December 14, 2017

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

Re: Tug Hill Operating, LLC, G70-D General Permit Application – Shields Well Pad

Dear Mr. Durham,

Tug Hill Operating, LLC (Tug Hill) and SLR International Corporation (SLR) have prepared the attached G70-D General Permit Application for the Shields well pad located in Marshall County, West Virginia. This application reflects the site as having (10) Marcellus wells, (4) 1.0 MMBtu/hr gas processing units, (2) 400 bbl produced water tanks, and (1) 840 HP 4SRB compressor engine (Waukesha F3524GSI). Emissions from the tanks will be controlled by a 2 MMBtu/hr enclosed combustor.

All site emissions have been evaluated and are attached for your review within this application.

The public notice was delivered to the *Moundsville Daily Echo* for publication. The legal advertisement has been scheduled to run in the December 18th edition of the paper and will be forwarded to your office as soon as SLR receives the original affidavit from the newspaper.

If any additional information is needed, please feel free to contact me by telephone at (304) 545-8563 or by e-mail at jhanshaw@slrconsulting.com

Sincerely,
SLR International Corporation

Jesse Hanshaw

Jesse Hanshaw, P.E.
Principal Engineer

Tug Hill Operating, LLC

Shields Well Pad

Proctor, West Virginia

G70-D General Permit Application

SLR Ref: 116.01631.00019

December 2017

Shields Well Pad G70-D General Permit Application

Prepared for:

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

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

Alex Asbury
Staff Engineer

Jesse Hanshaw, P.E.
Principal Engineer

CONTENTS

Section

Notes:
ATTACHMENT B – N/A – No dwellings or businesses located within 300’ of the facility.
ATTACHMENT P – N/A - No glycol dehydration unit in use at the facility.

SECTION 1.

TECHNICAL SUPPORT DOCUMENT

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

1.1 INTRODUCTION

Tug Hill Operating, LLC has prepared this application to reflect the new construction of equipment at the Shields well pad, and is seeking coverage under the G70-D General Permit. This document contains all applicable permitting forms and fees in accordance with 45CSR13.

The site as evaluated has been classified as a minor NSR and Title V facility. The details of this evaluation are provided in section 2.0 with supporting documentation presented within the calculations section.

1.2 DESCRIPTION OF FACILITY

Tug Hill Operating, LLC is applying for a General Permit Registration under G70-D for the new construction and operation of equipment at the Shields well pad. The site consists of (10) Marcellus wells, (4) 1 MMBtu/hr gas processing units, and (2) 400 bbl produced water tanks. The proposed (1) 840 HP Waukesha 4SRB compressor engine (Unit 1807) would be used to boost pressure prior to the gas entering the sales pipeline. The predicted increase in production will make it necessary to also install a (2) MMBtu/hr flare to control tank VOC emissions.

DESCRIPTION OF PROCESS

Natural gas, condensate and produced water will be separated from 10 horizontal wells located onsite producing from the Marcellus formation. Each well stream will first pass through one of four (4) 1 MMBtu/hr gas processing units (GPU-1 through GPU-4).

The gas exiting the gas processing units will be sent to the compressor before being routed into a sales pipeline. The water will be sent into one of two (2) 400 bbl produced water tanks. The condensate is sent to a condensate pipeline and is removed from the site. There will be no dedicated condensate storage tanks located at the Shields site.

The emissions from the produced water storage tanks will be directed to a 2 MMBtu/hr enclosed vapor combustor (F-1) for VOC and methane destruction. The produced water is hauled offsite by 140 bbl pump trucks. The displaced emissions from truck loading were accounted for as a point source on an uncontrolled basis.

The site is proposing to install a sales gas compressor in order to increase production gas volumes. The equipment will consist of an F3524GSI Waukesha engine which is rated at 840 HP.

1.3 FEDERAL AND STATE REQUIREMENT

APPLICABLE REGULATIONS

This facility is subject to the following applicable rules and regulations:

Federal and State:

45 CSR 2 – Particulate Matter Standards from Combustion of Fuel in Indirect Heat Exchangers

The indirect heat exchanger consisting of the line heater is subject to the visible emission standard of §45-2-3 as follows:

3.1. No person shall cause, suffer, allow or permit emission of smoke and/or particulate matter into the open air from any fuel burning unit which is greater than ten (10) percent opacity based on a six minute block average.

However, in accordance with the exemptions defined with §45-2-11 these sources have limited requirements as follows:

11.1. Any fuel burning unit(s) having a heat input less than ten (10) million B.T.U.'s per hour will be exempt from sections 4, 5, 6, 8 and 9. However, failure to attain acceptable air quality in parts of some urban areas may require the mandatory control of these sources at a later date.

45 CSR 10 - Emission of Sulfur Oxides

The well pad facility evaluated within this determination application utilizes fuel burning units, but they are all less than the exemption threshold of 10 MMBtu/hr as stated in 45CSR§10-10.1 as follows:

10.1 Any fuel burning units having a design heat input less than ten (10) million BTU's per hour will be exempt from section 3 and sections 6 through 8. However, failure to attain acceptable air quality in parts of some urban areas may require the mandatory control of these sources at a later date.

40 CFR 61 - This facility is subject to the asbestos inspection and notification requirements. However, no asbestos is affected by the proposed construction activities.

45 CSR 13 - Permits for Construction, Modification, Relocation, and Operation of Stationary Source of Air Pollutants

The company is applying for a general well pad permit. The throughput to the site is expected to increase with the installation of on-site compression, and after evaluation of the resulting production increase using ProMax modeling software, it has been deemed necessary to control tank emissions by utilizing an enclosed combustor.

WV Code § 22-5-4 (a) (14)
The Secretary can request any pertinent information such as annual emission inventory reporting. This station is not required to submit an annual air emission inventory.

45 CSR 17 - Fugitive Particulate Emissions

The site shall minimize fugitive PM so that emissions do not travel offsite.

40 CFR 60, Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines

The compressor engine (CE-1) at the station was manufactured on 1-23-2007, which predates the January 1, 2008 applicability date for rich burn engines greater than 500 hp. Therefore, the compressor engine is not subject to emissions limits according to 40 CFR§60.4230-(a)(4)(i). Additionally, the compressor is proposed as a sales gas compressor at the Shields location and therefore was evaluated for applicability to §60.4236 related to requirements for installing previous model year engines. This engine was found to be exempt as a relocated unit according to §60.4236(e).

40 CFR 63, Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

The natural gas compressor engine (CE-1) is a 4SRB Waukesha F3524GSI engine manufactured on 1-23-2007; therefore, per 40CFR63.6590(c)(1) the requirements of this regulation are to comply with new SI engines standards in accordance with 40CFR60, Subpart JJJJ.

NON-APPLICABILITY DETERMINATIONS

The following requirements have been determined “not applicable” due to the following:

45 CSR 27 - To Prevent and Control the Emissions of Toxic Air Pollutants

This rule is not applicable because natural gas is included as a petroleum product and contains less than 5% benzene by weight. 45CSR § 27-2.4 exempts equipment “used in the production and distribution of petroleum products providing that such equipment does not produce or contact materials containing more than 5% benzene by weight.”

45 CSR 30 – Requirements for Operating Permits – Title V of the Clean Air Act

This facility does not meet the emission thresholds to trigger a 45 CSR 30 Title V Operating Permit nor is it subject to any Federal Standards that require a Title V Permit.

40 CFR 60 Subpart K, Ka, Kb - Storage Vessel NSPS

The two 400 bbl [16,800 gal] produced liquid tanks T01-T02 are below the size capacity threshold of 75 meters cubed (m^3) [19,813 gallons] defined within the applicability section 60.110b(a) of this Federal standard.

40 CFR 60 Subpart KKK - Natural Gas Processing Plant NSPS

This subpart is not applicable because this site is not a processing plant engaged in extracting natural gas liquids by fractionation from natural gas.

> *Natural gas processing plant (gas plant) means any processing site engaged in the extraction of natural gas liquids from field gas, fractionation of mixed natural gas liquids to natural gas products, or both.*

40 CFR 60 Subpart OOOO - Storage Vessel NSPS Requirements

The existing storage vessels (T01-T02) was constructed after August 23, 2011 but before, September 18, 2015 and has been demonstrated to have a PTE VOCs < 6 tpy with controls using ProMax Equation of State estimation techniques with representative inputs. Therefore, the existing storage vessel is not considered an affected source under this regulation.

40 CFR 60 Subpart OOOOa - Storage Vessel NSPS Requirements

The existing storage vessels predate the applicability date of this regulation, September 18, 2015

40 CFR 60 Subpart OOOOa – Fugitive Component Leak Monitoring

The site is classified as a well pad facility, which will not be subject to the monitoring requirement of this section since the existing well site predates the applicability date of September 18, 2015 as defined under this Federal regulation.

40 CFR 60 Subpart OOOOa – Compressor Packing Requirements

The site is classified as a well pad facility, which will not be subject to the monitoring requirement of this section since the compressor meets the exemption for units operated at well sites as defined under this federal regulation.

40 CFR 63 Subpart HH - National Emission Standards for Hazardous Air Pollutants from Oil and Natural Gas Production Facilities

There is no dehydration unit at this site.

40 CFR 63 Subpart JJJJJJ - Boilers Located at Area Sources of HAPs

This subpart is not applicable because the process heaters at this facility are not classified as boilers under this area source GACT standard.

40 CFR 82 Subpart F - Ozone Depleting Substances

The purpose of this subpart is to reduce emissions of class I and class II refrigerants and their substitutes. The facility does not utilize class I and class II refrigerants nor any substitutes.

Aggregation Discussion (Facility Determination)

The Shields well site is operated solely by Tug Hill Operating, LLC. This well pad facility has the ability to transfer its products via pipeline to midstream compression companies, of which are located on non-contiguous sites over a mile away. Additionally, these sources are not under common control nor is there any support and/or dependency relationship between the midstream companies and Tug Hill.

No other facilities operated by Tug Hill are within a quarter-mile radius and as a result this pad should be considered a single facility as defined within this determination application.

SECTION 2.

APPLICATION FOR PERMIT

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

west virginia department of environmental protection

Division of Air Quality
601 57th Street SE
Charleston, WV 25 4
Phone (304) 926-0475
Fax (304) 926-0479
www.dep.wv.gov

G70-D GENERAL PERMIT REGISTRATION APPLICATION

PREVENTION AND CONTROL OF AIR POLLUTION IN REGARD TO THE CONSTRUCTION, MODIFICATION, RELOCATION, ADMINISTRATIVE UPDATE AND OPERATION OF NATURAL GAS PRODUCTION FACILITIES LOCATED AT THE WELL SITE

☒CONSTRUCTION
☐MODIFICATION
☐RELOCATION
☐CLASS I ADMINISTRATIVE UPDATE
☐CLASS II ADMINISTRATIVE UPDATE

SECTION 1. GENERAL INFORMATION

Name of Applicant (as registered with the WV Secretary of State's Office): Tug Hill Operating, LLC

Federal Employer ID No. (FEIN): 26-2056245

Applicant's Mailing Address:
380 Southpointe Blvd., Suite 200

City: Canonsburg	State: PA	ZIP Code: 15317

Facility Name: Shields Well Pad

Operating Site Physical Address: Burch Ridge Proctor, WV 26155
If none available, list road, city or town and zip of facility.

City: Proctor	Zip Code: 26155	County: Marshall

Latitude & Longitude Coordinates (NAD83, Decimal Degrees to 5 digits):
Latitude: 39.76026
Longitude: -80.78795

SIC Code: 1311 NAICS Code: 211111	DAQ Facility ID No. (For existing facilities)

CERTIFICATION OF INFORMATION

This G70-D General Permit Registration Application shall be signed below by a Responsible Official. A Responsible Official is a President, Vice President, Secretary, Treasurer, General Partner, General Manager, a member of the Board of Directors, or Owner, depending on business structure. A business may certify an Authorized Representative who shall have authority to bind the Corporation, Partnership, Limited Liability Company, Association, Joint Venture or Sole Proprietorship. Required records of daily throughput, hours of operation and maintenance, general correspondence, compliance certifications and all required notifications must be signed by a Responsible Official or an Authorized Representative. If a business wishes to certify an Authorized Representative, the official agreement below shall be checked off and the appropriate names and signatures entered. **Any administratively incomplete or improperly signed or unsigned G70-D Registration Application will be returned to the applicant. Furthermore, if the G70-D forms are not utilized, the application will be returned to the applicant. No substitution of forms is allowed.**

I hereby certify that is an Authorized Representative and in that capacity shall represent the interest of the business (e.g., Corporation, Partnership, Limited Liability Company, Association Joint Venture or Sole Proprietorship) and may obligate and legally bind the business. If the business changes its Authorized Representative, a Responsible Official shall notify the Director of the Division of Air Quality immediately.

I hereby certify that all information contained in this G70-D General Permit Registration Application and any supporting documents appended hereto is, to the best of my knowledge, true, accurate and complete, and that all reasonable efforts have been made to provide the most comprehensive information possible.

Responsible Official Signature: S.K. Willis
Name and Title: Sean Willis Vice President Phone: 817-632-5200 Fax:
Email: swillis@tug-hillop.com Date: 12/01/2017

If applicable:
Authorized Representative Signature: _____
Name and Title: Phone: Fax:
Email: Date:

If applicable:
Environmental Contact
Name and Title: Amy Miller Environmental Coordinator Phone: (724) 338-2030 Fax:
Email: amiller@tug-hillop.com Date:

OPERATING SITE INFORMATION
Briefly describe the proposed new operation and/or any change(s) to the facility: This site will encompass 10 existing Marcellus wells and associated separation and new gas compression equipment. The facility will also utilize liquid storage vessels.
Directions to the facility: Traveling from Proctor get onto WV-2 S and travel 7.3 miles. Turn right onto Burch Ridge Rd and travel 3.7 miles. The access road to the well pad will be located on the left. The site will be straight ahead in approximately 0.4 miles.

ATTACHMENTS AND SUPPORTING DOCUMENTS	
I have enclosed the following required documents:	
Check payable to WVDEP – Division of Air Quality with the appropriate application fee (per 45CSR13 and 45CSR22). ☒ Check attached to front of application. ☐ I wish to pay by electronic transfer. Contact for payment (incl. name and email address): ☐ I wish to pay by credit card. Contact for payment (incl. name and email address): ☒$500 (Construction, Modification, and Relocation) ☐$300 (Class II Administrative Update) ☐$1,000 NSPS fee for 40 CFR60, Subpart IIII, JJJJ, OOOO and/or OOOOa [1] ☐$2,500 NESHAP fee for 40 CFR63, Subpart ZZZZ and/or HH [2] [1] Only one NSPS fee will apply. [2] Only one NESHAP fee will apply. The Subpart ZZZZ NESHAP fee will be waived for new engines that satisfy requirements by complying with NSPS, Subparts IIII and/or JJJJ. *NSPS and NESHAP fees apply to new construction or if the source is being modified.*	
☒ Responsible Official or Authorized Representative Signature (if applicable)	
☒ Single Source Determination Form **(must be completed)** – Attachment A	
☒ Siting Criteria Waiver (if applicable) – Attachment B	☒ Current Business Certificate – Attachment C
☒ Process Flow Diagram – Attachment D	☒ Process Description – Attachment E
☒ Plot Plan – Attachment F	☒ Area Map – Attachment G
☒ G70-D Section Applicability Form – Attachment H	☒ Emission Units/ERD Table – Attachment I
☒ Fugitive Emissions Summary Sheet – Attachment J	
☒ Gas Well Affected Facility Data Sheet (if applicable) – Attachment K	
☒ Storage Vessel(s) Data Sheet (include gas sample data, USEPA Tanks, simulation software (e.g. ProMax, E&P Tanks, HYSYS, etc.), etc. where applicable) – Attachment L	
☒ Natural Gas Fired Fuel Burning Unit(s) Data Sheet (GPUs, Heater Treaters, In-Line Heaters if applicable) – Attachment M	
☒ Internal Combustion Engine Data Sheet(s) (include manufacturer performance data sheet(s) if applicable) – Attachment N	
☒ Tanker Truck/Rail Car Loading Data Sheet (if applicable) – Attachment O	
☐ Glycol Dehydration Unit Data Sheet(s) (include wet gas analysis, GRI- GLYCalc™ input and output reports and information on reboiler if applicable) – Attachment P	
☒ Pneumatic Controllers Data Sheet – Attachment Q	
☒ Pneumatic Pump Data Sheet – Attachment R	
☒ Air Pollution Control Device/Emission Reduction Device(s) Sheet(s) (include manufacturer performance data sheet(s) if applicable) – Attachment S	
☒ Emission Calculations (please be specific and include all calculation methodologies used) – Attachment T	
☒ Facility-wide Emission Summary Sheet(s) – Attachment U	
☒ Class I Legal Advertisement – Attachment V	
☒ One (1) paper copy and two (2) copies of CD or DVD with pdf copy of application and attachments	

All attachments must be identified by name, divided into sections, and submitted in order.

ATTACHMENT A

SINGLE SOURCE DETERMINATION FORM

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT A - SINGLE SOURCE DETERMINATION FORM

Classifying multiple facilities as one "stationary source" under 45CSR13, 45CSR14, and 45CSR19 is based on the definition of Building, structure, facility, or installation as given in §45-14-2.13 and §45-19-2.12. The definition states:

"Building, Structure, Facility, or Installation" means all of the pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control). Pollutant-emitting activities are a part of the same industrial grouping if they belong to the same "Major Group" (i.e., which have the same two (2)-digit code) as described in the Standard Industrial Classification Manual, 1987 (United States Government Printing Office stock number GPO 1987 0-185-718:QL 3).

The Source Determination Rule for the oil and gas industry was published in the Federal Register on June 3, 2016 and will become effective on August 2, 2016. EPA defined the term "adjacent" and stated that equipment and activities in the oil and gas sector that are under common control will be considered part of the same source if they are located on the same site or on sites that share equipment and are within ¼ mile of each other.

Is there equipment and activities in the same industrial grouping (defined by SIC code)?
Yes ☐ No ☒

Is there equipment and activities under the control of the same person/people?
Yes ☐ No ☒

Is there equipment and activities located on the same site or on sites that share equipment and are within ¼ mile of each other?
Yes ☐ No ☒

ATTACHMENT B

SITING CRITERIA WAIVER

NOT APPLICABLE – No dwellings or businesses located within 300’ of the facility

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT C

BUSINESS CERTIFICATE

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

State of West Virginia

Certificate

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

TH EXPLORATION II, LLC

Control Number: 9ADVD

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

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 March 30, 2016, 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 March 30, 2016

Natalie E Tennant

Secretary of State

H

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

FILED
MAR 30 2016
IN THE OFFICE OF
SECRETARY OF STATE

Penney Barker, Manager
Business & Licensing 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. EST

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

WEST VIRGINIA APPLICATION FOR CERTIFICATE OF AUTHORITY OF LIMITED LIABILITY COMPANY

FILING FEE: $150
* **Fee Waived for Veteran-owned organization**

Control # 9ADVD

***** The undersigned, having authority to transact business on behalf of a foreign (out-of-state) registered entity, agrees to *** comply with the requirements of West Virginia Code §31B-10-1002 to apply for Certificate of Authority.**

1. The **name** of the **limited liability company** as registered in its home state is: TH Exploration II, LLC

   and the **State or Country of organization** is: Texas

   [X] **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 formation 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 formation.**

2. The **business 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.]

   [X] **Home State name as listed in Section 1. above,** if available in West Virginia
   (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. Click here to see a sample Letter of Resolution.)

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. See (*) note at the right.]

   [X] **regular LLC**

   [ ] **Professional LLC*** for the profession of: _____

   * In most cases, a **Letter of Authorization/Approval from the appropriate State Licensing Board** is required to process the application. See attached instructions.

4. The **address** of the **principal office** of the company will be:
   Street: 1320 South University Drive, Suite 500
   City: Fort Worth State: Texas Zip Code: 76107

   Located in the **County** of (required): County: Tarrant

   The **mailing address** of the above location, if different, will be:
   Street: _____
   City: _____ State: _____ Zip Code: _____

5. The **address** of the initial **designated** (physical) office of the company in West Virginia, if any, will be:
   Street: _____
   City: _____ State: _____ Zip Code: _____

   Located in the **County** of: County: _____

RECEIVED
MAR 30 2016

5. (*Continued from previous page....*)

The **mailing address** of the above location, if different, will be:

Street: _____

City: _____ State: _____ Zip Code: _____

6. **Agent of Process:** may be sent, if any, will be:

Name: Corporation Service Company

Street: 209 West Washington Street

City: Charleston State: WV Zip Code: 25302

7. **E-mail address** where business correspondence may be received: eradler@tug-hillop.com

8. **Website address** of the business, if any (*ex: yourdomainname.com*): _____

9. Do you **own or operate more than one business in West Virginia**? [X] **Yes** * *Answer **a. and b.** below.* [ ] **No** [ ] **Decline to answer**

If "**Yes**"... a. How many businesses? 2 b. Located in how many West Virginia counties? 1

10. The company is: (required)
[X] an **AT-WILL** company, conducting business for an indefinite period.
[ ] a **TERM** company, conducting business for the term of _____ years.

11. The company is: (required)
[ ] **MEMBER**-MANAGED [List the names and addresses of all **members** below.]
[X] **MANAGER**-MANAGED [List the names and addresses of all **managers** below.]

List the **name(s) and address(es) of the Member(s)/Manager(s)** of the company (required; attach additional pages if necessary):

Name	No. & Street Address	City	State	Zip Code
Tug Hill, Inc.	1320 South University Drive, Suite 500	Fort Worth	TX	76107

12. 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 (required):

[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.

13. The **purpose(s)** for which this limited liability company is formed is as follows:
[Describe the type(s) of business activity which will be conducted, for example, "real estate," "construction of residential and commercial buildings," "commercial painting," "professional practice of law" (see **Section 2.** for acceptable "professional" business activities). Purpose may conclude with words "...including the transaction of any or all lawful business for which corporations may be incorporated in West Virginia."]

Oil and gas extraction activities including the transaction of any or all related lawful business for which limited liability companies may be formed in West Virginia

14. 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 Section 15.]
[X] **No** [Proceed to Section 15.]

15. Other provisions which may be set forth in the operating agreement or matters not inconsistent with law:
[See instructions for further information; use extra pages if necessary.]

N/A

16. The number of pages attached and included in these Articles is: 3

17. The **requested effective date** is:
[Requested date ***may not be earlier than filing nor later than 90 days after filing in our office.***]

[X] the **date and time of filing** in the Secretary of State's Office.

[ ] the following date _____ and time _____ .

18. Is the organization a "**veteran-owned**" organization?

Effective **JULY 1, 2015**, to meet the requirements for a "**veteran-owned**" organization, the entity filing the registration must meet the following criteria per West Virginia Code §59-1-2a:

1. A "**veteran**" must be honorably discharged or under honorable conditions, and
2. A "**veteran-owned business**" means a business that meets one of the following criteria:
   - o Is at least fifty-one percent (51%) unconditionally owned by one or more veterans; or
   - o In the case of a publicly owned business, at least fifty-one percent (51%) of the stock is unconditionally owned by one or more veterans.

[ ] **Yes** (If "**Yes,**" attach **Form DD214**) → [ ] **CHECK BOX** indicating you have attached **Veteran Affairs Form DD214**

[X] **No**

You may obtain a copy of your Veterans Affairs Form DD214 by contacting:

National Personnel Records Center
Military Personnel Records
1 Archives Drive
St. Louis, MO 63138
Toll free: 1-86-NARA-NARA or 1-866-272-6272
Phone: 314-801-0800
www.archives.gov/veterans/military-service-records

Per WV Code 59-1-2(j) effective July 1, 2015, the **registration fee is waived** for entities that meet the requirements as a "**veteran-owned**" organization. See attached instructions to determine if the organization qualifies for this waiver. In addition, a "**veteran-owned**" entity will have **four (4) consecutive years of Annual Report fees waived** AFTER the organization's initial formation [see WV Code 59-1-2a(m)].

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

a. Contact person to reach in case there is a problem with filing: Courtney J. Roane Phone: 214-969-1312

b. Print or type name of signer: Tug Hill, Inc., Manager
Michael Evan Radler, Vice President Title/Capacity of signer:

c. **Signature:** _____ **Date:** March 24, 2016

****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.

Important Note: This form is a public document. Please **do NOT provide any personal identifiable information on this form** such as social security number, bank account numbers, credit card numbers, tax identification or driver's license numbers.

Reset Form Print Form

Corporations Section
P.O.Box 13697
Austin, Texas 78711-3697

Carlos H. Cascos
Secretary of State

Office of the Secretary of State

Certificate of Fact

The undersigned, as Secretary of State of Texas, does hereby certify that the document, Certificate of Formation for TH Exploration II, LLC (file number 802423622), a Domestic Limited Liability Company (LLC), was filed in this office on March 28, 2016.

It is further certified that the entity status in Texas is in existence.

In testimony whereof, I have hereunto signed my name officially and caused to be impressed hereon the Seal of State at my office in Austin, Texas on March 29, 2016.

Carlos H. Cascos
Secretary of State

ATTACHMENT D

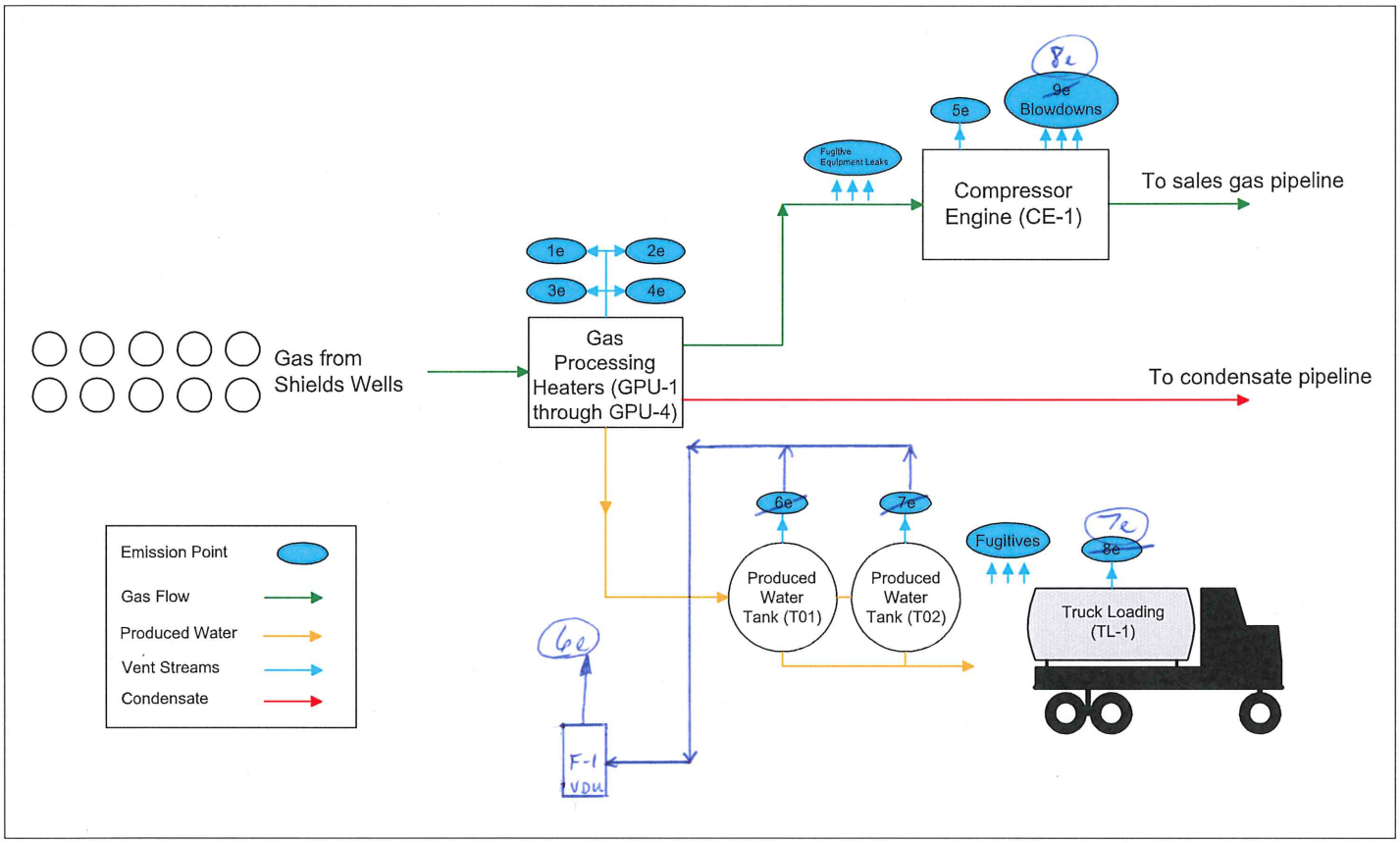
PROCESS FLOW DIAGRAM

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017



SLR	Tug-Hill Operating, LLC	
	Attachment D - Process Flow Diagram	
	Shields Well Pad	Nov 2017

ATTACHMENT E

PROCESS DESCRIPTION

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

Tug Hill Operating, LLC is applying for a General Permit Registration under G70-D for the new construction and operation of equipment at the Shields well pad. The site consists of (10) Marcellus wells, (4) 1 MMBtu/hr gas processing units, and (2) 400 bbl produced water tanks. The proposed (1) 840 HP Waukesha 4SRB compressor engine (Unit 1807) will be used to lower the wells operating pressure and boost pressure prior to the gas entering the sales pipeline. The predicted increase in production will make it necessary to also install a (2) MMBtu/hr flare to control tank VOC emissions.

DESCRIPTION OF PROCESS

Natural gas, condensate and produced water will be separated from 10 horizontal wells located onsite producing from the Marcellus formation. Each well stream will first pass through one of four (4) 1 MMBtu/hr gas processing units (GPU-1 through GPU-4).

The gas exiting the processing units will be sent to the compressor before being routed into a sales pipeline. The water will be sent into one of two (2) 400 bbl produced water tanks. The condensate is sent to a condensate pipeline and is removed from the site. There will be no dedicated condensate storage tanks located at the Shields site.

The emissions from the produced water storage tanks will be directed to a 2 MMBtu/hr enclosed vapor combustor (F-1) for VOC and methane destruction. The produced water is hauled offsite by 140 bbl pump trucks. The displaced emissions from truck loading were accounted for as point source emissions on an uncontrolled basis.

ATTACHMENT F

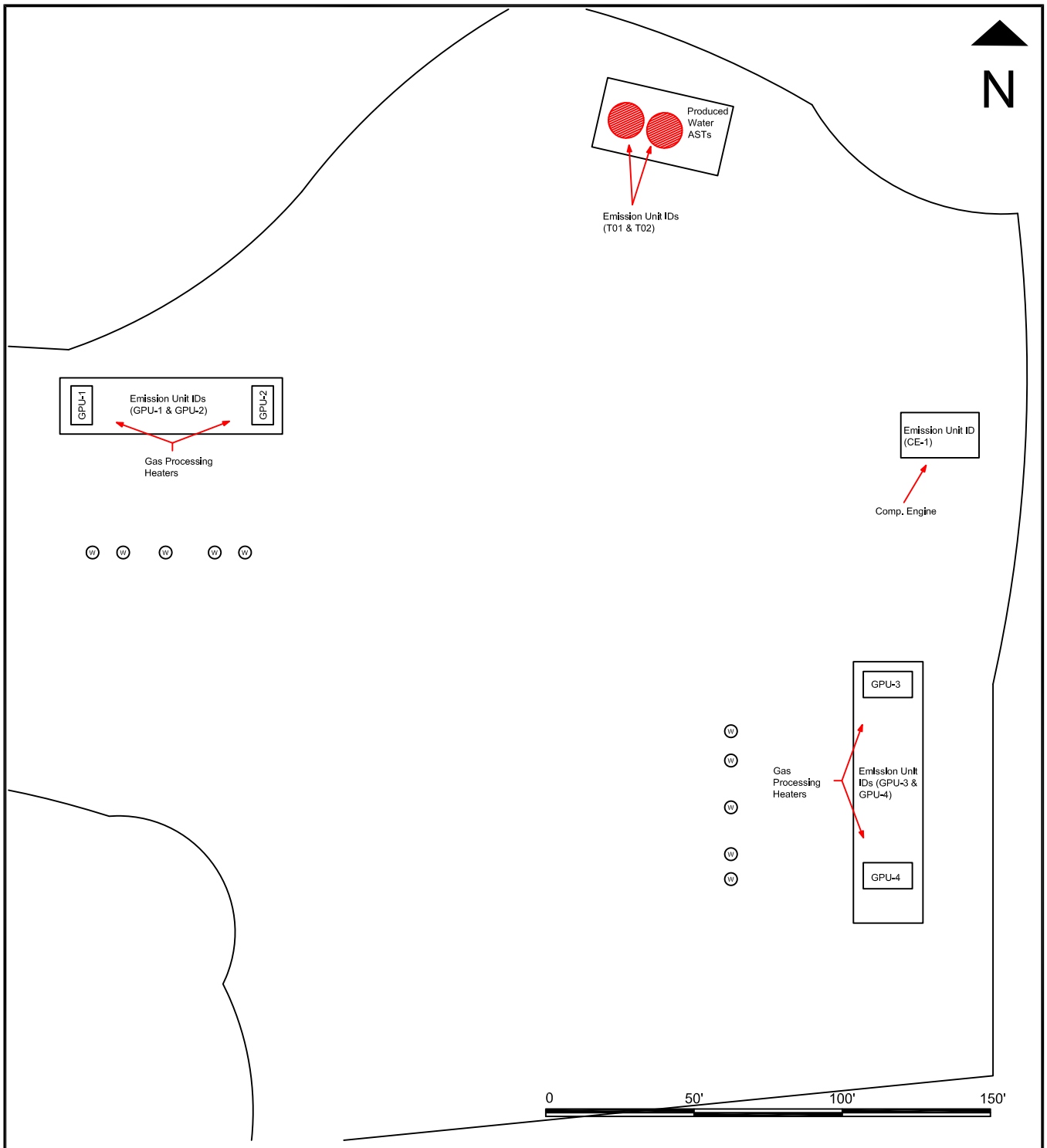
PLOT PLAN

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017



DRAWING LEGEND

- O/H Electric Line
- Utility Pole
- Piping (above ground)
- Piping (under ground)
- Valve
- Plug
- Tree/Brush line
- Crushed Stone Pad
- Storage Tank
- Secondary Containment Area
- Direction of Surface Runoff
- (W) Well Head
- (M) Meter
- (S) Separator
- (D) Drain
- (C) Compressor
- (RM) Residential Meter
- (DRIP) Drip Tank

SLR

Tug-Hill Operating, LLC

380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

Report:
G70-D General Permit Application
Shields Well Pad

Drawing	Drawn By:
Plot Plan	CLB

Date: November 2017	ATTACHMENT F	
	Project #: 116.01631.00014	

ATTACHMENT G

AREA MAP

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

Attachment G - Area Map

Tug Hill Operating LLC - Shields Well Pad

GPS Coordinates of Site:
Lat: 39.76026, Long: -80.78795

ATTACHMENT H

G70-D SECTION APPLICABILITY FORM

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT H – G70-D SECTION APPLICABILITY FORM

General Permit G70-D Registration
Section Applicability Form

General Permit G70-D was developed to allow qualified applicants to seek registration for a variety of sources. These sources include gas well affected facilities, storage vessels, gas production units, in-line heaters, heater treaters, glycol dehydration units and associated reboilers, pneumatic controllers, pneumatic pumps, reciprocating internal combustion engines (RICEs), tank truck/rail car loading, fugitive emissions, completion combustion devices, flares, enclosed combustion devices, and vapor recovery systems. All registered facilities will be subject to Sections 1.0, 2.0, 3.0, and 4.0.

General Permit G70-D allows the registrant to choose which sections of the permit they are seeking registration under. Therefore, please mark which additional sections that you are applying for registration under. If the applicant is seeking registration under multiple sections, please select all that apply. Please keep in mind, that if this registration is approved, the issued registration will state which sections will apply to your affected facility.

GENERAL PERMIT G70-D APPLICABLE SECTIONS	
☒Section 5.0	Gas and Oil Well Affected Facility (NSPS, Subpart OOOO/OOOOa)
☒Section 6.0	Storage Vessels Containing Condensate and/or Produced Water[1]
☐Section 7.0	Storage Vessel Affected Facility (NSPS, Subpart OOOO/OOOOa)
☒Section 8.0	Control Devices and Emission Reduction Devices not subject to NSPS Subpart OOOO/OOOOa and/or NESHAP Subpart HH
☒Section 9.0	Small Heaters and Reboilers not subject to 40CFR60 Subpart Dc
☐Section 10.0	Pneumatic Controllers Affected Facility (NSPS, Subpart OOOO/OOOOa)
☐Section 11.0	Pneumatic Pump Affected Facility (NSPS, Subpart OOOOa)
☐Section 12.0	Fugitive Emissions GHG and VOC Standards (NSPS, Subpart OOOOa)
☒Section 13.0	Reciprocating Internal Combustion Engines, Generator Engines
☒Section 14.0	Tanker Truck/Rail Car Loading[2]
☐Section 15.0	Glycol Dehydration Units[3]

1 Applicants that are subject to Section 6 may also be subject to Section 7 if the applicant is subject to the NSPS, Subparts OOOO or OOOOa control requirements or the applicable control device requirements of Section 8.

2 Applicants that are subject to Section 14 may also be subject to control device and emission reduction device requirements of Section 8.

3 Applicants that are subject to Section 15 may also be subject to the requirements of Section 9 (reboilers). Applicants that are subject to Section 15 may also be subject to control device and emission reduction device requirements of Section 8.

ATTACHMENT I

EMISSION UNITS / ERD TABLE

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT I – EMISSION UNITS / EMISSION REDUCTION DEVICES (ERD) TABLE

Include ALL emission units and air pollution control devices/ERDs that will be part of this permit application review. Do not include fugitive emission sources in this table. Deminimis storage tanks shall be listed in the Attachment L table. This information is required for all sources regardless of whether it is a construction, modification, or administrative update.

Emission Unit ID[1]	Emission Point ID[2]	Emission Unit Description	Year Installed	Manufac. Date[3]	Design Capacity	Type[4] and Date of Change	Control Device(s)[5]	ERD(s)[6]
GPU-1	1e	GPU Heater	2012		1 MMBtu/hr	New	None	None
GPU-2	2e	GPU Heater	2012		1 MMBtu/hr	New	None	None
GPU-3	3e	GPU Heater	2012		1 MMBtu/hr	New	None	None
GPU-4	4e	GPU Heater	2012		1 MMBtu/hr	New	None	None
CE-1	5e	Waukesha F3524GSI	2017	1-23-2007	840 Hp	New	NSCR	None
T01-T02	6e	Produced Water Tanks	2012		400 bbl each	New	VDU-1	None
F-1	6e	Vapor Destruction Unit	2017		2 MMBTU/hr	New	None	None
TL-1	7e	Truck Loading	2012		345,618 gal/yr	New	None	None
Blowdowns	8e	Compressor Blowdowns	2017		3.6 lb/Event	New	None	None

[1] For Emission Units (or Sources) use the following numbering system:1S, 2S, 3S,... or other appropriate designation.
[2] For Emission Points use the following numbering system:1E, 2E, 3E, ... or other appropriate designation.
[3] When required by rule
[4] New, modification, removal, existing
[5] For Control Devices use the following numbering system: 1C, 2C, 3C,... or other appropriate designation.
[6] For ERDs use the following numbering system: 1D, 2D, 3D,... or other appropriate designation.

ATTACHMENT J

FUGITIVE EMISSION SUMMARY SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT J – FUGITIVE EMISSIONS SUMMARY SHEET

Sources of fugitive emissions may include loading operations, equipment leaks, blowdown emissions, etc.
Use extra pages for each associated source or equipment if necessary.

Source/Equipment: Fugitives

Leak Detection Method Used	☐ Audible, visual, and olfactory (AVO) inspections	☒ Infrared (FLIR) cameras	☐ Other (please describe)	☐ None required

Component Type	Closed Vent System	Count	Source of Leak Factors (EPA, other (specify))	Stream type (gas, liquid, etc.)	Estimated Emissions (tpy)		
					VOC	HAP	GHG (methane, CO_2e)
Pumps	☐ Yes ☐ No	--	--	☐ Gas ☐ Liquid ☐ Both	--	--	--
Valves	☐ Yes ☒ No	157	*1995 EPA Protocol for Equipment Leak Emission Estimates* - Table 2-4, Oil & Gas Production Operations Average Emission Factors (kg/hr/source) (4.5E-03)	☒ Gas ☐ Liquid ☐ Both	0.60	0.01	11.19
Safety Relief Valves	☐ Yes ☒ No	3	*1995 EPA Protocol for Equipment Leak Emission Estimates* - Table 2-4, Oil & Gas Production Operations Average Emission Factors (kg/hr/source) (8.8E-03)	☒ Gas ☐ Liquid ☐ Both	0.02	<0.01	0.42
Open Ended Lines	☐ Yes ☒ No	9	*1995 EPA Protocol for Equipment Leak Emission Estimates* - Table 2-4, Oil & Gas Production Operations Average Emission Factors (kg/hr/source) (2.0E-03)	☒ Gas ☐ Liquid ☐ Both	0.02	<0.01	0.29
Sampling Connections	☐ Yes ☐ No	--	--	☐ Gas ☐ Liquid ☐ Both	--	--	--
Connections (Not sampling)	☐ Yes ☒ No	685	*1995 EPA Protocol for Equipment Leak Emission Estimates* - Table 2-4, Oil & Gas Production Operations Average Emission Factors (kg/hr/source) (3.9E-03)	☒ Gas ☐ Liquid ☐ Both	0.23	<0.01	4.23
Compressors	☐ Yes ☒ No	1	*1995 EPA Protocol for Equipment Leak Emission Estimates* - Table 2-4, Oil & Gas Production Operations Average Emission Factors (kg/hr/source) (8.8E-03)	☒ Gas ☐ Liquid ☐ Both	0.01	<0.01	0.14
Flanges	☐ Yes ☒ No	See Notes Below (2)	See Notes Below (2)	☐ Gas ☐ Liquid ☐ Both	--	--	--
Other[1]	☐ Yes ☐ No	--	--	☐ Gas ☐ Liquid ☐ Both	--	--	--

[1] Other equipment types may include compressor seals, relief valves, diaphragms, drains, meters, etc.

[2] Assumption made that flange connections are included in connections (not sampling) count

Please provide an explanation of the sources of fugitive emissions (e.g. pigging operations, equipment blowdowns, pneumatic controllers, etc.):
Please indicate if there are any closed vent bypasses (include component):
Specify all equipment used in the closed vent system (e.g. VRU, ERD, thief hatches, tanker truck/rail car loading, etc.)

ATTACHMENT K

GAS WELL AFFECTED FACILITY DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT K – GAS WELL AFFECTED FACILITY DATA SHEET

Complete this data sheet if you are the owner or operator of a gas well affected facility for which construction, modification or reconstruction commenced after August 23, 2011. This form must be completed for natural gas well affected facilities regardless of when flowback operations occur (or have occurred).

API Number	Date of Flowback	Date of Well Completion	Green Completion and/or Combustion Device	Subject to OOOO or OOOOa?
47-051-01533		2012	Green	OOOO
47-051-01534		2012	Green	OOOO
47-051-01535		2012	Green	OOOO
47-051-01536		2012	Green	OOOO
47-051-01537		2012	Green	OOOO
47-051-01538		2012	Green	OOOO
47-051-01539		2012	Green	OOOO
47-051-01540		2012	Green	OOOO
47-051-01541		2012	Green	OOOO
47-051-01542		2012	Green	OOOO

Note: If future wells are planned and no API number is available please list as PLANNED.
If there are existing wells that commenced construction prior to August 23, 2011, please acknowledge as existing.

This is the same API (American Petroleum Institute) well number(s) provided in the well completion notification and as provided to the WVDEP, Office of Oil and Gas for the well permit. The API number may be provided on the application without the state code (047).

Every oil and gas well permitted in West Virginia since 1929 has been issued an API number. This API is used by agencies to identify and track oil and gas wells.

The API number has the following format: 047-001-00001

Where,

047 = State code. The state code for WV is 047.
001 = County Code. County codes are odd numbers, beginning with 001 (Barbour) and continuing to 109 (Wyoming).
00001= Well number. Each well will have a unique well number.

ATTACHMENT L

STORAGE VESSEL(S) DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT L – STORAGE VESSEL DATA SHEET

Complete this data sheet if you are the owner or operator of a storage vessel that contains condensate and/or produced water. This form must be completed for ***each*** new or modified bulk liquid storage vessel(s) that contains condensate and/or produced water. (If you have more than one (1) identical tank (i.e. 4-400 bbl condensate tanks), then you can list all on one (1) data sheet). **Include gas sample analysis, flashing emissions, working and breathing losses, USEPA Tanks, simulation software (ProMax, E&P Tanks, HYSYS, etc.), and any other supporting documents where applicable.**

The following information is REQUIRED:

☒ Composition of the representative sample used for the simulation
☒ For each stream that contributes to flashing emissions:
- ☒ Temperature and pressure (inlet and outlet from separator(s))
- ☒ Simulation-predicted composition
- ☒ Molecular weight
- ☒ Flow rate

☒ Resulting flash emission factor or flashing emissions from simulation
☒ Working/breathing loss emissions from tanks and/or loading emissions if simulation is used to quantify those emissions

Additional information may be requested if necessary.

GENERAL INFORMATION (REQUIRED)

1. Bulk Storage Area Name: Shields Well Pad	2. Tank Name Produced Water Tanks
2. Emission Unit ID number: T01-T02	3.Emission Point ID number: 6e
5. Date Installed , Modified or Relocated *(for existing tanks)* Was the tank manufactured after August 23, 2011 and on or before September 18, 2015? ☒ Yes ☐ No Was the tank manufactured after September 18, 2015? ☐ Yes ☒ No	6. Type of change: ☐ New construction ☐ New stored material ☒ Other ☐ Relocation
7A. Description of Tank Modification *(if applicable)*	
7B. Will more than one material be stored in this tank? *If so, a separate form must be completed for each material.* ☐ Yes ☒ No	
7C. Was USEPA Tanks simulation software utilized? ☐ Yes ☒ No ProMax Model Simulation (See Calculations) ***If Yes, please provide the appropriate documentation and items 8-42 below are not required.***	

TANK INFORMATION

8. Design Capacity *(specify barrels or gallons).* Use the internal cross-sectional area multiplied by internal height. 400 bbl	
9A. Tank Internal Diameter (ft.) 12	9B. Tank Internal Height (ft.) 20
10A. Maximum Liquid Height (ft.) 20	10B. Average Liquid Height (ft.) 10
11A. Maximum Vapor Space Height (ft.) 20	11B. Average Vapor Space Height (ft.) 10
12. Nominal Capacity *(specify barrels or gallons).* This is also known as "working volume".	
13A. Maximum annual throughput (gal/yr) 172,922.40 per tank	13B. Maximum daily throughput (gal/day) 473.76 per tank
14. Number of tank turnovers per year 10.3 per tank	15. Maximum tank fill rate (gal/min) 0.33 per tank
16. Tank fill method ☒ Submerged ☐ Splash ☐ Bottom Loading	
17. Is the tank system a variable vapor space system? ☐ Yes ☒ No If yes, (A) What is the volume expansion capacity of the system (gal)? (B) What are the number of transfers into the system per year?	
18. Type of tank (check all that apply): ☒ Fixed Roof ☐ vertical ☐ horizontal ☐ flat roof ☒ cone roof ☐ dome roof ☐ other (describe) ☐ External Floating Roof ☐ pontoon roof ☐ double deck roof ☐ Domed External (or Covered) Floating Roof ☐ Internal Floating Roof ☐ vertical column support ☐ self-supporting ☐ Variable Vapor Space ☐ lifter roof ☐ diaphragm ☐ Pressurized ☐ spherical ☒ cylindrical ☐ Other (describe)	

PRESSURE/VACUUM CONTROL DATA

19. Check as many as apply:

☐ Does Not Apply ☐ Rupture Disc (psig)

☐ Inert Gas Blanket of _____ ☐ Carbon Adsorption[1]

☒ Vent to Vapor Combustion Device[1] (vapor combustors, flares, thermal oxidizers, enclosed combustors)

☒ Conservation Vent (psig) ☐ Condenser[1]

-0.03 Vacuum Setting 0.88 Pressure Setting

☒ Emergency Relief Valve (psig)

-0.03 Vacuum Setting 0.88 Pressure Setting

☐ Thief Hatch Weighted ☐ Yes ☒ No

[1] Complete appropriate Air Pollution Control Device Sheet

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

Material Name	**Flashing Loss**		**Working/ Breathing Loss**		**Total Emissions Loss**		**Estimation Method[1]**
	lb/hr	**tpy**	**lb/hr**	**tpy**	**lb/hr**	**tpy**	
VOC (All tanks-Controlled)	0.15	0.66	<0.01	<0.01	0.15	0.66	O - ProMax

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

TANK CONSTRUCTION AND OPERATION INFORMATION		
21. Tank Shell Construction: ☐ Riveted ☐ Gunite lined ☐ Epoxy-coated rivets ☒ Other (describe) Welded		
21A. Shell Color: Green	21B. Roof Color: Green	21C. Year Last Painted: 2012
22. Shell Condition (if metal and unlined): ☒ No Rust ☐ Light Rust ☐ Dense Rust ☐ Not applicable		
22A. Is the tank heated? ☐ Yes ☒ No	22B. If yes, operating temperature:	22C. If yes, how is heat provided to tank?

23. Operating Pressure Range (psig): 0.88 **Must be listed for tanks using VRUs with closed vent system.**		
24. Is the tank a **Vertical Fixed Roof Tank**? ☒ Yes ☐ No	24A. If yes, for dome roof provide radius (ft):	24B. If yes, for cone roof, provide slop (ft/ft): 0.17
25. Complete item 25 for **Floating Roof Tanks** ☐ Does not apply ☒		
25A. Year Internal Floaters Installed:		
25B. Primary Seal Type *(check one):* ☐ Metallic (mechanical) shoe seal ☐ Liquid mounted resilient seal ☐ Vapor mounted resilient seal ☐ Other (describe):		
25C. Is the Floating Roof equipped with a secondary seal? ☐ Yes ☐ No		
25D. If yes, how is the secondary seal mounted? *(check one)* ☐ Shoe ☐ Rim ☐ Other (describe):		
25E. Is the floating roof equipped with a weather shield? ☐ Yes ☐ No		
25F. Describe deck fittings:		
26. Complete the following section for **Internal Floating Roof Tanks** ☒ Does not apply		
26A. Deck Type: ☐ Bolted ☐ Welded	26B. For bolted decks, provide deck construction:	
26C. Deck seam. Continuous sheet construction: ☐ 5 ft. wide ☐ 6 ft. wide ☐ 7 ft. wide ☐ 5 x 7.5 ft. wide ☐ 5 x 12 ft. wide ☐ other (describe)		
26D. Deck seam length (ft.):	26E. Area of deck (ft^2):	26F. For column supported tanks, # of columns:	26G. For column supported tanks, diameter of column:
27. Closed Vent System with VRU? ☐ Yes ☒ No		
28. Closed Vent System with Enclosed Combustor? ☒ Yes ☐ No		
SITE INFORMATION		
29. Provide the city and state on which the data in this section are based: Elkins, WV		
30. Daily Avg. Ambient Temperature (°F): 49.06	31. Annual Avg. Maximum Temperature (°F): 61.15	
32. Annual Avg. Minimum Temperature (°F): 36.97	33. Avg. Wind Speed (mph): 6.17	
34. Annual Avg. Solar Insulation Factor (BTU/ft^2-day): 1193.89	35. Atmospheric Pressure (psia): 13.73	
LIQUID INFORMATION		
36. Avg. daily temperature range of bulk liquid (°F): 52.14	36A. Minimum (°F): 36.97	36B. Maximum (°F): 61.15
37. Avg. operating pressure range of tank (psig): 0.88	37A. Minimum (psig): -0.03	37B. Maximum (psig): 0.88
38A. Minimum liquid surface temperature (°F): 47.17	38B. Corresponding vapor pressure (psia): 0.28	
39A. Avg. liquid surface temperature (°F): 57.20	39B. Corresponding vapor pressure (psia): 0.37	
40A. Maximum liquid surface temperature (°F): 67.23	40B. Corresponding vapor pressure (psia): 0.49	
41. Provide the following for each liquid or gas to be stored in the tank. Add additional pages if necessary. SEE PROMAX MODEL IN CALCULATIONS.		

41A. Material name and composition:			
41B. CAS number:			
41C. Liquid density (lb/gal):			
41D. Liquid molecular weight (lb/lb-mole):			
41E. Vapor molecular weight (lb/lb-mole):			
41F. Maximum true vapor pressure (psia):			
41G. Maximum Reid vapor pressure (psia):			
41H. Months Storage per year. From: To:			
42. Final maximum gauge pressure and temperature prior to transfer into tank used as inputs into flashing emission calculations.			

ATTACHMENT M

NATURAL GAS FIRED FUEL BURNING UNIT(S) DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

SMALL HEATERS AND REBOILERS NOT SUBJECT TO 40CFR60 SUBPART DC DATA SHEET

Complete this data sheet for each small heater and reboiler not subject to 40CFR60 Subpart Dc at the facility. ***The Maximum Design Heat Input (MDHI) must be less than 10 MMBTU/hr.***

Emission Unit ID#[1]	Emission Point ID#[2]	Emission Unit Description (manufacturer, model #)	Year Installed/ Modified	Type[3] and Date of Change	Maximum Design Heat Input (MMBTU/hr)[4]	Fuel Heating Value (BTU/scf)[5]
GPU-1	1e	GPU Heater	2012	New	1 MMBtu/hr	1,293
GPU-2	2e	GPU Heater	2012	New	1 MMBtu/hr	1,293
GPU-3	3e	GPU Heater	2012	New	1 MMBtu/hr	1,293
GPU-4	4e	GPU Heater	2012	New	1 MMBtu/hr	1,293

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

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

3 New, modification, removal

4 Enter design heat input capacity in MMBtu/hr.

5 Enter the fuel heating value in BTU/standard cubic foot.

ATTACHMENT N

INTERNAL COMBUSTION ENGINE DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

INTERNAL COMBUSTION ENGINE DATA SHEET

Complete this data sheet for each internal combustion engine at the facility. Include manufacturer performance data sheet(s) or any other supporting document if applicable. Use extra pages if necessary. *Generator(s) and microturbine generator(s) shall also use this form.*

Emission Unit ID#[1]	CE-1		
Engine Manufacturer/Model	Waukesha/ F3524GSI		
Manufacturers Rated bhp/rpm	840/ 1200		
Source Status[2]	RS		
Date Installed/ Modified/Removed/Relocated[3]	2017		
Engine Manufactured /Reconstruction Date[4]	1/23/2007		
Check all applicable Federal Rules for the engine (include EPA Certificate of Conformity if applicable)[5]	☐40CFR60 Subpart JJJJ ☐JJJJ Certified? ☐40CFR60 Subpart IIII ☐IIII Certified? ☐40CFR63 Subpart ZZZZ ☒ NESHAP ZZZZ/ NSPS JJJJ Window ☐ NESHAP ZZZZ Remote Sources	☐40CFR60 Subpart JJJJ ☐JJJJ Certified? ☐40CFR60 Subpart IIII ☐IIII Certified? ☐40CFR63 Subpart ZZZZ ☐ NESHAP ZZZZ/ NSPS JJJJ Window ☐ NESHAP ZZZZ Remote Sources	☐40CFR60 Subpart JJJJ ☐JJJJ Certified? ☐40CFR60 Subpart IIII ☐IIII Certified? ☐40CFR63 Subpart ZZZZ ☐ NESHAP ZZZZ/ NSPS JJJJ Window ☐ NESHAP ZZZZ Remote Sources
Engine Type[6]	4SRB		
APCD Type[7]	NSCR		
Fuel Type[8]	RG		
H_2S (gr/100 scf)	0.25		
Operating bhp/rpm	840/ 1200		
BSFC (BTU/bhp-hr)	9,504		
Hourly Fuel Throughput	6,184 ft^3/hr		ft^3/hr gal/hr
Annual Fuel Throughput (Must use 8,760 hrs/yr unless emergency generator)	54.17 $MMft^3$/yr		$MMft^3$/yr gal/yr
Fuel Usage or Hours of Operation Metered	Yes ☐ No ☒	Yes ☐ No ☐	Yes ☐ No ☐

Calculation Methodology[9]	Pollutant[10]	Hourly PTE (lb/hr)[11]	Annual PTE (tons/year)[11]	Hourly PTE (lb/hr)[11]	Annual PTE (tons/year)[11]	Hourly PTE (lb/hr)[11]	Annual PTE (tons/year)[11]
MD	NO_x	3.52	15.41				
MD	CO	3.24	14.19				
MD	VOC	0.07	0.32				
AP	SO_2	<0.01	0.02				
AP	PM_{10}	0.15	0.68				
MD	Formaldehyde	0.02	0.09				
MD	Total HAPs	0.12	0.50				
MD	GHG (CO_2e)	217.09	864.61				

1 Enter the appropriate Source Identification Number for each natural gas-fueled reciprocating internal combustion engine/generator engine located at the well site. Multiple engines should be designated CE-1, CE-2, CE-3 etc. Generator engines should be designated GE-1, GE-2, GE-3 etc. Microturbine generator engines should be designated MT-1, MT-2, MT-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	Relocated Source
REM	Removal of Source		

3 Enter the date (or anticipated date) of the engine's installation (construction of source), modification, relocation 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 IIII/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 as appropriate.

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

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

2SLB	Two Stroke Lean Burn	4SRB	Four Stroke Rich Burn
4SLB	Four Stroke Lean Burn		

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	OxCat	Oxidation Catalyst
SCR	Lean Burn & Selective Catalytic Reduction		

8 Enter the Fuel Type using the following codes:

PQ	Pipeline Quality Natural Gas	RG	Raw Natural Gas /Production Gas	D	Diesel

9 Enter the Potential Emissions Data Reference designation using the following codes. Attach all reference data used.

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*.

11 PTE for engines shall be calculated from manufacturer's data unless unavailable.

Engine Air Pollution Control Device
(Emission Unit ID# CE-1, use extra pages as necessary)

Air Pollution Control Device Manufacturer's Data Sheet included?
Yes ☒ No ☐

☒ NSCR ☐ SCR ☐ Oxidation Catalyst

Provide details of process control used for proper mixing/control of reducing agent with gas stream: NA

Manufacturer: DCL	Model #: DCX7
Design Operating Temperature:	Design gas volume:
Service life of catalyst:	Provide manufacturer data? ☒Yes ☐ No
Volume of gas handled:	Operating temperature range for NSCR/Ox Cat: From 931 °F to
Reducing agent used, if any: NA	Ammonia slip (ppm): NA

Pressure drop against catalyst bed (delta P): inches of H_2O

Provide description of warning/alarm system that protects unit when operation is not meeting design conditions:

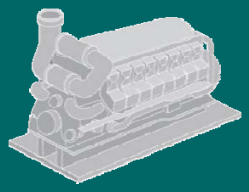
Is temperature and pressure drop of catalyst required to be monitored per 40CFR63 Subpart ZZZZ?
☐ Yes ☒ No

How often is catalyst recommended or required to be replaced (hours of operation)?

How often is performance test required?
☐ Initial
☐ Annual
☐ Every 8,760 hours of operation
☐ Field Testing Required
☒No performance test required. If so, why (please list any maintenance required and the applicable sections in NSPS/GACT, EPA Certified Engine – See regulatory discussion in introduction

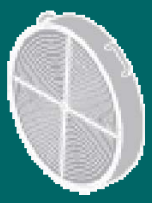
EMISSION GUARANTEE- UNIT 1807

ENGINE DATA



Engine Model	Waukesha F3524GSI
Power	840 BHP
Fuel	NG – Per Supplied Data Sheet
Exhaust Flow Rate	6631 lb/hr
Exhaust Temperature	1267 F

CATALYST SPECIFICATIONS



Catalyst Housing	GT 201V0-3-0-6112-1
Catalyst Part #	DCX7
Formulation	NSCR, 3-Way
# of Elements	2
# of Blanks	4
Cell Density	300 cpsi
Approx. Dimensions	24.75” x 15.50” 3.5" thick

EMISSION REQUIREMENTS

Exhaust Component	Engine Output (g/bhp-hr)	Converter Output (g/bhp-hr)
NOx	15.7	1.90
CO	12.5	1.75
VOC (NMNEHC)	.08	.04
HCHO	.05	.01

The catalyst model selection is based upon the reduction requirements above. Any variance in these requirements may affect the price and model required.

DCL America Inc. 27603 Commerce Oaks Drive, Oak Ridge North, TX 77385
Toll free: 1-877-965-8989 **Fax:** 281-605-5858 **Email:** info@dcl-inc.com **www.dcl-inc.com**

USA COMPRESSION

USA Compression Unit 1807 Waukesha F3524GSI Engine Emissions

Date of Manufacture	January 23, 2007	Engine Serial Number	C17081/1	Date Modified/Reconstructed	N/A
Driver Rated HP	840	Rated Speed in RPM	1200	Combustion Type	Spark Ignited 4 Stroke
Number of Cylinders	6	Compression Ratio	8:1	Combustion Setting	Rich Burn
Total Displacement (in^3)	3520	Fuel Delivery Method	Carburetor	Combustion Air Treatment	T.C./Intercooled

Raw Engine Emissions with Customer Supplied Fuel Gas Analysis

Fuel Consumption *8591 LHV BTU/bhp-hr or 9504 HHV BTU/bhp-hr*
Altitude *1200 ft*
Maximum Air Inlet Temp *100 F*

	g/bhp-hr [1]	lb/MMBTU [2]	lb/hr	TPY
Nitrogen Oxides (NOx)	15.6		28.89	126.53
Carbon Monoxide (CO)	12.5		23.15	101.39
Volatile Organic Compounds (VOC or NMNEHC excluding CH2O)	0.08		0.15	0.65
Formaldehyde (CH2O)	0.05		0.09	0.41
Particulate Matter (PM) Filterable+Condensable		1.94E-02	1.55E-01	6.79E-01
Sulfur Dioxide (SO2)		5.88E-04	4.69E-03	2.06E-02

	g/bhp-hr [1]	lb/hr	Metric Tonne/yr
Carbon Dioxide (CO2)	550	1019	4046
Methane (CH4)	0.23	0.43	1.69

[1] g/bhp-hr are based on Waukesha Specifications assuming 934 LHV BTU/SCF fuel gas, 1000 ft elevation, and 77 F Max Air Inlet Temperature. Note that g/bhp-hr values are based on 100% Load Operation. For Air Permitting, it is recommended to add a safety margin to CO, VOC, and Formaldehyde to account for variations in fuel gas composition and load.

[2] Emission Factor obtained from EPA's AP-42, Fifth Edition, Volume I, Chapter 3: Stationary Internal Combution Sources (Section 3.2 Natural Gas-Fired Reciprocating Engines, Table 3.2-3).

Catalytic Converter Emissions

Catalytic Converter Make and Model: *GT 201*
Element Type: *V0-3-0-6112-1*
Number of Elements in Housing: *Øxidation*
Air/Fuel Ratio Control *Compliance Controls AFR9, Oxygen Feedback*

	% Reduction	g/bhp-hr	lb/hr	TPY
Nitrogen Oxides (NOx)	88	1.9	**3.47**	**15.18**
Carbon Monoxide (CO)	86	1.75	**3.24**	**14.19**
Volatile Organic Compounds (VOC or NMNEHC excluding CH2O)	50	0.04	**0.07**	**0.32**
Formaldehyde (CH2O)	76	0.01	**0.02**	**0.10**
Particulate Matter (PM)	0		**1.55E-01**	**6.79E-01**
Sulfur Dioxide (SO2)	0		**4.69E-03**	**2.06E-02**

	% Reduction	lb/hr	Metric Tonne/yr
Carbon Dioxide (CO2)	0	**1019**	**4046**
Methane (CH4)	0	**0.43**	**1.69**

GE Power

TUG HILL "SHIELDS" U1807 - WETZEL WV

VHP - F3524GSI

USAC CSM CMAGEE@USACOMPRESSION.COM

Gas Compression

ENGINE SPEED (rpm):	1200		
DISPLACEMENT (in3):	3520	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):	49
COMBUSTION:	Rich Burn, Turbocharged	AUXILIARY WATER CAPACITY (gal):	8
ENGINE DRY WEIGHT (lbs):	16000	LUBE OIL CAPACITY (gal):	72
AIR/FUEL RATIO SETTING:	0.38% CO	MAX. EXHAUST BACKPRESSURE (in. H2O):	18
ENGINE SOUND LEVEL (dBA)	101	MAX. AIR INLET RESTRICTION (in. H2O):	15
		EXHAUST SOUND LEVEL (dBA)	110

SITE CONDITIONS:

FUEL:	TUG HILL "SHIELDS"	ALTITUDE (ft):	1200
FUEL PRESSURE RANGE (psig):	30 - 60	MAXIMUM INLET AIR TEMPERATURE (°F):	90
FUEL HHV (BTU/ft3):	1,291.8	FUEL WKI:	59.1
FUEL LHV (BTU/ft3):	1,167.8		

SITE SPECIFIC TECHNICAL DATA

POWER RATING	UNITS	110% OVERLOAD SITE DATA (See note 18)	MAX RATING AT 100 °F AIR TEMP	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE OF 90 °F		
				100%	75%	55%
CONTINUOUS ENGINE POWER	BHP	924	840	840	630	464
OVERLOAD	% 2/24 hr	Note 18	10	10	-	-
MECHANICAL EFFICIENCY (LHV)	%	29.9	29.6	29.6	28.8	27.8
CONTINUOUS POWER AT FLYWHEEL	BHP	924	840	840	630	464
based on no auxiliary engine driven equipment						
FUEL CONSUMPTION						
FUEL CONSUMPTION (LHV)	BTU/BHP-hr	8516	8591	8591	8836	9171
FUEL CONSUMPTION (HHV)	BTU/BHP-hr	9420	9504	9504	9775	10145
FUEL FLOW *based on fuel analysis LHV*	SCFM	112	103	103	79	61
HEAT REJECTION						
JACKET WATER (JW)	BTU/hr x 1000	2467	2306	2287	1810	1409
LUBE OIL (OC)	BTU/hr x 1000	357	357	349	325	298
INTERCOOLER (IC)	BTU/hr x 1000	146	143	131	86	40
EXHAUST	BTU/hr x 1000	2299	2045	2066	1503	1092
RADIATION	BTU/hr x 1000	401	368	386	347	317
EMISSIONS (ENGINE OUT):						
NOx (NO + NO2)	g/bhp-hr	15.7	15.6	15.7	16.1	16.8
CO	g/bhp-hr	12.5	12.5	12.5	12.4	12.5
THC	g/bhp-hr	0.4	0.4	0.4	0.4	0.4
NMHC	g/bhp-hr	0.16	0.17	0.17	0.22	0.30
NM,NEHC (VOC)	g/bhp-hr	0.08	0.08	0.08	0.11	0.15
CO2	g/bhp-hr	545	550	550	565	587
CO2e	g/bhp-hr	550	555	555	572	597
CH2O	g/bhp-hr	0.05	0.05	0.05	0.05	0.05
CH4	g/bhp-hr	0.21	0.23	0.23	0.29	0.41
AIR INTAKE / EXHAUST GAS						
INDUCTION AIR FLOW	SCFM	1424	1306	1306	1008	770
EXHAUST GAS MASS FLOW	lb/hr	6631	6082	6082	4691	3586
EXHAUST GAS FLOW *at exhaust temp, 14.5 psia*	ACFM	5090	4601	4606	3419	2525
EXHAUST TEMPERATURE	°F	1267	1242	1244	1180	1124

HEAT EXCHANGER SIZING[12]			
TOTAL JACKET WATER CIRCUIT (JW)	BTU/hr x 1000	2797	2615
TOTAL AUXILIARY WATER CIRCUIT (IC + OC)	BTU/hr x 1000	570	568

COOLING SYSTEM WITH ENGINE MOUNTED WATER PUMPS		
JACKET WATER PUMP MIN. DESIGN FLOW	GPM	225
JACKET WATER PUMP MAX. EXTERNAL RESTRICTION	psig	15
AUX WATER PUMP MIN. DESIGN FLOW	GPM	48
AUX WATER PUMP MAX. EXTERNAL RESTRICTION	psig	22

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

Data Generated by EngCalc Program Version 3.6.Dresser Inc.

11/6/2017 12:19 PM

FUEL COMPOSITION

HYDROCARBONS:		Mole or Volume %
Methane	CH4	75.326
Ethane	C2H6	15.432
Propane	C3H8	5.511
Iso-Butane	I-C4H10	0.536
Normal Butane	N-C4H10	1.48
Iso-Pentane	I-C5H12	0.268
Normal Pentane	N-C5H12	0.373
Hexane	C6H14	0.378
Heptane	C7H16	0
Ethene	C2H4	0
Propene	C3H6	0
	SUM HYDROCARBONS	99.304
NON-HYDROCARBONS:		
Nitrogen	N2	0.499
Oxygen	O2	0
Helium	He	0
Carbon Dioxide	CO2	0.197
Carbon Monoxide	CO	0
Hydrogen	H2	0
Water Vapor	H2O	0
	TOTAL FUEL	100

FUEL:	TUG HILL "SHIELDS"
FUEL PRESSURE RANGE (psig):	30 - 60
FUEL WKI:	59.1
FUEL SLHV (BTU/ft3):	1147.49
FUEL SLHV (MJ/Nm3):	45.12
FUEL LHV (BTU/ft3):	1167.81
FUEL LHV (MJ/Nm3):	45.92
FUEL HHV (BTU/ft3):	1291.83
FUEL HHV (MJ/Nm3):	50.80
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 ± 50°F (28°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. It is permissible to operate the engine at the indicated overload power, for two hours in every 24 hour period.
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

August 24, 2017

FESCO, Ltd.
104 Fesco Run Rd Bridgeport, WV 26330

For: Tug Hill Operating, LLC
1320 S. University Drive, Suite 500
Fort Worth, Texas 76107

Sample: Shields Check Meter
Meter Run Gas @ 383 psig & 71 °F

Field: Marshall West

Station: GSC-063
Date Sampled: 7/30/2017 at 13:00 hours

CHROMATOGRAPH ANALYSIS - GPA 2261

COMPONENT	MOL%	GPM
Nitrogen	0.499	
Carbon Dioxide	0.197	
Methane	75.326	
Ethane	15.432	4.142
Propane	5.511	1.524
Isobutane	0.536	0.176
n-Butane	1.480	0.468
Isopentane	0.268	0.098
n-Pentane	0.373	0.136
Hexanes Plus	0.378	0.166
Totals:	**100.000**	**6.710**

Computed Real Properties:

Specific Gravity	0.740 (Air=1.000)
Compressibility(Z)	0.9962
Gross Heating Value at 14.730 psia and 60 °F	
Dry Basis	1291 BTU/CF
Saturated Basis	1269 BTU/CF

Base Conditions: 14.730 psia and 60 °F

Certified: FESCO, Ltd. - Bridgeport, WV

Jeff Fluharty 304-592-3366

Job Number: 01966.046
Analyst ID: AC

Cyl Number: T-1779

ATTACHMENT O

TANKER TRUCK/ RAIL CAR LOADING DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT O – TANKER TRUCK/RAIL CAR LOADING DATA SHEET

Complete this data sheet for each new or modified bulk liquid transfer area or loading rack at the facility. This is to be used for bulk liquid transfer operations to tanker trucks/rail cars. Use extra pages if necessary.

Truck/Rail Car Loadout Collection Efficiencies

The following applicable capture efficiencies of a truck/rail car loadout are allowed:

- For tanker trucks/rail cars passing the MACT level annual leak test – 99.2%
- For tanker trucks/rail cars passing the NSPS level annual leak test – 98.7%
- For tanker trucks/rail cars not passing one of the annual leak tests listed above – 70%

Compliance with this requirement shall be demonstrated by keeping records of the applicable MACT or NSPS Annual Leak Test certification for ***every*** truck and railcar loaded/unloaded. This requirement can be satisfied if the trucking/rail car company provided certification that its entire fleet was compliant. This certification must be submitted in writing to the Director of the DAQ. These additional requirements must be noted in the Registration Application.

Emission Unit ID#: TL-1	Emission Point ID#: 7e	Year Installed/Modified:2017
Emission Unit Description: Tank Truck Loading (Water & Condensate)		
Loading Area Data		
Number of Pumps: 1	Number of Liquids Loaded: 1	Max number of trucks/rail cars loading at one (1) time: 1
Are tanker trucks/rail cars pressure tested for leaks at this or any other location? ☐ Yes ☐ No ☒ Not Required If Yes, Please describe:		
Provide description of closed vent system and any bypasses.		
Are any of the following truck/rail car loadout systems utilized? ☐ Closed System to tanker truck/rail car passing a MACT level annual leak test? ☐ Closed System to tanker truck/rail car passing a NSPS level annual leak test? ☐ Closed System to tanker truck/rail car not passing an annual leak test and has vapor return?		

Projected Maximum Operating Schedule (for rack or transfer point as a whole)

Time	Jan – Mar	Apr - Jun	Jul – Sept	Oct - Dec
Hours/day	24	24	24	24
Days/week	7	7	7	7

Bulk Liquid Data (use extra pages as necessary)

Liquid Name	Produced Water		
Max. Daily Throughput (1000 gal/day)	0.95		
Max. Annual Throughput (1000 gal/yr)	345.70		
Loading Method[1]	SUB		
Max. Fill Rate (gal/min)	0.66		
Average Fill Time (min/loading)	60		
Max. Bulk Liquid Temperature (°F)	52.14		
True Vapor Pressure[2]	0.37		
Cargo Vessel Condition[3]	C		
Control Equipment or Method[4]	None		
Max. Collection Efficiency (%)	0		

Max. Control Efficiency (%)		0			
Max.VOC Emission Rate	Loading (lb/hr)	<0.01			
	Annual (ton/yr)	<0.01			
Max.HAP Emission Rate	Loading (lb/hr)	0			
	Annual (ton/yr)	0			
Estimation Method[5]		O – ProMax Tank Stencil based on EPA AP-42			

1 BF Bottom Fill SP Splash Fill SUB Submerged Fill

2 At maximum bulk liquid temperature

3 B Ballasted Vessel C Cleaned U Uncleaned (dedicated service)
O Other (describe)

4 List as many as apply (complete and submit appropriate Air Pollution Control Device Sheets)
CA Carbon Adsorption VB Dedicated Vapor Balance (closed system)
ECD Enclosed Combustion Device F Flare
TO Thermal Oxidization or Incineration

5 EPA EPA Emission Factor in AP-42 MB Material Balance
TM Test Measurement based upon test data submittal O Other (describe)

ATTACHMENT P

GLYCOL DEHYDRATION UNIT DATA SHEET(S)

NOT APPLICABLE- No glycol dehydration unit in use at the facility.

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT Q

PNEUMATIC CONTROLLERS DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT Q – PNEUMATIC CONTROLLERS DATA SHEET

Are there any continuous bleed natural gas driven pneumatic controllers at this facility that commenced construction, modification or reconstruction after August 23, 2011, and on or before September 18, 2015?

☐ Yes ☒ No

Please list approximate number.

Are there any continuous bleed natural gas driven pneumatic controllers at this facility that commenced construction, modification or reconstruction after September 18, 2015?

☐ Yes ☒ No

Please list approximate number.

Are there any continuous bleed natural gas driven pneumatic controllers at this facility with a bleed rate greater than 6 standard cubic feet per hour that are required based on functional needs, including but not limited to response time, safety and positive actuation that commenced construction, modification or reconstruction after August 23, 2011, and on or before September 18, 2015?

☐ Yes ☒ No

Please list approximate number.

Are there any continuous bleed natural gas driven pneumatic controllers at this facility with a bleed rate greater than 6 standard cubic feet per hour that are required based on functional needs, including but not limited to response time, safety and positive actuation that commenced construction, modification or reconstruction after September 18, 2015?

☐ Yes ☒ No

Please list approximate number.

ATTACHMENT R

PNEUMATIC PUMP DATA SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT R – PNEUMATIC PUMP DATA SHEET

Are there any natural gas-driven diaphragm pumps located at a well site that commenced construction, modification or reconstruction after September 18, 2015?

☐ Yes ☒ No

Please list.

Source ID #	Date	Pump Make/Model	Pump Size

ATTACHMENT S

AIR POLLUTION CONTROL DEVICE/ EMISSION REDUCTION DEVICE SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT S – AIR POLLUTION CONTROL DEVICE / EMISSION REDUCTION DEVICE SHEETS

Complete the applicable air pollution control device sheets for each flare, vapor combustor, thermal oxidizer, condenser, adsorption system, vapor recovery unit, BTEX Eliminator, Reboiler with and without Glow Plug, etc. at the facility. Use extra pages if necessary.

Emissions calculations must be performed using the most conservative control device efficiency.

The following five (5) rows are only to be completed if registering an alternative air pollution control device.

Emission Unit ID: T01-T02	Make/Model:
Primary Control Device ID: F-1	Make/Model: The Frederick Logan Company, Inc
Control Efficiency (%): 98	APCD/ERD Data Sheet Completed: ☒ Yes ☐ No
Secondary Control Device ID:	Make/Model:
Control Efficiency (%):	APCD/ERD Data Sheet Completed: ☐ Yes ☐ No

VAPOR COMBUSTION
(Including Enclosed Combustors)

General Information

Control Device ID#: F-1	Installation Date: 2017 ☒ New ☐ Modified ☐ Relocated	
Maximum Rated Total Flow Capacity 2,000 scfh 48,000 scfd	Maximum Design Heat Input (from mfg. spec sheet) 2 MMBTU/hr	Design Heat Content 1,000 BTU/scf

Control Device Information

Type of Vapor Combustion Control?

☒ Enclosed Combustion Device ☐ Elevated Flare ☐ Ground Flare
☐ Thermal Oxidizer

Manufacturer: The Frederick Logan Company, Inc Model:	Hours of operation per year? 8760

List the emission units whose emissions are controlled by this vapor control device (Emission Point ID# 6e)

Emission Unit ID#	Emission Source Description	Emission Unit ID#	Emission Source Description
T01-T02	Produced Water Tanks		

If this vapor combustor controls emissions from more than six (6) emission units, please attach additional pages.

Assist Type (Flares only)	Flare Height	Tip Diameter	Was the design per §60.18?
☐ Steam ☐ Air ☐ Pressure ☒ Non	20 feet	TBD	☒ Yes ☐ No Provide determination. (See ProMax Calculations)

Waste Gas Information

Maximum Waste Gas Flow Rate 19.85 (scfm)	Heat Value of Waste Gas Stream 200 BTU/ft^3 or greater	Exit Velocity of the Emissions Stream < 60 (ft/s)

Provide an attachment with the characteristics of the waste gas stream to be burned. (See ProMax Calculations)

Pilot Gas Information

Number of Pilot Lights 1	Fuel Flow Rate to Pilot Flame per Pilot 5 scfh	Heat Input per Pilot 5,000 BTU/hr	Will automatic re-ignition be used? ☒ Yes ☐ No

If automatic re-ignition is used, please describe the method. Electronic re-ignition will be installed and monitored for proof of pilot flame through flame ionization, auto relight.

Is pilot flame equipped with a monitor to detect the presence of the flame? ☒ Yes ☐ No	If Yes, what type? ☐ Thermocouple ☐ Infrared ☐ Ultraviolet ☐ Camera ☒ Other: Ionization rod which sends a signal to controller as long as it is in contact with the flame.

Describe all operating ranges and maintenance procedures required by the manufacturer to maintain the warranty. *(If unavailable, please indicate).* Available upon request

Additional information attached? ☒ Yes ☐ No
Please attach copies of manufacturer's data sheets, drawings, flame demonstration per §60.18 or §63.11(b) and performance testing.

Equipment Description

ITEM	QTY	DESCRIPTION
1	**1**	**DVC-36 Skid Mounted, Valve Train Enclosed Flare complete with:**

- 36" Dia. Combustion Chamber
- 36" x 20' Tall Exhaust Stack
- (3) 24" Adjustable Flame Cell Air Inlets (one Hinged)
- (2) Dual Type K thermocouples with Thermowell
- (2) 4" Flanged Sample Ports
- Stack Lined with 4" 2300 deg. Folded Blanket Flue Liners
- Lower stack lined with 4" Castable Refractory
- (1) Sight Glass
- Stack Material –A-36
- Surface prep and paint:
  - Standard 2 coat paint
  - Color to be determined
- 4" Dehy Overhead Still Column Vapor Inlet. To be mounted on top of the Heated Enclosure. Block & Vent valves to be installed. Vent line to extend 6' above roof. (vent line to be removed for shipping)
- Install low point drains on bottom of vent line, run SS tubing with hand valve to + 1' above grade.
- Install low point drain upstream of the 3" Flame arrestor. Install SS tubing and hand valve.
- (1) 1" NPT for Flash Gas and Vessel Relief Vapors Inlet.
- (2) Lifting lug mounted on top stack section.
- Valve Train C/W: Pneumatic Shutoff Valve, Pilot Solenoid, Manual Block Valve, Strain, and Regulator.

2	**1**	**2 MMBTU/HR Burner**

- Natural Draft Gas induced Burner

3	**1**	**MR-1000 Pilot**

- Self-inspirited pilot.
- Direct Spark Ignition
- Flame Ionization Detection Rod.

4	**1**	**Burner Control Panel**

- 24 VDC Solar power Option
  - Solar Panel and mounting bracket
  - Solar Charging Module

- (2) 12 VDC deep cycle batteries
- (1) Battery enclosure
- Mounting pole

- ProFire 2100 Ignition System with Modbus Communications card.
- NEMA 4 Main Enclosure
- Assist heat burner is on when temperature drops below 1450 deg F.
- Continuous pilot operation.
- System shut down for the following events:
  - Loss of Flame
  - High Stack Temp

  - Customer contacts for the following signals
  - Fault
  - At Temp

5 1 Process Valve Train

- 4" Pneumatic Block Valve for Dehy Stream Vapors.
- 1/2" ASCO Solenoid Low draw Valve for burner gas
- 1" Pneumatic block Valve for flash Gas inlet.
- ½" ASCO Next Generation low draw solenoid valve for pilot gas
- ¼" 3-way Solenoid valve for Pneumatic valve operation.
- Manual block valve for pilot gas
- fuel gas regulator
- Instrument gas regulator for pneumatic controls
- Fuel Gas Strainer

6 2 Flame Arrestor

- 3" 150#, CS/AL construction, for Low Pressure Overhead Dehy Inlet.
- 1" NPT Threaded, CS/AL construction, for High Pressure Flash Gas Vapors.

7 3 Documentation

- Operation and Maintenance Manual

8 1 FAT – Factory Acceptance Test

- Complete test of system at Fort Worth, TX location

9 1 Heated Enclosure for Vessels and Skid mounted Valve train

- 1” thick lined insulation on roof and walls
- 6,000 BTU/HR Catco Heater
- Access door
- Louvered Vent ports

10 1 24” Dia. Knockout/Blow Pot Vessel with complete instrumentation

- ASME Pressure Vessel
- 150 PSIG @250 deg F
- 4” NPT inlet
- 4” NPT Outlet
- 1” NPT Liquid Drain
- 2” NPT Level Controller Connection
- 1” NPT Level Gauge Connections
- Kimray Gen II Level controller
- Kimray dump valve
- 1” Check valve
- 3-way pneumatic valve

Technical Summary

Process inlet stream:

Overhead Still Inlet

Inlet Temperature:	212 °F
Inlet Pressure:	≥ 2” WC

Flash Gas Inlet

Inlet Temperature:	100 °F
Inlet Pressure:	20-50 PSIG
Combustion Chamber Temp:	1450 – 1600 deg F
Destruction Efficiency:	≥98.0%

Site Conditions:

Wind Speed	90 MPH
Seismic Zone	1
Elevation	1,000 ft.
Humidity	High

Utilities:

Gas Service Required for Burner	400 SCFH – Natural Gas Intermittent use, Only on when temp <1450 deg F
Electrical Service Required	Solar Powered 24 VDC, 5 amps
Gas Consumption at Start-up	400,000 Btu/hr
Gas Consumption under load	≤ 400 SCFH, Dependent on BTU value of waste stream

ATTACHMENT T

EMISSION CALULATIONS

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

Table 1. Annual Potential To Emit (PTE) Summary
Tug Hill Operating, LLC - Shields Well Pad

Criteria Pollutants

Proposed Facility Wide PTE - Criteria Pollutants

Source	PM	PM10	PM2.5	SO2	NOx	CO	VOC *	CO2e
Engines (ton/yr)	0.679	0.679	0.679	0.021	15.411	14.194	0.324	864.613
Line Heaters (ton/yr)	0.131	0.131	0.131	0.010	1.718	1.443	0.094	2050.014
Combustor (ton/yr)	--	--	--	0.151	0.598	2.724	1.230	1023.839
Tanks (ton/yr)	-	-	-	-	-	-	0.657	-
Truck Loading (ton/yr)	-	-	-	-	-	-	0.041	-
Compressor Blowdowns (ton/yr)	-	-	-	-	-	-	0.108	-
Fugitives (ton/yr)	-	-	-	-	-	-	0.867	16.261
Total Emissions (ton/yr)	0.809	0.809	0.809	0.182	17.726	18.361	2.665	3954.727
Total Emissions (lb/hr)	0.185	0.185	0.185	0.042	4.047	4.192	0.608	902.906

*Tank VOCs accounted for within combustor.

Hazardous Air Pollutants (HAPs)

Proposed Facility Wide PTE - HAPs

Source	Acetaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	Total HAPs
Engines (ton/yr)	0.0976	0.0552	0.0195	0.0009	0.0068	--	0.081	0.498
Line Heaters (ton/yr)	--	0.0000	0.0001	--	--	0.0309	0.001	0.032
Tanks (ton/yr)	-	-	-	-	-	-	-	-
Truck Loading (ton/yr)	-	-	-	-	-	-	-	-
Compressor Blowdowns (ton/yr)	-	-	-	-	-	-	-	-
Fugitives (ton/yr)	-	0.0002	0.0002	0.0000	0.0000	0.0144	-	0.015
Total Emissions (ton/yr)	0.098	0.055	0.020	0.001	0.007	0.045	0.082	0.545
Total Emissions (lb/hr)	0.022	0.013	0.005	0.000	0.002	0.010	0.019	0.124

Table 1 Compressor Engine Emissions (CE-1)
Waukesha F3524GSI
Tug Hill Operating, LLC - Shields Well Pad

Pollutant	Emission Factor		PTE (lb/hr)		PTE (tons/yr)	
Criteria Pollutants						
PM/PM10/PM2.5**	1.94E-02 lb/MMBtu	(1)	0.15	(a)	0.68	(c)
SO_2	5.88E-04 lb/MMBtu	(1)	0.00	(a)	0.02	(c)
NOx	1.90E+00 g/hp-hr	(2)	3.52	(b)	15.41	(d)
CO	1.75E+00 g/hp-hr	(2)	3.24	(b)	14.19	(d)
VOC*	4.00E-02 g/hp-hr	(2)	0.07	(b)	0.32	(d)
*VO'C's does not include formaldehyde						
Hazardous Air Pollutants						
1,1,2,2-Tetrachloroethane	2.53E-05 lb/MMBtu	(1)	0.000	(a)	0.001	(c)
1,1,2-Trichloroethane	1.53E-05 lb/MMBtu	(1)	0.000	(a)	0.001	(c)
1,3-Butadiene	6.63E-04 lb/MMBtu	(1)	0.005	(a)	0.023	(c)
1,3-Dichloropropene	1.27E-05 lb/MMBtu	(1)	0.000	(a)	0.000	(c)
Acetaldehyde	2.79E-03 lb/MMBtu	(1)	0.022	(a)	0.098	(c)
Acrolein	2.63E-03 lb/MMBtu	(1)	0.021	(a)	0.092	(c)
Benzene	1.58E-03 lb/MMBtu	(1)	0.013	(a)	0.055	(c)
Carbon Tetrachloride	1.77E-05 lb/MMBtu	(1)	0.000	(a)	0.001	(c)
Chlorobenzene	1.29E-05 lb/MMBtu	(1)	0.000	(a)	0.000	(c)
Chloroform	1.37E-05 lb/MMBtu	(1)	0.000	(a)	0.000	(c)
Ethylbenzene	2.48E-05 lb/MMBtu	(1)	0.000	(a)	0.001	(c)
Ethylene Dibromide	2.13E-05 lb/MMBtu	(1)	0.000	(a)	0.001	(c)
Formaldehyde	1.00E-02 g/hp-hr	(2)	0.019	(b)	0.081	(d)
Methanol	3.06E-03 lb/MMBtu	(1)	0.024	(a)	0.107	(c)
Methylene Chloride	4.12E-05 lb/MMBtu	(1)	0.000	(a)	0.001	(c)
Naphthalene	9.71E-05 lb/MMBtu	(1)	0.001	(a)	0.003	(c)
PAH (POM)	1.41E-04 lb/MMBtu	(1)	0.001	(a)	0.005	(c)
Styrene	1.19E-05 lb/MMBtu	(1)	0.000	(a)	0.000	(c)
Toluene	5.58E-04 lb/MMBtu	(1)	0.004	(a)	0.020	(c)
Vinyl Chloride	7.16E-06 lb/MMBtu	(1)	0.000	(a)	0.000	(c)
Xylenes	1.95E-04 lb/MMBtu	(1)	0.002	(a)	0.007	(c)
Total HAP			**0.114**		**0.498**	
Greenhouse Gas Emissions					Metric Tonne/yr	
CO_2	116.89 g/hp-hr	(2)	216.46	(b)	861.91	(d)
CH_4	2.2E-03 g/hp-hr	(2)	0.00	(b)	0.02	(d)
N_2O	2.2E-04 lb/MMBtu	(3)	0.00	(a)	0.01	(c)
CO_2e[(e)]	- -		217.09		864.61	

** includes condensible PM

Calculations:

Hourly Emissions - If emission factor note 1 is used, use calculation (a). If emission factor note 2 is used, use calculation (b).

(a) Hourly Emissions (lb/hr) = Emission factor (lb/MMBtu) * (1MMBtu/1000000 Btu) * Engine Power Output (hp) * BSFC (Btu/hp-hr)

(b) Hourly Emissions (lb/hr) = Emission factor (g/hp-hr) * Engine Power Output (hp) * (lb/453.6g)

Annual Emissions - If emission factor note 1 is used, use calculation (c). If emission factor note 2 is used, use calculation (d).

(c) Annual emissions (tons/yr) = Emission factor (lb/MMBtu) * (1MMBtu/1000000Btu) * Engine Power Output (hp) * BSFC (Btu/hp-hr) * Annual Hours of operation (hr/yr) * (1ton/2000lbs)

(d) Annual emissions (tons/yr) = Emission factor (g/hp-hr) * Engine Power Output (hp) * Annual Hours of operation (hr/yr) * (1ton/2000lbs) * (lb/453.6g)

MAXIMUM HOURLY EMISSION INPUTS

Engine Power Output (kW) =	626	
Engine Power Output (hp) =	840	
Number of Engines =	1	
BSFC (BTU/HP-hr) =	9,504	(4)
Heat Content Natural Gas(Btu/scf) =	1,291.0	(5)
Fuel Throughput (ft3/hr) =	6,183.9	(6)
PTE Hours of Operation =	8,760	

(e) CO_2 equivalent = $[(CO_2 \text{ emissions})*(GWP_{CO2})]+[(CH_4 \text{ emissions})*(GWP_{CH4})]+[(N_2O \text{ emissions})*(GWP_{N2O})]$
Global Warming Potential (GWP)

CO_2	1	(7)
CH_4	25	(7)
N_2O	298	(7)

Notes:

(1) AP-42, Chapter 3.2, Table 3.2-3. Natural Gas-fired Reciprocating Engines (7/00). *Uncontrolled Emission Factors for 4-Stroke Rich-Burn Engines.*

(2) Emission factors supplied from manufacturer's specification sheet

(3) Emission factors supplied from 40 CFR 98, Subpart C, Table C-1 and C-2.

(4) Fuel consumption from manufacturer's specification sheet.

(5) Value obtained from AP-42, Chapter 3.2, Table 3.2-1, footnote b

(6) Fuel throughput = BSFC (BTU/HP-hr) x Power (HP) / Heat Content (BTU/scf)

(7) Global Warming Potentials obtained from 40 CFR 98, Subpart A, Table A-1

Table 3. Tank Emissions
Tug Hill Operating, LLC - Shields Well Pad

Emission Unit ID	Tank Capacity (gal)	Tank Contents	Control Devices	Tank Throughput (bbls/day)	VOC Emission Factor (lbs/bbls)		VOC Emissions (lbs/yr)[a]	VOC Emissions (lb/hr)[b]	VOC Emissions (tons/yr)[c]
T-1	16800	Produced Water	None	11.28	7.98E+00	(1)	32859.77	3.751	16.430
T-2	16800	Produced Water	None	11.28	7.98E+00	(1)	32859.77	3.751	16.430
Totals							**65719.55**	**7.50**	**32.86**
							Controlled	0.15	0.66

Calculations:

(a) VOC Emissions (lb/yr) = Tank Throughput (bbls/day) * VOC Emission Factor (lbs/bbls) * (365days/yr)

(b) VOC Emissions (lb/hr) = VOC Emissions (lbs/yr) * (yr/8760hr)

(c) VOC Emissions (ton/yr) = VOC Emissions (lbs/yr) * (1ton/2000lbs)

Notes:

(1) VOC emission factor includes Flashing/Working/Breathing losses as calculated from the Promax Model Simulation report

Table 4 GPU Heater (GPU-1 through GPU-4) Rates and Emissions
Tug Hill Operating, LLC - Shields Well Pad

Pollutant	Emission Factor			1.50 MBtu/hr GPU Emissions (lb/hr)	1.00 MMBtu/hr GPU Emissions (ton/yr)	1.00 MBtu/hr GPU Emissions (lb/hr) x4	1.00 MMBtu/hr GPU Emissions (ton/yr) x4
Criteria Pollutants							
PM/PM10/PM2.5	7.6	lb/MMcf	(1)	0.007	0.033	0.119	0.131
SO_2	0.6	lb/MMcf	(1)	0.001	0.003	0.009	0.010
NOx	100	lb/MMcf	(2)	0.098	0.429	1.569	1.718
CO	84	lb/MMcf	(2)	0.082	0.361	1.318	1.443
VOC	5.5	lb/MMcf	(1)	0.005	0.024	0.086	0.094
Hazardous Air Pollutants							
Arsenic	2.0E-04	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Benzene	2.1E-03	lb/MMcf	(4)	0.000	0.000	0.000	0.000
Beryllium	1.2E-05	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Cadmium	1.1E-03	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Chromium	1.4E-03	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Cobalt	8.4E-05	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Dichlorobenzene	1.2E-03	lb/MMcf	(4)	0.000	0.000	0.000	0.000
Formaldehyde	7.5E-02	lb/MMcf	(4)	0.000	0.000	0.001	0.001
Hexane	1.8E+00	lb/MMcf	(4)	0.002	0.008	0.028	0.031
Lead	5.0E-04	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Manganese	3.8E-04	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Mercury	2.6E-04	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Naphthalene	6.1E-04	lb/MMcf	(4)	0.000	0.000	0.000	0.000
Nickel	2.1E-03	lb/MMcf	(3)	0.000	0.000	0.000	0.000
PAH/POM	1.3E-03	lb/MMcf	(4)	0.000	0.000	0.000	0.000
Selenium	2.4E-05	lb/MMcf	(3)	0.000	0.000	0.000	0.000
Toluene	3.4E-03	lb/MMcf	(4)	0.000	0.000	0.000	0.000
Total HAP	**1.9E+00**	**lb/MMCF**		0.002	0.008	0.030	0.032
Greenhouse Gas Emissions							
CO_2	116.89	lb/MMBtu	(5)	116.889	511.974	467.556	2047.897
CH_4	2.2E-03	lb/MMBtu	(5)	0.002	0.010	0.009	0.039
N_2O	0.0	lb/MMBtu	(5)	0.000	0.001	0.001	0.004
CO_2e[(b)]	-	-		117.010	512.503	468.040	2050.014

Calculations:

(a) Annual emissions (tons/yr) = [Annual Usage (MMBtu/yr or MMCF/yr)]x [Number of Identical Heaters]x [Emission Factor (lb/MMBtu or lb/MMCF)] / [2,000 lb/ton]

Number of Heaters= 4
Fuel Use (MMBtu/hr) = 1
Hours of Operation (hr/yr)= 8760
PTE Fuel Use (MMcf/yr) = 8.6

(b) CO_2 equivalent = [(CO_2 emissions)*(GWP_{CO2})]+[(CH_4 emissions)*(GWF \
Global Warming Potential (GWP)

CO_2	1	(6)
CH_4	25	(6)
N_2O	298	(6)

Notes:

(1) AP-42, Chapter 1.4, Table 1.4-2. Emission Factors For Criteria Pollutants and Greenhouse Gases From Natural Gas Combustion, July 1998.
(2) AP-42, Chapter 1.4, Table 1.4-1. Emission Factors For Nitrogen Oxides (Nox) and Carbon Monoxide(CO) From Natural Gas Combustion, July 1998.
(3) AP-42, Chapter 1.4, Table 1.4-4. Emission Factors For Metals From Natural Gas Combustion, July 1998.
(4) AP-42, Chapter 1.4, Table 1.4-3. Emission Factors for Speciated Organic Compounds from Natural Gas Combustion, July 1998.
(5) Emission factors are from 40 CFR 98, Subpart C, Table C-1 and C-2.
(6) Global Warming Potentials obtained from 40 CFR 98, Subpart A, Table A-1
(7) MMBtu to MMcf conversion factor is 1020. AP-42, Chapter 1.4

Table 5. Truck Loading (TL-1) VOC Emissions
Tug Hill Operating, LLC - Shields Well Pad

Contents	Volume Transferred [3]	PTE VOC Emissions (lb/hr)	PTE VOC Emissions (ton/yr) [(a)]
Pipeline Liquids	345,618 gal/yr	9.33E-03	4.09E-02
Total		**9.33E-03**	**4.09E-02**

Calculations:

(a) PTE VOC Emissions (ton/yr) given as calculated in the Promax Model simulation report

	Pipeline liquids	
Saturation factor	0.60	Note [(1)]
Pvap (psia)	0.37	Note [(2)]
Molecular Weight Vap (lb/lbmol)	19.05	Note [(2)]
Bulk Liquid Tempurature (F)	52.14	Note [(2)]

Notes:

(1) AP-42 Section 5.2, Table 5.2-1 Saturation Factors for Calculating Petroleum Liquid Loading Losses, Submerged loading - dedicated normal service

(2) Input parameters as defined by the Promax Model simulation report

Table 6. Fugitive Leak Emissions
Tug Hill Operating, LLC - Shields Well Pad

Pollutant	Emission Factor		PTE[(a) Gas Service] (tons/yr)	PTE VOC emissions (ton/yr)	PTE CO_2e emissions (ton/yr)	PTE Total HAPs emissions (ton/yr)
Valves	9.9E-03	lb/hr/source	6.82	0.60	11.19	0.01
Pressure Relief Valves	1.9E-02	lb/hr/source	0.25	0.02	0.42	0.00
Connectors (2)	8.6E-04	lb/hr/source	2.58	0.23	4.23	0.00
Compressors	1.9E-02	lb/hr/source	0.08	0.01	0.14	0.00
Open Ended Lines	4.4E-03	lb/hr/source	0.17	0.02	0.29	0.00
Total	-	-	9.91	0.87	16.26	0.01

Pollutant	PTE Benzene emissions (ton/yr)	PTE Toluene emissions (ton/yr)	PTE Ethylbenzene emissions (ton/yr)	PTE Xylenes emissions (ton/yr)	PTE n-Hexane emissions (ton/yr)
Valves	1.36E-04	1.36E-04	0.00E+00	0.00E+00	9.88E-03
Pressure Relief Valves	5.09E-06	5.09E-06	0.00E+00	0.00E+00	3.69E-04
Connectors (2)	5.15E-05	5.15E-05	0.00E+00	0.00E+00	3.74E-03
Compressors	1.70E-06	1.70E-06	0.00E+00	0.00E+00	1.23E-04
Open Ended Lines	3.47E-06	3.47E-06	0.00E+00	0.00E+00	2.52E-04
Total	0.00	0.00	0.00	0.00	0.01

Calculations:

(a) Annual emissions (tons/yr) = [Emission Factor (lb/hr/source)] x [Number of Sources] x [Hours of Operation per Year] x [ton/2000lb]

WET GAS INPUTS TABLE	
Gas Stream Components	**Wt Percent**
Methane	75.00%
Ethane	15.38%
VOC	8.75%
Benzene	0.00%
Toluene	0.00%
Ethylbenzene	0.00%
Xylenes	0.00%
n-Hexane	0.15%

Number of Components in Gas Service

Valves =	157
Pressure Relief Valves =	3
Connectors =	685
Open Ended Lines =	9
Compressors=	1.000
Maximum Hour of Operation =	8,760

Global Warming Potential (GWP)

CO_2	1
CH_4	25
N_2O	298

(1) Emission factors from 1995 EPA Protocol for Equipment Leak Emission Estimates, Table 2-4 Oil and Gas Production

(2) Connectors is assumed to include flange connections in the total count

(3) Worst case VOC wt % assumption for station based on gas sample analysis from facility

(4) *Default Average Component Counts for Major Onshore Natural Gas Production Equipment* from 40 CFR 98, Subpart W, Table W-1B

(5) Global Warming Potentials obtained from 40 CFR 98, Subpart A, Table A-1

Table 6. Reciprocating Engine / Integral Compressor Emissions (E01) Blowdown Venting
Waukesha F3524GSI
Tug Hill Operating, LLC - Shields Well Pad

Pollutant	Maximum Hourly Emissions		Annual Emissions	
	Emission Factor	PTE per Engine Event (lb/hr)	Emission Factor	Annual PTE (tons/yr)
Criteria Pollutants				
VOC	3.60E+00 lb/Event (1)	3.60 (a)	3.60E+00 lb/Event (1)	0.11 (a)

(1) - 7.7 lbs VOC/ Engine blowdown event; based on 717 scf/event of 21.48 MW gas with 9 wt % VOC

(a) - Worst case blowdowns per year equal normal rate 6 times 10 = 60 Events/yr

Table 8. Combustor (VDU-1) Emissions
Tug Hill Operating, LLC - Shields Well Pad

Pollutant	Emission Factor (lb/MMBtu)	Volume (scf/hr)	Gas Heat Value (Btu/scf)	(MMBtu/ 1000000Btu)	Emissions (lbs/hr)	Emissions (ton/yr)
CO	0.31	840	2,380	(1/1,000,000)	0.62	2.72
NOx	0.068	840	2,380	(1/1,000,000)	0.14	0.60
VOC[a]	0.14	840	2,380	(1/1,000,000)	0.28	1.23
CO2	116.89	840	2,380	(1/1,000,000)	233.75	1023.84

Example Formula:

$$emissions\left(\frac{ton}{yr}\right) = emission\,factor\left(\frac{lb}{MMBtu}\right) \times Volume\left(\frac{scf}{hr}\right) \times gas\,heat\,value\left(\frac{Btu}{scf}\right) \times \frac{MMBtu}{1{,}000{,}000\,Btu} \times \frac{659\,hrs}{1\,yr} \times \frac{1\,ton}{2{,}000\,lbs}$$

Emission Factor = AP-42 Tables 13.5-1 and 2 emission factor for specific pollutant
[a] - 98% DRE for VOCs from ProMax simulated unconrolled emissions was found to be less than AP-42 Factor.
Hours of operation calculated at 8760 hrs/yr for worst case
Volume from manufacturer spec. sheet.
Gas Heat Value = 2380 Btu/scf from flash gas ProMax Estimate

Pollutant	Volume (scf/hr)	grain H2S/ 100 scf	Mol Fraction	Mol weight (g/mol)	(lb-mol /scf)	Emissions (lbs/hr)	Emissions (ton/yr)
SO2	840	15.26	0.0002423	64.00	1/379.4	0.0343	0.1505

Example Formula:

$$emissions\left(\frac{ton}{yr}\right) = Volume\left(\frac{scf}{hr}\right) \times mol\,fraction\left(\frac{H2S}{100\,scf} \times 0.00001588\right) \times molecular\,weight \times \frac{lb\text{-}mol}{scf} \times \frac{659\,hrs}{1\,yr} \times \frac{1\,ton}{2{,}000\,lbs}$$

$$\frac{1\,grain\ H2S}{100\,scf} = 15.26\,ppm\ of\ H2S$$

Volume from manufacturer spec. sheet.
H2S conversion taken from supporting Sulfur Measurement Handbook
grain H2S/100 scf = 15.26
1 lb mol = 379.4 cubic feet

For Pilot Light

Pollutant	Emission Factor (lb/MMBtu)	Volume (scf/hr)	Gas Heat Value (Btu/scf)	(MMBtu/ 1000000Btu)	Emissions (lbs/hr)	Emissions (ton/yr)
CO	0.31	5.0	1,291	(1/1,000,000)	0.0020	0.0088
NOx	0.068	5.0	1,291	(1/1,000,000)	0.0004	0.0019
VOC[a]	0.14	5.0	1,291	(1/1,000,000)	0.0009	0.0040

[a] - Measured as methane equivalent, assumed worst case

Example Formula:

$$emissions\left(\frac{ton}{yr}\right) = emission\,factor\left(\frac{lb}{MMBtu}\right) \times Volume\left(\frac{scf}{hr}\right) \times gas\,heat\,value\left(\frac{Btu}{scf}\right) \times \frac{MMBtu}{1{,}000{,}000\,Btu} \times \frac{8760\,hrs}{1\,yr} \times \frac{1\,ton}{2{,}000\,lbs}$$

Volume from manufacturer spec. sheet.
Emission Factor = AP-42 Tables 13.5-1 and 2 emission factor for specific pollutant
Gas Heat Value = 2380 Btu/scf from flash gas ProMax Estimate

Pollutant	Volume (scf/hr)	grain H2S/ 100 scf	Mol Fraction	Mol weight (g/mol)	(lb-mol /scf)	Emissions (lbs/hr)	Emissions (ton/yr)
SO2	5.0	15.26	0.0002423	64.00	1/379.4	0.0002	0.0009

Example Formula:

$$emissions\left(\frac{ton}{yr}\right) = Volume\left(\frac{scf}{hr}\right) \times mol\,fraction\left(\frac{H2S}{100\,scf} \times 0.00001588\right) \times molecular\,weight \times \frac{lb\text{-}mol}{scf} \times \frac{8760\,hrs}{1\,yr} \times \frac{1\,ton}{2{,}000\,lbs}$$

$$\frac{1\,grain\ H2S}{100\,scf} = 15.26\,ppm\ of\ H2S$$

Volume from manufacturer spec. sheet.
H2S conversion taken from supporting Sulfur Measurement Handbook
grain H2S/100 scf = 15.26
1 lb mol = 379.4 cubic feet

Note: Controlled emissions from 2% of captured emissions predicted by ProMax = 0.66 tpy VOCs. Therefore, VOC emissions were taken from higher estimates of VOCs using AP-42's THC emission factor.

Flare and Pilot Combined		
Pollutant	**lb/hr**	**ton/yr**
CO	**0.62**	**2.72**
Nox	**0.14**	**0.60**
VOC	**0.28**	**1.23**
SO2	**0.03**	**0.15**

Bryan Research & Engineering, Inc.

ProMax® 4.0

Simulation Report

Project: TugHill_Shields_WellPad.pmx

Licensed to SLR International Corporation and Affiliates

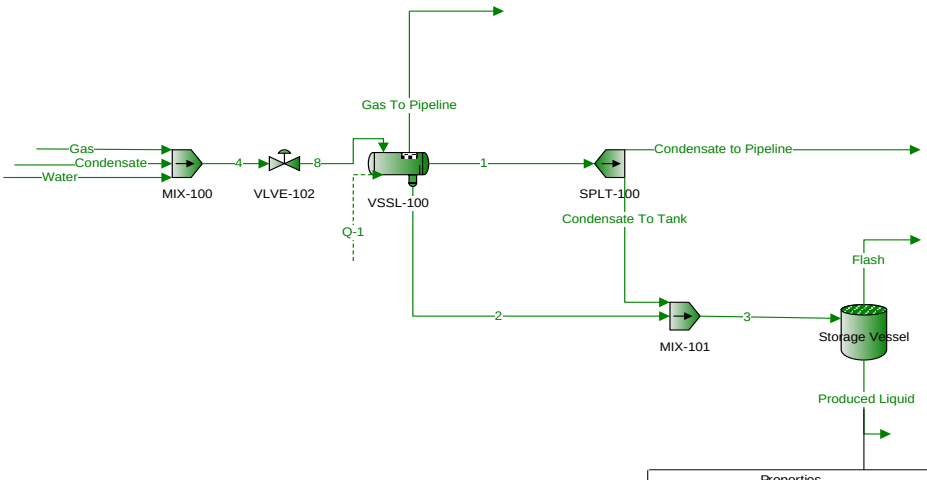
Client Name: Tug Hill
Location: Shields
Job: G70-D Permit

ProMax Filename: N:\West Virginia\Tug Hill\Projects\Determination\Shields\ProMax\TugHill_Shields_WellPad.pmx
ProMax Version: 4.0.16071.0
Simulation Initiated: 11/1/2017 11:49:59 AM

Bryan Research & Engineering, Inc.
Chemical Engineering Consultants
P.O. Box 4747 Bryan, Texas 77805
Office: (979) 776-5220
FAX: (979) 776-4818
mailto:sales@bre.com
http://www.bre.com/

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.

Shields Well Pad



"Flash" VOCs = 31.29 ton/yr

Annual tank loss calculations for "3".
Total working and breathing losses from the Vertical Cylinder are 0.04083 ton/yr.
Flashing losses are 32.85 ton/yr.
Loading losses are 0.009767 ton/yr of loaded liquid.
* Only Non-Exempt VOCs are reported.

Properties	Produced Liquid	
Liquid Volumetric Flow (Light Liquid)	2.0946	bbl/d
Liquid Volumetric Flow (Total)	22.513	bbl/d
Analysis	Produced Liquid	
True Vapor Pressure(Vapor Pressure 1, Total)	7.7995	psig
Composition	Produced Liquid	
Water(Volumetric Flow , Total)	20.416	bbl/d

Process Streams		Condensate	Condensate to Pipeline	Condensate To Tank	Flash	Gas	Gas To Pipeline	Produced Liquid	Water
Composition	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved	Solved	Solved
Phase: **Total**	**From Block:**	--	SPLT-100	SPLT-100	Storage Vessel	--	VSSL-100	Storage Vessel	--
	To Block:	MIX-100	--	MIX-101	--	MIX-100	--	--	MIX-100
Mass Flow		lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h	lb/h
C1		36.4621*	44.0938	0.683963	0.797361	13210.9*	13202.5	0.00552072	0*
C2		83.5793*	90.4186	1.40253	1.40942	5076.10*	5067.80	0.0522023	0*
C3		144.957*	149.891	2.32504	2.07778	2684.68*	2677.40	0.266619	0*
iC4		42.0875*	44.6298	0.692277	0.521905	352.271*	349.034	0.171982	0*
nC4		159.384*	174.215	2.70234	1.81316	968.744*	951.205	0.894657	0*
iC5		85.9810*	87.1653	1.35207	0.601616	217.850*	215.313	0.751226	0*
nC5		151.123*	157.324	2.44034	0.908262	306.574*	297.931	1.53249	0*
N2		0.141458*	0.237235	0.00367988	0.00467249	209.771*	209.671	1.13977E-05	0*
CO2		0.611140*	0.769374	0.0119342	0.0262629	90.8447*	90.6588	0.00143893	0*
Benzene		1.61719*	2.06471	0.0320268	0.00439755	1.71531*	1.23487	0.0285258	0*
Ethylbenzene		7.02286*	6.44133	0.0999149	0.00145778	0*	0.481443	0.0986361	0*
Toluene		6.97901*	7.39855	0.114763	0.00503702	2.02333*	1.48831	0.110435	0*
o-Xylene		12.8395*	11.9464	0.185307	0.00208772	0*	0.707432	0.183604	0*
C6		131.308*	166.982	2.59015	0.357661	137.198*	98.9336	2.23257	0*
C7		90.8243*	98.5446	1.52858	0.0713046	30.8056*	21.5567	1.45729	0*
C8		50.6443*	53.2193	0.825514	0.0119551	7.52525*	4.12470	0.813560	0*
C9		30.4069*	30.5553	0.473960	0.00205391	1.40822*	0.785840	0.471906	0*
C10		17.1356*	16.7094	0.259188	0.000359182	0*	0.167005	0.258829	0*
C11		57.8953*	56.8157	0.881299	0.000362753	0*	0.198348	0.880936	0*
C12		38.6629*	38.0235	0.589803	7.95123E-05	0*	0.0496201	0.589724	0*
C13		27.5564*	27.1216	0.420698	1.84472E-05	0*	0.0141123	0.420680	0*
2,2-Dimethylpropane		2.51385*	2.65256	0.0411454	0.0250826	11.8827*	11.7028	0.0160932	0*
2,2-Dimethylbutane		3.74234*	5.52414	0.0856879	0.0226641	8.51571*	6.64821	0.0630321	0*
Cyclopentane		0*	0	0	0	0*	0	0	0*
2,3-Dimethylbutane		8.76839*	13.3943	0.207767	0.0431862	17.0314*	12.1977	0.164614	0*
2-Methylpentane		66.1437*	84.1367	1.30509	0.247745	88.9419*	69.6436	1.05747	0*
3-Methylpentane		41.2745*	51.8096	0.803647	0.139506	50.1481*	38.8092	0.664312	0*
Methylcyclopentane		17.4665*	17.6354	0.273552	0.0397771	11.0887*	10.6461	0.233857	0*
Cyclohexane		18.5715*	21.0584	0.326648	0.0363744	12.9368*	10.1230	0.290453	0*
2-Methylhexane		50.6997*	52.5946	0.815824	0.0551009	18.7034*	15.9926	0.760740	0*
3-Methylhexane		44.9568*	49.3138	0.764933	0.0466505	18.7034*	13.5814	0.718301	0*
2,2,4-Trimethylpentane		0*	0	0	0	0*	0	0	0*
Methylcyclohexane		46.5313*	50.2430	0.779346	0.0366645	15.0929*	10.6019	0.742753	0*
m-Xylene		7.04967*	6.50275	0.100868	0.00133824	0*	0.445943	0.0996326	0*
p-Xylene		0*	0	0	0	0*	0	0	0*
Water		0*	0.219308	0.00340181	0.0900210	0*	21.5708	297.598	319.478*
Tetradecane		19.8355*	19.5284	0.302916	4.51774E-06	0*	0.00409426	0.302912	0*
Pentadecane		13.4077*	13.2019	0.204781	1.04774E-06	0*	0.00110963	0.204780	0*
Hexadecane		7.60394*	7.48752	0.116143	2.15428E-07	0*	0.000269903	0.116143	0*
Heptadecane		4.61426*	4.54370	0.0704798	5.18472E-08	0*	7.68013E-05	0.0704798	0*
Octadecane		4.11235*	4.04950	0.0628140	1.81153E-08	0*	3.11799E-05	0.0628140	0*
Nonadecane		2.64408*	2.60368	0.0403871	4.11269E-09	0*	8.43007E-06	0.0403871	0*
Eicosane		1.28409*	1.26447	0.0196140	4.90660E-10	0*	1.25156E-06	0.0196140	0*
Heneicosane		0.748798*	0.737360	0.0114376	1.25842E-10	0*	3.73602E-07	0.0114376	0*
Docosane		0.470528*	0.463340	0.00718712	3.49135E-11	0*	1.20061E-07	0.00718712	0*
Tricosane		0.245888*	0.242132	0.00375585	5.15333E-12	0*	2.16662E-08	0.00375585	0*
Tetracosane		0.171008*	0.168396	0.00261209	1.21993E-12	0*	6.14315E-09	0.00261209	0*
Pentacosane		0.0890457*	0.0876855	0.00136014	2.47394E-13	0*	1.45959E-09	0.00136014	0*
Hexacosane		0.277761*	0.273519	0.00424270	2.49827E-13	0*	1.78553E-09	0.00424270	0*
Heptacosane		0.0961286*	0.0946603	0.00146833	2.17359E-14	0*	1.91984E-10	0.00146833	0*
Octacosane		0.0996701*	0.0981477	0.00152242	1.17314E-14	0*	1.18256E-10	0.00152242	0*
Nonacosane		0*	0	0	0	0*	0	0	0*
Triacontane		0*	0	0	0	0*	0	0	0*
Hentriacontane		0*	0	0	0	0*	0	0	0*
Other C10s		66.2663*	64.4263	0.999352	0.00190485	0*	0.840595	0.997451	0*
Other C7s		21.9056*	31.1074	0.482523	0.0273925	17.5800*	7.89568	0.455154	0*
Other C8s		120.196*	123.088	1.90929	0.0354029	16.2835*	11.4817	1.87394	0*
Other C9s		68.3031*	66.3859	1.02975	0.00611101	1.40641*	2.29391	1.02365	0*

Process Streams		Condensate	Condensate to Pipeline	Condensate To Tank	Flash	Gas	Gas To Pipeline	Produced Liquid	Water
Properties	**Status:**	Solved	Solved	Solved	Solved	Solved	Solved	Solved	Solved
Phase: Total	**From Block:**	--	SPLT-100	SPLT-100	Storage Vessel	--	VSSL-100	Storage Vessel	--
	To Block:	MIX-100	--	MIX-101	--	MIX-100	--	--	MIX-100
Property	**Units**								
Temperature	°F	100*	71.0000	71.0000	66.9992	100*	71.0000	66.9992	100*
Pressure	psig	1000*	364	364	-1.35077E-13	1000*	364	-1.35077E-13	1000*
Molecular Weight	lb/lbmol	71.9790	71.0021	71.0021	42.2395	21.4819	21.3751	19.0482	18.0153
Mass Density	lb/ft^3	39.2290	39.6459	39.6459	0.111566	4.60899	1.58334	60.5387	62.0089
Molar Flow	lbmol/h	25.2478	27.5978	0.428085	0.224248	1097.98	1096.40	16.7382	17.7337
Mass Flow	lb/h	1817.31	1959.50	30.3949	9.47214	23586.8	23435.7	318.833	319.478
Std Vapor Volumetric Flow	MMSCFD	0.229947	0.251350	0.00389883	0.00204237	10*	9.98562	0.152445	0.161512
Std Liquid Volumetric Flow	sgpm	5.83333*	6.31636	0.0979765	0.0381212	135.493	134.954	0.656227	0.638660*
Gross Ideal Gas Heating Value	Btu/ft^3	3971.83	3920.32	3920.32	2379.83	1286.51	1279.66	118.804	50.3101
Gross Liquid Heating Value	Btu/lb	20763.4	20776.8	20776.8	21223.1	22659.4	22651.2	1365.23	0

Environments Report

Client Name:	G70-D Permit	**Job:**	N:\West Virginia\Tug Hill\Projects\Determination\Shields\ProMax\TugHill_Shields_WellPad.pmx
Location:	0		
Flowsheet:	Flowsheet1		

Project-Wide Constants

Atmospheric Pressure	14.6959 psia	Ideal Gas Reference Volume	379.484 ft^3/lbmol
Ideal Gas Reference Pressure	14.6959 psia	Liquid Reference Temperature	60 °F
Ideal Gas Reference Temperature	60 °F		

Environment1

Environment Settings

Number of Poynting Intervals	0	Phase Tolerance	1 %
Gibbs Excess Model Evaluation Temperature	77 °F	Emulsion Enabled	FALSE
Freeze Out Temperature Threshold Difference	10 °F		

Components

Component	Henry's Law Comp.	Phase Initiator	Component	Henry's Law Comp.	Phase Initiator
C1	FALSE	FALSE	C2	FALSE	FALSE
C3	FALSE	FALSE	iC4	FALSE	FALSE
nC4	FALSE	FALSE	iC5	FALSE	FALSE
nC5	FALSE	FALSE	N2	FALSE	FALSE
CO2	FALSE	FALSE	Benzene	FALSE	FALSE
Ethylbenzene	FALSE	FALSE	Toluene	FALSE	FALSE
o-Xylene	FALSE	FALSE	C6	FALSE	FALSE
C7	FALSE	FALSE	C8	FALSE	FALSE
C9	FALSE	FALSE	C10	FALSE	FALSE
C11	FALSE	FALSE	C12	FALSE	FALSE
C13	FALSE	FALSE	2,2-Dimethylpropane	FALSE	FALSE
2,2-Dimethylbutane	FALSE	FALSE	Cyclopentane	FALSE	FALSE
2,3-Dimethylbutane	FALSE	FALSE	2-Methylpentane	FALSE	FALSE
3-Methylpentane	FALSE	FALSE	Methylcyclopentane	FALSE	FALSE
Cyclohexane	FALSE	FALSE	2-Methylhexane	FALSE	FALSE
3-Methylhexane	FALSE	FALSE	2,2,4-Trimethylpentane	FALSE	FALSE
Methylcyclohexane	FALSE	FALSE	m-Xylene	FALSE	FALSE
p-Xylene	FALSE	FALSE	Water	FALSE	TRUE
Tetradecane	FALSE	FALSE	Pentadecane	FALSE	FALSE
Hexadecane	FALSE	FALSE	Heptadecane	FALSE	FALSE
Octadecane	FALSE	FALSE	Nonadecane	FALSE	FALSE
Eicosane	FALSE	FALSE	Heneicosane	FALSE	FALSE
Docosane	FALSE	FALSE	Tricosane	FALSE	FALSE
Tetracosane	FALSE	FALSE	Pentacosane	FALSE	FALSE
Hexacosane	FALSE	FALSE	Heptacosane	FALSE	FALSE
Octacosane	FALSE	FALSE	Nonacosane	FALSE	FALSE
Triacontane	FALSE	FALSE	Hentriacontane	FALSE	FALSE
Other C10s	FALSE	FALSE	Other C7s	FALSE	FALSE
Other C8s	FALSE	FALSE	Other C9s	FALSE	FALSE

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Vapor Package	Peng-Robinson
Overall Package	Peng-Robinson	Light Liquid Package	Peng-Robinson
Stability Calculation	Peng-Robinson	Heavy Liquid Package	Peng-Robinson

Notes:

Simple Solver 3

Source Code

Residual Error (for CV1) = GPUTemp-71

Calculated Variable [CV1]

SourceMoniker	ProMax:ProMax!Project!Flowsheets!Flowsheet1!QStreams!Q-1!Energy Rate
Value	0.244210
Units	MMBtu/h

Measured Variable [GPUTemp]

SourceMoniker	ProMax:ProMax!Project!Flowsheets!Flowsheet1!PStreams!Gas To Pipeline!Phases!Total!Properties!Temperature
Value	71.0000
Units	°F

Solver Properties

Status: **Solved**

Error	1.30041E-08		Iterations	3
Calculated Value	244210	Btu/h	Max Iterations	20
Lower Bound		Btu/h	Weighting	1
Upper Bound		Btu/h	Priority	0
Step Size		Btu/h	Solver Active	Active
Is Minimizer	FALSE		Group	
Algorithm	Default		Skip Dependency Check	FALSE

Notes:

User Value Sets Report

Client Name:	G70-D Permit	**Job:**	N:\West Virginia\
Location:	0		
Flowsheet:	Flowsheet1		

Tank-1

User Value [BlockReady]

Parameter	1*		Upper Boun		
Lower Bound			Enforce Bou	FALSE	

User Value [ShellLength]

Parameter	20*	ft	Upper Boun		ft
Lower Bound	0*	ft	Enforce Bou	FALSE	

User Value [ShellDiam]

Parameter	12*	ft	Upper Boun		ft
Lower Bound	0*	ft	Enforce Bou	FALSE	

User Value [BreatherVP]

Parameter	0.0300000*	psig	Upper Boun		psig
Lower Bound		psig	Enforce Bou	FALSE	

User Value [BreatherVacP]

Parameter	-0.0300000*	psig	Upper Boun		psig
Lower Bound		psig	Enforce Bou	FALSE	

User Value [DomeRadius]

Parameter	0.17*	ft	Upper Boun		ft
Lower Bound		ft	Enforce Bou	FALSE	

User Value [OpPress]

Parameter	0*	psig	Upper Boun		psig
Lower Bound		psig	Enforce Bou	FALSE	

User Value [AvgPercentLiq]

Parameter	50*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

User Value [MaxPercentLiq]

Parameter	90*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

User Value [AnnNetTP]

Parameter	22.4310*	bbl/day	Upper Boun		bbl/day
Lower Bound	0*	bbl/day	Enforce Bou	FALSE	

User Value [OREff]

Parameter	0*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

User Value [MaxAvgT]

Parameter	61.15*	°F	Upper Boun		°F
Lower Bound		°F	Enforce Bou	FALSE	

User Value [MinAvgT]

Parameter	36.9667*	°F	Upper Boun		°F
Lower Bound		°F	Enforce Bou	FALSE	

User Value [BulkLiqT]					
Parameter	52.1383*	°F	Upper Boun		°F
Lower Bound		°F	Enforce Bou	FALSE	

User Value [AvgP]					
Parameter	13.7315*	psia	Upper Boun		psia
Lower Bound		psia	Enforce Bou	FALSE	

User Value [ThermI]					
Parameter	1193.89*	Btu/ft^2/day	Upper Boun		Btu/ft^2/day
Lower Bound		Btu/ft^2/day	Enforce Bou	FALSE	

User Value [AvgWindSpeed]					
Parameter	6.16667*	mi/h	Upper Boun		mi/h
Lower Bound		mi/h	Enforce Bou	FALSE	

User Value [MaxHourlyLoadingRate]					
Parameter	0.934625*	bbl/hr	Upper Boun		bbl/hr
Lower Bound	0*	bbl/hr	Enforce Bou	FALSE	

User Value [EntrainedOilFrac]					
Parameter	1*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

User Value [TurnoverRate]					
Parameter	11.2891*		Upper Boun		
Lower Bound			Enforce Bou	FALSE	

User Value [LLossSatFactor]					
Parameter	0.5*		Upper Boun		
Lower Bound			Enforce Bou	FALSE	

User Value [AtmPressure]					
Parameter	13.7315*	psia	Upper Boun		psia
Lower Bound		psia	Enforce Bou	FALSE	

User Value [TVP]					
Parameter	0.368396*	psia	Upper Boun		psia
Lower Bound		psia	Enforce Bou	FALSE	

User Value [MaxVP]					
Parameter	0.488083*	psia	Upper Boun		psia
Lower Bound		psia	Enforce Bou	FALSE	

User Value [MinVP]					
Parameter	0.278019*	psia	Upper Boun		psia
Lower Bound		psia	Enforce Bou	FALSE	

User Value [AvgLiqSurfaceT]					
Parameter	57.1967*	°F	Upper Boun		°F
Lower Bound		°F	Enforce Bou	FALSE	

User Value [MaxLiqSurfaceT]					
Parameter	67.2326*	°F	Upper Boun		°F
Lower Bound		°F	Enforce Bou	FALSE	

User Value [TotalLosses]					
Parameter	0.0408273*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	

User Value [WorkingLosses]					
Parameter	0.00723500*	ton/yr	Upper Boun		ton/yr

Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [StandingLosses]					
Parameter	0.0131786*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [RimSealLosses]					
Parameter	0*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [WithdrawalLoss]					
Parameter	0*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [LoadingLosses]					
Parameter	0.00976711*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [MaxHourlyLoadingLoss]					
Parameter	0.00222993*	lb/hr	Upper Boun		lb/hr
Lower Bound		lb/hr	Enforce Bou	FALSE	
User Value [PStar]					
Parameter			Upper Boun		
Lower Bound			Enforce Bou	FALSE	
User Value [AllCTotalLosses]					
Parameter	0.0902764*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [AllCLoadingLosses]					
Parameter	0.0215968*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [AllCMaxHLoadingLoss]					
Parameter	0.00493078*	lb/hr	Upper Boun		lb/hr
Lower Bound		lb/hr	Enforce Bou	FALSE	
User Value [AllCFlashingLosses]					
Parameter	43.1178*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [DeckFittingLosses]					
Parameter	0*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [DeckSeamLosses]					
Parameter	0*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [FlashingLosses]					
Parameter	32.8521*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [TotalResidual]					
Parameter	1394.77*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	
User Value [GasMoleWeight]					
Parameter	0.0282882*	kg/mol	Upper Boun		kg/mol
Lower Bound		kg/mol	Enforce Bou	FALSE	

User Value [VapReportableFrac]					
Parameter	45.2247*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

User Value [LiqReportableFrac]					
Parameter	6.53761*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

User Value [FlashReportableFrac]					
Parameter	76.1915*	%	Upper Boun		%
Lower Bound		%	Enforce Bou	FALSE	

Notes:
This User Value Set was programmatically generated. GUID={1EDE36BA-2D5D-4876-9370-5B5F79CCFF0E}

Sum Component Flow/Frac

User Value [CompSum]					
Parameter	31.2925*	ton/yr	Upper Boun		ton/yr
Lower Bound		ton/yr	Enforce Bou	FALSE	

Notes:
This User Value Set was programmatically generated. GUID={06B303CE-D6A3-4C69-ABCE-29F0C05F34E0}

ATTACHMENT U

FACILITY-WIDE EMISSION SUMMARY SHEET(S)

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

ATTACHMENT U - FACILITY WIDE CONTROLLED EMISSIONS SUMMARY SHEET

List all sources of emissions in this table. Use extra pages if necessary

Emission Point ID#	NO_X		CO		VOC		SO_2		PM_{10}		$PM_{2.5}$		GHG (CO_2e)	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
1e	0.10	0.43	0.08	0.36	0.01	0.02	0.00	0.00	0.01	0.03	0.01	0.03	117.01	512.50
2e	0.10	0.43	0.08	0.36	0.01	0.02	0.00	0.00	0.01	0.03	0.01	0.03	117.01	512.50
3e	0.10	0.43	0.08	0.36	0.01	0.02	0.00	0.00	0.01	0.03	0.01	0.03	117.01	512.50
4e	0.10	0.43	0.08	0.36	0.01	0.02	0.00	0.00	0.01	0.03	0.01	0.03	117.01	512.50
5e	3.52	15.41	3.24	14.19	0.07	0.32	0.00	0.02	0.15	0.68	0.15	0.68	217.09	864.61
6e	0.14	0.60	0.62	2.72	0.28	1.23	0.03	0.15	--	--	--	--	233.75	1023.84
7e	--	--	--	--	0.01	0.04	--	--	--	--	--	--	--	--
8e	--	--	--	--	0.02	0.11	--	--	--	--	--	--	--	--
TOTAL	4.05	17.73	4.19	18.36	0.41	1.80	0.04	0.18	0.18	0.81	0.18	0.81	918.88	3938.47

Annual emissions shall be based on 8,760 hours per year of operation for all emission units except for emergency generators.

According to 45CSR14 Section 2.43.e, fugitive emissions are not included in the major source determination because it is not listed as one of the source catergories in Table 1. Therefore fugitive emissions shall not be included in the PTE above.

ATTACHMENT U - FACILITY WIDE HAP CONTROLLED EMISSIONS SUMMARY SHEET

List all sources of emissions in this table. Use extra pages if necessary

Emission Point ID#	Formaldehyde		Benzene		Toluene		Ethylbenzene		Xylenes		Hexane		Total HAPs	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
1e	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	0.00	0.01	0.00	0.01
2e	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	0.00	0.01	0.00	0.01
3e	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	0.00	0.01	0.00	0.01
4e	0.00	0.00	0.00	0.00	0.00	0.00	--	--	--	--	0.00	0.01	0.00	0.01
5e	0.02	0.08	0.01	0.06	0.00	0.02	0.00	0.00	0.00	0.01	--	--	0.11	0.50
6e	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7e	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8e	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TOTAL	0.02	0.08	0.01	0.06	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.03	0.12	0.53

Annual emissions shall be based on 8,760 hours per year of operation for all emission units except for emergency generators.

According to 45CSR14 Section 2.43.e, fugitive emissions are not included in the major source determination because it is not listed as one of the source catergories in Table 1. Therefore fugitive emissions shall not be included in the PTE above.

ATTACHMENT V

CLASS I LEGAL ADVERTISEMENT

General G70-D Permit Application

Shields Well Pad
Proctor, West Virginia

Tug Hill Operating, LLC
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317

December 2017

AIR QUALITY PERMIT NOTICE
Notice of Application

Notice is given that Tug Hill Operating, LLC has applied to the West Virginia Department of Environmental Protection, Division of Air Quality, for a G70-D General Permit Registration, for a natural gas well pad located off Burch Ridge, North of Proctor, in Marshall County, West Virginia. The latitude and longitude coordinates are 39.76026 and -80.78795.

The applicant estimates the potential to discharge of the following Regulated Air Pollutants will be:

Pollutant	Tons/yr
PM/PM_{10}/$PM_{2.5}$	0.81
SO2	0.19
NO_X	17.73
CO	18.37
VOCs	2.67
Benzene	0.06
Toluene	0.02
Xylenes	0.01
n-Hexane	0.05
Formaldehyde	0.09
Total HAPs	0.55

Startup of operation is planned to begin in the 1st quarter of 2018. Written comments will be received by the West Virginia Department of Environmental Protection, Division of Air Quality, 601 57th Street, SE, Charleston, WV 25304, for at least 30 calendar days from the date of publication of this notice.

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

Dated this the 18 day of December, 2017.

By: Tug Hill Operating, LLC
Sean Willis
Vice President
380 Southpointe Blvd., Suite 200
Canonsburg, PA 15317