



TUG HILL
OPERATING

Tug Hill Operating, LLC

Wayne Well Pad

New Martinsville, West Virginia

Permit Determination

SLR Ref: 116.01631.00010

July 2017



Wayne Well Pad Permit Determination

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.



Chris Boggess
Associate Engineer



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Principal Engineer



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SECTION 1.0
TECHNICAL SUPPORT DOCUMENT

PERMIT DETERMINATION

Wayne Well Pad
New Martinsville, West Virginia

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

July 2017

1.1 INTRODUCTION

The Wayne Well Site previously owned and operated by Gastar Exploration LLC has been purchased by Tug Hill Operating, LLC (Tug Hill). The site was purchased as a non-permitted pad as a result of being below permitting thresholds based on (4) 1.5 MMBtu/hr heaters and (2) produced water tanks. As a result, no DAQ ownership transfer documents have to be completed and this should be the first determination submitted for the site.

Tug has prepared this permit determination in order to evaluate the existing equipment as well as a 1.5 MM gallon produced water tank proposed to be added to the site.

The details of this evaluation are provided in section 2.0 with supporting calculations and ProMax Simulations conducted for worst case operating scenarios.

1.2 SITE HISTORY

The following is a brief summary of the history related to this site:

- The four wells onsite were put into production in 2014
- The tanks were installed in 2014.

1.3 DESCRIPTION OF FACILITY

Tug Hill Operating, LLC is submitting a permit determination to evaluate the installation of a 1.5 MM gallon produced water accumulation/recycle tank at their existing Wayne well pad site. The newly proposed water tank will be used to consolidate and store produced water from Tug Hill's operating area. The accumulated water will be recycled and re-used to offset the amount of freshwater needed for subsequent well development and minimize volumes that would otherwise be sent to disposal.

The existing facility as purchased from Gastar was a non-permitted site operating 4 wells and associated separation equipment. The existing site utilized 2-400 bbl produced water tanks, which were installed between August 23, 2011 and September 18, 2015. The current plan is to remove one of these tanks since the two tank capacity is not necessary at a produced water rate of 7 barrels per day (bbl/d). Additionally, the site was designed to flow condensate into a dedicated pipeline for transport offsite and, therefore, no condensate is stored on-site.

DESCRIPTION OF PROCESS

Natural gas, condensate and produced water will be generated from four (4) horizontal wells located onsite producing from the Marcellus formation. Each well stream will pass through a

Gas Processing Unit (GPU), which consists of a combination 1.5 MMBtu/hr line heaters and 3-phase separator.

In the separator, the multiphase stream is divided into sales gas and its associated liquids (produced water and condensate). The gas and condensate will leave the separators and go directly into their individual respective sales lines. The separated water phase will be routed to a single 400 (bbl) tank (T01) and the second 400 bbl tank will be removed. Because the organic liquid phase flows into its respective sales pipeline, the need for on-site condensate storage is eliminated.

The produced water is hauled to the newly proposed water tank on-site using 140 bbl pump trucks. This water will be accumulated in the 1.5 MM gallon produced water tank (T02). Since this large accumulation tank is intended for produced water storage only VOC emissions are expected to be nonexistent. Additionally, any emissions displaced from truck loading are expected to be minimal as a result of being 99.4% water. Due to these emissions being fugitive in nature they are not controlled, but released to the atmosphere via the pump truck's vacuum system.

Description of Emission Calculations

The existing process water tank (T01) was estimated to collect no more than 15 (bbl) of condensate per year as a worst case historical estimate. The balance throughput is made up of 7 bbl/d of produced water. The tank emissions were estimated using ProMax with representative samples of gas and condensate measured from the Shields Pad in 2016. The Shields gas analysis was found to be virtually identical to the Wayne pad, therefore these inputs were viewed to be representative and reflect the most recent data available from the area. This estimate predicts approximately 1 tpy of VOCs originating from this tank as flash gas emissions. Working, breathing and loading losses are all predicted by ProMax to be very small as a result of tank contents being mostly water. The water is drained off the bottom of this atmospheric storage vessel and transferred via truck to the produced water storage tank (T02).

The 1.5 MM gallon produced water tank (T02) was intended for produced water storage only, but to account for any entrained oil a worst case analysis was conducted using US EPA's Tanks 4.09 software to assess working and breathing losses assuming #2 fuel oil as the tank's contents. This is truly a hypothetical case, but was run to show that at an average throughput of 300 bbl/d the tank remains below any permitting thresholds. Additionally, since the water trucked to this storage vessel originates from area storage tanks there will be little chance of oil entrainment due to extended settling times at the well pads and additionally no potential for flashing.

The combustion emissions were evaluated on 4 – 1.5 MMBtu/hr GPU burners and also found to result emissions below permitting thresholds.

1.4 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 exchangers consisting of the line heaters are 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 60 Subpart OOOO - Storage Vessel NSPS Requirements

The existing storage vessel (T01) was constructed after August 23, 2011 but before, September 18, 2015 and has been demonstrated to have a PTE VOCs < 6 tpy 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 newly proposed produced water storage vessel (T02) will be constructed after September 18, 2015 and has been demonstrated to have a PTE VOCs < 6 tpy using US EPA Tanks 4.09 software. Therefore, the existing storage vessel is not considered an affected source under this regulation

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 apply for this permit determination to assure all permitting thresholds are evaluated and the proper minor source permits are identified if applicable.

WV Code § 22-5-4 (a) (14)

The Secretary can request any pertinent information such as annual emission inventory reporting. This station is 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.

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 threshold to trigger a 45 CSR 30 Title V Operating Permit nor is it subject to any Federal Standards that trigger the need for a Title V Permit.

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 HHH - National Emission Standards for Hazardous Air Pollutants from Natural Gas Transmission and Storage Facilities

This subpart is related to Natural Gas Transmission Facilities which are major sources of HAPs. This federal regulation is not applicable since this facility is neither a transmission facility nor is it a major source.

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 K, Ka, Kb - Storage Vessel NSPS

The single 400 bbl [16,800 gal] produced water tank (T01) is below the size capacity threshold of 75 meters cubed (m³) [19,813 gallons] defined within the applicability section 60.110b(a) of this Federal standards.

The 1.5 MM gallon produced water storage vessel (T02) is not intended to store volatile organic liquids (VOL) as defined by this regulation. Additionally the tank will be inspected regularly and, if entrained oil were found to have been introduced to the tank causing organic phase liquids to be observed, it would be promptly removed and the cause of the malfunction investigated and corrected. Nevertheless, with respect to the well pad produced water storage vessels, any entrained oil that remains after settling in these source tanks would fall under the vapor pressure exemption of 3.5 kPa (0.508 psi) for tanks greater than 151 cubic meters (39,890 gal) as listed under the exempt criteria in 60.110b(b).

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 proposed produced water tank will not constitute a modification as defined under this Federal regulation.

40 CFR 63 Subpart DDDDD - Boilers & Process Heaters Located at Major Sources of HAPs

This subpart is not applicable because the facility is not a major source of HAPs.

40 CFR 63 Subpart JJJJJJ - Boilers & Process Heaters 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 Wayne 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.

Tug Hill operates other well pads in the area, the closest being the Greer Pad, which has a straight line distance greater than 0.25 miles away. Therefore, 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

Permit Determination

Wayne Well Pad
New Martinsville, West Virginia

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

July 2017



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

**PERMIT DETERMINATION FORM
(PDF)**

FOR AGENCY USE ONLY: PLANT I.D. # _____
 PDF # _____ PERMIT WRITER: _____

1. NAME OF APPLICANT (AS REGISTERED WITH THE WV SECRETARY OF STATE'S OFFICE):

Tug Hill Operating, LLC

2. NAME OF FACILITY (IF DIFFERENT FROM ABOVE):

Wayne Well Pad

3. NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE:

211111

4A. MAILING ADDRESS:

380 Southpointe Blvd, Suite 200
 Cannonsburg, PA 15317

4B. PHYSICAL ADDRESS:

Access Road located off County Route 78 (Waynes Ridge Rd)
 Near New Martinsville, WV

5A. DIRECTIONS TO FACILITY (PLEASE PROVIDE MAP AS ATTACHMENT A):

Travelling North on State Route 2 from New Martinsville, turn Right onto County Route 2/2 (Wells Hill Road). Travel along County Route 2/2 for approximately 2.5 miles to the junction of County Route 78 (Waynes Ridge Road). Turn left on County Route 78 and travel approximately 0.25 miles to well pad access road located on the left.

5B. NEAREST ROAD:

County Route 78 (Wayne's Ridge Rd)

5C. NEAREST CITY OR TOWN:

New Martinsville

5D. COUNTY:

Marshall

5E. UTM NORTHING (KM):

4,399.557

5F. UTM EASTING (KM):

515.845

5G. UTM ZONE:

17

6A. INDIVIDUAL TO CONTACT IF MORE INFORMATION IS REQUIRED:

Jerry V. DeRosa

6B. TITLE:

Director, EH&S Affairs

6C. TELEPHONE:

(412) 736-5767

6D. FAX:

6E. E-MAIL:

jderosa@tug-hillop.com

7A. DAQ PLANT I.D. NO. (FOR AN EXISTING FACILITY ONLY):

_____ - _____

7B. PLEASE LIST ALL CURRENT 45CSR13, 45CSR14, 45CSR19 AND/OR TITLE V (45CSR30) PERMIT NUMBERS ASSOCIATED WITH THIS PROCESS (FOR AN EXISTING FACILITY ONLY):

N/A

7C. IS THIS PDF BEING SUBMITTED AS THE RESULT OF AN ENFORCEMENT ACTION? IF YES, PLEASE LIST: **No**

8A. TYPE OF EMISSION SOURCE (CHECK ONE):

- NEW SOURCE** **ADMINISTRATIVE UPDATE**
 MODIFICATION **OTHER (PLEASE EXPLAIN IN 11B)**

8B. IF ADMINISTRATIVE UPDATE, DOES DAQ HAVE THE APPLICANT'S CONSENT TO UPDATE THE EXISTING PERMIT WITH THE INFORMATION CONTAINED HEREIN?

- YES** **NO**

9. IS *DEMOLITION* OR *PHYSICAL RENOVATION* AT AN EXISTING FACILITY INVOLVED? **YES** **NO**

10A. DATE OF ANTICIPATED INSTALLATION OR CHANGE:

7/20/2017

10B. DATE OF ANTICIPATED START-UP:

August /1/2017

11A. PLEASE PROVIDE A **DETAILED PROCESS FLOW DIAGRAM** SHOWING EACH PROPOSED OR MODIFIED PROCESS EMISSION POINT AS **ATTACHMENT B**.

11B. PLEASE PROVIDE A DETAILED PROCESS DESCRIPTION AS ATTACHMENT C.

12. PLEASE PROVIDE MATERIAL SAFETY DATA SHEETS (MSDS) FOR ALL MATERIALS PROCESSED, USED OR PRODUCED AS ATTACHMENT D. FOR CHEMICAL PROCESSES, PLEASE PROVIDE A MSDS FOR EACH COMPOUND EMITTED TO AIR.

13A. REGULATED AIR POLLUTANT EMISSIONS:

⇒ FOR A NEW FACILITY, PLEASE PROVIDE PLANT WIDE EMISSIONS BASED ON THE POTENTIAL TO EMIT (PTE) FOR THE FOLLOWING AIR POLLUTANTS INCLUDING ALL PROCESSES.

⇒ FOR AN EXISTING FACILITY, PLEASE PROVIDE THE PROPOSED CHANGE IN EMISSIONS BASED ON THE PTE OF ALL PROCESS CHANGES FOR THE FOLLOWING AIR POLLUTANTS.

PTE FOR A GIVEN POLLUTANT IS TYPICALLY BEFORE AIR POLLUTION CONTROL DEVICES AND IS COLLECTED BASED ON THE MAXIMUM DESIGN CAPACITY OF PROCESS EQUIPMENT.

POLLUTANT	HOURLY PTE (LB/HR)	YEARLY PTE (TON/YR) (HOURLY PTE MULTIPLIED BY 8760 HR/YR) DIVIDED BY 2000 LB/TON
PM	0.05	0.20
PM ₁₀	0.05	0.20
VOCs	0.54	2.35
CO	0.49	2.16
NO _x	0.59	2.58
SO ₂	<0.01	0.02
Pb	0.00	0.00
HAPs (AGGREGATE AMOUNT)	0.01	0.03
TAPs (INDIVIDUALLY)*		
Benzene	<0.01	<0.01
Formaldehyde	<0.01	<0.01
OTHER (INDIVIDUALLY)*		

* ATTACH ADDITIONAL PAGES AS NEEDED

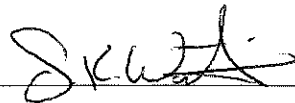
13B. PLEASE PROVIDE ALL SUPPORTING CALCULATIONS AS ATTACHMENT E.

CALCULATE AN HOURLY AND YEARLY PTE OF EACH PROCESS EMISSION POINT (SHOWN IN YOUR DETAILED PROCESS FLOW DIAGRAM) FOR ALL AIR POLLUTANTS LISTED ABOVE INCLUDING INDIVIDUAL HAP'S (LISTED IN SECTION 112(b) OF THE 1990 CAAA), TAP'S (LISTED IN 45CSR27), AND OTHER AIR POLLUTANTS (E.G. POLLUTANTS LISTED IN TABLE 45-13A OF 45CSR13. MINERAL ACIDS PER 45CSR7. ETC.).

14. CERTIFICATION OF DATA

I, SEAN WILLIS (TYPE NAME) ATTEST THAT ALL THE REPRESENTATIONS CONTAINED IN THIS APPLICATION, OR APPENDED HERETO, ARE TRUE, ACCURATE, AND COMPLETE TO THE BEST OF MY KNOWLEDGE BASED ON INFORMATION AND BELIEF AFTER REASONABLE INQUIRY, AND THAT I AM A RESPONSIBLE OFFICIAL** (PRESIDENT, VICE PRESIDENT, SECRETARY OR TREASURER, GENERAL PARTNER OR SOLE PROPRIETOR) OF THE APPLICANT.

SIGNATURE OF RESPONSIBLE OFFICIAL: _____



TITLE: VICE PRESIDENT – ENGINEERING & DEVELOPMENT MANAGER – APPALACHIA REGION

DATE: 07/17/2017

** THE DEFINITION OF THE PHRASE 'RESPONSIBLE OFFICIAL' CAN BE FOUND AT 45CSR13, SECTION 2.23.

NOTE: PLEASE CHECK ENCLOSED ATTACHMENTS:

ATTACHMENT A ATTACHMENT B ATTACHMENT C ATTACHMENT D ATTACHMENT E

RECORDS ON ALL CHANGES ARE REQUIRED TO BE KEPT AND MAINTAINED ON-SITE FOR TWO (2) YEARS.

THE PERMIT DETERMINATION FORM WITH THE INSTRUCTIONS CAN BE FOUND ON DAQ'S PERMITTING SECTION WEB SITE:

www.dep.wv.gov/daq

ATTACHMENT A

AREA MAP

Permit Determination

**Wayne Well Pad
New Martinsville, West Virginia**

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

July 2017



Attachment A - Area Map

Tug Hill Operating, LLC - Wayne Well Pad

GPS Coordinates of Site:
Lat: 39.74577, Long: -80.81506

UTM Coordinates of Site:
Northing: 4,399.557 km, Easting: 515.845 km, Zone: 17

Legend

-  300' Barrier
-  Tug Hill - Wayne Well Pad

Tug Hill - Wayne Well Pad





ATTACHMENT B

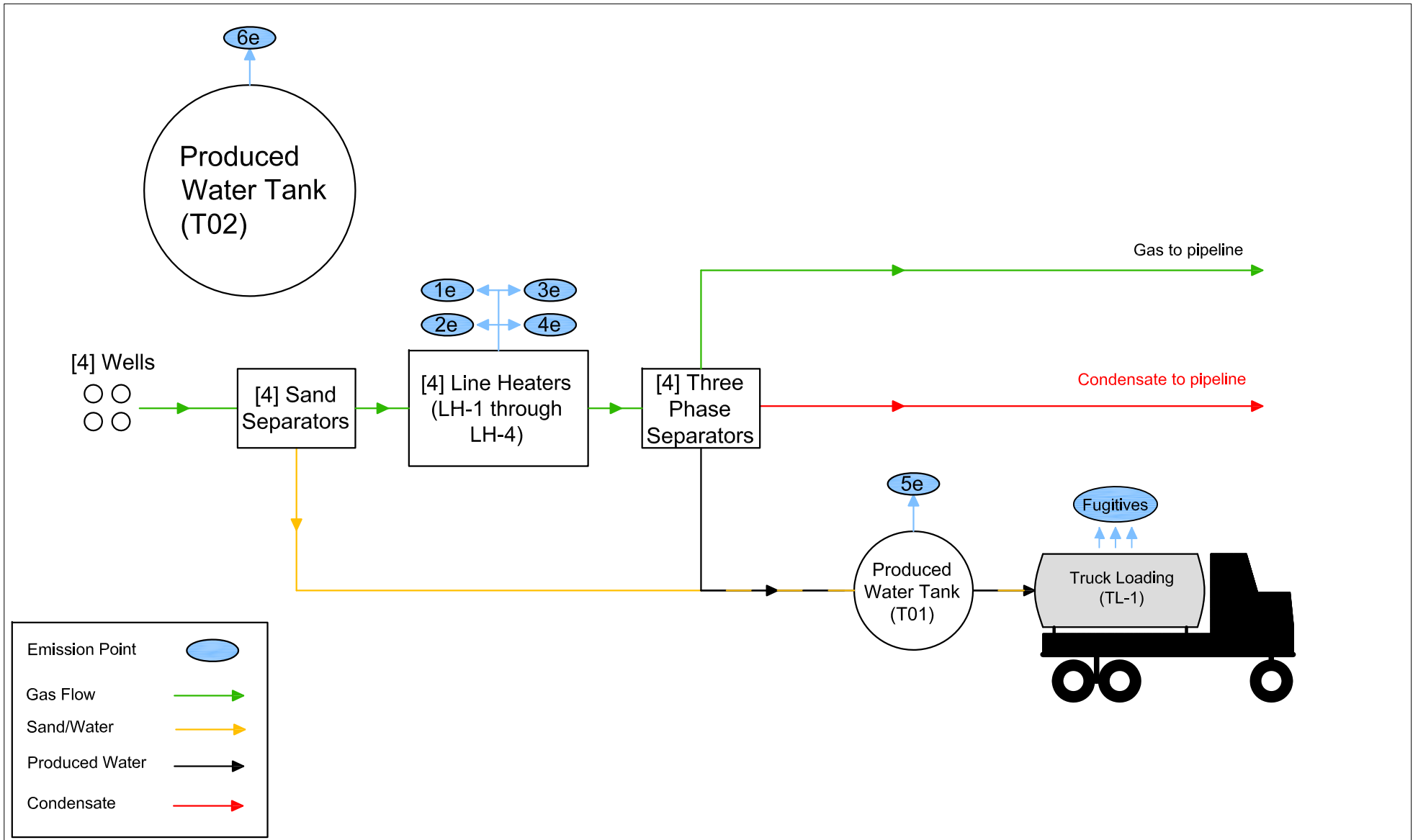
PROCESS FLOW DIAGRAM

Permit Determination

Wayne Well Pad
New Martinsville, West Virginia

Tug Hill Operating, LLC
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July 2017



ATTACHMENT C

PROCESS DESCRIPTION

Permit Determination

Wayne Well Pad
New Martinsville, West Virginia

Tug Hill Operating, LLC
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July 2017

PROCESS DESCRIPTION

Tug Hill Operating, LLC is submitting a permit determination to evaluate the installation of a 1.5 MM gallon produced water accumulation/recycle tank at their existing Wayne well pad site. The newly proposed water tank will be used to consolidate and store produced water from Tug Hill's sites in the area. The accumulated water will be recycled and used to offset the amount of freshwater needed for subsequent well development in the area and minimize volumes sent for disposal.

The existing facility was purchased from Gastar as a non-permitted site operating 4 wells and associated separation equipment. The existing site utilized 2-400 bbl produced water tanks, which were installed between August 23, 2011 and September 18, 2015. The current plan is to remove one of these tanks since the two tank capacity is not necessary at a produced water rate of 7 barrels per day (bbl/d). Additionally, the site was designed to flow condensate into the gas pipeline for transport off-site so, no condensate is stored on-site.

DESCRIPTION OF PROCESS

Natural gas, condensate and produced water will be collected from four (4) horizontal wells located on-site producing from the Marcellus formation. Each well stream will pass through a Gas Processing Unit (GPU), which consist of a combination 1.5 MMBtu/hr line heater and 3-phase separator.

The well stream will require heating due to reductions in pressure. In the separator, the multiphase stream is divided into sales gas and its associated liquids (produced water and condensate). The gas will leave the separators and go directly into the sales line. The separated water phase will be routed to a single 400 barrel (bbl) tank (T01) and the second 400 bbl tank will be removed. The organic liquid phase is piped to a midstream condensate sales line, which eliminates the need for on-site storage.

The produced water is hauled to the newly proposed produced water tank by 140 bbl pump trucks. This water will be accumulated in the 1.5 MM gallon produced water tank (T02). Since this large accumulation tank is intended for produced water storage only VOC emissions are expected to be nonexistent. Additionally, any emissions displaced from truck loading are expected to be minimal as a result of being over 99% by volume water. Due to the truck loading emissions being minimal and fugitive in nature they are not controlled, but released to the atmosphere via the pump truck's vacuum system.

ATTACHMENT D

SAFETY DATA SHEETS

Permit Determination

Wayne Well Pad
New Martinsville, West Virginia

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

July 2017

SAFETY DATA SHEET

Date Issued :
SDS No :
Date Revised :
Revision No : 1

Non-Sour Natural Gas (West Virginia)

*****IMPORTANT*****

This SDS has been prepared for Non-Sour Natural Gas. Refer to the following sections for important safety and response information.

Section 4- First Aid Measures (for accidental exposure).

Section 5- Fire Fighting Measures.

Section 6- Accidental Release Measures.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Non-Sour Natural Gas

GENERAL USE: Refinery Feedstock.

Common Name and Synonyms:




2. HAZARDS IDENTIFICATION

This product has not been tested to determine its specific health hazards. Therefore, the information provided in this section includes health hazard information based on the product components.

GHS CLASSIFICATIONS

Health	Physical
Carcinogenicity, Category 1 Hazard Not Otherwise Classified, Simple Asphyxiant	Gases Under Pressure, Liquefied gas Flammable Gases, Category 1

GHS LABEL

<p>WARNING</p> <p>H000: May displace oxygen and cause rapid suffocation.</p>	 <p>DANGER</p> <p>H220: Extremely flammable gas.</p>
 <p>WARNING</p> <p>H280: Contains gas under pressure; may explode if heated.</p>	 <p>DANGER</p> <p>H350: May cause cancer.</p>

PRECAUTIONARY

STATEMENT(S) Prevention:

P210: Keep away from heat/sparks/open flames/hot surfaces – no smoking.

Sweet Natural Gas

P201: Obtain special instructions before use.

P202: Do not handle until all safety precautions have been read and understood. P281: Use personal protective equipment as required.

Response:

P377: Leaking gas fire: Do not extinguish unless leak can be stopped safely. P381: Eliminate all ignition sources if safe to do so.

P308+P313: IF exposed or concerned: Get medical advice/attention.

Storage:

P403: Store in a well-ventilated place.

P410+P403: Protect from sunlight. Store in a well-ventilated place

Disposal:

P501: Dispose of contents/container in accordance with local/regional/national regulations.

EMERGENCY OVERVIEW

PHYSICAL APPEARANCE:

IMMEDIATE CONCERNS: HAZARD DESCRIPTION / WARNING INFORMATION SUMMARY - This material is a flammable gas. This product is toxic; inhalation of this material may cause severe injury or death. Please read entire contents of Section 2 of this Safety Data Sheet (SDS) for details.

POTENTIAL HEALTH EFFECTS

EYES: This product is unlikely to cause eye irritation.

SKIN: This product is unlikely to cause skin irritation or injury.

INGESTION: This product is a compressed gas; hence oral exposure and resulting acute toxicity are unlikely.

INHALATION: This product is a simple asphyxiant. Excessive exposure may cause central nervous system effects such as dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure and death.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

CARCINOGENICITY: No component of this product present at levels greater than or equal to 0.1% is identified as a probable, possible, or confirmed carcinogen by IARC, NTP, OSHA or ACGIH.

MUTAGENICITY: Not Established.

REPRODUCTIVE TOXICITY

REPRODUCTIVE EFFECTS: Not Established.

TERATOGENIC EFFECTS: Not Established.

MEDICAL CONDITIONS AGGRAVATED: Persons with pre-existing central nervous system disorders should refrain from contact with this material.

ROUTES OF ENTRY: Inhalation, skin contact, eye contact.

TARGET ORGAN STATEMENT: May cause damage to lungs and central nervous system.

SENSITIZATION: Not Established.

COMMENTS: OTHER HAZARDS - Not Established.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	Vol. %	CAS
Methane	70 - 94	74-82-8
Ethane	5 - 10	74-84-0
Propane	1 - 4	74-98-6
i-Butane	0.5 - 3	75-28-5
n-Butane	0.5 - 2	106-97-8
Carbon Dioxide	0.5 - 10	124-38-9
Nitrogen	0.5 - 10	7727-37-9

Sweet Natural Gas

Benzene	may contain	71-43-2
Hydrogen Sulfide	may contain	7783-06-4

COMMENTS: This may not be a complete list of components. Compositions given are typical values, not specifications.

4. FIRST AID MEASURES

EYES: Immediately flush eyes with plenty of water. Get medical attention, if irritation persists.

SKIN: Wash with soap and water. Get medical attention if irritation develops or persists. **INGESTION:** This is not considered a major potential route of exposure.

INHALATION: Move victim to fresh air. Call 911, emergency medical service, or Emergency Phone Numbers(s) provided in Section 1 of this SDS. Give artificial respiration if victim is not breathing. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult.

ANTIDOTES: Not Established.

NOTES TO PHYSICIAN: CLINICAL TESTING & MEDICAL MONITORING FOR DELAYED EFFECTS - Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed. Provide general supportive measures and treat symptomatically.

5. FIRE FIGHTING MEASURES

FLASH POINT: -188°C (-306.4°F) **Notes:** Based on methane. .

AUTOIGNITION TEMPERATURE: 482°C (900°F) to 649°C (1200 °F)

GENERAL HAZARD: DECOMPOSITION TEMPERATURE - Not Established.

EXTINGUISHING MEDIA:

SMALL FIRE - Class B fire extinguisher, carbon dioxide, multipurpose dry chemical, water fog or alcohol-resistant foam.

LARGE FIRE - Water fog or alcohol-resistant foam.

HAZARDOUS COMBUSTION PRODUCTS: Any combustion, including incomplete combustion, may form carbon monoxide and carbon dioxide. Burning produces noxious and toxic fumes. Downwind personnel must be evacuated.

OTHER CONSIDERATIONS: INAPPROPRIATE EXTINGUISHING MEDIA - Do not use water jet.

FIRE EXPLOSION: HIGHLY FLAMMABLE. Will be easily ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapor explosion hazard indoors, outdoors or in sewers. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated.

COMMENTS:

SPECIFIC HAZARDS THAT MAY ARISE FROM THE PRODUCT - Vapors are flammable and heavier than air. Vapors may travel across the ground and reach remote ignition sources causing a flashback fire danger.

Sweet Natural Gas

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: For emergency information and procedures to follow in the case of an accidental release, call the Emergency Telephone Number(s) listed in Section 1 of this SDS. Remove any ignition sources and protect from ignition. Water spray may reduce vapor but may not prevent ignition in closed spaces. A vapor suppressing foam may be used to reduce vapors. Provide sufficient ventilation in the affected area(s) and wear appropriate personal protective equipment as indicated in Section 8 of this SDS when handling spill material. Isolate the area until gas has dispersed. Never discharge releases directly into sewers or surface waters.

LARGE SPILL: Use similar response procedures as indicated under Small Spill.

7. HANDLING AND STORAGE

GENERAL PROCEDURES: Handle in accordance with good industrial hygiene and safety practices. These practices include but are not limited to avoiding unnecessary exposure and prompt removal of material from eyes, skin and clothing. If needed, take first aid actions as indicated in Section 4 of this SDS.

HANDLING: Use only with adequate ventilation. Wear appropriate personal protective equipment and use exposure controls as indicated in Section 8 of this SDS. Vent slowly to the atmosphere when opening. Avoid all contact with skin and eyes. Avoid breathing product dust or vapors. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not reuse container. Remove contaminated clothing immediately. Wash with soap and water after working with this product.

STORAGE: Keep in airtight container away from all heat sources. Store in a segregated and approved area. Store in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Keep container in a well-ventilated area. Ground all containers during transfer. Store away from incompatible materials. Cylinders should be separated from oxygen cylinders or other oxidizers by a minimum distance of 20 feet, or by a barrier of non-combustible material at least 5 feet high having a fire resistance rating of at least 1/2 hour. Store in the original container or an approved alternative made from compatible material. Do not store in unlabeled containers. Treat empty containers in a similar fashion as residual product may exist. Use appropriate containment to avoid environmental contamination.

STORAGE TEMPERATURE: Store containers in a room with ambient temperature.

STORAGE PRESSURE: Containers should be stored in room with ambient pressure.

SHELF LIFE:

HOW TO MAINTAIN THE INTEGRITY OF THE SUBSTANCE BY USE OF STABILIZERS OR ANTIOXIDANTS - Not Established.

ELECTROSTATIC ACCUMULATION HAZARD: To minimize the hazard of static electricity during transfer operations, bonding and grounding may be necessary, but may not by themselves be sufficient. For more information, refer to OSHA Standard 29 CFR 1910.106; National Fire Protection Standard (NFPA) 77 - "Recommended Practice on Static Electricity"; and/or the American Petroleum Institute (API) Recommended Practice 2003 - "Protection Against Ignitions Arising Out of Static, Lighting and Stray Currents."

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE GUIDELINES

OSHA HAZARDOUS COMPONENTS (29 CFR1910.1200)					
		EXPOSURE LIMITS			
		OSHA PEL		ACGIH TLV	
Chemical Name		ppm	mg/m ³	ppm	mg/m ³
Ethane	TWA	N/E	N/E	1000	N/E
	STEL	N/E	N/E	N/E	N/E
Propane	TWA	1000	1800	1000	N/E
	STEL	N/E	N/E	N/E	N/E
i-Butane	TWA	N/E	N/E	1000	N/E
	STEL	N/E	N/E	N/E	N/E
	TWA	N/E	N/E	1000	N/E

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n-Butane	STEL	N/E	N/E	N/E	N/E
Carbon Dioxide	TWA	5000	9000	5000	9000
	STEL	N/E	N/E	30000	54000

ENGINEERING CONTROLS: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Employees should be provided with and required to use splash-proof safety goggles and splash shields where there is any possibility of product coming in contact with eyes. Ensure that eye wash station is operable and nearby.

SKIN: GLOVES AND BOOTS - Any impervious gloves and boots including butyl rubber, nitrile rubber or neoprene rubber.

RESPIRATORY: Depending on airborne concentration a full-face supplied air respirator is recommended, because air purifying respirators cannot provide adequate protection.

PROTECTIVE CLOTHING: Depending on the conditions of use, protective gloves, apron, boots, head and face protection should be worn. Cotton clothing is recommended.

WORK HYGIENIC PRACTICES: Consider the potential hazards of this material, applicable exposure limits, job activities, environmental working conditions, and other substances in the workplace when designing engineering controls and selecting personal protective equipment (PPE). The user should read and understand all manufacturer instructions and limitations supplied with the personal protection equipment before use.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR: Generally odorless (if no H₂S is present and no mercaptan added for odor).

APPEARANCE: Colorless gas.

pH: Not Applicable.

PERCENT VOLATILE: 100%

VAPOR PRESSURE: Not Established.

VAPOR DENSITY: 0.6 to 0.8 (Air = 1)

BOILING POINT: -161 °C (-258 °F)

Notes: Based on methane.

FREEZING POINT: Not Applicable.

MELTING POINT: Not Applicable.

FLASH POINT: -188 °C (-306.4 °F)

Notes: Based on methane.

AUTO IGNITION TEMP: Not Established.

DECOMPOSITION TEMP: Not Established.

EVAPORATION RATE: Not Established.

DENSITY: Not Established.

SPECIFIC GRAVITY: Not Established.

VISCOSITY: Not Applicable.

SOLUBILITY: Not Established.

COEFF. OIL/WATER: Not Established.

ODOR THRESHOLD: Not Established.

COMMENTS: FLAMMABILITY - Refer to Section 2 and Section 5 of this SDS for classification and flammability characteristics.

Sweet Natural Gas

10. STABILITY AND REACTIVITY

STABLE: Yes

HAZARDOUS POLYMERIZATION: No

STABILITY: This product is anticipated to be stable under normal ambient storage and handling conditions of temperature and pressure.

POLYMERIZATION: This product is not anticipated to cause hazardous reactions or polymerizations under normal ambient storage and handling conditions of temperature and pressure.

CONDITIONS TO AVOID: Avoid contact with incompatible materials. Avoid exposure to excess heat, sparks, open flame, or other potential ignition sources. Prevent vapor accumulation.

HAZARDOUS DECOMPOSITION PRODUCTS: Products of thermal decomposition include carbon oxides and nitrogen oxides.

INCOMPATIBLE MATERIALS: Strong oxidizing agents, liquid oxygen, mineral acids and metal catalysts.

11. TOXICOLOGICAL INFORMATION

ACUTE

Chemical Name	ORAL LD ₅₀ (rat)	DERMAL LD ₅₀ (rabbit)	INHALATION LC ₅₀ (rat)
Ethane	Not Established.	Not Established.	> 800000 ppm (15 min)
Propane	Not Established.	Not Established.	658 mg/L (4 hours)
i-Butane	Not Established.	Not Established.	658 mg/L (4 hours)
n-Butane	Not Established.	Not Established.	658 g/m ³
Carbon Dioxide	Not Established.	Not Established.	30000 to 50000 ppm (30 min)
Benzene	930 mg/kg	> 9400 ug/kg	10000 ppm (7 hours)
Hydrogen Sulfide	Not Established.	Not Established.	444 ppm

NOTES: ACUTE TOXICITY & HEALTH EFFECTS - This product is a simple asphyxiant; higher concentrations may cause dizziness. Refer to Section 2 of this SDS for additional hazards identification.

EYE EFFECTS: Not expected to cause prolonged or significant eye irritation.

SKIN EFFECTS: Not expected to cause prolonged or significant skin irritation.

CHRONIC: TOXICITY & HEALTH EFFECTS - This product is not expected to be toxic. Refer to Section 2 of this SDS for additional hazards identification.

CARCINOGENICITY

Chemical Name	NTP Status	IARC Status	OSHA Status
Benzene	1	1	Carcinogen.

Notes: No component of this product at levels greater than 0.1% is identified as a carcinogen by ACGIH, the International Agency for Research on Cancer (ARC), the U.S. National Toxicology Program (NTP) or the U.S. Occupational Safety and Health Act (OSHA).

SENSITIZATION: Not Established.

NEUROTOXICITY: Not Established.

GENETIC EFFECTS: Not Established.

REPRODUCTIVE EFFECTS: Not Established.

Sweet Natural Gas

TARGET ORGANS: Contact may cause damage to the lungs and central nervous system.

TERATOGENIC EFFECTS: Not Established.

MUTAGENICITY: Not Established.

SYNERGISTIC MATERIALS: Not Established.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: MOBILITY IN SOIL POTENTIAL - Not Established.

ECOTOXICOLOGICAL INFORMATION: TERRESTRIAL/MICROORGANISM TOXICITY -

ACUTE: Ecological data does not exist for this mixture.

CHRONIC: Ecological data does not exist for this mixture.

BIOACCUMULATION/ACCUMULATION: Ecological data does not exist for this mixture.

AQUATIC TOXICITY (ACUTE): Ecological data does not exist for this mixture.

Notes: (CHRONIC) - Ecological data does not exist for this mixture.

CHEMICAL FATE INFORMATION: PERSISTENCE & DEGRADABILITY - Not Established.

GENERAL COMMENTS: Any other adverse environmental effects, such as environmental fate (exposure), ozone depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and global warming potential are indicated in this section if data exists. Otherwise, this data has not been established.

COMMENTS: Data from laboratory studies and from scientific literature is noted in this section if available. Otherwise, data has not been established.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: It is recommended that this product, in any form, be incinerated in a suitable combustion chamber for disposal. Empty containers should be disposed of in a similar fashion due to presence of product residue. Follow applicable Federal, state, and local regulations.

PRODUCT DISPOSAL: Persons conducting disposal of this product and its containers/packaging should refer to Section 8 of this SDS for the proper selection of exposure controls and personal protective equipment.

EMPTY CONTAINER: Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death.

GENERAL COMMENTS: PHYSICAL & CHEMICAL PROPERTIES THAT MAY AFFECT DISPOSAL OPTIONS - Not Established.

COMMENTS: Dispose of material in accordance with national, state, regional, and local regulations. Never discharge directly into sewers or surface waters. Consult with environmental regulatory agencies for guidance on acceptable disposal practices for the product, in any form, and its containers/packaging.

14. TRANSPORT INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)

PROPER SHIPPING NAME: Compressed gas, flammable, n.o.s.

PRIMARY HAZARD CLASS/DIVISION: 2.1

UN/NA NUMBER: 1954

NAERG: 115

LABEL: 2.1: Flammable Gas

MARINE POLLUTANT #1: Not Listed.

Sweet Natural Gas

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

311/312 HAZARD CATEGORIES: Fire Hazard. Immediate (Acute) Health Hazard.

FIRE: Yes PRESSURE GENERATING: No REACTIVITY: No ACUTE: Yes CHRONIC: Yes

CERCLA (COMPREHENSIVE RESPONSE, COMPENSATION, AND LIABILITY ACT)

Chemical Name	Wt. %	CERCLA RQ
Benzene	may contain	10
Hydrogen Sulfide	may contain	100

TSCA (TOXIC SUBSTANCE CONTROL ACT)

Chemical Name	CAS
Methane	74-82-8
Ethane	74-84-0
Propane	74-98-6
i-Butane	75-28-5
n-Butane	106-97-8
Carbon Dioxide	124-38-9
Nitrogen	7727-37-9

CLEAN AIR ACT

Chemical Name	Vol. %	CAS
Ethane	5 - 10	74-84-0
Propane	1 - 4	74-98-6
i-Butane	0.5 - 3	75-28-5
n-Butane	0.5 - 2	106-97-8

Sweet Natural Gas

16. OTHER INFORMATION

RELEVANT R-PHRASES:R61: May cause harm to the unborn child.

R26: Very toxic by inhalation.

R48/23: Toxic : danger of serious damage to health by prolonged exposure through inhalation.

R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

R12: Extremely flammable.

R45: May cause cancer.

R46: May cause heritable genetic damage.

R11: Highly flammable.

R36/38: Irritating to eyes and skin.

R65: Harmful: may cause lung damage if swallowed.

PREPARED BY:

REVISION SUMMARY:

NATIONAL FIRE PROTECTION ASSOCIATION®HAZARD RATING

HEALTH: 2- Slight Hazard

FIRE: 4-Severe Flammability

REACTIVITY: 0- Stable

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM®HAZARD RATING

HEALTH: 2- Slight Hazard

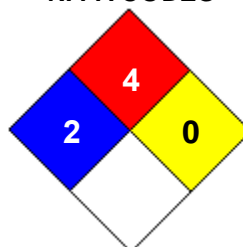
FIRE: 4- Severe Flammable Gas

PHYSICAL: 0- Minimal Hazard

HMIS RATING

HEALTH	2
FLAMMABILITY	4
PHYSICAL HAZARD	0
PERSONAL PROTECTION	H

NFPA CODES



HMIS RATINGS NOTES: Please refer to Section 8 of this SDS for recommended personal protective equipment.

DATA SOURCES:

REFERENCES

ACGIH. 2012 Guide to Occupational Exposure Values. Cincinnati, OH. Signature Publications, 2012.

Forsberg, K.; Mansdorf, S.Z. Quick Selection Guide to Chemical Protective Clothing. Fifth Edition. Hoboken, NJ. John Wiley & Sons, 2007.

Lide, D.R. CRC Handbook of Chemistry and Physics. 88th Edition. Boca Raton, FL. CRC Press, 2008.

UNECE. Globally Harmonized System of Classification and labelling of Chemicals (GHS). Third Revised Edition. New York and Geneva. United Nations, 2009.

US DOT; Pipeline and Hazardous Materials Safety Administration. 2008 Emergency Response Guidebook. Neenah, WI. J.J. Keller & Associates, Inc. 2008.

US EPA. Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112(r) of the Clean Air Act. [Available] Online: <http://www.epa.gov/ceppo/pubs/title3.pdf>. Retrieved 02/02/2011.

ADDITIONAL MSDS INFORMATION:

KEY / LEGEND

ACGIH - American Conference of Governmental Industrial Hygienists

ADR - Agreement on Dangerous Goods by Road

CAA - Clean Air Act

CAS - Chemical Abstracts Service Registry Number

CDG - Carriage of Dangerous Goods By Road and Rail Manual

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

CFR - Code of Federal Regulations

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EINECS - European Inventory of Existing Chemical Substances Registry Number
ERG - Emergency Response Guidebook
EPCRA - Emergency Planning and Community Right-to-Know Act
GHS - Globally Harmonized System of Classification and Labelling of Chemicals
IARC - International Agency for Research on Cancer
IATA - International Air Transport Association
ICAO - International Civil Aviation Organization
IMDG - International Maritime Dangerous Goods Code
IMO - International Maritime Organization
N/E - Not Established
NTP - National Toxicology Program
OSHA - Occupational Safety and Health Administration
PEL - Permissible Exposure Limit
PPE - Personal Protective Equipment
RCRA - Resource Conservation and Recovery Act
RID - Regulations Concerning the International Transport of Dangerous Goods by Rail
RQ - Reportable Quantities
SARA - Superfund Amendments and Reauthorization Act of 1986
SDS - Safety Data Sheet
TCC - Tag Closed Cup
TDG - Transportation of Dangerous Goods
TLV - Threshold Limit Value
TSCA - Toxic Substance Control Act
UN/NA - United Nations / North American Number
UNECE - United Nations Economic Commission for Europe
US DOT - United States Department of Transportation
US EPA - United States Environmental Protection Agency
Vol. - Volume
WHMIS - Workplace Hazardous Materials Information System

GENERAL STATEMENTS: Other information not included anywhere else in this SDS is included in this section if, in fact, such data exists.

MANUFACTURER DISCLAIMER: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

SAFETY DATA SHEET

Date Issued:
SDS NO:
Date Revised:
Revision No:

Non-Sour Natural Gas Condensate (Atmospheric Liquid)
(West Virginia)

IMPORTANT

This SDS has been prepared for Non-Sour Natural Gas Condensate at atmospheric pressure (i.e., atmospheric liquid). Refer to the following sections for important safety and response information.

Section 4- First Aid Measures (for accidental exposure).

Section 5- Fire Fighting Measures.

Section 6- Accidental Release Measures.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Non-Sour Natural Gas Condensate (Atmospheric Liquid)

GENERAL USE: Condensate extracted from natural gas well production.

Common Name and Synonyms: Gas Liquid, Condensate Liquids, Drip Gas, Natural Gas Condensate



2. HAZARDS IDENTIFICATION

This product has not been tested to determine its specific health hazards. Therefore, the information provided in this section includes health hazard information based on the product components.

GHS CLASSIFICATIONS

Health	Physical
H319 -- Eye damage/irritation -- Category 2 H315 -- Skin corrosion/irritation -- Category 2 H304 -- Aspiration Hazard -- Category 1 H331 -- Acute toxicity, Inhalation -- Category 3 H336 -- Specific target organ toxicity (single exposure) -- Category 3 H350 -- Carcinogenicity -- Category 1B H412 -- Harmful to aquatic life, chronic toxicity -- Category 3	H224 -- Extremely flammable liquid and vapor -- Category 1

GHS LABEL

 WARNING H320: Causes eye irritation. H315: Causes skin irritation.	 DANGER H350: May cause cancer.
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Non-Sour Natural Gas Condensate (Atmospheric Liquid)



WARNING

H224 Extremely flammable liquid and vapor



DANGER

H331 Toxic if inhaled

PRECAUTIONARY STATEMENT(S)

Prevention:

- P201: Obtain special instructions before use.
P202: Do not handle until all safety precautions have been read and understood.
P210: Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
P233: Keep container tightly closed.
P235: Keep cool.
P240: Ground/bond container and receiving equipment.
P241: Use with explosion-proof equipment.
P242: Use only non-sparking tools.
P243: Take precautionary measures against static discharge.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.

P264: Wash thoroughly after handling.
P271: Use only outdoors or in a well-ventilated area.
P273: Avoid release to the environment.
P280: Wear protective gloves / protective clothing / eye protection / face protection.

Response:

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. (P304+P340)
If experiencing respiratory symptoms: Immediately call a POISON CENTER or doctor/physician. (P342+310)

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. (P302+P310)

Call a POISON CENTER or doctor/physician. (P311)

Do NOT induce vomiting. (P331)

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.
Continue rinsing. (P305+P351+338)

: If eye irritation persists: Get medical advice/attention. (P337+P313)

IF ON SKIN: Remove/Take off immediately all contaminated clothing. (P302+P361)

Wash with plenty of soap and water. (P352)

If skin irritation or a rash occurs: Get medical advice/attention. (P333+P313)

IF ON CLOTHING: Take off contaminated clothing and wash before reuse. (P306+P362)

IF exposed or concerned: Call a POISON CENTER or doctor/physician if you feel unwell. (P308+P312)

In case of fire: Use dry chemical, carbon dioxide, or foam for extinction. (P370+P378)

Collect spillage. (P391)*

Store in a well-ventilated place. Keep container tightly closed. Keep cool. (P403+P233+235)

Store locked up. (P405)

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

IF exposed or concerned: Call a POISON CENTER or doctor/physician if you feel unwell. (P308+3312)

Disposal:

Dispose of contents/container in accordance with local/regional/national regulations. (P501)

EMERGENCY OVERVIEW

PHYSICAL APPEARANCE: Clear liquid.

IMMEDIATE CONCERNS: HAZARD DESCRIPTION / WARNING INFORMATION SUMMARY – This product is a highly flammable liquid which may be harmful if ingested, inhaled, comes in contact with skin or eyes, or is released into the environment. Please read entire contents of Section 2 of this Safety Data Sheet (SDS) for details.

POTENTIAL HEALTH EFFECTS

EYES: Eye contact with vapors may cause eye irritation, watering of eyes and reddening. Eye contact with liquid may cause irritation and pain. Prolonged contact may result in tissue damage.

SKIN: Skin contact may cause skin irritation and redness. Repeated or prolonged skin contact may cause dermatitis.

INGESTION: Ingestion may cause irritation to the gastrointestinal tract with nausea and diarrhea. May be harmful if swallowed in large quantities.

INHALATION: Breathing the mist and vapors may be irritating to the respiratory tract.

SIGNS AND SYMPTOMS OF OVEREXPOSURE

CHRONIC EFFECTS: Skin, eye, and respiratory tract irritation. Gastrointestinal and vascular effects and death may occur at high concentrations. May cause nervous system effects, such as headache, nausea and drowsiness.

CARCINOGENICITY: Condensate contains Category 2 constituents (Benzene).

MUTAGENICITY: Not Established.

REPRODUCTIVE TOXICITY

REPRODUCTIVE EFFECTS: Not Established.

TERATOGENIC EFFECTS: Not Established.

MEDICAL CONDITIONS AGGRAVATED: Benzene – Pre-existing blood system disorders, respiratory conditions, central nervous, liver, kidney, and cardio-vascular conditions may be aggravated by severe or chronic overexposure to benzene. Skin disorders may also be aggravated by exposures to benzene.

ROUTES OF ENTRY: Inhalation, skin contact, eye contact, ingestion.

TARGET ORGAN STATEMENT: May cause damage to eyes, skin and respiratory system.

CANCER STATEMENT: This product may cause cancer. Refer to Section 11 of this SDS for details.

SENSITIZATION: Not Established.

COMMENTS: ADDITIONAL MEDICAL AND TOXICOLOGICAL INFORMATION: Natural gas condensate and some of its fractions have been shown to cause skin irritation, damage and even cancers when applied directly and repeatedly to skin. When laboratory animals inhale oil vapors at high concentration or ingest in repeated doses, various tumors have developed.

This product contains benzene, which can cause degeneration in blood forming bone marrow leading to anemia which may further degrade to leukemia, a type of cancer (see 29 CFR 1910.1028 of standard). Benzene is recognized as a human carcinogen by OSHA, NTP, ACGIH, and IARC.

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

3. COMPOSITION / INFORMATION ON INGREDIENTS

Compositions given are typical values, not specifications. Compositions provided may vary with geographic location, geologic formation, temperature and pressure and actual values could be higher or lower than the ranges provided.

	Non-Sour Atmospheric Condensate Liquid	
Chemical Name	WT % (All Vary)	CAS
Water	<1.0 – 5.0	7732-18-5
Nitrogen	0.0 – 0.015	7727-37-9
Carbon Dioxide	0.0 – 0.04	124-38-9
Benzene	<0.10 – 0.70	71-43-2
Ethyl benzene	<1.0 – 3.0	100-41-4
Toluene	<1.0 – 5.0	108-88-3
Xylenes	<1.0 – 5.0	1330-20-7
Methane	<1.0 – 5.0	74-82-8
Ethane	<1.0 – 8.0	74-84-0
Propane	1.0 – 10.0	74-98-6
Isobutane	1.0 – 3.0	75-28-5
n-Butane	2.0 – 9.0	106-97-8
2,2-Dimethylpropane	0.0 – 0.20	463-82-1
Isopentane	2.0 – 5.0	78-78-4
n-Pentane	2.0 – 7.0	109-66-0
2,2-Dimethylbutane	0.10 – 0.40	75-83-2
Cyclopentane	0.000	287-92-3
2,3-Dimethylbutane	0.30 – 0.70	79-29-8
2-Methylpentane	1.0 – 4.0	107-83-5
3-Methylpentane	1.0 – 3.0	96-14-0
n-Hexane	2.0 – 5.0	110-54-3
Heptanes Plus	45.0 – 80.0	Mixture
Hydrogen Sulfide	<1.0	7783-06-4

COMMENTS: Some components of this material such as benzene, toluene and xylene have been shown to produce fetal toxicity and/or reduce female or male reproductive capacity in laboratory animals.

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

4. FIRST AID MEASURES

EYES: Immediately flush with large amounts of water, holding eyelids open, for at least 20 minutes. Repeat if necessary. Remove contact lenses, if present and easy to do. If pain or redness persists, seek medical attention. If eye is exposed to hot liquid, cover eyes with cloth and seek medical attention immediately.

SKIN: In case of hot liquid exposure, do not remove clothing or treat, wash only unburned area and seek medical attention immediately.

INGESTION: Do not induce vomiting. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Have exposed individual rinse mouth thoroughly with water. Never give anything by mouth to an unconscious person. Obtain medical assistance immediately and treat as directed by a medical professional.

INHALATION: Move victim to fresh air. Call 911, emergency medical service, or Emergency Phone Numbers(s) provided in Section 1 of this SDS. Give artificial respiration if victim is not breathing. Do not use mouth-to-mouth methods if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Administer oxygen if breathing is difficult.

ANTIDOTES: Not Established.

NOTES TO PHYSICIAN: No specific treatment. Treat symptomatically. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

CLINICAL TESTING & MEDICAL MONITORING FOR DELAYED EFFECTS – Not Established.

COMMENTS: CONTRAINDICATIONS – Not Established.

5. FIRE FIGHTING MEASURES

FLASH POINT: This material is capable of flashing at temperatures of 22°C (72°F) or lower.

******IMPORTANT:** *This material is highly flammable. When separator condensate liquid under pressure encounters normal atmospheric pressures, each 42-gallon barrel equivalent of condensate is capable of flashing over 92 pounds of volatile vapors to the atmosphere in a relatively short amount of time*****

AUTOIGNITION TEMPERATURE: Not Established.

EXTINGUISHING MEDIA:

SMALL FIRE – Class B fire extinguisher, carbon dioxide, multipurpose dry chemical, water fog or alcohol-resistant foam.

LARGE FIRE – Water fog or alcohol-resistant foam.

COMMENTS:

SPECIFIC HAZARDS THAT MAY ARISE FROM THE PRODUCT - Vapors are flammable and some constituents may be heavier than air. Vapors may travel through the air as well as across the ground and reach remote ignition sources causing a flashback fire danger. Sudden reaction and fire may result if product is mixed with an oxidizing agent.

FIRE EXPLOSION: This product is extremely flammable. Hydrocarbon vapors that are released are a potential fire hazard. The condensate as well as its related vapors can easily be ignited by heat, sparks or flames. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Some vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks). Vapor explosion hazard indoors, outdoors or in sewers. Many liquids are lighter than water. Runoff to sewer may create fire or explosion hazard. Containers may explode when heated.

SENSITIVE TO STATIC DISCHARGE: Not Established.

SENSITIVITY TO IMPACT: Not Established.

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: For emergency information and procedures to follow in the case of an accidental release, call the Emergency Telephone Number(s) listed in Section 1 of this SDS. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). As an immediate precautionary measure, isolate spill or leak area 50 meters (160 feet) in all directions. Evacuate building and all affected areas. Keep unauthorized personnel away. Do not touch or walk through spilled material. Stay upwind. Keep out of low areas. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. Dike far ahead of liquid for later disposal. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material. Water spray may reduce vapor; but may not prevent ignition in closed spaces. A vapor suppressing foam may be used to reduce vapors. Provide sufficient ventilation in the affected area(s) and wear appropriate personal protective equipment as indicated in Section 8 when handling spill material. This material has been reported to behave when spilled in water in a manner that it partitions and the lighter ends volatilize off and the heavier ends can sink.

LARGE SPILL: Use similar response procedures as indicated under Small Spill. Consider initial downwind evacuation for at least 100 meters (330 feet). Large releases may require the notification of local emergency response agencies. Wear self-contained breathing apparatus if conditions or air monitoring warrants.

7. HANDLING AND STORAGE

GENERAL PROCEDURES: Handle in accordance with good industrial hygiene and safety practices. These practices include but are not limited to avoiding unnecessary exposure and prompt removal of material from eyes, skin and clothing. Wash exposed skin and clothing frequently. If needed, take first aid actions as indicated in Section 4 of this SDS.

HANDLING: Wear appropriate personal protective equipment and use exposure controls as indicated in Section 8. Vent slowly to the atmosphere when opening. Avoid all contact with skin and eyes. Avoid breathing product dust or vapors. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Remove contaminated clothing immediately. Wash with soap and water after working with this product.

STORAGE: Keep in airtight container away from all heat sources. Store the container in a segregated and approved area. Store in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Keep container in a well-ventilated area. Ground all containers during transfer. Store containers away from incompatible materials. Store in the original container or an approved alternative made from compatible material. Do not store in unlabeled containers. Treat empty containers in a similar fashion as residual product may exist. Use appropriate containment to avoid environmental contamination.

STORAGE TEMPERATURE: Store containers of product in a cool (between 50°F or below), well ventilated location.

STORAGE PRESSURE: Store in a room with ambient atmospheric pressure.

ELECTROSTATIC ACCUMULATION HAZARD: Not Established.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

OSHA HAZARDOUS COMPONENTS (29 CFR1910.1200)		EXPOSURE LIMITS	
		OSHA PEL	ACGIH TLV
Chemical Name		ppm	ppm
Benzene	TWA	1	0.5
	STEL	5	2.5
Toluene	TWA	200	20
	STEL	300	N/E
Ethyl benzene	TWA	100	20

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

	STEL	125	N/E
m-p Xylene	TWA	100	100
	STEL	150	150
o- Xylene	TWA	100	100
	STEL	150	150
Hexane	TWA	50	50
	STEL	N/E	N/E
Hydrogen Sulfide	TWA	N/E	1
	STEL	20	5
Propane	TWA	1000	N/E
	STEL	N/E	N/E
n-Pentane	TWA	1000	1000
	STEL	N/E	N/E
<p>Note: OSHA has also assigned H₂S a STEL value of 50 ppm for a 10-minute peak that may be reached only once per 8-hour shift. In the event no Federal OSHA PEL exists for a constituent, California/OSHA PELs have been substituted, as appropriate.</p>			

EXPOSURE GUIDELINES

ENGINEERING CONTROLS: Provide adequate general and local ventilation to maintain airborne chemical concentrations below applicable exposure limits, to prevent accumulation of flammable vapors and formation of explosive atmospheres, and to prevent formation of oxygen deficient atmospheres, especially in confined spaces. This product may release gases or vapors that can displace oxygen in enclosed areas.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Employees should be provided with and required to use splash-proof safety goggles and full face splash shields where there is any possibility of product coming in contact with eyes. Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses. Ensure that eye wash station is operable and nearby.

SKIN: Consider wearing long-sleeve, FRC, otherwise normal working clothes should be worn. Wash contaminated clothing prior to reuse. If gloves are required for job operations involving this product, wear nitrile rubber or polyvinylalcohol (PVAL) gloves.

RESPIRATORY: Respiratory protection is normally not required except in emergencies or when conditions cause excessive airborne levels of mists or vapors. Select NIOSH-approved organic vapor air-purifying respirator, SCBA or air-supplied respirator where there may be potential for overexposure.

PROTECTIVE CLOTHING: Long sleeve shirt and long pants or coveralls; Consider wearing long-sleeve, FRC, . Consider wearing butyl rubber apron or outerwear where splashing may occur. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire.

WORK HYGIENIC PRACTICES: Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove contaminated clothing and laundry before reuse. Shower after work using plenty of soap and water.

OTHER USE PRECAUTIONS: FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR DEATH CONDITIONS - A self-contained breathing apparatus with full face piece operated in a pressure-demand or other positive pressure mode is recommended for firefighting or other immediately dangerous to life and death conditions. Supplied-air respirator with full face piece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode may also be used.

COMMENTS: EXPOSURE LIMITS & SOURCES - Refer to Section 16 Table 1 for additional exposure limits and sources for this product or its components, whichever applies.

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR: Hydrocarbon.

APPEARANCE: Brown to Clear Liquid

pH: 5.5 to 8.0

VAPOR PRESSURE: Not Established.

VAPOR DENSITY: > 3-4 (natural gasoline) (Air = 1)

BOILING POINT: Varies depending on hydrocarbon content.

FREEZING POINT: Not Available

POUR POINT: Not Established.

FLASH POINT: 22°C (72°F) May flash at lower temperatures..

SOLUBILITY IN WATER: Not Established.

EVAPORATION RATE: Not Established.

SPECIFIC GRAVITY: < 1.0 at 0°C (32°F)

VISCOSITY: Not Established.

COEFF. OIL/WATER: Not Established.

ODOR THRESHOLD: Not Established.

RELATIVE DENSITY: Not Established.

DECOMPOSTION TEMP: Not Established.

AUTO-IGNITION TEMP: Not Established.

10. STABILITY AND REACTIVITY

STABLE: Yes

HAZARDOUS POLYMERIZATION: No

STABILITY: CHEMICAL STABILITY - This product is anticipated to be stable under normal ambient storage and handling conditions of temperature and pressure.

POLYMERIZATION: This product is not anticipated to cause hazardous reactions or polymerizations under normal ambient storage and handling conditions of temperature and pressure.

CONDITIONS TO AVOID: Avoid contact with incompatible materials such as heat, open flame, other sources of ignition, and oxidizing materials such as chlorine and concentrated nitric acid.

HAZARDOUS DECOMPOSITION PRODUCTS: This product may produce carbon monoxide and carbon dioxide during decomposition.

11. TOXICOLOGICAL

INFORMATION ACUTE

Chemical Name	ORAL LD ₅₀ (rat)	DERMAL LD ₅₀ (rabbit)	INHALATIO N LC ₅₀ (rat)
Xylene	5000 mg/kg	12400 mg/kg	4550 ppm (4 hours)
Hexane	25 g/kg	Not Established.	48000 ppm (4 hours)
Crude Oil	< 5000 mg/kg	> 2000 mg/kg	Not Established
Toluene	636 mg/kg	14100 ug/kg	49 g/m ³ (4 hours)

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

Benzene	930 mg/kg	< 9400 ug/kg	10000 ppm (7 hours)
Ethyl benzene	<= 3500 mg/kg	<= 3500 mg/kg	<= 55000 mg/m ³
Hydrogen Sulfide	Not Established	Not Established.	700 mg/m ³ (4 hours)

EYE EFFECTS: May cause moderate to severe eye irritation.

SKIN EFFECTS: May cause mild skin irritation. Prolonged or repeated contact may result in mild irritation. May be absorbed through skin with toxic effects.

CHRONIC: This product contains benzene, which can cause degeneration in blood forming bone marrow leading to anemia, which may further degrade to leukemia, a type of cancer. Chronic exposure affects the hematopoietic system causing blood disorders including anemia and pancytopenia.

CARCINOGENICITY

Chemical Name	NTP Status	IARC Status	OSHA Status
Crude Oil		3	
Benzene	1	1	Carcinogen.

SENSITIZATION: This product is not expected to be a skin sensitizer.

NEUROTOXICITY: Not Established.

GENETIC EFFECTS: Not Established.

REPRODUCTIVE EFFECTS: Not Established.

TERATOGENIC EFFECTS: Not Established.

MUTAGENICITY: Not Established.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: MOBILITY IN SOIL POTENTIAL - Not Established.

BIOACCUMULATION/ACCUMULATION: Not Established.

DISTRIBUTION: Do not discharge into or allow runoff to flow into sewers and natural waterways. Contain spill material and dike for proper disposal.

AQUATIC TOXICITY (ACUTE): This product is not expected to be acutely harmful to aquatic life.

CHEMICAL FATE INFORMATION: PERSISTENCE & DEGRADABILITY - Not Established.

GENERAL COMMENTS: Any other adverse environmental effects, such as environmental fate (exposure), ozone depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and global warming potential are indicated in this section if data exists. Otherwise, this data has not been established.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Properly characterize the material and to manage it in accordance with applicable Federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)

PROPER SHIPPING NAME: Flammable liquid, n.o.s.

PRIMARY HAZARD CLASS/DIVISION: 3

UN/NA NUMBER: 1993

PACKING GROUP: II

NAERG: 128

Non-Sour Natural Gas Condensate (Atmospheric Liquid)

15. REGULATORY

INFORMATION UNITED

STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

311/312 HAZARD CATEGORIES: Fire hazard. Immediate (acute) health hazard. Delayed (chronic) health hazard.

FIRE: Yes **PRESSURE GENERATING:** No **REACTIVITY:** No **ACUTE:** Yes **CHRONIC:** Yes

EPCRA SECTION 313 SUPPLIER NOTIFICATION

Chemical Name	Vol. %	CAS
Benzene	<0-1.0	71-43-2

CERCLA (COMPREHENSIVE RESPONSE, COMPENSATION, AND LIABILITY ACT)

Chemical Name	Vol. %	CERCLA RQ
Benzene	<0-1.0	10
Hydrogen Sulfide	<0-1.0	100

TSCA (TOXIC SUBSTANCE CONTROL ACT)

Chemical Name	CAS
Crude Oil	8002-05-9
Benzene	71-43-2
Hydrogen Sulfide	7783-06-4

CLEAN AIR ACT

Chemical Name	Vol. %	CAS
Hydrogen Sulfide	<0-1.0	7783-06-4

16. OTHER INFORMATION

RELEVANT R-PHRASES:

R36/37/38: Irritating to eyes, respiratory system and skin.

R45: May cause cancer.

R46: May cause heritable genetic damage.

R11: Highly flammable.

R36/38: Irritating to eyes and skin.

R65: Harmful: may cause lung damage if swallowed.

R12: Extremely flammable.

R26: Very toxic by inhalation.

R50: Very toxic to aquatic organisms.

PREPARED BY:

REVISION SUMMARY:

NATIONAL FIRE PROTECTION ASSOCIATION®HAZARD RATING

HEALTH: 1-Slightly Hazardous

FIRE: 4- Severely Flammable

REACTIVITY: 0- Stable

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM®HAZARD RATING

HEALTH: 1- Slight Hazard (*Chronic)

FIRE: 4- Severely Flammable Liquid

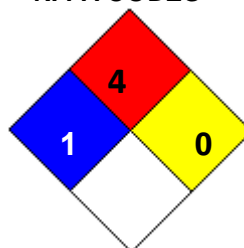
Non-Sour Natural Gas Condensate (Atmospheric Liquid)

PHYSICAL: 0- Minimal Hazard

HMIS RATING

HEALTH	*	1
FLAMMABILITY		4
PHYSICAL HAZARD		
PERSONAL PROTECTION		G

NFPA CODES



DATA SOURCES: REFERENCES

- ACGIH. 2012 Guide to Occupational Exposure Values. Cincinnati, OH. Signature Publications, 2012.
- Forsberg, K.; Mansdorf, S.Z. Quick Selection Guide to Chemical Protective Clothing. Fifth Edition. Hoboken, NJ. John Wiley & Sons, 2007.
- Lide, D.R. CRC Handbook of Chemistry and Physics. 88th Edition. Boca Raton, FL. CRC Press, 2008.
- UNECE. Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Third Revised Edition. New York and Geneva. United Nations, 2009.
- US DOT; Pipeline and Hazardous Materials Safety Administration. 2008 Emergency Response Guidebook. Neenah, WI. J.J. Keller & Associates, Inc. 2008.
- US EPA. Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) and Section 112(r) of the Clean Air Act. [Available] Online: <http://www.epa.gov/ceppo/pubs/title3.pdf>. Retrieved 02/02/2011.

ADDITIONAL MSDS

INFORMATION: KEY / LEGEND

- ACGIH - American Conference of Governmental Industrial Hygienists
- ADR - Agreement on Dangerous Goods by Road
- CAA - Clean Air Act
- CAS - Chemical Abstracts Service Registry Number
- CDG - Carriage of Dangerous Goods By Road and Rail Manual
- CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
- CFR - Code of Federal Regulations
- EINECS - European Inventory of Existing Chemical Substances Registry Number
- ERG - Emergency Response Guidebook
- EPCRA - Emergency Planning and Community Right-to-Know Act
- GHS - Globally Harmonized System of Classification and Labeling of Chemicals
- IARC - International Agency for Research on Cancer
- IATA - International Air Transport Association
- ICAO - International Civil Aviation Organization
- IMDG - International Maritime Dangerous Goods Code
- IMO - International Maritime Organization
- N/E - Not Established
- NTP - National Toxicology Program
- OSHA - Occupational Safety and Health Administration
- PEL - Permissible Exposure Limit
- PPE - Personal Protective Equipment
- RCRA - Resource Conservation and Recovery Act
- RID - Regulations Concerning the International Transport of Dangerous Goods by Rail
- RQ - Reportable Quantities
- SARA - Superfund Amendments and Reauthorization Act of 1986
- SDS - Safety Data Sheet
- TCC - Tag Closed Cup
- TDG - Transportation of Dangerous Goods
- TLV - Threshold Limit Value
- TSCA - Toxic Substance Control Act
- UN/NA - United Nations / North American Number
- UNECE - United Nations Economic Commission for Europe

Sweet Produced Water

US DOT - United States Department of Transportation
US EPA - United States Environmental Protection Agency
Vol. - Volume
WHMIS - Workplace Hazardous Materials Information System

GENERAL STATEMENTS: Other information not included anywhere else in this SDS is included in this section if, in fact, such data exists.

MANUFACTURER DISCLAIMER: This information relates to the specific material designated and may not be valid for such material used in combination with any other materials or in any process. Such information is to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty or guarantee is made as to its accuracy, reliability or completeness. NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION HEREIN PROVIDED. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information nor do we offer warranty against patent infringement.

SAFETY DATA SHEET

Date Issued :
SDS No :
Date Revised :
Revision No :

Non-Sour Produced Water (West Virginia)

IMPORTANT

This SDS has been prepared for Non-Sour Produced Water. Refer to the following sections for important safety and response information.

Section 4- First Aid Measures (for accidental exposure).

Section 5- Fire Fighting Measures.

Section 6- Accidental Release Measures.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Non-Sour Produced Water (West Virginia)

GENERAL USE: Water extracted from natural gas well production.

2. HAZARDS IDENTIFICATION

This material is not considered hazardous according to OSHA criteria.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	Vol. %	CAS
Water	>90	7732-18-5
Sodium Chloride	<10	7647-14-5

COMMENTS: Compositions given are typical values, not specifications. Composition may vary with geographic location, geologic formation, temperature and pressure.

4. FIRST AID MEASURES

EYES: Immediately flush with large amounts of water, holding eyelids open, for at least 20 minutes. Repeat if necessary. Remove contact lenses, if present and easy to do. If pain or redness persists, seek medical attention. If eye is exposed to hot liquid, cover eyes with cloth and seek medical attention immediately.

SKIN: In case of hot liquid exposure, do not remove clothing or treat, wash only unburned area and seek medical attention immediately.

INGESTION: Do not induce vomiting. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Have exposed individual rinse mouth thoroughly with water. Never give anything by mouth to an unconscious person. Obtain medical assistance immediately and treat as directed by a medical professional.

INHALATION: Move victim to fresh air. Call 911, emergency medical service,

NOTES: Contact poison treatment center immediately if large quantities have been ingested or inhaled.

5. FIRE FIGHTING MEASURES

FLASH POINT: N/A

EXTINGUISHING MEDIA: Material is not flammable.

FIRE FIGHTING PROCEDURES: PROTECTIVE ACTIONS TO TAKE DURING FIRE FIGHTING - Move containers from fire area if you can do it without risk. Dike fire-control water for later disposal; do not scatter the material. Do not get water inside containers.

FIRE FIGHTING EQUIPMENT: PRECAUTIONS FOR FIRE INVOLVING TANKS OR CAR/TRAILER LOADS - Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.

6. ACCIDENTAL RELEASE MEASURES

SMALL SPILL: For emergency information and procedures to follow in the case of an accidental release, call the Emergency Telephone Number(s) listed in Section 1 of this SDS. As an immediate precautionary measure, isolate spill or leak area 50 meters (160 feet) in all directions. Keep unauthorized personnel away. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers. Dike far ahead of liquid for later disposal. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

LARGE SPILL: Use similar response procedures as indicated under Small Spill. Large releases may require the notification of local emergency response agencies.

COMMENT: CAUTION This material is capable of off gassing volatiles.

7. HANDLING AND STORAGE

GENERAL PROCEDURES: Handle in accordance with good industrial hygiene and safety practices. These practices include but are not limited to avoiding unnecessary exposure and prompt removal of material from eyes, skin and clothing. Wash exposed skin and clothing frequently. If needed, take first aid actions as indicated in Section 4 of this SDS.

HANDLING: Wear appropriate personal protective equipment and use exposure controls as indicated in Section 8. Avoid all contact with skin and eyes. Avoid breathing product dust or vapors. Wash with soap and water after working with this product.

STORAGE: Keep in airtight container away from all heat sources. Store in a segregated and approved area. Store in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Keep container in a well-ventilated area. Ground all containers during transfer. Store in the original container or an approved alternative made from compatible material. Do not store in unlabeled containers. Treat empty containers in a similar fashion as residual product may exist. Use appropriate containment to avoid environmental contamination.

STORAGE TEMPERATURE: Store containers of product in cool well ventilated location.

STORAGE PRESSURE: Store in a room with ambient pressure.

ELECTROSTATIC ACCUMULATION HAZARD: Not Established.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE GUIDELINES

OSHA HAZARDOUS COMPONENTS (29 CFR1910.1200)			
		EXPOSURE LIMITS	
		OSHA PEL	ACGIH TLV
Chemical Name		ppm	ppm
Sodium Chloride	TWA	N/E	N/E
	STEL	N/E	N/E

ENGINEERING CONTROLS: Provide adequate general and local ventilation to maintain airborne chemical concentrations below applicable exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Produced Water

EYES AND FACE: Employees should be provided with and required to use splash-proof safety goggles and full face splash shields where there is any possibility of product coming in contact with eyes. Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses. Ensure that eye wash station is operable and nearby.

SKIN: Consider wearing long-sleeve, FRC, otherwise normal working clothes should be worn. Wash contaminated clothing prior to reuse. If gloves are required for job operations involving this product, wear nitrile rubber or butyl rubber gloves.

RESPIRATORY: Respiratory protection is normally not required except in emergencies or when conditions cause excessive airborne levels of mists or vapors. Select NIOSH-approved organic vapor air-purifying respirator, SCBA or air-supplied respirator where there may be potential for overexposure.

PROTECTIVE CLOTHING: Long sleeve shirt and long pants or coveralls. Consider wearing butyl rubber apron or outerwear where splashing may occur. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire.

WORK HYGIENIC PRACTICES: Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove contaminated clothing and launder before reuse. Shower after work using plenty of soap and water.

COMMENTS: EXPOSURE LIMITS & SOURCES - Refer to Section 16 Table 1 for additional exposure limits and sources for this product or its components, whichever applies.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR: Salty.

APPEARANCE: Clear or opaque liquid.

pH: 6-8

PERCENT VOLATILE:

Negligible. **VAPOR PRESSURE:**

Not Established. **VAPOR**

DENSITY: > 1.0 (Air = 1)

BOILING POINT: 212° F / 100° C

FREEZING POINT: < 0°C (<32°F)

POUR POINT: Not Established.

FLASH POINT: Not Applicable

LOWER EXPLOSIVE LIMITS: Not Applicable

SOLUBILITY IN WATER: Not

Established. **EVAPORATION RATE:**

Not Established. **SPECIFIC**

GRAVITY: > 1.000 at 0°C (32°F)

VISCOSITY: Not Established.

COEFF. OIL/WATER: Not Established.

ODOR THRESHOLD: Not Established.

10. STABILITY AND REACTIVITY

STABLE: Yes

HAZARDOUS POLYMERIZATION: No

STABILITY: CHEMICAL STABILITY - This product is anticipated to be stable under normal ambient storage and handling conditions of temperature and pressure.

POLYMERIZATION: This product is not anticipated to cause hazardous reactions or polymerizations under normal ambient storage and handling conditions of temperature and pressure.

CONDITIONS TO AVOID: Avoid contact with incompatible materials such as heat.

11. TOXICOLOGICAL INFORMATION ACUTE

Produced Water

Chemical Name	ORAL LD ₅₀ (rat)	DERMAL LD ₅₀ (rabbit)	INHALATION LC ₅₀ (rat)
Sodium Chloride	3000 mg/kg	N/E	N/E

EYE EFFECTS: May cause moderate to severe eye irritation.

SKIN EFFECTS: May cause mild skin irritation. Prolonged or repeated contact may result in mild irritation.

CHRONIC: Not Established.

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

SENSITIZATION: This product is not expected to be a skin sensitizer.

NEUROTOXICITY: Not Established.

GENETIC EFFECTS: Not Established.

REPRODUCTIVE EFFECTS: Not Established.

TERATOGENIC EFFECTS: Not Established.

MUTAGENICITY: Not Established.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL DATA: MOBILITY IN SOIL POTENTIAL - Not Established.

BIOACCUMULATION/ACCUMULATION: Not Established.

DISTRIBUTION: Do not discharge into or allow runoff to flow into sewers and natural waterways. Contain spill material and dike for proper disposal.

AQUATIC TOXICITY (ACUTE): This product is not expected to be harmful to aquatic life.

96-HOUR LC₅₀: 3930 - 5360 mg/L *Pimephales promelas* for calcium chloride.

48-HOUR EC₅₀: 52 mg/L for *Daphnia magna* for calcium chloride.

CHEMICAL FATE INFORMATION: PERSISTENCE & DEGRADABILITY - Not Established.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: The generator of a waste is responsible to determine if the material disposed of meets federal, state, or local criteria to be defined as a hazardous waste and dispose of accordance with applicable Federal, state and local regulations.

14. TRANSPORT INFORMATION

DOT (DEPARTMENT OF TRANSPORTATION)

Not Regulated

15. REGULATORY INFORMATION UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

311/312 HAZARD CATEGORIES: Fire hazard. Immediate (acute) health hazard. Delayed (chronic) health hazard.

FIRE: No **PRESSURE GENERATING:** No **REACTIVITY:** No **ACUTE:** No **CHRONIC:** No

EPCRA SECTION 313 SUPPLIER NOTIFICATION

This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

CERCLA (COMPREHENSIVE RESPONSE, COMPENSATION, AND LIABILITY ACT)

This material does not contain any chemicals with CERCLA Reportable Quantities.

TSCA (TOXIC SUBSTANCE CONTROL ACT)

All components are either listed on the TSCA Inventory, or are not regulated under TSCA.

16. OTHER INFORMATION

RELEVANT R-PHRASES:

R36/37/38: Irritating to eyes, respiratory system and skin.
R36/38: Irritating to eyes and skin.
R65: Harmful: may cause lung damage if swallowed.

PREPARED BY:

REVISION SUMMARY:

NATIONAL FIRE PROTECTION ASSOCIATION®HAZARD RATING

HEALTH: 0-Hazard No greater than Ordinary Material
FIRE: 0-Will Not Burn
REACTIVITY: 0- Stable

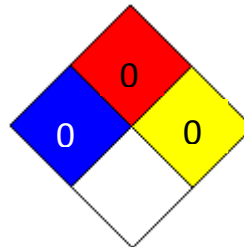
HAZARDOUS MATERIAL IDENTIFICATION SYSTEM®HAZARD RATING

HEALTH: 0- Minimal Hazard
FIRE: 0- Minimal Hazard
PHYSICAL: 0- Minimal Hazard

HMIS RATING

HEALTH	0
FLAMMABILITY	0
PHYSICAL HAZARD	0
PERSONAL PROTECTION	B

NFPA CODE



Sweet Produced Water

ADDITIONAL MSDS INFORMATION: KEY / LEGEND

ACGIH - American Conference of Governmental Industrial Hygienists
ADR - Agreement on Dangerous Goods by Road
CAA - Clean Air Act
CAS - Chemical Abstracts Service Registry Number
CDG - Carriage of Dangerous Goods by Road and Rail Manual
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CFR - Code of Federal Regulations
EINECS - European Inventory of Existing Chemical Substances Registry Number
NAERG - Emergency Response Guidebook
EPCRA - Emergency Planning and Community Right-to-Know Act
GHS - Globally Harmonized System of Classification and Labeling of Chemicals
IARC - International Agency for Research on Cancer
IATA - International Air Transport Association
ICAO - International Civil Aviation Organization
IMDG - International Maritime Dangerous Goods Code
IMO - International Maritime Organization
MSDS - Material Safety Data Sheet
N/E - Not Established
NOV - National Oil well Varco
NTP - National Toxicology Program
OSHA - Occupational Safety and Health Administration
PEL - Permissible Exposure Limit
PPE - Personal Protective Equipment
RCRA - Resource Conservation and Recovery Act
RID - Regulations Concerning the International Transport of Dangerous Goods by Rail
RQ - Reportable Quantities
SARA - Superfund Amendments and Reauthorization Act of 1986
SDS - Safety Data Sheet
TCC - Tag Closed Cup
TDG - Transportation of Dangerous Goods
TLV - Threshold Limit Value
TSCA - Toxic Substance Control Act
UN/NA - United Nations / North American Number
UNECE - United Nations Economic Commission for Europe
US DOT - United States Department of Transportation
US EPA - United States Environmental Protection Agency
Vol. - Volume
WHMIS - Workplace Hazardous Materials Information System

GENERAL STATEMENTS: Other information not included anywhere else in this SDS is included in this section if, in fact, such data exists.

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ATTACHMENT E

EMISSION CALCULATIONS

Permit Determination

Wayne Well Pad
New Martinsville, West Virginia

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

July 2017

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

Criteria Pollutants

Proposed Facility Wide PTE - Criteria Pollutants

Source	PM	PM10	PM2.5	SO2	NOx	CO	VOC	CO2e
Line Heaters (ton/yr)	0.196	0.196	0.196	0.015	2.576	2.164	0.142	3075.020
Tanks (ton/yr)	-	-	-	-	-	-	1.325	-
Truck Loading (ton/yr)	-	-	-	-	-	-	0.000	-
Fugitives (ton/yr)	-	-	-	-	-	-	0.885	16.588
Total Emissions (ton/yr)	0.196	0.196	0.196	0.015	2.576	2.164	2.351	3091.608
Total Emissions (lb/hr)	0.045	0.045	0.045	0.004	0.588	0.494	0.537	705.847

Hazardous Air Pollutants (HAPs)

Proposed Facility Wide PTE - HAPs

Source	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	Total HAPs
Line Heaters (ton/yr)	0.0000	0.0000	--	--	0.0116	0.000	0.012
Tanks (ton/yr)	-	-	-	-	-	-	-
Truck Loading (ton/yr)	-	-	-	-	-	-	-
Fugitives (ton/yr)	0.0002	0.0000	0.0000	0.0000	0.0133	--	0.014
Total Emissions (ton/yr)	0.000	0.000	0.000	0.000	0.025	0.000	0.026
Total Emissions (lb/hr)	0.000	0.000	0.000	0.000	0.006	0.000	0.006

**Table 2 GPU Heater (LH-1 through LH-4) Rates and Emissions
Tug Hill Operating, LLC Wayne Well Pad**

Pollutant	Emission Factor	1.50 MBtu/hr GPU Emissions (lb/hr)	1.50 MMBtu/hr GPU Emissions (ton/yr)	1.50 MBtu/hr GPU Emissions (lb/hr) x4	1.50 MMBtu/hr GPU Emissions (ton/yr) x4
Criteria Pollutants					
PM/PM10/PM2.5	7.6 lb/MMcf (1)	0.011	0.049	0.179	0.196
SO ₂	0.6 lb/MMcf (1)	0.001	0.004	0.014	0.015
NO _x	100 lb/MMcf (2)	0.147	0.644	2.353	2.576
CO	84 lb/MMcf (2)	0.124	0.541	1.976	2.164
VOC	5.5 lb/MMcf (1)	0.008	0.035	0.129	0.142
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	0.002	0.002
Hexane	1.8E+00 lb/MMcf (4)	0.003	0.012	0.042	0.046
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	0.003	0.012	0.044	0.049
Greenhouse Gas Emissions					
CO ₂	116.89 lb/MMBtu (5)	175.334	767.961	701.335	3071.845
CH ₄	2.2E-03 lb/MMBtu (5)	0.003	0.014	0.013	0.058
N ₂ O	0.0 lb/MMBtu (5)	0.000	0.001	0.001	0.006
CO ₂ e ^(b)	-	175.515	768.755	702.059	3075.020

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) = 1.5
 Hours of Operation (hr/yr)= 8760
 PTE Fuel Use (MMcf/yr) = 12.9

(b) CO₂ equivalent = [(CO₂ emissions)*(GWP_{CO2})]+[(CH₄ emissions)*(GWP_{CH4})]+[(N₂O emissions)*(GWP_{N2O})]
 Global Warming Potential (GWP)

CO₂ 1 (6)
 CH₄ 25 (6)
 N₂O 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 3. Tank Emissions
Tug Hill Operating, LLC Wayne Well Pad

Emission Unit ID	Tank Capacity (bbl)	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)
T01	400	Pipeline Liquids	None	7.04	8.26E-01	(1)	2121.74	0.242	1.061
T02	35714	Pipeline Liquids	None	300.07	4.82E-03	(1)	528.20	0.060	0.264
Totals							2649.94	0.30	1.32

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. Truck Loading (TL-1) VOC Emissions
Tug Hill Operating, LLC Wayne Well Pad**

Contents	Volume Transferred (1)	PTE VOC Emissions (lb/hr)	PTE VOC Emissions (ton/yr) ^(a)
Pipeline Liquids	107,923 gal/yr	3.38E-05	1.48E-04
Total		3.38E-05	1.48E-04

Calculations:

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

107923.2

Notes:

(1) Annual rates based on maximum throughput of 7.04 bbls/day

**Table 5 Fugitive Leaks
Tug Hill Operating, LLC Wayne Well Pad**

Pollutant	Emission Factor	PTE ^(a) Gas Service (tons/yr)	PTE VOC emissions (ton/yr)	PTE CO ₂ e emissions (ton/yr)	PTE Total HAPs emissions (ton/yr)
Valves	9.9E-03 lb/hr/source	6.25	0.60	11.28	0.01
Pressure Relief Valves	1.9E-02 lb/hr/source	0.34	0.03	0.61	0.00
Connectors (2)	8.6E-04 lb/hr/source	2.41	0.23	4.35	0.00
Open Ended Lines	4.4E-03 lb/hr/source	0.19	0.02	0.35	0.00
Total	-	9.19	0.88	16.59	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	1.25E-04	1.25E-04	6.25E-06	6.25E-06	9.06E-03
Pressure Relief Valves	6.79E-06	6.79E-06	3.40E-07	3.40E-07	4.92E-04
Connectors (2)	4.82E-05	4.82E-05	2.41E-06	2.41E-06	3.49E-03
Open Ended Lines	3.86E-06	3.86E-06	1.93E-07	1.93E-07	2.80E-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	9.62%
Benzene	0.00%
Toluene	0.00%
Ethylbenzene	0.00%
Xylenes	0.00%
n-Hexane	0.15%

Number of Components in Gas Service

Valves =	144
Pressure Relief Valves =	4
Connectors =	640
Open Ended Lines =	10
Maximum Hour of Operation =	8,760

Global Warming Potential
(GWP)

CO ₂	1
CH ₄	25
N ₂ O	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



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ProMax[®] 4.0

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Simulation Report

Project: Tug Hill_Wayne_WellPad.pmx

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Client Name: Tug Hill
Location: Wayne Well Pad
Job: Determination

ProMax Filename: N:\West Virginia\Tug Hill\Projects\Determination\Wayne\ProMax\Tug Hill_Wayne_WellPad.pmx
ProMax Version: 4.0.16071.0
Simulation Initiated: 7/17/2017 9:51:16 AM

Bryan Research & Engineering, Inc.

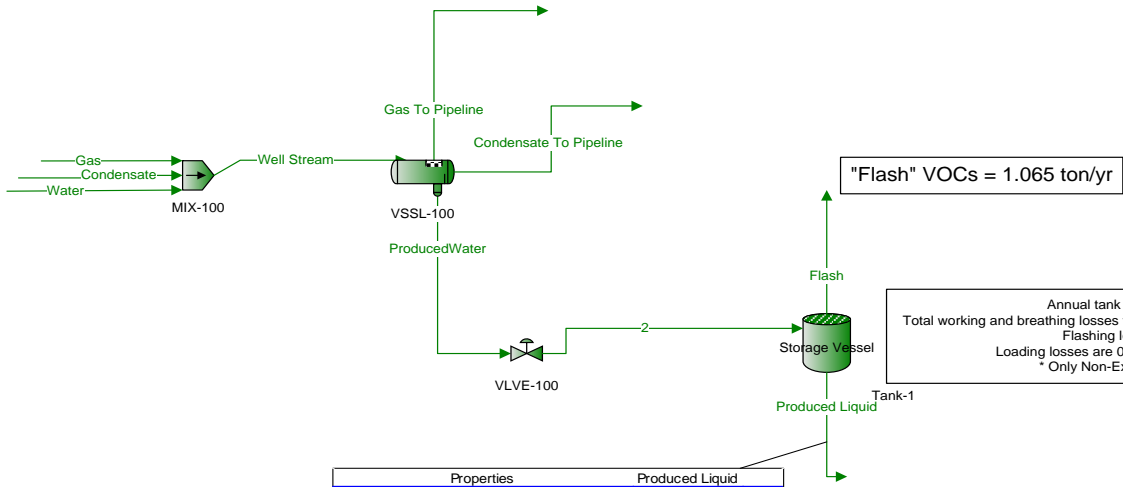
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Report Navigator can be activated via the ProMax Navigator Toolbar.

An asterisk (*), throughout the report, denotes a user specified value.

A question mark (?) after a value, throughout the report, denotes an extrapolated or approximate value.

Tug Hill- Wayne



Annual tank loss calculations for "2".
 Total working and breathing losses from the Vertical Cylinder are 0.0008704 ton/yr.
 Flashing losses are 1.06 ton/yr.
 Loading losses are 0.0001481 ton/yr of loaded liquid.
 Only Non-Exempt VOCs are reported.

Properties	Produced Liquid
Std Liquid Volumetric Flow (Total)	7.0411 bb/d
Analysis	
True Vapor Pressure(Vapor Pressure 1, Total)	6.3673 psig
Composition	
Water(Std Liquid Volumetric Flow , Total)	7 bb/d

Environments Report

Client Name:	Determination	Job:	N:\West Virginia\Tug Hill\Projects\Determination\Wayne\ProMax\Tug Hill_Wayne_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	C4	FALSE	FALSE
nC4	FALSE	FALSE	C5	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
C14	FALSE	FALSE	C15	FALSE	FALSE
C16	FALSE	FALSE	C17	FALSE	FALSE
C18	FALSE	FALSE	C19	FALSE	FALSE
C20	FALSE	FALSE	C21	FALSE	FALSE
C22	FALSE	FALSE	C23	FALSE	FALSE
C24	FALSE	FALSE	C25	FALSE	FALSE
C26	FALSE	FALSE	C27	FALSE	FALSE
C28	FALSE	FALSE	C29	FALSE	FALSE
C30	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:

**Single Oil Report
Other C7s**

Client Name:	Determination	Job:	N:\West Virginia\Tug Hill\Projects\Determination\Wayne\ProMax\Tug Hill_Wayne_WellPad.pmx
Location:	0		
Flowsheet:	Flowsheet1		

Properties

Volume Average Boiling Point	203.724 °F	Low Temperature Viscosity	0.346990 cP
Molecular Weight	100.07 lb/lbmol	Temperature of High T Viscosity	210 °F
Specific Gravity	0.7016	High Temperature Viscosity	0.210907 cP
API Gravity	70.1819	Watson K	12.4309
Critical Temperature	512.577 °F	ASTM D86 10-90% Slope	0 °F/%
Critical Pressure	396.762 psig	ASTM D93 Flash Point	22.3697 °F
Critical Volume	6.60925 ft ³ /lbmol	Pour Point	-5.748687 °F
Acentric Factor	0.327670	Paraffinic Fraction	72.7939 %
Carbon to Hydrogen Ratio	5.34782	Naphthenic Fraction	21.4640 %
Refractive Index	1.39188	Aromatic Fraction	5.74203 %
Temperature of Low T Viscosity	100 °F	Ideal Gas Heat Capacity	37.1038 Btu/(lbmol*°F)

Notes:

**Single Oil Report
Other C8s**

Client Name:	Determination	Job:	N:\West Virginia\Tug Hill\Projects\Determination\Wayne\ProMax\Tug Hill_Wayne_WellPad.pmx
Location:	0		
Flowsheet:	Flowsheet1		

Properties

Volume Average Boiling Point	251.782 °F	Low Temperature Viscosity	0.447017 cP
Molecular Weight	114.08 lb/lbmol	Temperature of High T Viscosity	210 °F
Specific Gravity	0.724	High Temperature Viscosity	0.258671 cP
API Gravity	63.9420	Watson K	12.3304
Critical Temperature	565.249 °F	ASTM D86 10-90% Slope	0 °F/%
Critical Pressure	367.106 psig	ASTM D93 Flash Point	55.5298 °F
Critical Volume	7.44256 ft ³ /lbmol	Pour Point	-9.536637 °F
Acentric Factor	0.374355	Paraffinic Fraction	66.6400 %
Carbon to Hydrogen Ratio	5.49489	Naphthenic Fraction	23.6733 %
Refractive Index	1.40407	Aromatic Fraction	9.68675 %
Temperature of Low T Viscosity	100 °F	Ideal Gas Heat Capacity	41.8448 Btu/(lbmol*°F)

Notes:

**Single Oil Report
Other C9s**

Client Name:	Determination	Job:	N:\West Virginia\Tug Hill\Projects\Determination\Wayne\ProMax\Tug Hill_Wayne_WellPad.pmx
Location:	0		
Flowsheet:	Flowsheet1		

Properties

Volume Average Boiling Point	296.856 °F	Low Temperature Viscosity	0.570492 cP
Molecular Weight	128.09 lb/lbmol	Temperature of High T Viscosity	210 °F
Specific Gravity	0.7424	High Temperature Viscosity	0.314212 cP
API Gravity	59.0981	Watson K	12.2735
Critical Temperature	612.701 °F	ASTM D86 10-90% Slope	0 °F/%
Critical Pressure	339.690 psig	ASTM D93 Flash Point	86.6305 °F
Critical Volume	8.29059 ft ³ /lbmol	Pour Point	-10.97107 °F
Acentric Factor	0.420726	Paraffinic Fraction	62.4329 %
Carbon to Hydrogen Ratio	5.61990	Naphthenic Fraction	24.7431 %
Refractive Index	1.41425	Aromatic Fraction	12.8241 %
Temperature of Low T Viscosity	100 °F	Ideal Gas Heat Capacity	46.6869 Btu/(lbmol*°F)

Notes:

**Single Oil Report
Other C10s**

Client Name:	Determination	Job:	N:\West Virginia\Tug Hill\Projects\Determination\Wayne\ProMax\Tug Hill_Wayne_WellPad.pmx
Location:	0		
Flowsheet:	Flowsheet1		

Properties

Volume Average Boiling Point	338.806 °F	Low Temperature Viscosity	0.715950 cP
Molecular Weight	142.1 lb/lbmol	Temperature of High T Viscosity	210 °F
Specific Gravity	0.756	High Temperature Viscosity	0.376056 cP
API Gravity	55.6693	Watson K	12.2715
Critical Temperature	654.485 °F	ASTM D86 10-90% Slope	0 °F/%
Critical Pressure	313.037 psig	ASTM D93 Flash Point	115.576 °F
Critical Volume	9.16628 ft ³ /lbmol	Pour Point	-9.659657 °F
Acentric Factor	0.467467	Paraffinic Fraction	60.2425 %
Carbon to Hydrogen Ratio	5.70210	Naphthenic Fraction	24.8511 %
Refractive Index	1.42187	Aromatic Fraction	14.9065 %
Temperature of Low T Viscosity	100 °F	Ideal Gas Heat Capacity	51.7717 Btu/(lbmol*°F)

Notes:

Calculators Report

Client Name:	Determination	Job:	N:\W
Location:	0		
Flowsheet:	Flowsheet1		

Simple Solver 1

Source Code

Residual Error (for CV1) = ProducedWater-7

Calculated Variable [CV1]

SourceMoniker	ProMax\ProMax\Project\Flowsheets\Flowsheet1\IPStreams\Water\Phases\Total\Properties\Std Liquid Volumetric Flow
Value	7.57716
Units	bb/d

Measured Variable [ProducedWater]

SourceMoniker	ProMax\ProMax\Project\Flowsheets\Flowsheet1\IPStreams\Produced Liquid\Phases\Total\Composition\Std Liquid Volumetric Flow\Water
Value	7.00000
Units	bb/d

Solver Properties

Status: Solved			
Error	8.52873E-07	Iterations	5
Calculated Value	0.221000 sghm	Max Iterations	40*
Lower Bound	sgpm	Weighting	1*
Upper Bound	sgpm	Priority	0*
Step Size	sgpm	Solver Active	Active
Is Minimizer	FALSE	Group	
Algorithm	Default	Skip Dependency Check	FALSE

Notes:

Simple Solver 3

Source Code

Residual Error (for CV1) = ProducedLiquid-7.041

Calculated Variable [CV1]

SourceMoniker	ProMax\ProMax\Project\Flowsheets\Flowsheet1\Blocks\VSSL-100\Entrainments\Entrainment 1\Properties\Numerator Value
Value	27.4562
Units	bbi

Measured Variable [ProducedLiquid]

SourceMoniker	ProMax\ProMax\Project\Flowsheets\Flowsheet1\IPStreams\Produced Liquid\Phases\Total\Properties\Std Liquid Volumetric Flow
Value	7.04113
Units	bb/d

Solver Properties

Status: Solved			
Error	0.000132747	Iterations	5
Calculated Value	1153.16 gal	Max Iterations	20
Lower Bound	gal	Weighting	1
Upper Bound	gal	Priority	0
Step Size	gal	Solver Active	Active
Is Minimizer	FALSE	Group	
Algorithm	Default	Skip Dependency Check	FALSE

Notes:

User Value Sets Report

Client Name:	Determination	Job:	N:\West Virginia
Location:	0		
Flowsheet:	Flowsheet1		

Tank-1

User Value [BlockReady]

Parameter	1*	Upper Bour	
Lower Bound		Enforce Boi	FALSE

User Value [ShellLength]

Parameter	20* ft	Upper Bour	ft
Lower Bound	0* ft	Enforce Boi	FALSE

User Value [ShellDiam]

Parameter	12* ft	Upper Bour	ft
Lower Bound	0* ft	Enforce Boi	FALSE

User Value [BreatherVP]

Parameter	0.0300000* psig	Upper Bour	psig
Lower Bound	psig	Enforce Boi	FALSE

User Value [BreatherVacP]

Parameter	-0.0300000* psig	Upper Bour	psig
Lower Bound	psig	Enforce Boi	FALSE

User Value [DomeRadius]

Parameter	0.17* ft	Upper Bour	ft
Lower Bound	ft	Enforce Boi	FALSE

User Value [OpPress]

Parameter	0* psig	Upper Bour	psig
Lower Bound	psig	Enforce Boi	FALSE

User Value [AvgPercentLiq]

Parameter	50* %	Upper Bour	%
Lower Bound	%	Enforce Boi	FALSE

User Value [MaxPercentLiq]

Parameter	90* %	Upper Bour	%
Lower Bound	%	Enforce Boi	FALSE

User Value [AnnNetTP]

Parameter	7.03781* bbl/day	Upper Bour	bbl/day
Lower Bound	0* bbl/day	Enforce Boi	FALSE

User Value [OREff]

Parameter	0* %	Upper Bour	%
Lower Bound	%	Enforce Boi	FALSE

User Value [MaxAvgT]

Parameter	61.15* °F	Upper Bour	°F
Lower Bound	°F	Enforce Boi	FALSE

User Value [MinAvgT]

Parameter	36.9667* °F	Upper Bour	°F
Lower Bound	°F	Enforce Boi	FALSE

User Value [BulkLiqT]

Parameter	52.1383* °F	Upper Bour	°F
Lower Bound	°F	Enforce Boi	FALSE

User Value [AvgP]

Parameter	13.7315* psia	Upper Bour	psia
Lower Bound	psia	Enforce Boi	FALSE

User Value [Therml]

Parameter	1193.89* Btu/ft^2/day	Upper Bour	Btu/ft^2/day
Lower Bound	Btu/ft^2/day	Enforce Boi	FALSE

User Value [AvgWindSpeed]

Parameter	6.16667* mi/h	Upper Bour	mi/h
Lower Bound	mi/h	Enforce Boi	FALSE

User Value [MaxHourlyLoadingRate]

Parameter	0.293242* bbl/hr	Upper Bour	bbl/hr
Lower Bound	0* bbl/hr	Enforce Boi	FALSE

User Value [EntrainedOilFrac]

Parameter	1* %	Upper Bour	%
Lower Bound	%	Enforce Boi	FALSE

User Value [TurnoverRate]

Parameter	6.42400*	Upper Bour	
Lower Bound		Enforce Boi	FALSE

User Value [LLossSatFactor]

Parameter	0.5*	Upper Bour	
Lower Bound		Enforce Boi	FALSE

User Value [AtmPressure]

Parameter	13.7315* psia	Upper Bour	psia
Lower Bound	psia	Enforce Boi	FALSE

User Value [TVP]

Parameter	0.251438* psia	Upper Bour	psia
Lower Bound	psia	Enforce Boi	FALSE

User Value [MaxVP]

Parameter	0.352008* psia	Upper Bour	psia
Lower Bound	psia	Enforce Boi	FALSE

User Value [MinVP]

Parameter	0.177917* psia	Upper Bour	psia
Lower Bound	psia	Enforce Boi	FALSE

User Value [AvgLiqSurfaceT]

Parameter	57.1967* °F	Upper Bour	°F
Lower Bound	°F	Enforce Boi	FALSE

User Value [MaxLiqSurfaceT]

Parameter	67.2326* °F	Upper Bour	°F
Lower Bound	°F	Enforce Boi	FALSE

User Value [TotalLosses]

Parameter	0.000870434* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE

User Value [WorkingLosses]			
Parameter	0.000219365* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [StandingLosses]			
Parameter	0.000651069* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [RimSealLosses]			
Parameter	0* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [WithdrawalLoss]			
Parameter	0* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [LoadingLosses]			
Parameter	0.000148069* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [MaxHourlyLoadingLoss]			
Parameter	3.38058E-05* lb/hr	Upper Bour	lb/hr
Lower Bound	lb/hr	Enforce Boi	FALSE
User Value [PStar]			
Parameter		Upper Bour	
Lower Bound		Enforce Boi	FALSE
User Value [AIICTotalLosses]			
Parameter	0.0184960* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [AIICLoadingLosses]			
Parameter	0.00314635* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [AIICTotalLoadingLoss]			
Parameter	0.000718345* lb/hr	Upper Bour	lb/hr
Lower Bound	lb/hr	Enforce Boi	FALSE
User Value [AIICTotalFlashingLosses]			
Parameter	1.57194* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [DeckFittingLosses]			
Parameter	0* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [DeckSeamLosses]			
Parameter	0* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [FlashingLosses]			
Parameter	1.05996* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [TotalResidual]			
Parameter	449.142* ton/yr	Upper Bour	ton/yr
Lower Bound	ton/yr	Enforce Boi	FALSE
User Value [GasMoleWeight]			

Parameter	0.0192450*	kg/mol	Upper Bour	kg/mol
Lower Bound		kg/mol	Enforce Boi	FALSE
User Value [VapReportableFrac]				
Parameter	4.70606*	%	Upper Bour	%
Lower Bound		%	Enforce Boi	FALSE
User Value [LiqReportableFrac]				
Parameter	0.402713*	%	Upper Bour	%
Lower Bound		%	Enforce Boi	FALSE
User Value [FlashReportableFrac]				
Parameter	67.4305*	%	Upper Bour	%
Lower Bound		%	Enforce Boi	FALSE
Notes:				
This User Value Set was programmatically generated. GUID={1EDE36BA-2D5D-4876-9370-5B5F79CCFF0E}				
Sum Component Flow/Frac				
User Value [CompSum]				
Parameter	1.06496*	ton/yr	Upper Bour	ton/yr
Lower Bound		ton/yr	Enforce Boi	FALSE
Notes:				
This User Value Set was programmatically generated. GUID={06B303CE-D6A3-4C69-ABCE-29F0C05F34E0}				

FESCO, Ltd.
1100 Fesco Ave. - Alice, Texas 78332

For: SLR International Corporation
8 Capitol Street, Suite 300
Charleston, West Virginia 25301

Sample: Tug Hill - Shields No. 9 & No. 10
GPU Sales Line
Spot Gas Sample @ 366 psig & 71 °F

Date Sampled: 11/01/16

Job Number: 63606.021

CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2286

COMPONENT	MOL%	GPM
Nitrogen	0.682	
Carbon Dioxide	0.188	
Methane	75.001	
Ethane	15.375	4.104
Propane	5.545	1.525
Isobutane	0.552	0.180
n-Butane	1.518	0.478
2-2 Dimethylpropane	0.015	0.006
Isopentane	0.275	0.100
n-Pentane	0.387	0.140
Hexanes	0.319	0.131
Heptanes Plus	<u>0.143</u>	<u>0.061</u>
Totals	100.000	6.725

Computed Real Characteristics Of Heptanes Plus:

Specific Gravity ----- 3.411 (Air=1)
Molecular Weight ----- 98.43
Gross Heating Value ----- 5207 BTU/CF

Computed Real Characteristics Of Total Sample:

Specific Gravity ----- 0.744 (Air=1)
Compressibility (Z) ----- 0.9962
Molecular Weight ----- 21.48
Gross Heating Value
Dry Basis ----- 1287 BTU/CF
Saturated Basis ----- 1266 BTU/CF

Base Conditions: 14.650 PSI & 60 Deg F

Sampled By: (SLR) N. Lanham
Analyst: MR
Processor: OA
Cylinder ID: T-4675

Certified: FESCO, Ltd. - Alice, Texas

David Dannhaus 361-661-7015

**CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2286
TOTAL REPORT**

COMPONENT	MOL %	GPM	WT %
Nitrogen	0.682		0.889
Carbon Dioxide	0.188		0.385
Methane	75.001		56.011
Ethane	15.375	4.104	21.522
Propane	5.545	1.525	11.382
Isobutane	0.552	0.180	1.494
n-Butane	1.518	0.478	4.107
2,2 Dimethylpropane	0.015	0.006	0.050
Isopentane	0.275	0.100	0.924
n-Pentane	0.387	0.140	1.300
2,2 Dimethylbutane	0.009	0.004	0.036
Cyclopentane	0.000	0.000	0.000
2,3 Dimethylbutane	0.018	0.007	0.072
2 Methylpentane	0.094	0.039	0.377
3 Methylpentane	0.053	0.022	0.213
n-Hexane	0.145	0.060	0.582
Methylcyclopentane	0.012	0.004	0.047
Benzene	0.002	0.001	0.007
Cyclohexane	0.014	0.005	0.055
2-Methylhexane	0.017	0.008	0.079
3-Methylhexane	0.017	0.008	0.079
2,2,4 Trimethylpentane	0.000	0.000	0.000
Other C7's	0.016	0.007	0.074
n-Heptane	0.028	0.013	0.131
Methylcyclohexane	0.014	0.006	0.064
Toluene	0.002	0.001	0.009
Other C8's	0.013	0.006	0.067
n-Octane	0.006	0.003	0.032
Ethylbenzene	0.000	0.000	0.000
M & P Xylenes	0.000	0.000	0.000
O-Xylene	0.000	0.000	0.000
Other C9's	0.001	0.001	0.006
n-Nonane	0.001	0.001	0.006
Other C10's	0.000	0.000	0.000
n-Decane	0.000	0.000	0.000
Undecanes (11)	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>
Totals	100.000	6.725	100.000

Computed Real Characteristics of Total Sample

Specific Gravity -----	0.744	(Air=1)
Compressibility (Z) -----	0.9962	
Molecular Weight -----	21.48	

Gross Heating Value

Dry Basis -----	1287	BTU/CF
Saturated Basis -----	1266	BTU/CF

FESCO, Ltd.
1100 Fesco Ave. - Alice, Texas 78332

Sample: Tug Hill - Shields No. 9 & No. 10
GPU Sales Line
Spot Gas Sample @ 366 psig & 71 °F

Date Sampled: 11/01/16

Job Number: 63606.021

GLYCALC FORMAT

COMPONENT	MOL%	GPM	Wt %
Carbon Dioxide	0.188		0.385
Hydrogen Sulfide	----		----
Nitrogen	0.682		0.889
Methane	75.001		56.011
Ethane	15.375	4.104	21.522
Propane	5.545	1.525	11.382
Isobutane	0.552	0.180	1.494
n-Butane	1.533	0.483	4.157
Isopentane	0.275	0.100	0.924
n-Pentane	0.387	0.140	1.300
Cyclopentane	0.000	0.000	0.000
n-Hexane	0.145	0.060	0.582
Cyclohexane	0.014	0.005	0.055
Other C6's	0.174	0.072	0.698
Heptanes	0.090	0.040	0.410
Methylcyclohexane	0.014	0.006	0.064
2,2,4 Trimethylpentane	0.000	0.000	0.000
Benzene	0.002	0.001	0.007
Toluene	0.002	0.001	0.009
Ethylbenzene	0.000	0.000	0.000
Xylenes	0.000	0.000	0.000
Octanes Plus	<u>0.021</u>	<u>0.010</u>	<u>0.111</u>
Totals	100.000	6.725	100.000

Real Characteristics Of Octanes Plus:

Specific Gravity -----	3.916	(Air=1)
Molecular Weight -----	112.99	
Gross Heating Value -----	5791	BTU/CF

Real Characteristics Of Total Sample:

Specific Gravity -----	0.744	(Air=1)
Compressibility (Z) -----	0.9962	
Molecular Weight -----	21.48	
Gross Heating Value		
Dry Basis -----	1287	BTU/CF
Saturated Basis -----	1266	BTU/CF

FESCO, Ltd.
1100 FESCO Avenue - Alice, Texas 78332

For: SLR International Corporation
8 Capitol Street, Suite 300
Charleston, West Virginia 25301

Sample: Tug Hill - Shields No. 9 & No. 10
Condensate Separator Hydrocarbon Liquid
Sampled @ 366 psig & 71 °F

Date Sampled: 11/01/16

Job Number: 63606.002

CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2186-M

COMPONENT	MOL %	LIQ VOL %	WT %
Nitrogen	0.020	0.006	0.008
Carbon Dioxide	0.055	0.026	0.034
Methane	9.002	4.177	2.022
Ethane	11.009	8.062	4.635
Propane	13.020	9.822	8.038
Isobutane	2.868	2.570	2.334
n-Butane	10.861	9.376	8.839
2,2 Dimethylpropane	0.138	0.145	0.140
Isopentane	4.720	4.727	4.768
n-Pentane	8.296	8.235	8.381
2,2 Dimethylbutane	0.172	0.197	0.208
Cyclopentane	0.000	0.000	0.000
2,3 Dimethylbutane	0.403	0.452	0.486
2 Methylpentane	3.040	3.455	3.668
3 Methylpentane	1.897	2.121	2.289
n-Hexane	6.035	6.795	7.281
Heptanes Plus	<u>28.464</u>	<u>39.833</u>	<u>46.869</u>
Totals:	100.000	100.000	100.000

Characteristics of Heptanes Plus:

Specific Gravity -----	0.7292 (Water=1)
°API Gravity -----	62.54 @ 60°F
Molecular Weight -----	117.6
Vapor Volume -----	19.68 CF/Gal
Weight -----	6.08 Lbs/Gal

Characteristics of Total Sample:

Specific Gravity -----	0.6197 (Water=1)
°API Gravity -----	96.82 @ 60°F
Molecular Weight -----	71.4
Vapor Volume -----	27.54 CF/Gal
Weight -----	5.16 Lbs/Gal

Base Conditions: 14.850 PSI & 60 °F

Certified: FESCO, Ltd. - Alice, Texas

Sampled By: SLR
Analyst: XG
Processor: XGdjv
Cylinder ID: PW-35024

David Dannhaus 361-661-7015

TOTAL EXTENDED REPORT - GPA 2186-M

COMPONENT	Mol %	LiqVol %	Wt %
Nitrogen	0.020	0.006	0.008
Carbon Dioxide	0.055	0.026	0.034
Methane	9.002	4.177	2.022
Ethane	11.009	8.062	4.635
Propane	13.020	9.822	8.038
Isobutane	2.868	2.570	2.334
n-Butane	10.861	9.376	8.839
2,2 Dimethylpropane	0.138	0.145	0.140
Isopentane	4.720	4.727	4.768
n-Pentane	8.296	8.235	8.381
2,2 Dimethylbutane	0.172	0.197	0.208
Cyclopentane	0.000	0.000	0.000
2,3 Dimethylbutane	0.403	0.452	0.486
2 Methylpentane	3.040	3.455	3.668
3 Methylpentane	1.897	2.121	2.289
n-Hexane	6.035	6.795	7.281
Methylcyclopentane	0.822	0.797	0.969
Benzene	0.082	0.063	0.090
Cyclohexane	0.874	0.815	1.030
2-Methylhexane	2.004	2.551	2.812
3-Methylhexane	1.777	2.234	2.494
2,2,4 Trimethylpentane	0.000	0.000	0.000
Other C-7's	0.867	1.093	1.204
n-Heptane	3.590	4.535	5.036
Methylcyclohexane	1.877	2.066	2.581
Toluene	0.300	0.275	0.387
Other C-8's	4.173	5.664	6.440
n-Octane	1.756	2.463	2.808
E-Benzene	0.262	0.277	0.390
M & P Xylenes	0.263	0.280	0.392
O-Xylene	0.479	0.499	0.712
Other C-9's	2.112	3.202	3.733
n-Nonane	0.939	1.447	1.687
Other C-10's	1.847	3.076	3.653
n-decane	0.477	0.802	0.950
Undecanes(11)	1.467	2.507	3.019
Dodecanes(12)	0.899	1.660	2.027
Tridecanes(13)	0.592	1.171	1.450
Tetradecanes(14)	0.396	0.840	1.055
Pentadecanes(15)	0.250	0.567	0.720
Hexadecanes(16)	0.133	0.323	0.413
Heptadecanes(17)	0.076	0.196	0.253
Octadecanes(18)	0.064	0.173	0.226
Nonadecanes(19)	0.039	0.111	0.145
Eicosanes(20)	0.018	0.054	0.071
Heneicosanes(21)	0.010	0.031	0.041
Docosanes(22)	0.006	0.019	0.025
Tricosanes(23)	0.003	0.009	0.013
Tetracosanes(24)	0.002	0.007	0.009
Pentacosanes(25)	0.001	0.005	0.007
Hexacosanes(26)	0.003	0.013	0.017
Heptacosanes(27)	0.001	0.003	0.004
Octacosanes(28)	0.001	0.002	0.003
Nonacosanes(29)	0.000	0.001	0.002
Triacosanes(30)	0.000	0.001	0.001
Hentriacontanes Plus(31+)	<u>0.000</u>	<u>0.002</u>	<u>0.003</u>
Total	100.000	100.000	100.000

November 14, 2016

FESCO, Ltd.
1100 Fesco Ave. - Alice, Texas 78332

For: SLR International Corporation
8 Capitol Street, Suite 300
Charleston, West Virginia 25301

Sample: Tug Hill - Shields No. 9 & No. 10
Gas Liberated From Separator Water
From 366 psig & 71 °F to 0 psig & 70 °F

Date Sampled: 11/01/16

Job Number: 63606.011

CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2286

COMPONENT	MOL%	GPM
Hydrogen Sulfide*	< 0.001	
Nitrogen	0.874	
Carbon Dioxide	2.675	
Methane	75.496	
Ethane	15.043	4.015
Propane	3.544	0.974
Isobutane	0.215	0.070
n-Butane	0.756	0.238
2-2 Dimethylpropane	0.000	0.000
Isopentane	0.190	0.069
n-Pentane	0.234	0.085
Hexanes	0.396	0.163
Heptanes Plus	<u>0.577</u>	<u>0.242</u>
Totals	100.000	5.856

Computed Real Characteristics Of Heptanes Plus:

Specific Gravity -----	3.447	(Air=1)
Molecular Weight -----	99.47	
Gross Heating Value -----	5174	BTU/CF

Computed Real Characteristics Of Total Sample:

Specific Gravity -----	0.742	(Air=1)
Compressibility (Z) -----	0.9964	
Molecular Weight -----	21.41	
Gross Heating Value		
Dry Basis -----	1216	BTU/CF
Saturated Basis -----	1196	BTU/CF

*Hydrogen Sulfide tested in laboratory by: Stain Tube Method (GPA 2377)
Results: <0.013 Gr/100 CF, <0.2 PPMV or <0.001 Mol %

Base Conditions: 14.650 PSI & 60 Deg F

Sampled By: (16)T. Gonzalez
Analyst: MR
Processor: OA
Cylinder ID: WF# 1S

Certified: FESCO, Ltd. - Alice, Texas

David Dannhaus 361-661-7015

**CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2286
TOTAL REPORT**

COMPONENT	MOL %	GPM	WT %
Hydrogen Sulfide*	< 0.001		< 0.001
Nitrogen	0.874		1.144
Carbon Dioxide	2.675		5.500
Methane	75.496		56.581
Ethane	15.043	4.015	21.132
Propane	3.544	0.974	7.301
Isobutane	0.215	0.070	0.584
n-Butane	0.756	0.238	2.053
2,2 Dimethylpropane	0.000	0.000	0.000
Isopentane	0.190	0.069	0.640
n-Pentane	0.234	0.085	0.789
2,2 Dimethylbutane	0.009	0.004	0.036
Cyclopentane	0.000	0.000	0.000
2,3 Dimethylbutane	0.031	0.013	0.125
2 Methylpentane	0.104	0.043	0.419
3 Methylpentane	0.068	0.028	0.274
n-Hexane	0.184	0.076	0.741
Methylcyclopentane	0.032	0.011	0.126
Benzene	0.047	0.013	0.172
Cyclohexane	0.047	0.016	0.185
2-Methylhexane	0.038	0.018	0.178
3-Methylhexane	0.041	0.019	0.192
2,2,4 Trimethylpentane	0.000	0.000	0.000
Other C7's	0.043	0.019	0.199
n-Heptane	0.081	0.037	0.379
Methylcyclohexane	0.058	0.023	0.266
Toluene	0.041	0.014	0.176
Other C8's	0.062	0.029	0.319
n-Octane	0.034	0.017	0.181
Ethylbenzene	0.000	0.000	0.000
M & P Xylenes	0.011	0.004	0.055
O-Xylene	0.000	0.000	0.000
Other C9's	0.026	0.013	0.153
n-Nonane	0.010	0.006	0.060
Other C10's	0.000	0.000	0.000
n-Decane	0.006	0.004	0.040
Undecanes (11)	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>
Totals	100.000	5.856	100.000

Computed Real Characteristics Of Total Sample:

Specific Gravity -----	0.742	(Air=1)
Compressibility (Z) -----	0.9964	
Molecular Weight -----	21.41	
Gross Heating Value		
Dry Basis -----	1216	BTU/CF
Saturated Basis -----	1196	BTU/CF

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification

User Identification:	T002
City:	New Martinsville
State:	WV
Company:	Tug Hill
Type of Tank:	Vertical Fixed Roof Tank
Description:	1.5 MMgal Frackwater AST

Tank Dimensions

Shell Height (ft):	12.00
Diameter (ft):	142.25
Liquid Height (ft) :	11.00
Avg. Liquid Height (ft):	6.00
Volume (gallons):	1,307,736.70
Turnovers:	3.52
Net Throughput(gal/yr):	4,600,000.00
Is Tank Heated (y/n):	N

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition:	Good
Roof Color/Shade:	Gray/Medium
Roof Condition:	Good

Roof Characteristics

Type:	Cone
Height (ft)	0.00
Slope (ft/ft) (Cone Roof)	0.06

Breather Vent Settings

Vacuum Settings (psig):	-0.03
Pressure Settings (psig)	0.03

Meteorological Data used in Emissions Calculations: Elkins, West Virginia (Avg Atmospheric Pressure = 13.73 psia)

TANKS 4.0.9d
Emissions Report - Detail Format
Liquid Contents of Storage Tank

T002 - Vertical Fixed Roof Tank
New Martinsville, WV

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F)			Liquid Bulk Temp (deg F)	Vapor Pressure (psia)			Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
		Avg.	Min.	Max.		Avg.	Min.	Max.					
Distillate fuel oil no. 2	All	57.20	47.16	67.23	52.14	0.0059	0.0041	0.0083	130.0000			188.00	Option 1: VP50 = .0045 VP60 = .0065

TANKS 4.0.9d
Emissions Report - Detail Format
Detail Calculations (AP-42)

T002 - Vertical Fixed Roof Tank
New Martinsville, WV

Annual Emission Calculations	
Standing Losses (lb):	443.6330
Vapor Space Volume (cu ft):	118,904.6483
Vapor Density (lb/cu ft):	0.0001
Vapor Space Expansion Factor:	0.0736
Vented Vapor Saturation Factor:	0.9977
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	118,904.6483
Tank Diameter (ft):	142.2500
Vapor Space Outage (ft):	7.4818
Tank Shell Height (ft):	12.0000
Average Liquid Height (ft):	6.0000
Roof Outage (ft):	1.4818
Roof Outage (Cone Roof)	
Roof Outage (ft):	1.4818
Roof Height (ft):	0.0000
Roof Slope (ft/ft):	0.0625
Shell Radius (ft):	71.1250
Vapor Density	
Vapor Density (lb/cu ft):	0.0001
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0059
Daily Avg. Liquid Surface Temp. (deg. R):	516.8667
Daily Average Ambient Temp. (deg. F):	49.0583
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	511.8083
Tank Paint Solar Absorptance (Shell):	0.6800
Tank Paint Solar Absorptance (Roof):	0.6800
Daily Total Solar Insulation Factor (Btu/sqft day):	1,193.8870
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0736
Daily Vapor Temperature Range (deg. R):	40.1436
Daily Vapor Pressure Range (psia):	0.0042
Breather Vent Press. Setting Range (psia):	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0059
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	0.0041
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	0.0083
Daily Avg. Liquid Surface Temp. (deg R):	516.8667
Daily Min. Liquid Surface Temp. (deg R):	506.8308
Daily Max. Liquid Surface Temp. (deg R):	526.9026
Daily Ambient Temp. Range (deg. R):	24.1833
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.9977
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0059
Vapor Space Outage (ft):	7.4818
Working Losses (lb):	
Working Losses (lb):	84.5649
Vapor Molecular Weight (lb/lb-mole):	130.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	0.0059
Annual Net Throughput (gal/yr.):	4,600,000.0000
Annual Turnovers:	3.5175
Turnover Factor:	1.0000
Maximum Liquid Volume (gal):	1,307,736.7033
Maximum Liquid Height (ft):	11.0000
Tank Diameter (ft):	142.2500
Working Loss Product Factor:	1.0000
Total Losses (lb):	528.1979

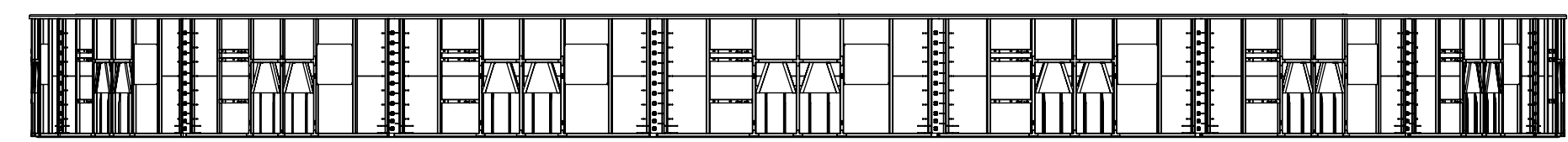
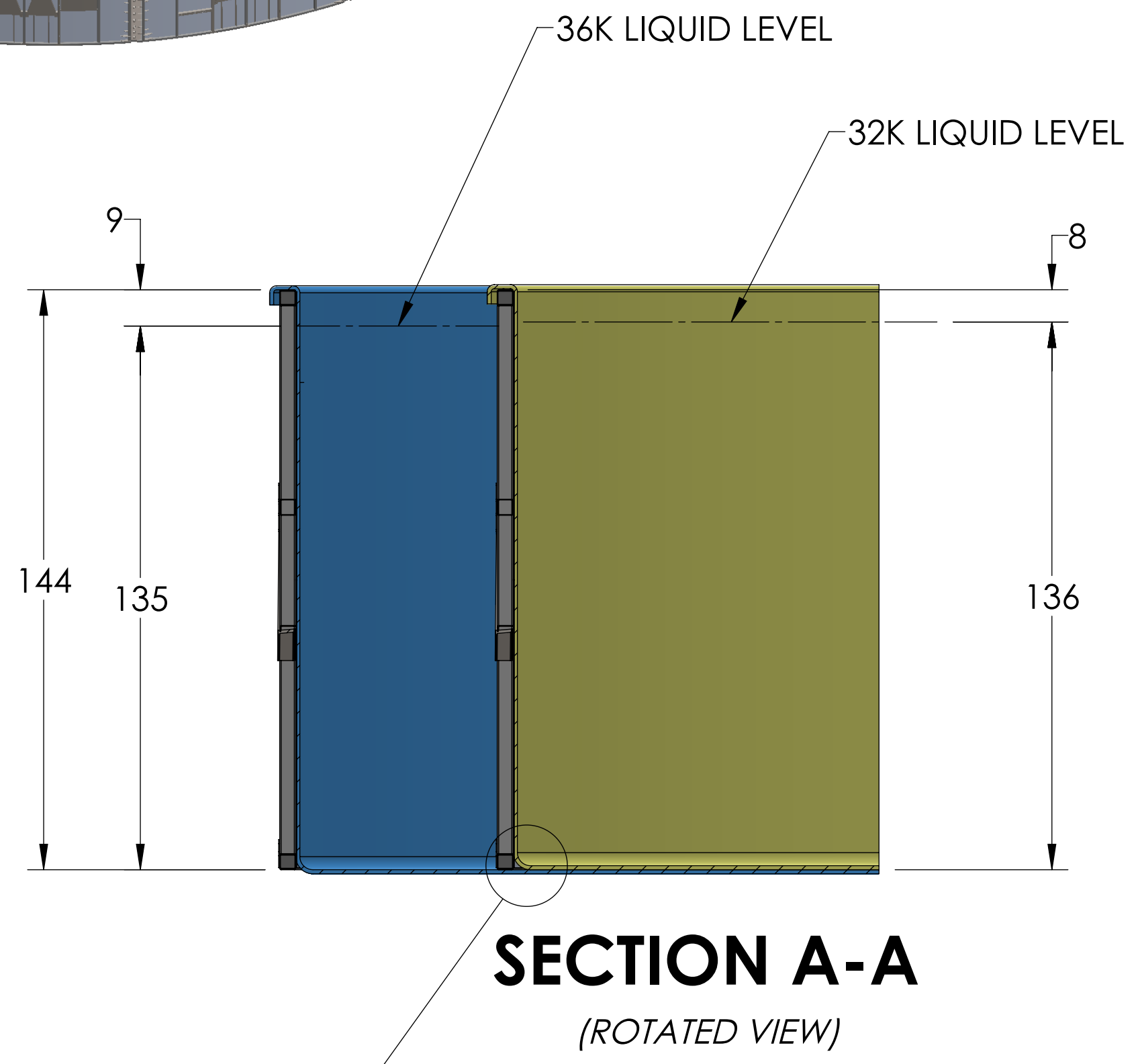
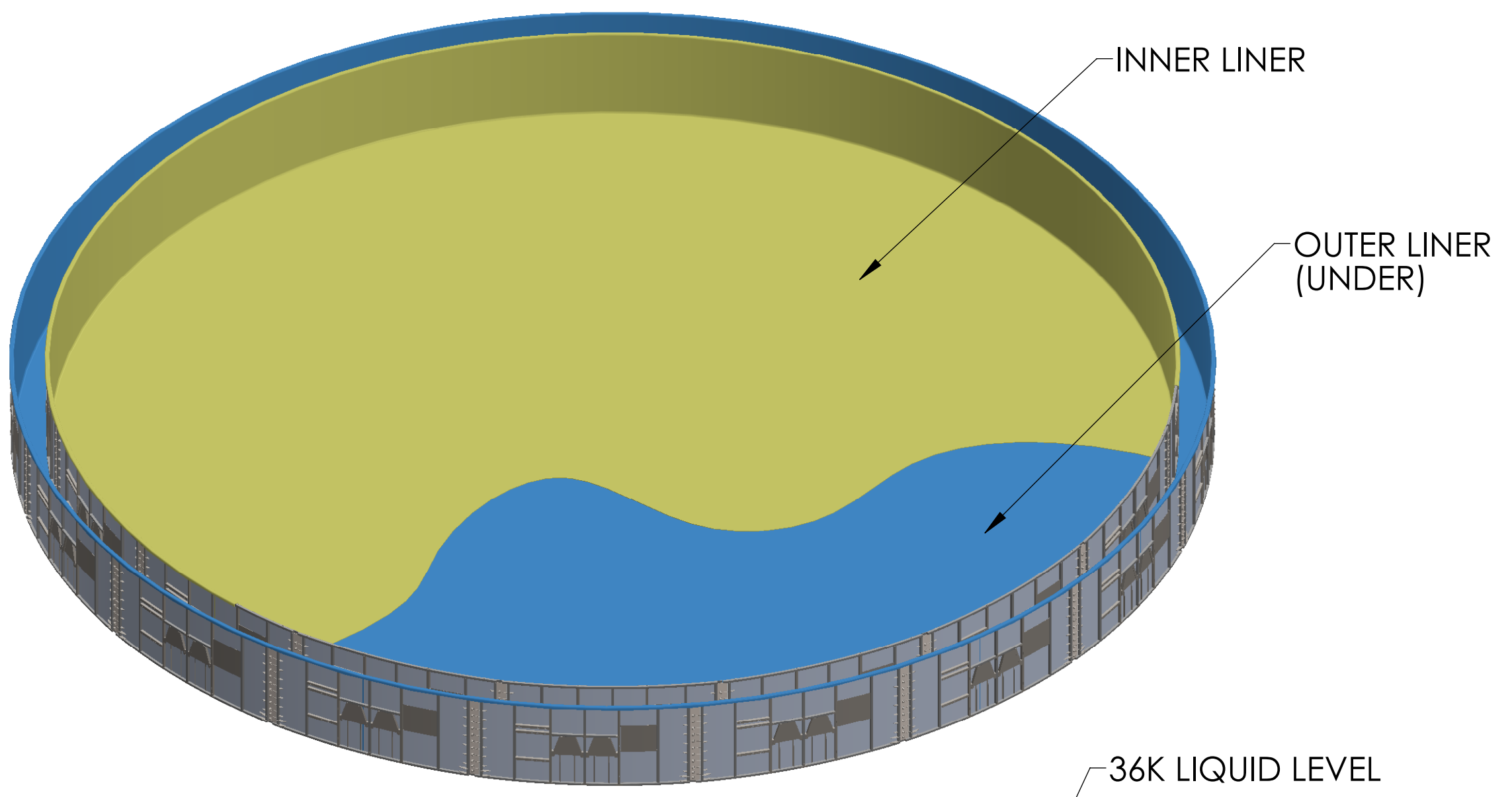
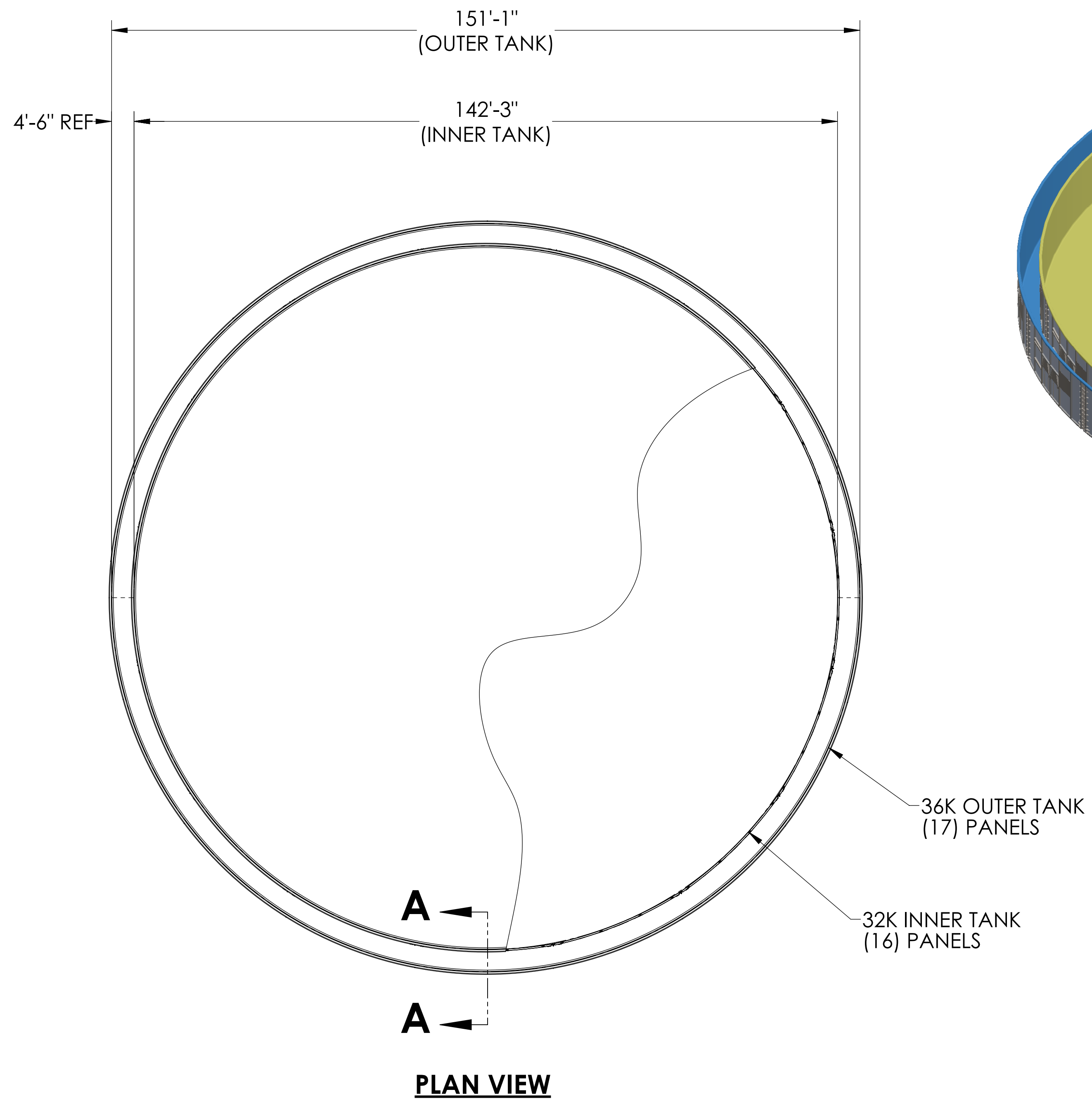
TANKS 4.0.9d
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: Annual

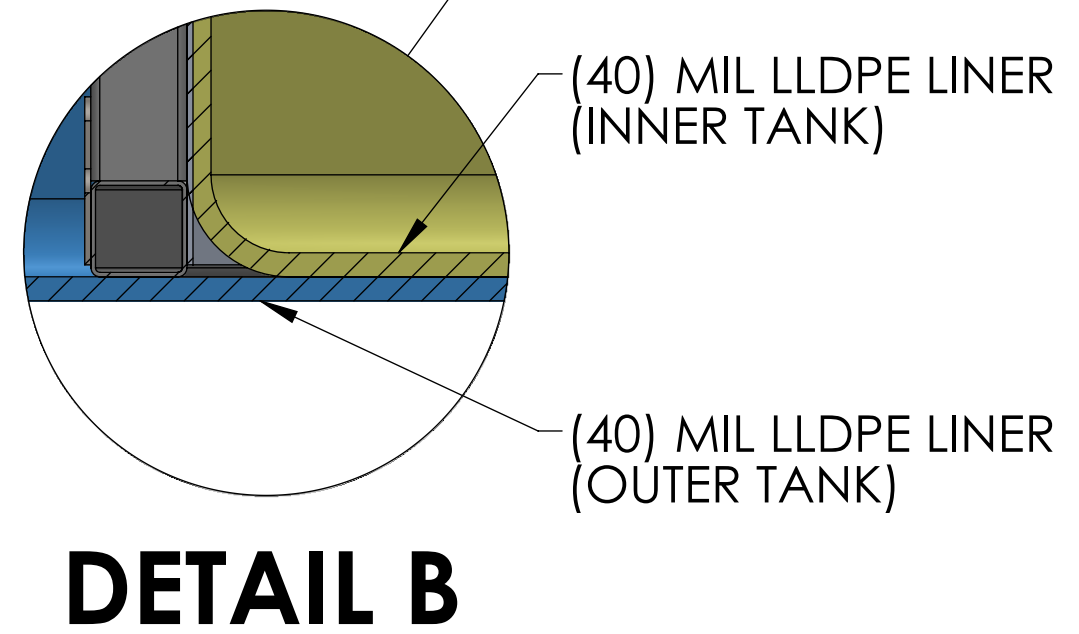
T002 - Vertical Fixed Roof Tank
New Martinsville, WV

Components	Losses(lbs)		
	Working Loss	Breathing Loss	Total Emissions
Distillate fuel oil no. 2	84.56	443.63	528.20

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	NEW RELEASE	7/13/2017	NJH
B	CHANGE OUT POND PANEL TO MATCH CUSTOMER STRAPPING CHARTS	7/13/2017	NJH



(NOTE: EGRESS LADDERS, ACCESS PLATFORMS & SUPPLY PIPING NOT SHOWN)



TMP-01272 REV B

MASTER COPY
7/13/2017

TOLERANCES <small>UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES</small>													
<small>FRACTIONAL: ± 1/16" DECIMAL: ± 0.005" ANGULAR: (MACH) ± 0.5° ANGULAR: (BEND) ± 0.5° HOLE Ø: -0.001" + 0.005" ONE PLACE DECIMAL: ± 0.1" TWO PLACE DECIMAL: ± 0.01" THREE PLACE DECIMAL: ± 0.003"</small>	<small>EST. WEIGHT</small> 421949	<small>PROPRIETARY AND CONFIDENTIAL</small> <small>THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF PCI MFG SOLUTIONS, LLC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF PCI MANUFACTURING, LLC IS PROHIBITED.</small>	PCI MFG. SOLUTIONS, LLC <table border="1"> <tr> <th>NAME</th> <th>DATE</th> </tr> <tr> <td>DRAWN</td> <td>10/20/2016</td> </tr> <tr> <td>ENG APPR.</td> <td></td> </tr> <tr> <td>MFG APPR.</td> <td></td> </tr> <tr> <td>Q.A.</td> <td></td> </tr> </table>	NAME	DATE	DRAWN	10/20/2016	ENG APPR.		MFG APPR.		Q.A.	
NAME	DATE												
DRAWN	10/20/2016												
ENG APPR.													
MFG APPR.													
Q.A.													
<small>DO NOT SCALE DRAWING</small>		32K TANK INSIDE 36K POND PANEL LAYOUT	<table border="1"> <tr> <td>SIZE</td> <td>DWG. NO.</td> <td>REV</td> </tr> <tr> <td>D</td> <td>TMP-01272</td> <td>B</td> </tr> <tr> <td>SCALE: NTS</td> <td colspan="2">SHEET 1 OF 1</td> </tr> </table>	SIZE	DWG. NO.	REV	D	TMP-01272	B	SCALE: NTS	SHEET 1 OF 1		
SIZE	DWG. NO.	REV											
D	TMP-01272	B											
SCALE: NTS	SHEET 1 OF 1												

TUG HILL OPERATING, LLC
WAYNE PAD AST SITE DESIGN AND LAYOUT
Located in Marshall County, WV

