %
	lb/hr	grains/acf		lb/hr	grains/acf	
A VOC	132.01		98	2.64		N/A
B HAPs	3.95		98	0.079		N/A
C CO2e	327		98	6.6		N/A
D						
E						

24. Dimensions of stack: Height TBD ft. Diameter TBD ft.

25. Supply a curve showing proposed collection efficiency versus gas volume from 25 to 130 percent of design rating of collector.

Particulate Distribution

26. Complete the table:	Particle Size Distribution at Inlet to Collector	Fraction Efficiency of Collector
Particulate Size Range (microns)	Weight % for Size Range	Weight % for Size Range
0 – 2		
2 – 4		
4 – 6		
6 – 8		
8 – 10		
10 – 12		
12 – 16		
16 – 20		
20 – 30		
30 – 40		
40 – 50		
50 – 60		
60 – 70		
70 – 80		
80 – 90		
90 – 100		
>100		

27. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification): **None**

28. Describe the collection material disposal system: **Closed loop system – vapors get recycled back into system**

29. Have you included ***Other Collectores Control Device*** in the Emissions Points Data Summary Sheet? **Yes**

30. **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: **see Attachment O**	RECORDKEEPING: **see Attachment O**
REPORTING: **see Attachment O**	TESTING: **see Attachment O**

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 or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

31. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
100% - Closed loop system. However, claiming 98% to account for down time with a back up VRU.

32. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
100% - Closed loop system. However, claiming 98% to account for down time with a back up VRU.

33. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.
None – system has automatic monitoring, shutdown and alerts systems for malfunctions.

Attachment M
Air Pollution Control Device Sheet
(OTHER COLLECTORS)

Control Device ID No. (must match Emission Units Table): 14C (VRU-6100)

Equipment Information

1. Manufacturer: TBD	2. Control Device Name: 14C (VRU-6100) Type: Vapor Recovery Unit for Storage Tanks
3. Provide diagram(s) of unit describing capture system with duct arrangement and size of duct, air volume, capacity, horsepower of movers. If applicable, state hood face velocity and hood collection efficiency.	
4. On a separate sheet(s) supply all data and calculations used in selecting or designing this collection device.	
5. Provide a scale diagram of the control device showing internal construction.	
6. Submit a schematic and diagram with dimensions and flow rates.	
7. Guaranteed minimum collection efficiency for each pollutant collected: **closed loop system, however claiming 98% efficiency.** **VRU-6100 is the backup VRU to collect storage tank vapors and VRU-6000 is the primary VRU. In the unlikely event that both VRU-6000 and VRU-6100 are under maintenance or are shutdown, a bypass system is in place to route tank vapors to the facility inlet.**	
8. Attached efficiency curve and/or other efficiency information.	
9. Design inlet volume: 40 Mscfd	10. Capacity: 40 Mscfd
11. Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any. N/A	
12. Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.	
13. Description of method of handling the collected material(s) for reuse of disposal. **Collected materials get recycled back into gas system – closed loop**	

Gas Stream Characteristics

14. Are halogenated organics present?	☐ Yes	☒ No
Are particulates present?	☐ Yes	☒ No
Are metals present?	☐ Yes	☒ No

15. Inlet Emission stream parameters:	**Maximum**	**Typical**
Pressure (mmHg):	0.01 psig	
Heat Content (BTU/scf):	Not specified	
Oxygen Content (%):	Not specified	
Moisture Content (%):	Not specified	
Relative Humidity (%):	Not specified	

16. Type of pollutant(s) controlled: ☐ SO_x ☐ Odor
☐ Particulate (type): ☒ Other VOC, HAPs, C1, C2

17. Inlet gas velocity: N/A ft/sec

18. Pollutant specific gravity:

19. Gas flow into the collector:
TBD ACF @ ambient and TBD PSIA

20. Gas stream temperature:
Inlet: ambient °F
Outlet: ambient °F

21. Gas flow rate:
Design Maximum: ACFM
Average Expected: 20.32 ACFM

22. Particulate Grain Loading in grains/scf: N/A
Inlet:
Outlet:

23. Emission rate of each pollutant (specify) into and out of collector:

Pollutant	IN Pollutant		Emission Capture Efficiency %	OUT Pollutant		Control Efficiency %
	lb/hr	grains/acf		lb/hr	grains/acf	
A VOC	132.01		98	2.64		N/A
B HAPs	3.95		98	0.079		N/A
C CO2e	327		98	6.6		N/A
D						
E						

24. Dimensions of stack: Height TBD ft. Diameter TBD ft.

25. Supply a curve showing proposed collection efficiency versus gas volume from 25 to 130 percent of design rating of collector.

Particulate Distribution

26. Complete the table:	Particle Size Distribution at Inlet to Collector	Fraction Efficiency of Collector
Particulate Size Range (microns)	Weight % for Size Range	Weight % for Size Range
0 – 2		
2 – 4		
4 – 6		
6 – 8		
8 – 10		
10 – 12		
12 – 16		
16 – 20		
20 – 30		
30 – 40		
40 – 50		
50 – 60		
60 – 70		
70 – 80		
80 – 90		
90 – 100		
>100		

27. Describe any air pollution control device inlet and outlet gas conditioning processes (e.g., gas cooling, gas reheating, gas humidification): **None**

28. Describe the collection material disposal system: **Closed loop system – vapors get recycled back into system**

29. Have you included ***Other Collectores Control Device*** in the Emissions Points Data Summary Sheet? **Yes**

30. **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: **see Attachment O**	RECORDKEEPING: **see Attachment O**
REPORTING: **see Attachment O**	TESTING: **see Attachment O**

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 or air control device.
RECORDKEEPING:	Please describe the proposed recordkeeping that will accompany the monitoring.
REPORTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.
TESTING:	Please describe any proposed emissions testing for this process equipment on air pollution control device.

31. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
100% - Closed loop system. However, claiming 98% to account for down time with a back up VRU.

32. Manufacturer's Guaranteed Control Efficiency for each air pollutant.
100% - Closed loop system. However, claiming 98% to account for down time with a back up VRU.

33. Describe all operating ranges and maintenance procedures required by Manufacturer to maintain warranty.
None – system has automatic monitoring, shutdown and alerts systems for malfunctions.

KAHUNA

VRU-100/200

Tank Vapor VRU's

Rev	Date	Desc.	By
A	22-Jun	IFB	JMW

Project			West Mntn
Project Number			0050.0053.00
Location			Doddridge County, WV
REV	A	Date	9.8.2014
By	JMW	CK	
Sheet	1	of	1

Site Information	
Elevation	1194
Temperature	-20°F to 100°F
Service	Tank Vapors
Area Classification	Class 1 Div 2
Code	ASME B31.8/API 619/ASME BPVC Section VIII
NACE	NA

Flow Conditions		Suction		Interstage		Discharge	
		in	out	in	out	in	out
Flow	Mscfd	40					40
Pressure	psig	0.01					200
Temperature	°F	100					**
Density	lb/ft^3	0.093					1
Specifc Gravity		1.28					1.28
Horsepower	BHP	**					**

Composition	Mol %	Process	Int. Stg.	Fuel
	C1	29.33	NA	NA
	C2	26.55	NA	NA
	C3	16.44	NA	NA
	iC4	2.72	NA	NA
	nC4	5.83	NA	NA
	iC5	2.13	NA	NA
	nC5	2.05	NA	NA
	C6+	8.06	NA	NA
	H2O	6.00	NA	NA
	CO2	0.89	NA	NA
	H2S	0	NA	NA
	Dew/Bubble Point		98°F	

Frame	
MFG	**
Model Number	**
Speed	**
MAWP	**
Horsepower	**
Volume Ratio	**
Cooling	**
Capacity Control	**

Driver	
Type	Electric
MFG	**
Size	**
Speed	**
Design Factor	**
Accessories	**

Cooler			
Service	MAWP	@Temp	Duty
Process	NA	NA	NA
Lube Oil	**	**	**
Cooling Water	NA	NA	NA

Suction Scrubber	
Size	**
MAWP	**
Design Temp	**
MDMT	**

Oil Seperator	
Size	**
MAWP	**
Design Temp	**
MDMT	**
Filters Type	**
Filter QTY	**

Panel	
MFG	**
Model Number	**

Notes

** - Denote information to be supplied by vendor.

1. Units are to be skid mounted but not enclosed.

2. Discharge gas does not need to be cooled for delivery into downstream piping but if necessary for package design temperature to be controlled between 100 °F and 140 °F.

3. All necessary instrumentation for operation is to be included in quote along with an inlet Oxygen sensor.

Attachment N.
Supporting Emissions Calculations

Emission Calculations

Emissions Summary Total

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**

UNCONTROLLED POTENTIAL EMISSION SUMMARY

Source	NOx		CO		VOC		SO_2		PM-10		HAPs		Formaldehyde		CO_2e
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	tpy
Engines															
Compressor Engine 1	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 2	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 3	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 4	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 5	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 6	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 7	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 8	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 9	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 10	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Compressor Engine 11	50.74	199.39	47.04	184.84	1.74	6.84	0.008	0.03	0.27	1.06	0.35	1.38	0.19	0.73	8,176
Turbines															
Microturbine Generator 1	0.24	1.05	0.66	2.89	0.06	0.26	0.02	0.09	0.04	0.18	0.006	0.03	0.004	0.02	3,499
Catalytic Heater for Generator Fuel	0.003	0.01	0.002	0.01	0.0002	0.0007	0.00002	0.00008	0.0002	0.001	0.00006	0.0002	0.000002	0.00001	12
Dehydrators															
TEG Dehydrator Still Vent 1	---	---	---	---	16.24	71.12	---	---	---	---	7.38	32.30	---	---	1,910
TEG Dehydrator Still Vent 2	---	---	---	---	16.24	71.12	---	---	---	---	7.38	32.30	---	---	1,910
TEG Dehydrator Flash Tank 1	---	---	---	---	32.26	141.31	---	---	---	---	0.67	2.93	---	---	5,929
TEG Dehydrator Flash Tank 2	---	---	---	---	32.26	141.31	---	---	---	---	0.67	2.93	---	---	5,929
Reboiler 1	0.18	0.81	0.15	0.68	0.01	0.04	0.001	0.005	0.01	0.06	0.003	0.02	0.0001	0.0006	771
Reboiler 2	0.18	0.81	0.15	0.68	0.01	0.04	0.001	0.005	0.01	0.06	0.003	0.02	0.0001	0.0006	771
Combustors															
Flare and Pilot	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hydrocarbon Loading															
Truck Loadout	---	---	---	---	52.65	7.94	---	---	---	---	0.13	0.02	---	---	3
Fugitive Emissions															
Component Leak Emissions	---	---	---	---	1.01	4.42	---	---	---	---	0.02	0.09	---	---	99
Venting Emissions	---	---	---	---	---	9.90	---	---	---	---	---	0.16	---	---	672
Haul Road Dust Emissions	---	---	---	---	---	---	---	---	0.15	0.67	---	---	---	---	---
Storage Tanks															
Produced Water Tanks	---	---	---	---	0.0002	0.0008	---	---	---	---	6.77E-08	2.97E-07	---	---	0.02
Settler Tank	---	---	---	---	128.90	564.59	---	---	---	---	3.94	17.25	---	---	1,427
Condensate Tanks	---	---	---	---	3.11	13.64	---	---	---	---	0.008	0.03	---	---	4
Total Facility PTE =	**558.76**	**2,196.00**	**518.38**	**2,037.49**	**301.90**	**1,100.93**	**0.11**	**0.45**	**3.19**	**12.62**	**24.05**	**103.25**	**2.04**	**8.03**	**112,870**

Emissions Summary Total

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**

CONTROLLED POTENTIAL EMISSION SUMMARY

Source	NOx		CO		VOC		SO_2		PM-10		HAPs		Formaldehyde		CO_2e
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	tpy
Engines															
Compressor Engine 1	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 2	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 3	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 4	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 5	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 6	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 7	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 8	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 9	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 10	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Compressor Engine 11	1.78	6.98	1.65	6.47	0.87	3.42	0.008	0.03	0.27	1.06	0.21	0.83	0.04	0.17	7,845
Turbines															
Microturbine Generator 1	0.24	1.05	0.66	2.89	0.06	0.26	0.02	0.09	0.04	0.18	0.006	0.03	0.004	0.02	3,499
Catalytic Heater for Generator Fuel	0.003	0.01	0.002	0.01	0.0002	0.0007	0.00002	0.00008	0.0002	0.001	0.00006	0.0002	0.000002	0.00001	12
Dehydrators															
TEG Dehydrator Still Vent 1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
TEG Dehydrator Still Vent 2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
TEG Dehydrator Flash Tank 1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
TEG Dehydrator Flash Tank 2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Reboiler 1	0.18	0.81	0.15	0.68	1.62	7.11	0.001	0.005	0.01	0.06	0.037	0.16	0.0001	0.0006	1,072
Reboiler 2	0.18	0.81	0.15	0.68	1.62	7.11	0.001	0.005	0.01	0.06	0.037	0.16	0.0001	0.0006	1,072
Combustion															
Flare and Pilot	0.63	2.75	2.86	12.51	0.65	2.84	0.00001	0.00004	0.0001	0.0005	0.29	1.29	---	---	4,822
Hydrocarbon Loading															
Truck Loadout	---	---	---	---	52.65	7.94	---	---	---	---	0.13	0.020	---	---	3
Fugitive Emissions															
Component Leak Emissions	---	---	---	---	1.01	4.42	---	---	---	---	0.02	0.09	---	---	99
Venting Emissions	---	---	---	---	---	9.90	---	---	---	---	---	0.16	---	---	672
Haul Road Dust Emissions	---	---	---	---	---	---	---	---	0.15	0.67	---	---	---	---	---
Storage Tanks															
Produced Water Tanks	---	---	---	---	0.000003	0.00002	---	---	---	---	1.35E-09	5.93E-09	---	---	0.0007
Settler Tank	---	---	---	---	2.58	11.29	---	---	---	---	0.079	0.35	---	---	29
Condensate Tanks	---	---	---	---	0.06	0.27	---	---	---	---	0.0002	0.0007	---	---	0.09
Total Facility PTE =	**20.77**	**82.19**	**21.94**	**87.93**	**69.83**	**88.78**	**0.11**	**0.45**	**3.19**	**12.62**	**2.91**	**11.39**	**0.49**	**1.94**	**97,571**

1. Controlled dehydrator still vent emissions are in the flare and pilot category.
2. Controlled dehydrator flash tank emissions are in the reboiler category.

HAP Emissions Summary Total

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**

CONTROLLED POTENTIAL EMISSION SUMMARY

Source	Benzene		Toluene		Ethylbenzene		Xylenes		n-Hexane	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Engines										
Compressor Engine 1	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 2	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 3	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 4	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 5	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 6	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 7	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 8	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 9	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 10	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Compressor Engine 11	0.022	0.086	0.0077	0.030	0.00034	0.0014	0.0027	0.011	---	---
Turbines										
Microturbine Generator 1	7.42E-05	3.25E-04	8.03E-04	3.52E-03	1.98E-04	8.66E-04	3.96E-04	1.73E-03	---	---
Catalytic Heater for Generator Fuel	---	---	---	---	---	---	---	---	---	---
Dehydrators										
TEG Dehydrator Still Vent 1	---	---	---	---	---	---	---	---	---	---
TEG Dehydrator Still Vent 2	---	---	---	---	---	---	---	---	---	---
TEG Dehydrator Flash Tank 1	---	---	---	---	---	---	---	---	---	---
TEG Dehydrator Flash Tank 2	---	---	---	---	---	---	---	---	---	---
Reboiler 1	0.0010	0.0046	0.0027	0.012	0.0012	0.0053	0.0033	0.014	0.025	0.11
Reboiler 2	0.0010	0.0046	0.0027	0.012	0.0012	0.0053	0.0033	0.014	0.025	0.11
Combustion										
Flare and Pilot	0.011	0.048	0.048	0.21	0.043	0.19	0.18	0.80	0.010	0.044
Hydrocarbon Loading										
Truck Loadout	0.0015	0.00023	0.0067	0.0010	0.0046	0.00070	0.012	0.0018	0.10	0.016
Fugitive Emissions										
Component Leak Emissions	0.00027	0.0012	0.00080	0.0035	0.00053	0.0023	0.0016	0.0069	0.016	0.071
Venting Emissions	---	0.0021	---	0.0074	---	0.0057	---	0.017	---	0.13
Haul Road Dust Emissions	---	---	---	---	---	---	---	---	---	---
Storage Tanks										
Produced Water Tanks	5.02E-10	2.20E-09	4.89E-10	2.14E-09	1.04E-10	4.55E-10	2.22E-10	9.73E-10	3.82E-11	1.67E-10
Settler Tank	1.22E-03	5.35E-03	2.49E-03	1.09E-02	8.91E-04	3.90E-03	2.15E-03	9.40E-03	7.20E-02	3.15E-01
Condensate Tanks	1.74E-06	7.64E-06	7.92E-06	3.47E-05	5.50E-06	2.41E-05	1.43E-05	6.27E-05	1.25E-04	5.48E-04
Total Facility PTE =	**0.26**	**1.01**	**0.15**	**0.60**	**0.06**	**0.23**	**0.24**	**0.98**	**0.25**	**0.80**

1. Controlled dehydrator still vent emissions are in the flare and pilot category.
2. Controlled dehydrator flash tank emissions are in the reboiler category.

Compressor Engine Emission Calculations

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Compressor Engines**

Source Information-Per Engine

Emission Unit ID:	C-2100 to C-2200	
Engine Make/Model	Waukesha L7044 GSI	
Service	Compression	
Controls - Y or N / Type	Y	NSCR/AFRC
Site Horsepower Rating[1]	1,680	hp
Fuel Consumption (BSFC)[1]	8,267	Btu/(hp-hr)
Heat Rating[2]	13.89	MMBtu/hr
Fuel Consumption[2,3]	93.19	MMscf/yr
Fuel Consumption[1]	11,820	scf/hr
Fuel Heating Value	1,171	Btu/scf
Operating Hours	8,760	hrs/yr

Notes:

1. Values from Waukesha specification sheet. Due to typical methane content in the fuel, the site horsepower is shown as 1674 hp; however, emissions are calculated at the max rating of 1680 hp.
2. Calculated values
3. Annual fuel consumption is 90% of maximum fuel consumption at 100% load.

Potential Emissions per Engine

	Uncontrolled					***Controlled***					
Pollutant	**Emission Factor**		**Estimated Emissions[2]**			**Emission Factor**		**Estimated Emissions[2]**			**Source of Emissions Factors**
	(lb/MMBtu)	**(g/bhp-hr)**	**(lb/hr)**	**(lb/yr)[4]**	**(tpy)[4]**	**(lb/MMBtu)**	**(g/bhp-hr)**	**(lb/hr)**	**(lb/yr)[4]**	**(tpy)[4]**	
NO_x[1,5]	---	13.7	50.74	---	199.39	---	0.48	1.78	---	6.98	Manufacturer's Specs - uncontrolled, Catalyst Specs - controlled
CO[1,5]	---	12.7	47.04	---	184.84	---	0.44	1.65	---	6.47	Manufacturer's Specs - uncontrolled, Catalyst Specs - controlled
VOC[1]	---	0.47	1.74	---	6.84	---	0.24	0.87	---	3.42	Manufacturer's Specs - uncontrolled, Catalyst Specs - controlled
SO_2	5.88E-04	---	0.0082	---	0.03	5.88E-04	---	0.0082	---	0.03	AP-42, Chapter 3.2, Table 3.2-3
$PM_{2.5}/PM_{10}$	1.94E-02	---	0.27	---	1.06	1.94E-02	---	0.27	---	1.06	AP-42, Chapter 3.2, Table 3.2-3
Total PM	1.94E-02	---	0.27	---	1.06	1.94E-02	---	0.27	---	1.06	AP-42, Chapter 3.2, Table 3.2-3
1,1,2,2-Tetrachloroethane	2.53E-05	---	0.0004	2.76	0.001	2.53E-05	---	0.0004	2.76	0.001	AP-42, Chapter 3.2, Table 3.2-3
1,3-Butadiene	6.63E-04	---	0.009	72.37	0.04	6.63E-04	---	0.009	72.37	0.04	AP-42, Chapter 3.2, Table 3.2-3
Acetaldehyde	2.79E-03	---	0.04	304.53	0.15	2.79E-03	---	0.04	304.53	0.15	AP-42, Chapter 3.2, Table 3.2-3
Acrolein	2.63E-03	---	0.04	287.07	0.14	2.63E-03	---	0.04	287.07	0.14	AP-42, Chapter 3.2, Table 3.2-3
Benzene	1.58E-03	---	0.02	172.46	0.09	1.58E-03	---	0.02	172.46	0.09	AP-42, Chapter 3.2, Table 3.2-3
Ethylbenzene	2.48E-05	---	0.0003	2.71	0.001	2.48E-05	---	0.0003	2.71	0.001	AP-42, Chapter 3.2, Table 3.2-3
Formaldehyde[1]	---	0.05	0.19	1,455	0.73	---	0.01	0.04	349.30	0.17	Manufacturer's Specs - uncontrolled, Catalyst Specs - controlled
Methanol	3.06E-03	---	0.04	334.01	0.17	3.06E-03	---	0.04	334.01	0.17	AP-42, Chapter 3.2, Table 3.2-3
Methylene Chloride	4.12E-05	---	0.0006	4.50	0.002	4.12E-05	---	0.0006	4.50	0.002	AP-42, Chapter 3.2, Table 3.2-3
PAH	1.41E-04	---	0.002	15.39	0.008	1.41E-04	---	0.002	15.39	0.008	AP-42, Chapter 3.2, Table 3.2-3
Toluene	5.58E-04	---	0.008	60.91	0.03	5.58E-04	---	0.008	60.91	0.03	AP-42, Chapter 3.2, Table 3.2-3
Xylenes	1.95E-04	---	0.003	21.28	0.01	1.95E-04	---	0.003	21.28	0.01	AP-42, Chapter 3.2, Table 3.2-3
Other HAPs[2]	2.10E-04	---	0.003	22.90	0.01	2.10E-04	---	0.003	22.90	0.01	AP-42, Chapter 3.2, Table 3.2-3
Total HAPS			0.35	2,756	1.38			0.21	1,650	0.83	

Pollutant	**Emission Factor**		**Estimated Emissions[2]**			**Emission Factor**		**Estimated Emissions[2]**			**Source of Emissions Factors**
	(kg/MMBtu)	**(g/bhp-hr)**	**(lb/hr)**	**(lb/yr)[4]**	**(tpy)[4]**	**(kg/MMBtu)**	**(g/bhp-hr)**	**(lb/hr)**	**(lb/yr)[4]**	**(tpy)[4]**	
CO_2[1]	---	529	1,959	---	7,699	---	529	1,959	---	7,699	Manufacturer's Specs
CH_4[1,5]	---	1.30	4.81	---	18.92	---	0.39	1.44	---	5.68	Manufacturer's Specs - uncontrolled, Catalyst Specs - controlled
N_2O	0.0001	---	0.003	---	0.01	0.0001	---	0.003	---	0.01	40 CFR Part 98, Subpart C, Table C-2
CO_2e[2]	---	---	2,081	---	8,176	---	---	1,996	---	7,845	40 CFR Part 98, Subpart A, Table A-1, effective January 2014

Notes:

4. Annual Emissions are based on engines operating with 90% fuel of total fuel usage
5. Due to variable load conditions, the catalyst efficiency may vary. The catalyst efficiencies used in the emissions are typical based on expected operating conditions. The specification sheets show efficiencies of 96% for NOx and CO, however, Antero is claiming 96.5% based on similar operating facilities.

Example Calculations

lb/hr = (g/hp-hr) * (hp) * (1 lb/453.6 g) or (lb/MMBtu) * (MMBtu/hr)

tpy = (MMscf/yr) * (Btu/scf) * (10^6 Btu/MMBtu) * (g/hp-hr) / (Btu/hp-hr) * (1 lb/453.59 g) * (1 ton/2000 lb) or (MMscf/yr) * (Btu/scf) * (lb/MMBtu) *(1 ton/2000 lb)

Microturbine Generator Emission Calculations

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Microturbine Generators**

Source Information

Emission Unit ID:	G-8000	
Make/Model	Capstone C600 Standard	
Microturbine Rating[2]	600	kWe
Number of Microturbines[2]	1	unit
Net Heat Rate	10,300	Btu/kWhe
Heat Input [1]	6.18	MMBtu/hr
Operating Hours[2]	8,760	hrs/yr

Notes:

1) Calculated

2) The Capstone C600 package is made up of three (3) 200 kWe units that can operate individually. While all three units may not be operating all at once, potential emissions are calculated as though all three are operating at 8,760 hours per year.

Potential Emissions per Generator

	Uncontrolled					***Controlled***					
Pollutant	**Emission Factor**		**Estimated Emissions[1]**			**Emission Factor**		**Estimated Emissions[1]**			**Source of Emissions Factors**
	(lb/MMBtu)	**(lb/MWhe)**	**(lb/hr)**	**(lb/yr)**	**(tpy)**	**(lb/MMBtu)**	**(lb/MWhe)**	**(lb/hr)**	**(lb/yr)**	**(tpy)**	
NOx	---	0.40	0.24	---	1.05	---	0.40	0.24	---	1.05	Manufacturer Specifications
CO	---	1.10	0.66	---	2.89	---	1.10	0.66	---	2.89	Manufacturer Specifications
VOC	---	0.10	0.06	---	0.26	---	0.10	0.06	---	0.26	Manufacturer Specifications
SO_2	3.40E-03	---	0.02	---	0.09	3.40E-03	---	0.02	---	0.09	AP-42, Chapter 3.1, Table 3.1-2a
$PM_{2.5}/PM_{10}$	6.60E-03	---	0.04	---	0.18	6.60E-03	---	0.04	---	0.18	AP-42, Chapter 3.1, Table 3.1-2a
1,3-Butadiene	4.30E-07	---	2.66E-06	0.02	1.16E-05	4.30E-07	---	2.66E-06	0.023	1.16E-05	AP-42, Chapter 3.1, Table 3.1-3
Acetaldehyde	4.00E-05	---	2.47E-04	2.17	1.08E-03	4.00E-05	---	2.47E-04	2.17	1.08E-03	AP-42, Chapter 3.1, Table 3.1-3
Acrolein	6.40E-06	---	3.96E-05	0.35	1.73E-04	6.40E-06	---	3.96E-05	0.35	1.73E-04	AP-42, Chapter 3.1, Table 3.1-3
Benzene	1.20E-05	---	7.42E-05	0.65	3.25E-04	1.20E-05	---	7.42E-05	0.65	3.25E-04	AP-42, Chapter 3.1, Table 3.1-3
Ethylbenzene	3.20E-05	---	1.98E-04	1.73	8.66E-04	3.20E-05	---	1.98E-04	1.73	8.66E-04	AP-42, Chapter 3.1, Table 3.1-3
Formaldehyde	7.10E-04	---	4.39E-03	38.44	1.92E-02	7.10E-04	---	4.39E-03	38.44	1.92E-02	AP-42, Chapter 3.1, Table 3.1-3
Naphthalene	1.30E-06	---	8.03E-06	0.07	3.52E-05	1.30E-06	---	8.03E-06	0.07	3.52E-05	AP-42, Chapter 3.1, Table 3.1-3
PAH	2.20E-06	---	1.36E-05	0.12	5.96E-05	2.20E-06	---	1.36E-05	0.12	5.96E-05	AP-42, Chapter 3.1, Table 3.1-3
Propylene Oxide	2.90E-05	---	1.79E-04	1.57	7.85E-04	2.90E-05	---	1.79E-04	1.57	7.85E-04	AP-42, Chapter 3.1, Table 3.1-3
Toluene	1.30E-04	---	8.03E-04	7.04	3.52E-03	1.30E-04	---	8.03E-04	7.04	3.52E-03	AP-42, Chapter 3.1, Table 3.1-3
Xylenes	6.40E-05	---	3.96E-04	3.46	1.73E-03	6.40E-05	---	3.96E-04	3.46	1.73E-03	AP-42, Chapter 3.1, Table 3.1-3
Total HAPS			0.006	55.62	0.03			0.006	55.62	0.03	
Pollutant	**Emission Factor**		**Estimated Emissions[1]**			**Emission Factor**		**Estimated Emissions[1]**			**Source of Emissions Factors**
	(kg/MMBtu)	**(lb/MWhe)**	**(lb/hr)**		**(tpy)**	**(kg/MMBtu)**	**(lb/MWhe)**	**(lb/hr)**		**(tpy)**	
CO_2	---	1,330	798	---	3,495	---	1,330	798	---	3,495	Manufacturer Specifications
CH_4	0.001	---	0.01	---	0.06	0.001	---	0.01	---	0.06	40 CFR Part 98, Subpart C, Table C-2
N_2O	0.0001	---	0.001	---	0.006	0.0001	---	0.001	---	0.006	40 CFR Part 98, Subpart C, Table C-2
CO_2e	---	---	799	---	3,499	---	---	799	---	3,499	40 CFR Part 98, Subpart A, Table A-1, effective January 2014

Example Calculations

lb/hr = (lb/Mwhe) * kWe * (1 MWe/1000 kWe) or (lb/MMBtu) * (MMBtu/hr) or (kg/MMBtu) * (MMBtu/hr) * (2.21 lb/kg)

tpy = (lb/hr) * (hr/yr) * (ton/2000 lb)

Natural Gas Fueled Catalytic Heater Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Location:	**Tyler County, West Virginia**
Source Description:	**Catalytic Heater for Generator Fuel**

Source Information

Emission Unit ID:	CATHT1	
Source Description:	Generator Fuel Heater	
Hours of Operation	8,760	hr/yr
Design Heat Rate	0.024	MMBtu/hr
Heater Efficiency	80%	
Fuel Heat Value	1,020	Btu/scf
Fuel Use	0.26	MMscf/yr

Emission Calculations per Heater

Pollutant	Emission Factor (lb/MMscf)	Emissions (lb/hr)	Emissions (tpy)	Emission Factor Source
NO_X	100	0.0029	0.013	AP-42 Ch. 1.4 Table 1.4-1
CO	84	0.0025	0.011	AP-42 Ch. 1.4 Table 1.4-1
VOC	5.5	0.00016	0.00071	AP-42 Ch. 1.4 Table 1.4-2
PM_{10}	7.6	0.00022	0.0010	AP-42 Ch. 1.4 Table 1.4-2
SO_2	0.6	0.000018	0.000077	AP-42 Ch. 1.4 Table 1.4-2
Formaldehyde	0.075	0.000002	0.000010	AP-42 Ch. 1.4 Table 1.4-3
Total HAPs (including HCHO)[1]	1.9	0.00006	0.00024	AP-42 Ch. 1.4 Table 1.4-3
Pollutant	**Emission Factor (kg/MMBtu)**	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emission Factor Source**
Carbon Dioxide	53.06	2.81	12	40 CFR Part 98, Subpart C, Table C-1
Methane	0.001	0.0001	0.00023	40 CFR Part 98, Subpart C, Table C-2
Nitrous Oxide	0.0001	0.00001	0.000023	40 CFR Part 98, Subpart C, Table C-2
CO_2e	----	2.82	12	40 CFR Part 98, Subpart A, Table A-1

1. Only those HAP pollutants above detection thresholds were included.

Sample Calculations:

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MMBtu/hr)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * \text{Heater Efficiency}}$$

$$\text{Emissions (tons/yr)} = \frac{\text{Emission Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)}}{\text{2,000 (lbs/ton)}}$$

Dehydrator Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Dehydrator Units**

Potential Emissions per Dehydrator

	Emission Unit ID: SV-3110/SV-3210		**Emission Unit ID: FT-3110/FT-3210**	
Pollutant	**Dehydrator Still Vent**		**Flash Tank Gas**	
	(lb/hr)	**(tpy)**	**(lb/hr)**	**(tpy)**
Uncontrolled Emissions [1]				
VOC	16.24	71.12	32.26	141.31
Total HAPs	7.38	32.30	0.67	2.93
Benzene	0.27	1.19	0.021	0.091
Toluene	1.21	5.29	0.053	0.23
Ethylbenzene	1.07	4.68	0.024	0.11
Xylenes	4.57	20.04	0.065	0.29
n-Hexane	0.25	1.10	0.51	2.21
Methane	17.44	76.38	54.11	236.98
Carbon Dioxide	0.17	0.74	0.98	4.30
CO_2e	436	1,910	1,354	5,929
Controlled Emissions [2,3]	**FL-1000**		**R-3110/R-3210**	
VOC	0.32	1.42	1.61	7.07
Total HAPs	0.15	0.65	0.033	0.15
Benzene	0.0054	0.024	0.0010	0.0046
Toluene	0.024	0.11	0.0027	0.012
Ethylbenzene	0.021	0.094	0.0012	0.0053
Xylenes	0.092	0.40	0.0033	0.014
n-Hexane	0.0050	0.022	0.025	0.11
Methane	0.35	1.53	2.71	11.85
Carbon Dioxide	0.17	0.74	0.98	4.30
CO_2e	9	39	69	301

[1]Output from GRI-GLYCalc 4.0 for both the still vent and flash tank gas emissions

[2]Controlled emissions assume that the glycol still vent is equipped with a condenser and is controlled by a combustor with at least 98% control efficiency. Controlled emissions are shown with FL-1000 in summary tables.

[3]Flash tank gas is used in the reboiler as the primary fuel source. Assumed 95% combustion of flash tank gas. Controlled emissions are shown with R-3110 and R-3210 in the summary tables.

Natural Gas Fueled Dehydrator Reboiler Combustion Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Location:	**Tyler County, West Virginia**
Source Description:	**Dehydrator Reboilers**

Source Information

Emission Unit ID:	R-3110 & R-3210	
Source Description:	Dehydrator Reboiler	
Hours of Operation	8,760	hr/yr
Design Heat Rate	1.5	MMBtu/hr
Heater Efficiency	0.8	
Fuel Heat Value	1,020	Btu/scf
Fuel Use	16.1	MMscf/yr

Emission Calculations per Reboiler

Pollutant	Emission Factor (lb/MMscf)	Emissions (lb/hr)	Emissions (tpy)	Emission Factor Source
NO_X	100	0.18	0.81	AP-42 Ch. 1.4 Table 1.4-1
CO	84	0.15	0.68	AP-42 Ch. 1.4 Table 1.4-1
VOC	5.5	0.01	0.04	AP-42 Ch. 1.4 Table 1.4-2
PM_{10}	7.6	0.01	0.06	AP-42 Ch. 1.4 Table 1.4-2
SO_2	0.6	0.001	0.005	AP-42 Ch. 1.4 Table 1.4-2
Formaldehyde	0.075	0.0001	0.0006	AP-42 Ch. 1.4 Table 1.4-3
Total HAPs (including HCHO)	1.9	0.003	0.02	AP-42 Ch. 1.4 Table 1.4-3
Pollutant	**Emission Factor (kg/MMBtu)**	**Emissions (lb/hr)**	**Emissions (tpy)**	**Emission Factor Source**
Carbon Dioxide	53.06	175.89	770	40 CFR Part 98, Subpart C, Table C-1
Methane	0.001	0.003	0.01	40 CFR Part 98, Subpart C, Table C-2
Nitrous Oxide	0.0001	0.0003	0.001	40 CFR Part 98, Subpart C, Table C-2
CO_2e	----	176.08	771	40 CFR Part 98, Subpart A, Table A-1

Sample Calculations:

$$\text{Fuel Consumption (MMscf/yr)} = \frac{\text{Heater Size (MMBtu/hr)} * \text{Hours of Operation (hrs/yr)}}{\text{Fuel Heat Value (Btu/scf)} * \text{Heater Efficiency}}$$

$$\text{Emissions (tons/yr)} = \frac{\text{Emission Factor (lbs/MMscf)} * \text{Fuel Consumption (MMscf/yr)}}{\text{2,000 (lbs/ton)}}$$

Flare Combustion Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Flare for Dehydrator Still Vent Gas**
Emission Unit ID:	**FL-1000**

Combusted Gas Emissions

Flare Heat Input :	9.21	MMBtu/hr
Hours of Operation:	8,760	hr/yr

Pollutant	Emission Factor[1] (lb/MMBtu)	Emissions (lbs/hr)	Emissions (tons/yr)
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)	N/A - Smokeless Design		
Nitrogen Oxides (NO_x)	0.068	0.63	2.74
Carbon Monoxide (CO)	0.31	2.86	12.51

[1] Emission Factors from Table 13.5-1 and 13.5-2 of AP-42 Section 13.5 (April 2015)

Pilot Emissions

Pilot Heating Value:	1,020	Btu/scf
Hours of Operation:	8,760	hr/yr
Total Pilot Natural Gas Usage:	1.64E-05	MMscf/hr

Pollutant	Emission Factor (lb/MMscf)	Emissions (lbs/hr)	Emissions (tons/yr)
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)[2]	7.6	1.25E-04	5.46E-04
Nitrogen Oxides (NOx)	100	1.64E-03	7.18E-03
Sulfur Dioxide (SO_2)[2]	0.6	9.84E-06	4.31E-05
Carbon Monoxide (CO)[2]	84	1.38E-03	6.03E-03
Volatile Organic Compounds (VOC)[2]	5.5	9.02E-05	3.95E-04
Total HAPs[2,3]	1.88	3.08E-05	1.35E-04

[2] Emission Factors from AP-42 Tables 1.4-1, 1.4-2, 1.4-3, and 1.4-4 (7/98).

[3] Sum of Emissions Factors published for pollutants classified as "HAPS" under AP-42 Table 1.4-3.

Total Flare Emissions

Pollutant	Emission Rate (lbs/hr)	Emission Rate (tons/year)
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)	1.25E-04	5.46E-04
Nitrogen Oxides (NOx)	0.63	2.75
Sulfur Dioxide (SO_2)	9.84E-06	4.31E-05
Carbon Monoxide (CO)	2.86	12.51
Volatile Organic Compounds (VOC)	9.02E-05	3.95E-04
Total HAPs	3.08E-05	1.35E-04

Greenhouse Gas Emissions

Pollutant	Emission Factor (kg/MMBtu)	Emissions (lb/hr)	Emissions (tpy)	Emission Factor Source
Carbon Dioxide	53.06	1,082	4,739	40 CFR Part 98, Subpart C, Table C-1
Methane	0.001	0.020	0.089	40 CFR Part 98, Subpart C, Table C-2
Nitrogen Dioxide	0.0001	0.0020	0.0089	40 CFR Part 98, Subpart C, Table C-2
CO_2e	----	1,083	4,744	40 CFR Part 98, Subpart A, Table A-1

Settling Tank Flashing Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Settling Tank**
Emission Unit ID:	**TK-9000**

Settling Tank Flashing Emissions

Component	Uncontrolled Flashing Emissions [1] (lb/hr)	Uncontrolled Flashing Emissions (tons/yr)	Controlled Flashing Emissions [2,3] (lb/hr)	Controlled Flashing Emissions [2,3] (tons/yr)
Methane	13.00	56.95	0.26	1.14
Ethane	31.90	139.70	0.64	2.79
Propane	45.56	199.56	0.91	3.99
i-Butane	12.01	52.60	0.24	1.05
n-Butane	30.60	134.02	0.61	2.68
i-Pentane	11.42	50.01	0.23	1.00
n-Pentane	13.12	57.48	0.26	1.15
i-Hexanes	5.62	24.62	0.11	0.49
Heptanes	3.28	14.36	0.066	0.29
Octanes	1.11	4.85	0.022	0.10
Nonanes	0.19	0.81	0.0037	0.016
Decanes+	0.02	0.07	0.00032	0.0014
n-Hexane	3.60	15.76	0.072	0.32
Benzene	0.06	0.27	0.0012	0.0053
Toluene	0.12	0.54	0.0025	0.011
Ethylbenzene	0.04	0.19	0.00089	0.0039
Xylenes	0.11	0.47	0.0021	0.0094
Nitrogen	0.06	0.27	0.063	0.27
Carbon Dioxide	0.17	0.74	0.17	0.74
Water	1.59	6.95	1.59	6.95
VOC Subtotal	126.85	555.61	2.54	11.11
HAP Subtotal	3.93	17.23	0.079	0.34
CO_2e Subtotal	325.23	1424.49	6.67	29.22
Total	173.57	760.22	5.25	23.01

Notes:

1. Flashing emissions calculated by ProMax 3.2. Flashing only occurs in the settling tank as all pressurized fluids flow into the settling tank and then separate out at atmospheric conditions to the condensate and produced water tanks.

2. Tanks are controlled by a VRU with assumed 98% capture efficiency; but will likely be higher as vapors are recycled back into the system

3. VRU-6000 is the primary VRU to collect storage tank vapors and VRU-6100 is the backup VRU in times when the primary VRU is undergoing maintenance or shutdown. In the unlikely event that both VRU-6000 and VRU-6100 are under maintenance or are shutdown, a bypass system is in place to route tank vapors to the facility inlet.

Storage Tank Working and Breathing Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Condensate, Settling, and Produced Water Tanks**
Emission Unit ID:	**TK-9000, TK-9100, TK-9110, TK-9200, TK-9210**

TANK DESCRIPTION	Uncontrolled VOC Emissions[1] (tons/yr)	Uncontrolled Benzene Emissions[1] (tons/yr)	Uncontrolled Toluene Emissions[1] (tons/yr)	Uncontrolled Ethylbenzene Emissions[1] (tons/yr)	Uncontrolled Xylene Emissions[1] (tons/yr)	Uncontrolled n-Hexane Emissions[1] (tons/yr)	Uncontrolled CH_4 Emissions[1] (tons/yr)	Uncontrolled CO_2e Emissions (tons/yr)
400 bbl Hydrocarbon Storage Tank (TK-9200)	6.82	1.91E-04	8.67E-04	6.03E-04	1.57E-03	1.37E-02	0.080	2.01
400 bbl Hydrocarbon Storage Tank (TK-9210)	6.82	1.91E-04	8.67E-04	6.03E-04	1.57E-03	1.37E-02	0.080	2.01
500 bbl Settling Tank (TK-9000)	8.98	2.51E-04	1.14E-03	7.94E-04	2.07E-03	1.81E-02	0.11	2.65
400 bbl Produced Water Storage Tank[2] (TK-9100)	0.00038	5.49E-08	5.35E-08	1.14E-08	2.43E-08	4.19E-09	0.00037	0.0093
400 bbl Produced Water Storage Tank[2] (TK-9110)	0.00038	5.49E-08	5.35E-08	1.14E-08	2.43E-08	4.19E-09	0.00037	0.0093
TOTAL	**22.62**	**0.00063**	**0.0029**	**0.0020**	**0.0052**	**0.045**	**0.27**	**6.69**

TANK DESCRIPTION	Controlled VOC Emissions[1,3] (tons/yr)	Controlled Benzene Emissions[1,3] (tons/yr)	Controlled Toluene Emissions[1,3] (tons/yr)	Controlled Ethylbenzene Emissions[1,3] (tons/yr)	Controlled Xylene Emissions[1,3] (tons/yr)	Controlled n-Hexane Emissions[1,3] (tons/yr)	Controlled CH_4 Emissions[1,3] (tons/yr)	Controlled CO_2e Emissions (tons/yr)
400 bbl Hydrocarbon Storage Tank (TK-9200)	0.14	3.82E-06	1.73E-05	1.21E-05	3.14E-05	2.74E-04	0.0016	0.047
400 bbl Hydrocarbon Storage Tank (TK-9210)	0.14	3.82E-06	1.73E-05	1.21E-05	3.14E-05	2.74E-04	0.0016	0.047
500 bbl Settling Tank (TK-9000)	0.18	5.03E-06	2.28E-05	1.59E-05	4.13E-05	3.61E-04	0.0021	0.062
400 bbl Produced Water Storage Tank[2] (TK-9100)	0.0000077	1.10E-09	1.07E-09	2.27E-10	4.87E-10	8.37E-11	7.36E-06	0.00033
400 bbl Produced Water Storage Tank[2] (TK-9110)	0.0000077	1.10E-09	1.07E-09	2.27E-10	4.87E-10	8.37E-11	7.36E-06	0.00033
TOTAL	**0.45**	**1.27E-05**	**5.75E-05**	**4.00E-05**	**1.04E-04**	**9.10E-04**	**0.0053**	**0.16**

Notes:

1. ProMax 3.2 used to calculate standing, working, and breathing (S,W,B) emissions
2. Produced water assumed to have no more than 10% hydrocarbon liquid
3. Tanks are controlled by a VRU with assumed 98% capture efficiency; but will likely be higher as vapors are recycled back into the system.
4. VRU-6000 is the primary VRU to collect storage tank vapors and VRU-6100 is the backup VRU in times when the primary VRU is undergoing maintenance or shutdown. In the unlikely event that both VRU-6000 and VRU-6100 are under maintenance or are shutdown, a bypass system is in place to route tank vapors to the facility inlet.

Truck Loading Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Production Liquids Truck Loadout**
Emission Unit ID:	**LDOUT1**

AP - 42, Chapter 5.2 $L_L = 12.46 \times S \times P \times M / T$

L_L = Loading Loss Emission Factor (lbs VOC/1000 gal loaded)
- S = Saturation Factor
- P = True Vapor Pressure of the Loaded Liquid (psia)
- M = Vapor Molecular Weight of the Loaded Liquid (lbs/lbmol)
- T = Temperature of Loaded Liquid (ºR)

VOC Emissions (tpy) = $\dfrac{L_L \text{ (lbs VOC/1000 gal)} * 42 \text{ gal/bbl} * 365 \text{ days/year} * \text{production (bbl/day)}}{1000 \text{ gal} * 2000 \text{ lbs/ton}}$

Source	S[1]	P (psia)[2]	M[3]	T (ºF)[4]	T (ºR)	L_L (lb/1000 gal)	Production (bbl/day)	VOC (tpy)	Benzene (tpy)	Toluene (tpy)	E-Benzene (tpy)	Xylene (tpy)	n-Hexane (tpy)	CH4 (tpy)	CO2e (tpy)
Condensate	0.6	11.8	41.1	65	524.75	6.88	150	7.91	0.00022	0.0010	0.00070	0.0018	0.016	0.093	2.33
Produced Water	0.6	0.31	18.6	65	524.75	0.08	45	0.03	4.12E-06	4.01E-06	8.52E-07	1.82E-06	3.14E-07	0.028	0.70

Notes:
1. Saturation factor from AP-42, Table 5.2-1 (Submerged loading (bottom loading): dedicated normal service)
2. True vapor pressure and molecular weight are estimated from tank-specific ProMax 3.2 simulations for both liquids.
3. Temperature based on the annual average temperature of Charleston, WV retrieved from ProMax working and breathing report.
4. HAP and CO2e emissions calculated with weight percentages of the working and breathing vent gas from the ProMax 3.2 simulation

Assume 1 truck loaded per hour, 180 bbl truck, for short term emissions

Source	S[1]	P (psia)[2]	M[3]	T (ºF)[4]	T (ºR)	L_L (lb/1000 gal)	Loading bbl/hr	VOC (lb/hr)	Benzene (lb/hr)	Toluene (lb/hr)	E-Benzene (lb/hr)	Xylene (lb/hr)	n-Hexane (lb/hr)	CH4 (lb/hr)	CO2e (lb/hr)
Condensate	0.6	11.8	41.1	65	524.75	6.88	180	52.02	0.0015	0.0066	0.0046	0.012	0.10	0.61	15.3
Produced Water	0.6	0.31	18.6	65	524.75	0.08	180	0.63	9.02E-05	8.79E-05	1.87E-05	4.00E-05	6.88E-06	0.60	15.3

Component Fugitive Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Fugitive Emissions - Component Leaks**

VOC Fugitive Emissions						
Equipment Type and Service	**Number of Units [1]**	**Hours of Operation (hours/yr)**	**THC Emission Factor[2] (kg/hr-unit)**	**VOC Weight Fraction[3]**	**THC Emissions (tpy)**	**VOC Emissions (tpy)**
Flanges - Gas Service	836	8,760	3.90E-04	0.21	3.16	0.66
Valves - Gas Service	250	8,760	4.50E-03	0.21	10.89	2.29
Compressor Seals Gas Service	33	8,760	8.80E-03	0.21	2.81	0.59
Flanges - Liquid Service	175	8,760	1.10E-04	0.73	0.19	0.14
Valves - Liquid Service	42	8,760	2.50E-03	0.73	1.02	0.74
Total Emissions (tons/yr)					**18.06**	**4.42**

HAPs Fugitive Emissions										
Equipment Type and Service	**Benzene Weight Fraction[3]**	**Benzene Emissions (tpy)**	**Toluene Weight Fraction[3]**	**Toluene Emissions (tpy)**	**Ethylbenzene Weight Fraction[3]**	**Ethylbenzene Emissions (tpy)**	**Xylene Weight Fraction[3]**	**Xylene Emissions (tpy)**	**n-Hexane Weight Fraction[3]**	**n-Hexane Emissions (tpy)**
Flanges - Gas Service	4.42E-05	0.00014	1.56E-04	0.00049	1.20E-04	0.00038	3.65E-04	0.0012	2.75E-03	0.0087
Valves - Gas Service	4.42E-05	0.00048	1.56E-04	0.0017	1.20E-04	0.0013	3.65E-04	0.0040	2.75E-03	0.030
Compressor Seals Gas Service	4.42E-05	0.00012	1.56E-04	0.00044	1.20E-04	0.00034	3.65E-04	0.0010	2.75E-03	0.0077
Flanges - Liquid Service	3.55E-04	0.000066	7.24E-04	0.00013	2.58E-04	0.000048	6.22E-04	0.00012	2.09E-02	0.0039
Valves - Liquid Service	3.55E-04	0.00036	7.24E-04	0.00074	2.58E-04	0.00026	6.22E-04	0.00063	2.09E-02	0.021
Total Emissions (tons/yr)		**0.0012**		**0.0035**		**0.0023**		**0.0069**		**0.071**

1) Component counts from similar facilities.

2) API average emission factors are for oil and gas production operations - Table 2.4, EPA Protocol for Equipment Leak Emission Estimates - 1995.

3) Gas and liquid weight fractions from representative analyses..

GHG Fugitive Emissions								
Equipment Type and Service	**Number of Units [1]**	**Hours of Operation (hours/yr)**	**Emission Factor[2] (scf/hr-unit)**	**CH_4 Concentration[3]**	**CO_2 Concentration[3]**	**CH_4 Emissions (tpy)**	**CO_2 Emissions (tpy)**	**CO_2e Emissions (tpy)**
Flanges	1,011	8,760	0.003	0.98	0.011	0.55	0.017	13.72
Valves - Gas Service	250	8,760	0.027	0.98	0.011	1.22	0.038	30.54
Valves - Liquid Service	42	8,760	0.050	0.98	0.011	0.38	0.012	9.50
Compressor Seals	33	8,760	0.300	0.98	0.011	1.79	0.055	44.79
Total Emissions (tons/yr)						**3.94**	**0.12**	**98.56**

1) Component counts from similar facilities.

2) Emission factors from 40 CFR Part 98 Subpart W, Table W1-A; Gas service where available, else light crude service

3) CH_4 and CO_2 concentrations as defined in 40 CFR Part 98.233(r)

Fugitive Emissions From Venting Episodes

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Fugitive Emissions-Venting Episodes**

VOC Venting Emissions						
Type of Event[1]	**Number Of Events (event/yr)**	**Amount Vented per Event (scf/event)**	**Molecular Weight of Vented Gas (lb/lb-mol)**	**Total Emissions (ton/yr)**	**VOC Weight Fraction[4]**	**VOC Emissions (ton/yr)**
Compressor Blowdown[2]	132	10,000	21.41	37.24	0.21	7.76
Compressor Startup[3]	132	1,050	21.41	3.91	0.21	0.81
Plant Shutdown	2	100,000	21.41	5.64	0.21	1.18
Pigging Venting	26	1,000	21.41	0.73	0.21	0.15
Total Emissions (tons/yr)						**9.90**

HAPs Venting Emissions										
Type of Event[1]	**Benzene Weight Fraction[4]**	**Benzene Emissions (tpy)**	**Toluene Weight Fraction[4]**	**Toluene Emissions (tpy)**	**Ethylbenzene Weight Fraction[4]**	**Ethylbenzene Emissions (tpy)**	**Xylene Weight Fraction[4]**	**Xylene Emissions (tpy)**	**n-Hexane Weight Fraction[4]**	**n-Hexane Emissions (tpy)**
Compressor Blowdown[2]	4.39E-05	0.0016	1.55E-04	0.0058	1.19E-04	0.0044	3.62E-04	0.013	2.72E-03	0.10
Compressor Startup[3]	4.39E-05	0.00017	1.55E-04	0.00061	1.19E-04	0.00047	3.62E-04	0.0014	2.72E-03	0.011
Plant Shutdown	4.39E-05	0.00025	1.55E-04	0.00088	1.19E-04	0.00067	3.62E-04	0.0020	2.72E-03	0.015
Pigging Venting	4.39E-05	0.000032	1.55E-04	0.00011	1.19E-04	0.000087	3.62E-04	0.00027	2.72E-03	0.0020
Total Emissions (tons/yr)		**0.0021**		**0.0074**		**0.0057**		**0.017**		**0.13**

GHG Venting Emissions								
Type of Event[1]	**Number Of Events (event/yr)**	**Amount Vented per Event (scf/event)**	**Molecular Weight of Vented Gas (lb/lb-mol)**	**CH_4 Weight Fraction[4]**	**CO_2 Weight Fraction[4]**	**CH_4 Emissions (ton/yr)**	**CO_2 Emissions (ton/yr)**	**CO_2e Emissions (tpy)**
Compressor Blowdown[2]	132	10,000	21.41	0.57	0.0033	21.05	0.12	526.45
Compressor Startup[3]	132	1,050	21.41	0.57	0.0033	2.21	0.013	55.28
Plant Shutdown	2	100,000	21.41	0.57	0.0033	3.19	0.019	79.77
Pigging Venting	26	1,000	21.41	0.57	0.0033	0.41	0.0024	10.37
Total Emissions (tons/yr)						**26.87**	**0.16**	**671.86**

1) Estimated number of events and venting per event from engineering based on other facilities

2) Total number of compressor blowdowns based on 12 blowdowns per compressor.

3) Total number of compressor startups based on 12 starts per compressor.

4) Weight Fraction is from a gas analysis that will be typical for the facility

Fugitive Dust Emissions

Company:	**Antero Midstream LLC**
Facility Name:	**Underwood Compressor Station**
Facility Location:	**Tyler County, West Virginia**
Source Description:	**Fugitive Dust Emissions**

Gravel Access Road	Loaded Truck Weight[1]	Trips per year[2]	Trips per day[2]	Distance per round trip (truck in and out)[3]		VMT per year[4]
	tons			feet	miles	miles
Condensate Tank Truck	40.00	365	1.0	4,700	0.89	325
Produced Water Tank Truck	40.00	365	1.0	4,700	0.89	325
Passenger Vehicles	3.00	1,095	3.0	4,700	0.89	975

Equation Parameter	PM-10/PM2.5	PM-Total
E, annual size-specific emission factor for PM_{10} & $PM_{2.5}$ (upaved industrial roads) extrapolated for natural mitigation[6]	**see table below**	**see table below**
k, Particle size multiplier for particle size range (PM_{10}), (lb/VMT) (Source: AP-42 Table 13.2.2-2)	**1.5**	**4.9**
k, Particle size multiplier for particle size range ($PM_{2.5}$), (lb/VMT) (Source: AP-42 Table 13.2.2-2)	**0.15**	
s, surface material silt content, (%) (Source: AP-42 Table 13.2.2-1)	**4.8**	**4.8**
W, mean weight (tons) of the vehicles traveling the road	**17.8**	**17.8**
a, constant for PM_{10} and $PM_{2.5}$ on industrial roads (Source: AP-42 Table 13.2.2-2)	**0.9**	**0.7**
b, constant for PM_{10} and $PM_{2.5}$ on industrial roads (Source: AP-42 Table 13.2.2-2)	**0.45**	**0.45**
P, number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, based on AP-42 Figure 13.2.2-1.	**160**	**160**

$$E = \left[k \left(\frac{s}{12} \right)^{a} \times \left(\frac{W}{3} \right)^{b} \right] \times (365 - P/365)$$

Source of Equation: AP-42 Section 13.2.2

PM_{10} Emissions

Emission Factor (lb/VMT)	Vehicle miles traveled (VMT/yr)	Annual Uncontrolled PM_{10} Emissions (tpy)
0.82	1,625	0.67

$PM_{2.5}$ Emissions

Emission Factor (lb/VMT)	Vehicle miles traveled (VMT/yr)	Annual Uncontrolled $PM_{2.5}$ Emissions (tpy)
0.082	1,625	0.067

PM- Total Emissions

Emission Factor (lb/VMT)	Vehicle miles traveled (VMT/yr)	Annual Uncontrolled PM-Total Emissions (tpy)
3.23	1,625	2.62

Table Notes:

1. Loaded truck weight is based on typical weight limit for highway vehicles.
2. Based on production, it's assumed a maximum of one condensate truck (180 bbl truck) and one produced water truck (180 bbl truck) will be onsite per day.
3. Distance per round trip is based on the proposed site layout. The one way distance is measured as 2,200 feet for the gravel access road and 150 feet on the dirt pad one way.

Facility Gas Analysis

	MOL %	MW	Component Weight lb/lb-mol	Wt. Fraction
Methane	75.469	16.04	12.11	0.57
Ethane	15.543	30.07	4.67	0.22
Propane	5.177	44.10	2.28	0.11
i-Butane	0.676	58.12	0.39	0.018
n-Butane	1.475	58.12	0.86	0.040
i-Pentane	0.348	72.15	0.25	0.012
n-Pentane	0.358	72.15	0.26	0.012
Hexanes+	0.347	100.00	0.35	0.016
n-Hexane	0.068	86.18	0.058	0.0027
Benzene	0.0012	78.11	0.0009	0.000044
Toluene	0.0036	92.14	0.0033	0.00016
Ethylbenzene	0.0024	106.17	0.0026	0.00012
Xylenes	0.0073	106.16	0.008	0.00036
Nitrogen	0.363	28.01	0.10	0.0047
Carbon Dioxide	0.162	44.01	0.071	0.0033
Totals	100.0		21.41	1.00

Molecular weight	21.41
VOC weight fraction	0.21
Methane weight fraction	0.57
THC weight fraction	0.99
VOC of THC wt fraction	0.21
CH4 of THC wt fraction	0.57
Benzene of THC wt fraction	0.000044
Toluene of THC wt fraction	0.00016
E-benzene of THC wt fraction	0.00012
Xylene of THC wt fraction	0.00036
n-Hexane of THC wt fraction	0.0027

Weigle Unit 1H analysis with BTEX relative fractions from similar wells

Facility Tank Vent Gas Analysis

	MOL %	MW	Component Weight lb/lb-mol	Wt. Fraction
Methane	19.177	16.04	3.08	0.075
Ethane	25.098	30.07	7.55	0.18
Propane	24.448	44.10	10.78	0.26
i-Butane	4.889	58.12	2.84	0.069
n-Butane	12.456	58.12	7.24	0.18
i-Pentane	3.744	72.15	2.70	0.066
n-Pentane	4.304	72.15	3.11	0.076
Other Hexanes	1.543	86.18	1.33	0.032
Heptanes	0.774	100.20	0.78	0.019
Octanes	0.229	114.23	0.26	0.0064
Nonanes	0.034	128.26	0.044	0.0011
Decanes+	0.002	142.28	0.0031	0.000076
n-Hexane	0.988	86.18	0.85	0.021
Benzene	0.018	78.11	0.014	0.00035
Toluene	0.032	92.14	0.029	0.00072
Ethylbenzene	0.010	106.17	0.010	0.00026
Xylenes	0.024	106.16	0.025	0.00062
Nitrogen	0.053	28.01	0.015	0.00036
Carbon Dioxide	0.091	44.01	0.040	0.0010
Water	2.084	18.02	0.38	0.0091
Totals	100.00		41.07	1.00

Molecular weight	41.07
VOC weight fraction	0.73
Methane weight fraction	0.075
THC weight fraction	0.99
VOC of THC wt fraction	0.74
CH4 of THC wt fraction	0.076
Benzene of THC wt fraction	0.00036
Toluene of THC wt fraction	0.00072
E-benzene of THC wt fraction	0.00026
Xylene of THC wt fraction	0.00062
n-Hexane of THC wt fraction	0.021

Tank vent gas is the Settling Tank flash gas stream from the ProMax 3.2 simulation

Facility Pressurized Liquid Analysis

	MOL % Blanche 1H	MOL % Hendershot 2H	MOL % Average	MOL % Water
Methane	3.925	4.898	4.412	0.4412
Ethane	4.741	7.946	6.344	0.6344
Propane	5.587	10.441	8.014	0.8014
i-Butane	1.733	3.134	2.434	0.2434
n-Butane	5.368	10.164	7.766	0.7766
i-Pentane	3.552	6.035	4.794	0.4794
n-Pentane	5.339	8.955	7.147	0.7147
Other Hexanes	4.649	7.234	5.942	0.5942
Heptanes	13.536	12.272	12.904	1.2904
Octanes	16.656	8.304	12.480	1.2480
Nonanes	7.581	4.253	5.917	0.5917
Decanes+	18.768	8.249	13.509	1.3509
n-Hexane	4.753	5.789	5.271	0.5271
Benzene	0.100	0.100	0.100	0.0100
Toluene	0.755	0.524	0.640	0.0640
Ethylbenzene	0.788	0.443	0.616	0.0616
Xylenes	2.143	1.221	1.682	0.1682
Nitrogen	0.013	0.011	0.012	0.0012
Carbon Dioxide	0.013	0.030	0.022	0.0022

C10+ specific gravity	0.7837	0.7832	0.7835
C10+ MW	179.40	166.30	172.850
API	63.35	69.12	66.24

Liquid analysis is the average of two representative analyses from the field. The pressurized water analysis assumes 10% hydrocarbons.

GlyCalc

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: Underwood Compressor Station
File Name: W:\20161767 Antero Lafferty and Underwood CS Air\2.0 Technical Information\2.9 - Deliverables to Client\Underwood CS\Model Files\Dehy Runs\Underwood Dehy.ddf
Date: October 14, 2015

DESCRIPTION:

Description: One (1) 60 MMscf/day TEG dehydration unit
Kimray 45015 PV glycol pump

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

Temperature: 120.00 deg. F
Pressure: 1100.00 psig
Wet Gas Water Content: Saturated

Component	Conc. (vol %)
Carbon Dioxide	0.1620
Nitrogen	0.3630
Methane	75.4690
Ethane	15.5430
Propane	5.1770
Isobutane	0.6760
n-Butane	1.4750
Isopentane	0.3480
n-Pentane	0.3580
n-Hexane	0.0680
Other Hexanes	0.3470
Benzene	0.0012
Toluene	0.0036
Ethylbenzene	0.0024
Xylenes	0.0073

DRY GAS:

Flow Rate: 60.0 MMSCF/day
Water Content: 5.0 lbs. H2O/MMSCF

LEAN GLYCOL:

Glycol Type: TEG
Water Content: 1.5 wt% H2O
Flow Rate: 7.9 gpm

PUMP:

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.032 acfm gas/gpm glycol

FLASH TANK:

Flash Control:	Combustion device
Flash Control Efficiency:	95.00 %
Temperature:	80.0 deg. F
Pressure:	5.0 psig

STRIPPING GAS:

Source of Gas:	Dry Gas
Gas Flow Rate:	9.000 scfm

REGENERATOR OVERHEADS CONTROL DEVICE:

Control Device:	Condenser
Temperature:	200.0 deg. F
Pressure:	14.7 psia
Control Device:	Combustion Device
Destruction Efficiency:	98.0 %
Excess Oxygen:	0.0 %
Ambient Air Temperature:	0.0 deg. F

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Underwood Compressor Station
File Name: W:\20161767 Antero Lafferty and Underwood CS Air\2.0 Technical Information\2.9 - Deliverables to Client\Underwood CS\Model Files\Dehy Runs\Underwood Dehy.ddf
Date: October 14, 2015

DESCRIPTION:

Description: One (1) 60 MMscf/day TEG dehydration unit
Kimray 45015 PV glycol pump

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.3488	8.370	1.5276
Ethane	0.1416	3.399	0.6203
Propane	0.0781	1.875	0.3422
Isobutane	0.0153	0.366	0.0669
n-Butane	0.0383	0.918	0.1676
Isopentane	0.0117	0.280	0.0511
n-Pentane	0.0141	0.339	0.0618
n-Hexane	0.0050	0.121	0.0220
Other Hexanes	0.0198	0.476	0.0868
Benzene	0.0054	0.130	0.0238
Toluene	0.0242	0.580	0.1058
Ethylbenzene	0.0214	0.513	0.0936
Xylenes	0.0915	2.195	0.4006
Total Emissions	0.8151	19.561	3.5699
Total Hydrocarbon Emissions	0.8151	19.561	3.5699
Total VOC Emissions	0.3247	7.792	1.4221
Total HAP Emissions	0.1475	3.539	0.6458
Total BTEX Emissions	0.1424	3.418	0.6238

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	17.4384	418.521	76.3802
Ethane	7.0812	169.948	31.0155
Propane	3.9060	93.743	17.1081
Isobutane	0.7635	18.324	3.3442
n-Butane	1.9129	45.910	8.3785
Isopentane	0.5830	13.991	2.5534
n-Pentane	0.7053	16.927	3.0891
n-Hexane	0.2516	6.038	1.1019
Other Hexanes	0.9908	23.779	4.3396
Benzene	0.2717	6.521	1.1901
Toluene	1.2087	29.008	5.2939
Ethylbenzene	1.0686	25.647	4.6807
Xylenes	4.5744	109.786	20.0359

Total Emissions	40.7559	978.142	178.5110
Total Hydrocarbon Emissions	40.7559	978.142	178.5110
Total VOC Emissions	16.2364	389.673	71.1153
Total HAP Emissions	7.3750	177.000	32.3024
Total BTEX Emissions	7.1234	170.962	31.2006

FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	2.7053	64.927	11.8492
Ethane	1.3934	33.441	6.1030
Propane	0.7757	18.618	3.3978
Isobutane	0.1421	3.412	0.6226
n-Butane	0.3462	8.308	1.5163
Isopentane	0.0919	2.205	0.4024
n-Pentane	0.1043	2.502	0.4567
n-Hexane	0.0253	0.606	0.1106
Other Hexanes	0.1195	2.867	0.5233
Benzene	0.0010	0.025	0.0046
Toluene	0.0027	0.064	0.0117
Ethylbenzene	0.0012	0.029	0.0053
Xylenes	0.0033	0.078	0.0143
Total Emissions	5.7118	137.083	25.0176
Total Hydrocarbon Emissions	5.7118	137.083	25.0176
Total VOC Emissions	1.6131	38.715	7.0654
Total HAP Emissions	0.0334	0.802	0.1464
Total BTEX Emissions	0.0082	0.196	0.0358

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	54.1060	1298.543	236.9842
Ethane	27.8674	668.818	122.0593
Propane	15.5149	372.358	67.9554
Isobutane	2.8430	68.231	12.4522
n-Butane	6.9236	166.167	30.3255
Isopentane	1.8373	44.095	8.0474
n-Pentane	2.0854	50.050	9.1341
n-Hexane	0.5051	12.122	2.2122
Other Hexanes	2.3894	57.345	10.4655
Benzene	0.0209	0.501	0.0914
Toluene	0.0532	1.277	0.2331
Ethylbenzene	0.0240	0.576	0.1052
Xylenes	0.0654	1.569	0.2863
Total Emissions	114.2355	2741.652	500.3515
Total Hydrocarbon Emissions	114.2355	2741.652	500.3515
Total VOC Emissions	32.2621	774.291	141.3081
Total HAP Emissions	0.6685	16.045	2.9281
Total BTEX Emissions	0.1634	3.923	0.7159

COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	3.0541	73.297	13.3768
Ethane	1.5350	36.840	6.7233
Propane	0.8539	20.493	3.7399
Isobutane	0.1574	3.778	0.6895
n-Butane	0.3844	9.227	1.6838
Isopentane	0.1035	2.485	0.4534
n-Pentane	0.1184	2.841	0.5185
n-Hexane	0.0303	0.727	0.1326
Other Hexanes	0.1393	3.343	0.6101
Benzene	0.0065	0.155	0.0284
Toluene	0.0268	0.644	0.1175
Ethylbenzene	0.0226	0.542	0.0988
Xylenes	0.0947	2.273	0.4149
Total Emissions	6.5268	156.644	28.5875
Total Hydrocarbon Emissions	6.5268	156.644	28.5875
Total VOC Emissions	1.9378	46.507	8.4875
Total HAP Emissions	0.1809	4.341	0.7922
Total BTEX Emissions	0.1506	3.614	0.6596

COMBINED REGENERATOR VENT/FLASH GAS EMISSION CONTROL REPORT:

Component	Uncontrolled tons/yr	Controlled tons/yr	% Reduction
Methane	313.3643	13.3768	95.73
Ethane	153.0748	6.7233	95.61
Propane	85.0635	3.7399	95.60
Isobutane	15.7963	0.6895	95.64
n-Butane	38.7040	1.6838	95.65
Isopentane	10.6008	0.4534	95.72
n-Pentane	12.2232	0.5185	95.76
n-Hexane	3.3141	0.1326	96.00
Other Hexanes	14.8050	0.6101	95.88
Benzene	1.2815	0.0284	97.79
Toluene	5.5270	0.1175	97.87
Ethylbenzene	4.7858	0.0988	97.93
Xylenes	20.3221	0.4149	97.96
Total Emissions	678.8625	28.5875	95.79
Total Hydrocarbon Emissions	678.8625	28.5875	95.79
Total VOC Emissions	212.4234	8.4875	96.00
Total HAP Emissions	35.2306	0.7922	97.75
Total BTEX Emissions	31.9164	0.6596	97.93

EQUIPMENT REPORTS:

CONDENSER AND COMBUSTION DEVICE

Condenser Outlet Temperature: 200.00 deg. F
Condenser Pressure: 14.70 psia

Condenser Duty: 2.22e-001 MM BTU/hr
Produced Water: 8.41 bbls/day
Ambient Temperature: 0.00 deg. F
Excess Oxygen: 0.00 %
Combustion Efficiency: 98.00 %
Supplemental Fuel Requirement: 2.22e-001 MM BTU/hr

Component	Emitted	Destroyed
Methane	2.00%	98.00%
Ethane	2.00%	98.00%
Propane	2.00%	98.00%
Isobutane	2.00%	98.00%
n-Butane	2.00%	98.00%
Isopentane	2.00%	98.00%
n-Pentane	2.00%	98.00%
n-Hexane	2.00%	98.00%
Other Hexanes	2.00%	98.00%
Benzene	2.00%	98.00%
Toluene	2.00%	98.00%
Ethylbenzene	2.00%	98.00%
Xylenes	2.00%	98.00%

ABSORBER

Calculated Absorber Stages: 1.83
Specified Dry Gas Dew Point: 5.00 lbs. H2O/MMSCF
Temperature: 120.0 deg. F
Pressure: 1100.0 psig
Dry Gas Flow Rate: 60.0000 MMSCF/day
Glycol Losses with Dry Gas: 4.3365 lb/hr
Wet Gas Water Content: Saturated
Calculated Wet Gas Water Content: 95.10 lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio: 2.11 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	5.25%	94.75%
Carbon Dioxide	99.83%	0.17%
Nitrogen	99.98%	0.02%
Methane	99.98%	0.02%
Ethane	99.96%	0.04%
Propane	99.95%	0.05%
Isobutane	99.94%	0.06%
n-Butane	99.92%	0.08%
Isopentane	99.93%	0.07%
n-Pentane	99.91%	0.09%
n-Hexane	99.88%	0.12%
Other Hexanes	99.90%	0.10%
Benzene	95.34%	4.66%
Toluene	94.30%	5.70%
Ethylbenzene	93.56%	6.44%
Xylenes	90.98%	9.02%

FLASH TANK

Flash Control: Combustion device
Flash Control Efficiency: 95.00 %

Flash Temperature: 80.0 deg. F
Flash Pressure: 5.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.89%	0.11%
Carbon Dioxide	6.51%	93.49%
Nitrogen	0.36%	99.64%
Methane	0.39%	99.61%
Ethane	1.52%	98.48%
Propane	4.07%	95.93%
Isobutane	6.72%	93.28%
n-Butane	9.11%	90.89%
Isopentane	11.20%	88.80%
n-Pentane	14.22%	85.78%
n-Hexane	25.25%	74.75%
Other Hexanes	19.66%	80.34%
Benzene	93.19%	6.81%
Toluene	96.10%	3.90%
Ethylbenzene	98.02%	1.98%
Xylenes	98.77%	1.23%

REGENERATOR

Regenerator Stripping Gas:
Dry Product Gas
Stripping Gas Flow Rate: 9.0000 scfm

Component	Remaining in Glycol	Distilled Overhead
Water	22.87%	77.13%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	2.58%	97.42%
n-Pentane	2.22%	97.78%
n-Hexane	1.38%	98.62%
Other Hexanes	3.30%	96.70%
Benzene	5.31%	94.69%
Toluene	8.16%	91.84%
Ethylbenzene	10.56%	89.44%
Xylenes	13.06%	86.94%

STREAM REPORTS:

WET GAS STREAM

Temperature: 120.00 deg. F
Pressure: 1114.70 psia

Flow Rate: 2.51e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	2.00e-001	2.38e+002
Carbon Dioxide	1.62e-001	4.70e+002
Nitrogen	3.62e-001	6.70e+002
Methane	7.53e+001	7.98e+004
Ethane	1.55e+001	3.08e+004
Propane	5.17e+000	1.50e+004
Isobutane	6.75e-001	2.59e+003
n-Butane	1.47e+000	5.65e+003
Isopentane	3.47e-001	1.65e+003
n-Pentane	3.57e-001	1.70e+003
n-Hexane	6.79e-002	3.86e+002
Other Hexanes	3.46e-001	1.97e+003
Benzene	1.20e-003	6.18e+000
Toluene	3.59e-003	2.19e+001
Ethylbenzene	2.40e-003	1.68e+001
Xylenes	7.29e-003	5.11e+001
Total Components	100.00	1.41e+005

DRY GAS STREAM

Temperature: 120.00 deg. F
Pressure: 1114.70 psia
Flow Rate: 2.50e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.05e-002	1.25e+001
Carbon Dioxide	1.62e-001	4.69e+002
Nitrogen	3.63e-001	6.70e+002
Methane	7.55e+001	7.98e+004
Ethane	1.55e+001	3.08e+004
Propane	5.17e+000	1.50e+004
Isobutane	6.76e-001	2.59e+003
n-Butane	1.47e+000	5.64e+003
Isopentane	3.48e-001	1.65e+003
n-Pentane	3.58e-001	1.70e+003
n-Hexane	6.79e-002	3.86e+002
Other Hexanes	3.47e-001	1.97e+003
Benzene	1.14e-003	5.89e+000
Toluene	3.40e-003	2.06e+001
Ethylbenzene	2.25e-003	1.57e+001
Xylenes	6.64e-003	4.65e+001
Total Components	100.00	1.41e+005

LEAN GLYCOL STREAM

Temperature: 120.00 deg. F
Flow Rate: 7.92e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)

TEG	9.85e+001	4.39e+003
Water	1.50e+000	6.69e+001
Carbon Dioxide	1.80e-012	8.02e-011
Nitrogen	2.70e-013	1.20e-011
Methane	9.16e-018	4.08e-016
Ethane	1.27e-007	5.67e-006
Propane	7.51e-009	3.35e-007
Isobutane	1.13e-009	5.04e-008
n-Butane	2.58e-009	1.15e-007
Isopentane	1.34e-004	5.97e-003
n-Pentane	1.72e-004	7.66e-003
n-Hexane	5.29e-005	2.36e-003
Other Hexanes	4.34e-004	1.93e-002
Benzene	3.40e-004	1.52e-002
Toluene	2.40e-003	1.07e-001
Ethylbenzene	2.82e-003	1.26e-001
Xylenes	1.54e-002	6.86e-001
Total Components	100.00	4.46e+003

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 120.00 deg. F
Pressure: 1114.70 psia
Flow Rate: 8.64e+000 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.13e+001	4.39e+003
Water	6.09e+000	2.93e+002
Carbon Dioxide	2.19e-002	1.05e+000
Nitrogen	9.87e-003	4.74e-001
Methane	1.13e+000	5.43e+001
Ethane	5.89e-001	2.83e+001
Propane	3.37e-001	1.62e+001
Isobutane	6.34e-002	3.05e+000
n-Butane	1.58e-001	7.62e+000
Isopentane	4.31e-002	2.07e+000
n-Pentane	5.06e-002	2.43e+000
n-Hexane	1.41e-002	6.76e-001
Other Hexanes	6.19e-002	2.97e+000
Benzene	6.38e-003	3.06e-001
Toluene	2.84e-002	1.36e+000
Ethylbenzene	2.53e-002	1.21e+000
Xylenes	1.11e-001	5.32e+000
Total Components	100.00	4.81e+003

FLASH TANK OFF GAS STREAM

Temperature: 80.00 deg. F
Pressure: 19.70 psia
Flow Rate: 1.88e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	3.67e-001	3.28e-001

Carbon Dioxide	4.49e-001	9.82e-001
Nitrogen	3.40e-001	4.73e-001
Methane	6.79e+001	5.41e+001
Ethane	1.87e+001	2.79e+001
Propane	7.08e+000	1.55e+001
Isobutane	9.85e-001	2.84e+000
n-Butane	2.40e+000	6.92e+000
Isopentane	5.13e-001	1.84e+000
n-Pentane	5.82e-001	2.09e+000
n-Hexane	1.18e-001	5.05e-001
Other Hexanes	5.58e-001	2.39e+000
Benzene	5.38e-003	2.09e-002
Toluene	1.16e-002	5.32e-002
Ethylbenzene	4.55e-003	2.40e-002
Xylenes	1.24e-002	6.54e-002
Total Components	100.00	1.16e+002

FLASH TANK GLYCOL STREAM

Temperature: 80.00 deg. F
Flow Rate: 8.38e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.35e+001	4.39e+003
Water	6.24e+000	2.92e+002
Carbon Dioxide	1.46e-003	6.84e-002
Nitrogen	3.60e-005	1.69e-003
Methane	4.50e-003	2.11e-001
Ethane	9.20e-003	4.31e-001
Propane	1.40e-002	6.58e-001
Isobutane	4.36e-003	2.05e-001
n-Butane	1.48e-002	6.94e-001
Isopentane	4.94e-003	2.32e-001
n-Pentane	7.37e-003	3.46e-001
n-Hexane	3.64e-003	1.71e-001
Other Hexanes	1.25e-002	5.85e-001
Benzene	6.09e-003	2.86e-001
Toluene	2.80e-002	1.31e+000
Ethylbenzene	2.54e-002	1.19e+000
Xylenes	1.12e-001	5.25e+000
Total Components	100.00	4.69e+003

FLASH GAS EMISSIONS

Flow Rate: 7.25e+003 scfh
Control Method: Combustion Device
Control Efficiency: 95.00

Component	Conc. (vol%)	Loading (lb/hr)
Water	6.15e+001	2.12e+002
Carbon Dioxide	3.71e+001	3.12e+002
Nitrogen	8.83e-002	4.73e-001
Methane	8.83e-001	2.71e+000
Ethane	2.43e-001	1.39e+000

Propane	9.21e-002	7.76e-001
Isobutane	1.28e-002	1.42e-001
n-Butane	3.12e-002	3.46e-001
Isopentane	6.67e-003	9.19e-002
n-Pentane	7.57e-003	1.04e-001
n-Hexane	1.53e-003	2.53e-002
Other Hexanes	7.26e-003	1.19e-001
Benzene	6.99e-005	1.04e-003
Toluene	1.51e-004	2.66e-003
Ethylbenzene	5.92e-005	1.20e-003
Xylenes	1.61e-004	3.27e-003
Total Components	100.00	5.30e+002

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia
Flow Rate: 5.35e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	8.89e+001	2.26e+002
Carbon Dioxide	2.74e-002	1.70e-001
Nitrogen	3.71e-002	1.46e-001
Methane	7.71e+000	1.74e+001
Ethane	1.67e+000	7.08e+000
Propane	6.28e-001	3.91e+000
Isobutane	9.32e-002	7.64e-001
n-Butane	2.34e-001	1.91e+000
Isopentane	5.73e-002	5.83e-001
n-Pentane	6.94e-002	7.05e-001
n-Hexane	2.07e-002	2.52e-001
Other Hexanes	8.16e-002	9.91e-001
Benzene	2.47e-002	2.72e-001
Toluene	9.31e-002	1.21e+000
Ethylbenzene	7.14e-002	1.07e+000
Xylenes	3.06e-001	4.57e+000
Total Components	100.00	2.67e+002

CONDENSER PRODUCED WATER STREAM

Temperature: 200.00 deg. F
Flow Rate: 2.45e-001 gpm

Component	Conc. (wt%)	Loading (lb/hr)	(ppm)
Water	1.00e+002	1.23e+002	999977.
Carbon Dioxide	2.71e-005	3.32e-005	0.
Nitrogen	1.02e-006	1.26e-006	0.
Methane	1.96e-004	2.41e-004	2.
Ethane	8.39e-005	1.03e-004	1.
Propane	6.24e-005	7.66e-005	1.
Isobutane	6.16e-006	7.55e-006	0.
n-Butane	1.89e-005	2.32e-005	0.
Isopentane	3.66e-006	4.49e-006	0.

n-Pentane	4.57e-006	5.61e-006	0.
n-Hexane	1.19e-006	1.46e-006	0.
Other Hexanes	3.94e-006	4.84e-006	0.
Benzene	1.12e-004	1.38e-004	1.
Toluene	3.64e-004	4.47e-004	4.
Ethylbenzene	2.19e-004	2.69e-004	2.
Xylenes	1.20e-003	1.47e-003	12.
Total Components	100.00	1.23e+002	999992.

CONDENSER RECOVERED OIL STREAM

Temperature: 200.00 deg. F

The calculated flow rate is less than 0.000001 #mol/hr.
The stream flow rate and composition are not reported.

CONDENSER VENT STREAM

Temperature: 200.00 deg. F
Pressure: 14.70 psia
Flow Rate: 2.76e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	7.85e+001	1.03e+002
Carbon Dioxide	5.29e-002	1.70e-001
Nitrogen	7.18e-002	1.46e-001
Methane	1.49e+001	1.74e+001
Ethane	3.23e+000	7.08e+000
Propane	1.22e+000	3.91e+000
Isobutane	1.80e-001	7.63e-001
n-Butane	4.52e-001	1.91e+000
Isopentane	1.11e-001	5.83e-001
n-Pentane	1.34e-001	7.05e-001
n-Hexane	4.01e-002	2.52e-001
Other Hexanes	1.58e-001	9.91e-001
Benzene	4.78e-002	2.72e-001
Toluene	1.80e-001	1.21e+000
Ethylbenzene	1.38e-001	1.07e+000
Xylenes	5.92e-001	4.57e+000
Total Components	100.00	1.44e+002

COMBUSTION DEVICE OFF GAS STREAM

Temperature: 1000.00 deg. F
Pressure: 14.70 psia
Flow Rate: 1.18e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Methane	6.97e+001	3.49e-001
Ethane	1.51e+001	1.42e-001
Propane	5.68e+000	7.81e-002
Isobutane	8.42e-001	1.53e-002
n-Butane	2.11e+000	3.83e-002

Isopentane	5.18e-001	1.17e-002
n-Pentane	6.27e-001	1.41e-002
n-Hexane	1.87e-001	5.03e-003
Other Hexanes	7.37e-001	1.98e-002
Benzene	2.23e-001	5.43e-003
Toluene	8.41e-001	2.42e-002
Ethylbenzene	6.45e-001	2.14e-002
Xylenes	2.76e+000	9.15e-002
Total Components	100.00	8.15e-001

ProMax 3.2

Bryan Research & Engineering, Inc.

ProMax® 3.2

with

TSWEET® & PROSIM®

Simulation Report

Project: UnderwoodCS.pmx

Licensed to Kleinfelder, Inc. and Affiliates

Client Name: Antero Midstream LLC
Location: Underwood CS
Job:

ProMax Filename: W:\20161767 Antero Lafferty and Underwood CS Air\2.0 Technical Information\2.9 - Deliverables to Client\Underwood CS\Model Files\UnderwoodCS.pmx
ProMax Version: 3.2.13330.0
Simulation Initiated: 10/7/2015 2:55:14 PM

Bryan Research & Engineering, Inc.
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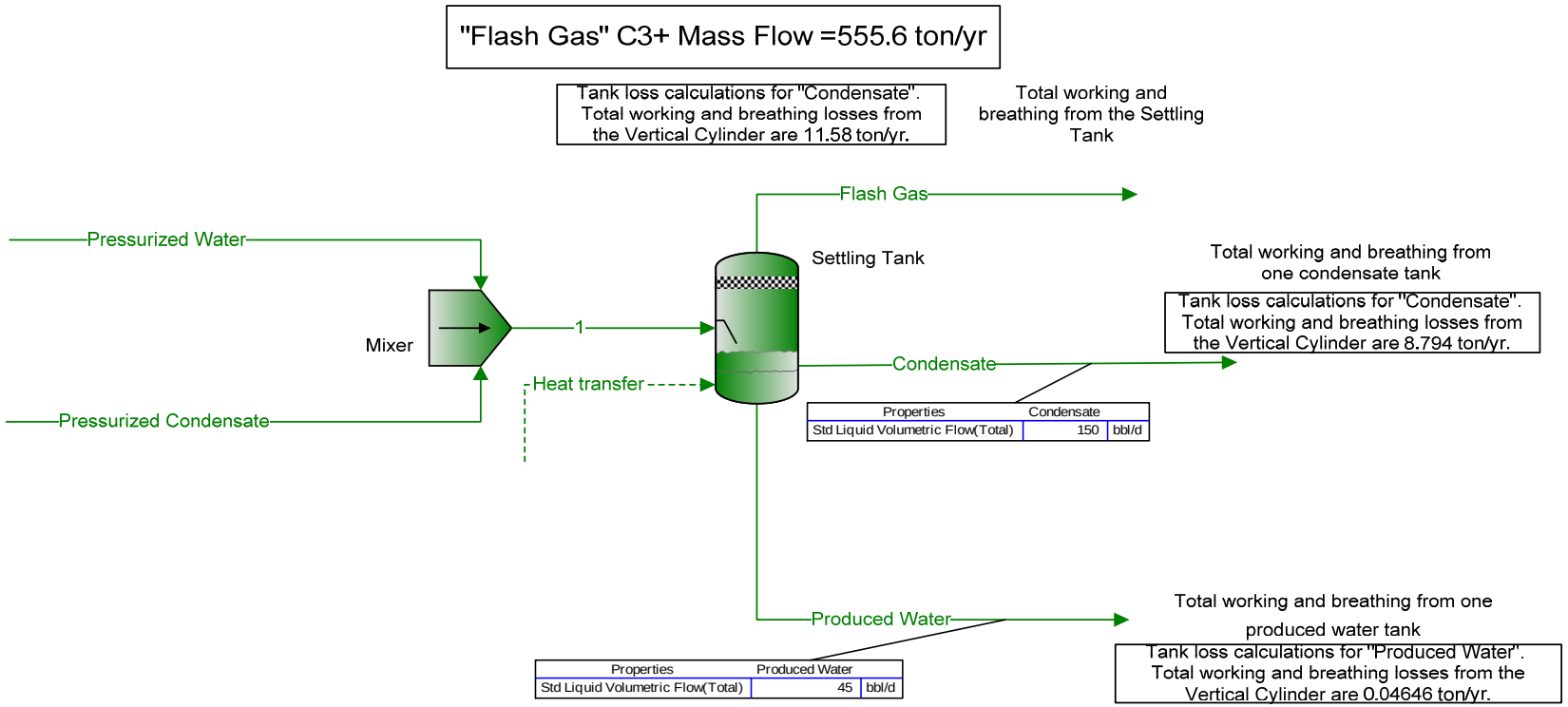
Report Navigator can be activated via the ProMax Navigator Toolbar.
An asterisk (*), throughout the report, denotes a user specified value.
A question mark (?) after a value, throughout the report, denotes an extrapolated or approximate value.


"Flash Gas" C3+ Mass Flow =555.6 ton/yr
Tank loss calculations for "Condensate". Total working and breathing losses from the Vertical Cylinder are 11.58 ton/yr.
Total working and breathing from the Settling Tank
Flash Gas
Pressurized Water
Settling Tank
Total working and breathing from one condensate tank
Tank loss calculations for "Condensate". Total working and breathing losses from the Vertical Cylinder are 8.794 ton/yr.
Mixer
1
Condensate
Heat transfer
Pressurized Condensate
Properties Condensate
Std Liquid Volumetric Flow(Total) 150 bbl/d
Produced Water
Total working and breathing from one produced water tank
Tank loss calculations for "Produced Water". Total working and breathing losses from the Vertical Cylinder are 0.04646 ton/yr.
Properties Produced Water
Std Liquid Volumetric Flow(Total) 45 bbl/d

Process Streams		Condensate	Flash Gas	Pressurized Condensate	Pressurized Water	Produced Water	1
Composition	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Total**	**From Block:**	Settling Tank	Settling Tank	--	--	Settling Tank	Mixer
	To Block:	--	--	Mixer	Mixer	--	Settling Tank
Mole Fraction		%	%	%	%	%	%
Methane		0.0980634	19.1774	4.41172*	0.441197*	0.000499442	1.49367
Ethane		0.859457	25.0985	6.34359*	0.634396*	0.000779467	2.14774
Propane		3.19158	24.4483	8.01349*	0.801395*	0.000901308	2.71311
i-Butane		1.70596	4.88851	2.43384*	0.243399*	6.08833E-05	0.824023
n-Butane		6.35453	12.4564	7.76591*	0.776588*	0.000333526	2.62926
i-Pentane		5.06746	3.74433	4.79369*	0.479397*	7.16100E-05	1.62299
n-Pentane		7.92559	4.30407	7.14654*	0.714696*	7.85084E-05	2.41959
2-Methylpentane		7.17994	1.54328	5.94162*	0.594196*	1.31936E-05	2.01165
n-Heptane		16.3403	0.773976	12.9032*	1.29039*	7.34560E-06	4.36861
n-Octane		15.9540	0.229409	12.4792*	1.24799*	1.21207E-06	4.22506
n-Nonane		7.58574	0.0342232	5.91662*	0.591696*	2.96474E-07	2.00318
n-Hexane		6.47977	0.987770	5.27066*	0.527097*	6.77084E-06	1.78448
Benzene		0.122827	0.0184885	0.0999936*	0.00999994*	7.14614E-05	0.0338547
Toluene		0.812046	0.0319492	0.639959*	0.0639996*	0.000101421	0.216670
Ethylbenzene		0.787818	0.00988380	0.615961*	0.0615996*	3.00857E-05	0.208545
p-Xylene		2.15211	0.0238089	1.68189*	0.168199*	6.75830E-05	0.569436
Nitrogen		8.25666E-05	0.0528003	0.0119992*	0.00119999*	6.71244E-07	0.00406256
Carbon Dioxide		0.00164829	0.0912178	0.0219986*	0.00219999*	5.03715E-05	0.00744803
Water		0.0401301	2.08351	0*	89.9995*	99.9969	66.1432
Decanes+		17.3409	0.00220372	13.5081*	1.35089*	1.89574E-08	4.57343
Mass Fraction		%	%	%	%	%	%
Methane		0.0148714	7.49121	0.772688*	0.278946*	0.000444729	0.558203
Ethane		0.244297	18.3763	2.08248*	0.751789*	0.00130094	1.50442
Propane		1.33037	26.2504	3.85782*	1.39270*	0.00220601	2.78696
i-Butane		0.937314	6.91847	1.54440*	0.557540*	0.000196417	1.11570
n-Butane		3.49140	17.6289	4.92788*	1.77889*	0.00107600	3.55994
i-Pentane		3.45615	6.57802	3.77594*	1.36314*	0.000286776	2.72780
n-Pentane		5.40548	7.56135	5.62925*	2.03220*	0.000314402	4.06667
2-Methylpentane		5.84894	3.23832	5.59002*	2.01804*	6.31080E-05	4.03833
n-Heptane		15.4778	1.88841	14.1156*	5.09582*	4.08548E-05	10.1973
n-Octane		17.2274	0.638081	15.5628*	5.61827*	7.68495E-06	11.2428
n-Nonane		9.19699	0.106878	8.28464*	2.99081*	2.11057E-06	5.98497
n-Hexane		5.27857	2.07267	4.95877*	1.79015*	3.23866E-05	3.58230
Benzene		0.0906952	0.0351650	0.0852736*	0.0307844*	0.000309833	0.0616031
Toluene		0.707286	0.0716791	0.643751*	0.232399*	0.000518693	0.465057
Ethylbenzene		0.790643	0.0255504	0.713936*	0.257736*	0.000177289	0.515760
p-Xylene		2.15983	0.0615477	1.94942*	0.703754*	0.000398252	1.40829
Nitrogen		2.18647E-05	0.0360159	0.00366982*	0.00132483*	1.04373E-06	0.00265114
Carbon Dioxide		0.000685729	0.0977502	0.0105698*	0.00381577*	0.000123047	0.00763580
Water		0.00683416	0.913962	0*	63.8994*	99.9925	27.7583
Decanes+		28.3344	0.00927507	25.4912*	9.20250*	1.81881E-07	18.4153
Mass Flow		lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
Methane		0.229144	13.0023	10.3614*	2.87294*	0.00291953	13.2343
Ethane		3.76422	31.8952	27.9251*	7.74288*	0.00854034	35.6680
Propane		20.4990	45.5621	51.7317*	14.3438*	0.0144819	66.0755
i-Butane		14.4425	12.0082	20.7097*	5.74225*	0.00128943	26.4520
n-Butane		53.7969	30.5980	66.0807*	18.3213*	0.00706366	84.4019
i-Pentane		53.2538	11.4173	50.6336*	14.0393*	0.00188261	64.6730
n-Pentane		83.2898	13.1240	75.4857*	20.9302*	0.00206397	96.4159
2-Methylpentane		90.1229	5.62066	74.9597*	20.7843*	0.000414288	95.7440
n-Heptane		238.489	3.27765	189.283*	52.4832*	0.000268202	241.767
n-Octane		265.446	1.10750	208.690*	57.8640*	5.04497E-05	266.554
n-Nonane		141.711	0.185505	111.093*	30.8032*	1.38554E-05	141.897
n-Hexane		81.3344	3.59747	66.4949*	18.4372*	0.000212610	84.9321
Benzene		1.39747	0.0610348	1.14348*	0.317056*	0.00203398	1.46054
Toluene		10.8981	0.124411	8.63242*	2.39354*	0.00340509	11.0260
Ethylbenzene		12.1826	0.0443470	9.57357*	2.65449*	0.00116386	12.2281
p-Xylene		33.2795	0.106827	26.1408*	7.24815*	0.00261443	33.3890
Nitrogen		0.000336900	0.0625117	0.0492106*	0.0136448*	6.85179E-06	0.0628554
Carbon Dioxide		0.0105660	0.169662	0.141736*	0.0392997*	0.000807773	0.181036
Water		0.105303	1.58634	0*	658.117*	656.425	658.117
Decanes+		436.589	0.0160985	341.826*	94.7790*	1.19400E-06	436.605

Process Streams		Condensate	Flash Gas	Pressurized Condensate	Pressurized Water	Produced Water	1
Properties	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Total**	**From Block:**	Settling Tank	Settling Tank	--	--	Settling Tank	Mixer
	To Block:	--	--	Mixer	Mixer	--	Settling Tank
Property	**Units**						
Temperature	°F	65.08	65.08*	120*	120*	65.08	119.793
Pressure	psig	0	0	300*	300*	0*	300
Mole Fraction Vapor	%	0	100	0	0	0	0
Mole Fraction Light Liquid	%	100	0	100	9.99020	100	33.8881
Mole Fraction Heavy Liquid	%	0	0	0	90.0098	0	66.1119
Molecular Weight	lb/lbmol	105.786	41.0685	91.5956	25.3737	18.0161	42.9272
Mass Density	lb/ft^3	44.1935	0.108813	41.1450	52.2815	62.3189	45.3558
Molar Flow	lbmol/h	14.5657	4.22629	14.6400	40.5903	36.4383	55.2303
Mass Flow	lb/h	1540.84	173.567	1340.96	1029.93	656.475	2370.88
Vapor Volumetric Flow	ft^3/h	34.8658	1595.09	32.5910	19.6996	10.5341	52.2730
Liquid Volumetric Flow	gpm	4.34690	198.868	4.06329	2.45606	1.31334	6.51716
Std Vapor Volumetric Flow	MMSCFD	0.132659	0.0384914	0.133335	0.369681	0.331866	0.503017
Std Liquid Volumetric Flow	sgpm	4.37487	0.716315	3.98349*	2.42013*	1.31243	6.40362
Compressibility		0.00624668	0.984933	0.112617	0.0245517	0.000754434	0.0478963
Specific Gravity		0.708581	1.41798	0.659703	0.838261	0.999197	0.727216
API Gravity		67.5067		73.1098	33.2532	10.0157	55.9841
Enthalpy	Btu/h	-1.37143E+06	-195441	-1.20092E+06	-4.79397E+06	-4.48561E+06	-5.99489E+06
Mass Enthalpy	Btu/lb	-890.051	-1126.03	-895.574	-4654.67	-6832.87	-2528.55
Mass Cp	Btu/(lb*°F)	0.489379	0.408507	0.535294	0.820776	0.983557	0.659193
Ideal Gas CpCv Ratio		1.05236	1.13537	1.05543	1.21803	1.32606	1.12268
Dynamic Viscosity	cP	0.486277	0.00846042	0.280616	0.438881	1.06070	0.340650
Kinematic Viscosity	cSt	0.686918	4.85387	0.425769	0.509251	1.06256	0.457572
Thermal Conductivity	Btu/(h*ft*°F)	0.0702006	0.0111480	0.0636448	0.228079	0.344706	0.125583
Net Ideal Gas Heating Value	Btu/ft^3	5339.96	2136.71	4642.61	464.286	0.0685448	1571.84
Net Liquid Heating Value	Btu/lb	18998.3	19589.7	19078.1	6210.12	-1058.25	13488.1
Gross Ideal Gas Heating Value	Btu/ft^3	5742.75	2325.37	4998.76	545.182	50.3826	1725.70
Gross Liquid Heating Value	Btu/lb	20443.3	21333.0	20553.6	7419.98	1.55037	14848.3

Settling Tank Working and Breathing:	195 bbl/day	
True vapor pressure at average temp	11.76	psia
average temp	65.08	F
Max temp	75.94	F

Single Condensate Tank Working and Breathing:	75 bbl/day	
True vapor pressure at average temp	11.76	psia
average temp	65.08	F
Max temp	75.94	F

Single Produced Water Tank Working and Breathing:	22.5 bbl/day	
True vapor pressure at average temp	0.3144	psia
average temp	65.08	F
Max temp	75.94	F

Promax AP-42 Emissions Report
Annual Emissions
Settling Tank

Components	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (ton/yr)
Mixture	6.891	4.688	11.58
Methane	0.0628	0.04272	0.1055
Ethane	1.479	1.006	2.485
Propane	1.998	1.359	3.357
i-Butane	0.5215	0.3548	0.8763
n-Butane	1.335	0.9083	2.244
i-Pentane	0.4872	0.3314	0.8186
n-Pentane	0.562	0.3823	0.9443
2-Methylpenta	0.2444	0.1662	0.4106
n-Heptane	0.1313	0.0893	0.2206
n-Octane	0.04316	0.02936	0.07251
n-Nonane	0.006822	0.004641	0.01146
n-Hexane	0.01075	0.00731	0.01806
Benzene	0.0001496	0.0001017	0.0002513
Toluene	0.0006794	0.0004622	0.001142
Ethylbenzene	0.0004723	0.0003213	0.0007936
p-Xylene	0.001229	0.0008361	0.002065
Nitrogen	3.17E-05	2.15E-05	5.32E-05
Carbon Dioxic	0.005571	0.00379	0.009361
Water	2.16E-05	1.47E-05	3.63E-05
Decanes+	0.0005193	0.0003533	0.0008726

Promax AP-42 Emissions Report
Annual Emissions
Single Condensate Tank

Components	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (ton/yr)
Mixture	4.179	4.615	8.794
Methane	0.03808	0.04205	0.08014
Ethane	0.8971	0.9906	1.888
Propane	1.212	1.338	2.549
i-Butane	0.3163	0.3493	0.6656
n-Butane	0.8098	0.8942	1.704
i-Pentane	0.2955	0.3263	0.6217
n-Pentane	0.3408	0.3764	0.7172
2-Methylpenta	0.1482	0.1637	0.3119
n-Heptane	0.07961	0.08791	0.1675
n-Octane	0.02617	0.0289	0.05507
n-Nonane	0.004137	0.004569	0.008706
n-Hexane	0.006517	0.007197	0.01371
Benzene	9.07E-05	0.0001002	0.0001909
Toluene	0.000412	0.000455	0.000867
Ethylbenzene	0.0002864	0.0003163	0.0006027
p-Xylene	0.0007454	0.0008231	0.001568
Nitrogen	1.92E-05	2.12E-05	4.04E-05
Carbon Dioxid	0.003379	0.003731	0.00711
Water	1.31E-05	1.45E-05	2.76E-05
Decanes+	0.000315	0.0003478	0.0006628

Promax AP-42 Emissions Report
Annual Emissions
Single Produced Water Tank

Components	Working Losses (ton/yr)	Breathing Losses (ton/yr)	Total Losses (ton/yr)
Mixture	0.02358	0.02283	0.0464
Methane	0.0001869	0.000181	0.0003679
Ethane	0.0004419	0.0004279	0.0008698
Propane	0.0001673	0.000162	0.0003292
i-Butane	4.38E-06	4.24E-06	8.62E-06
n-Butane	1.94E-05	1.87E-05	3.81E-05
i-Pentane	1.76E-06	1.71E-06	3.47E-06
n-Pentane	1.42E-06	1.38E-06	2.80E-06
2-Methylpenta	9.30E-08	9.00E-08	1.83E-07
n-Heptane	1.17E-08	1.13E-08	2.30E-08
n-Octane	5.40E-10	5.22E-10	1.06E-09
n-Nonane	5.35E-11	5.18E-11	1.05E-10
n-Hexane	2.13E-09	2.06E-09	4.19E-09
Benzene	2.79E-08	2.70E-08	5.49E-08
Toluene	2.72E-08	2.63E-08	5.35E-08
Ethylbenzene	5.78E-09	5.59E-09	1.14E-08
p-Xylene	1.24E-08	1.20E-08	2.43E-08
Nitrogen	2.81E-07	2.72E-07	5.53E-07
Carbon Dioxid	7.24E-05	7.01E-05	0.0001424
Water	0.02268	0.02196	0.04464
Decanes+	1.10E-13	1.06E-13	2.16E-13

Attachment O.
Monitoring, Recordkeeping, Reporting, and Testing Plans

Monitoring, Recordkeeping, Reporting, and Testing Plans

The following is a summary of the methods to comply with the requirements of West Virginia Division of Air Quality (WVDAQ) 45CSR13 rules and regulations for the Tamela Compressor Station, including federal and state regulatory requirements.

1. Summary of Key Operational Throughput Limits

a. Maximum wet gas throughput into each Dehy: 60 MMscf/day or 21,900 MMscf/year.

b. Maximum liquids loaded out: 2,989,350 gallons per year.

c. Maximum fuel use of all compressor engines is 1,025,077,680 scf/year

2. Operational Requirements

a. Compressor engines will operate with the catalytic converter in place at all times and will be fueled by natural gas only.

b. Catalysts installed on all compressor engines will be operated per manufacturer instructions.

c. Reciprocating compressor rod packing will be replaced within 36 months of last packing/startup or within 26,000 operating hours, whichever comes first.

d. Microturbines will be fueled by natural gas only.

e. Each Dehy Reboiler will operate at no more than 1.5 MMBtu/hr and fueled only by natural gas or off-gases from the Dehydrator flash tanks.

f. No fuel-burning unit of any kind will have opacity greater than 10 percent based on a six minute block average observation.

g. The Dehy Flare capacity will not exceed 9.2 MMBtu/hr, will achieve 98 percent destruction efficiency, will operate at all times that gas is vented to it, will have a flame present at all times, and will have no visible emissions other than for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

h. The flare will be operated per manufacturer instructions.

i. Produced water, Condensate, and Settling storage tanks potential emissions will be routed to the VRUs with recovery greater than 98 percent at all times.

j. Storage tanks will be covered and routed to a closed vent system with no detectable emissions.

k. Liquid loadout trucks will use the submerged-fill method.

l. Dehydrator still vents will be controlled by the flare.

3. Monitoring

a. Non-certified engines will be stack tested within 1 year of startup and every 8,760 hours of operation thereafter.

b. Catalyst inlet temperature will be monitored.

c. Compressor run time or number of months since compressor rod repacking will be monitored or tracked.

d. Daily, monthly, and rolling 12-month average wet gas throughput for the Dehy will be monitored.

e. Initial Method 22 observation of the Reboiler exhaust and flare will be conducted for a minimum of 2 hours.

f. Monthly Method 22 observations of the Reboiler exhaust and flare will be conducted for a minimum of 10 minutes each.

g. Monthly olfactory, visual, and auditory inspections will be conducted of the tanks closed vent and control system (flare) for leaks or defects that could result in emissions. Leaks will be repaired as soon as practicable (no later than 5 days for first attempt).

h. The presence of flare flame will continuously be monitored.

i. Monthly and rolling twelve-month average amount of liquids loaded out will be monitored.

4. Recordkeeping

a. Records will be kept for a minimum of 5 years.

b. Records of inspection, observations, preventive maintenance, malfunctions, and shutdowns of all onsite equipment will be kept.

c. Records of the date, time, duration of each time that a flame is not present at the flare and startup, shutdown, malfunctions of the flare will be kept.

d. Records of engine maintenance and engine run time will be kept.

e. Records of catalyst inlet temperature will be kept.

f. Records of the actual annual average natural gas throughput in the dehy will be kept.

5. Notifications and Reports

a. WVDAQ will be notified within 30 calendar days of commencement of construction.

b. WVDAQ will be notified within 30 calendar days of startup.

c. Upon startup, a Certificate to Operate (CTO) application will be filed and fees to WVDAQ will be paid for the period from startup to the following June 30 and then annually renew the CTO and pay fees. CTO will be maintained on-site.

d. An annual report of compliance with 40 CFR 60 Subpart OOOO for the compressors and storage tanks (for settling tank only) will be submitted within 90 days after one year of operation (i.e., within 90 days after 12 months after initial startup).

e. For stack testing, a protocol will be filed at least 30 days prior to test and WVDAQ and EPA will be notified of the test at least 15 days prior to test. Results will be reported within 60 days of the test.

f. If operations are suspended for 60 days or more, WVDAQ will be notified within 2 weeks after the 60th day.

Attachment P.
Public Notice

AIR QUALITY PERMIT NOTICE
Notice of Application – Underwood Compressor Station

Notice is given that Antero Midstream LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a 45CSR13 Construction Permit for a Natural Gas Compressor Station located west of Centerville and south of Wheelers Run Road, in Tyler County, West Virginia. The latitude and longitude coordinates are: 39.432520N, 80.871591W.

The applicant estimates the potential to discharge the following Regulated Air Pollutants will be: Nitrogen Oxides (NOx) – 82.19 tons per year (tpy); Carbon Monoxide (CO) – 87.93 tpy; Volatile Organic Compounds (VOC) – 88.78 tpy; Particulate Matter less than 10 µm (PM_{10}) – 12.62 tpy; Particulate Matter less than 2.5 µm ($PM_{2.5}$) – 12.02 tpy; Sulfur Dioxide (SO_2) – 0.45 tpy; Formaldehyde – 1.94 tpy; Benzene – 1.01 tpy; Toluene – 0.60 tpy; Ethylbenzene – 0.23 tpy; Xylenes – 0.98 tpy; n-Hexane – 0.80 tpy; and Carbon Dioxide equivalent (CO_2e) – 97,571 tpy.

Startup of operation is planned to begin on or about the 1st day of September 2016, with construction starting prior to that date. 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 11th day of November 2015.

By: Antero Midstream LLC
Barry Schatz
Midstream Environmental Supervisor
1615 Wynkoop Street
Denver, CO 80202

Attachment R.
Authority/Delegation of Authority

Attachment R
AUTHORITY OF CORPORATION
OR OTHER BUSINESS ENTITY (DOMESTIC OR FOREIGN)

TO: The West Virginia Department of Environmental Protection, Division of Air Quality

DATE: October 15 , 2014

ATTN.: Director

Corporation's / other business entity's Federal Employer I.D. Number 46-5517375

The undersigned hereby files with the West Virginia Department of Environmental Protection, Division of Air Quality, a permit application and hereby certifies that the said name is a trade name which is used in the conduct of an incorporated business or other business entity.

Further, the corporation or the business entity certifies as follows:

(1) Luz C. Slauter and Lou Ann Lee (is/are) the authorized representative(s) and in that capacity may represent the interest of the corporation or the business entity and may obligate and legally bind the corporation or the business entity.

(2) The corporation or the business entity is authorized to do business in the State of West Virginia.

(3) If the corporation or the business entity changes its authorized representative(s), the corporation or the business entity shall notify the Director of the West Virginia Department of Environmental Protection, Division of Air Quality, immediately upon such change.

Mark D. Mauz, Vice President

President or Other Authorized Officer
(Vice President, Secretary, Treasurer or other official in charge of a principal business function of the corporation or the business entity)

(If not the President, then the corporation or the business entity must submit certified minutes or bylaws stating legal authority of other authorized officer to bind the corporation or the business entity).

Secretary

Antero Midstream LLC
Name of Corporation or business entity