



global environmental solutions

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation

Armstrong Compressor Station

Powellton, West Virginia

Permit Determination

SLR Ref: 116.00400.00151

January 2017



Cabot Oil & Gas Corporation



global environmental solutions

Permit Determination

Armstrong Compressor Station

Powellton, West Virginia

Prepared for:

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street, East
Suite 1500
Charleston, West Virginia 25301

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.

A handwritten signature in blue ink, appearing to read "Chris Boggess", is written over a horizontal line.

Chris Boggess
Associate Engineer

A handwritten signature in blue ink, appearing to read "N. L. Lanham", is written over a horizontal line.

Nathaniel L. Lanham
WV Operations Manager

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APPLICATION FOR PERMIT DETERMINATION

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301



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): Cranberry Pipeline Corporation		
2. NAME OF FACILITY (IF DIFFERENT FROM ABOVE): Armstrong Compressor Station		3. NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE: 211111
4A. MAILING ADDRESS: 102 3 rd Street Glasgow, West Virginia 25086		4B. PHYSICAL ADDRESS: Unnamed Access Rd near Powellton, WV
5A. DIRECTIONS TO FACILITY (PLEASE PROVIDE MAP AS ATTACHMENT A): From Montgomery, travel South on WV Route 61 towards Mt. Carbon for approximately 3.5 miles. Merge right onto Armstrong Creek Rd and travel approximately 3 miles towards Powellton. In Powellton, turn right onto Elk Ridge Rd. and proceed for ¼ mile to unmarked access road on the right. Cross the creek and follow the access road to the station.		
5B. NEAREST ROAD: Elk Ridge Rd	5C. NEAREST CITY OR TOWN: Powellton	5D. COUNTY: Fayette
5E. UTM NORTHING (KM): 4216.080	5F. UTM EASTING (KM): 470.941	5G. UTM ZONE: 17
6A. INDIVIDUAL TO CONTACT IF MORE INFORMATION IS REQUIRED: Nathaniel L. Lanham		6B. TITLE: WV Operations Manager
6C. TELEPHONE: 304-932-3107	6D. FAX: N/A	6E. E-MAIL: nlanham@slrconsulting.com
7A. DAQ PLANT I.D. NO. (FOR AN EXISTING FACILITY ONLY): N/A		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: N/A		
8A. TYPE OF EMISSION SOURCE (CHECK ONE): <input type="checkbox"/> NEW SOURCE <input type="checkbox"/> ADMINISTRATIVE UPDATE <input type="checkbox"/> MODIFICATION <input checked="" type="checkbox"/> 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? <input type="checkbox"/> YES <input type="checkbox"/> NO
9. IS DEMOLITION OR PHYSICAL RENOVATION AT AN EXISTING FACILITY INVOLVED? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
10A. DATE OF ANTICIPATED INSTALLATION OR CHANGE: 09/2016		10B. DATE OF ANTICIPATED START-UP: 09/2016
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	0.02	0.09
PM ₁₀	0.02	0.09
VOCs	0.13	0.56
CO	0.22	0.95
NO _x	0.56	2.46
SO ₂	0.01	0.01
Pb	NA	NA
HAPs (AGGREGATE AMOUNT)	0.04	0.18
TAPs (INDIVIDUALLY)*	NA	NA
OTHER (INDIVIDUALLY)*	NA	NA

* 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, (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: BRODY WEBSTER

TITLE: Manager, Safety & Environment **Date:** 1/20/2017

** 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

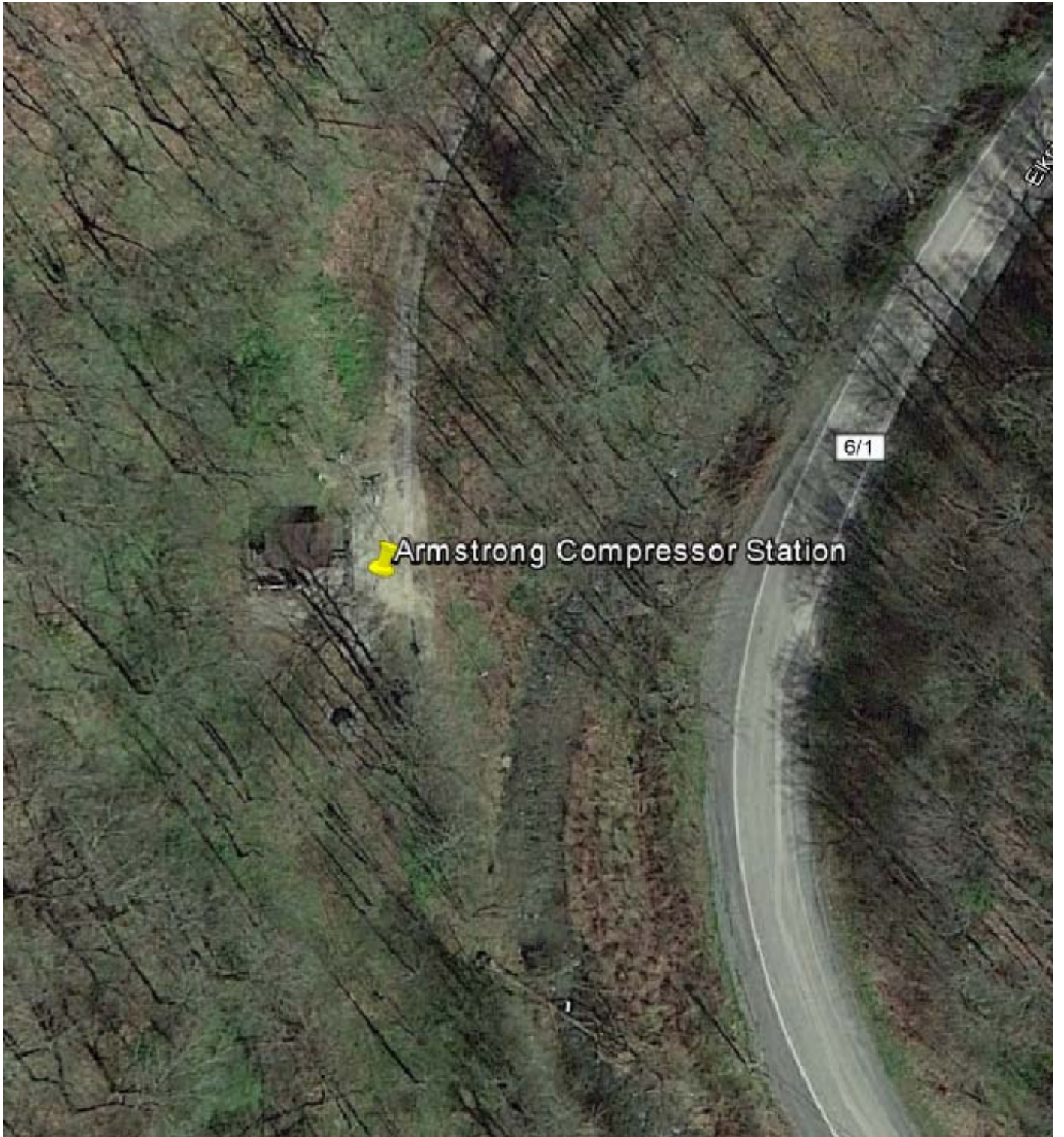
ATTACHMENT A

AREA MAP

Permit Determination

Armstrong Compressor Station Powellton, West Virginia

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301



GPS Coordinates of Sites:
Lat: 38.09205, Long: -81.33140

UTM Coordinates of Sites:
Easting: 470.941 km, Northing: 4,216.080 km, Zone: 17

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, WV 25301

Report
Permit Determination Application
Armstrong Compressor Station

Drawing
Attachment A - Area Map

Date: June 2016

Drawn By: CLB

Project: 116.00400.00151



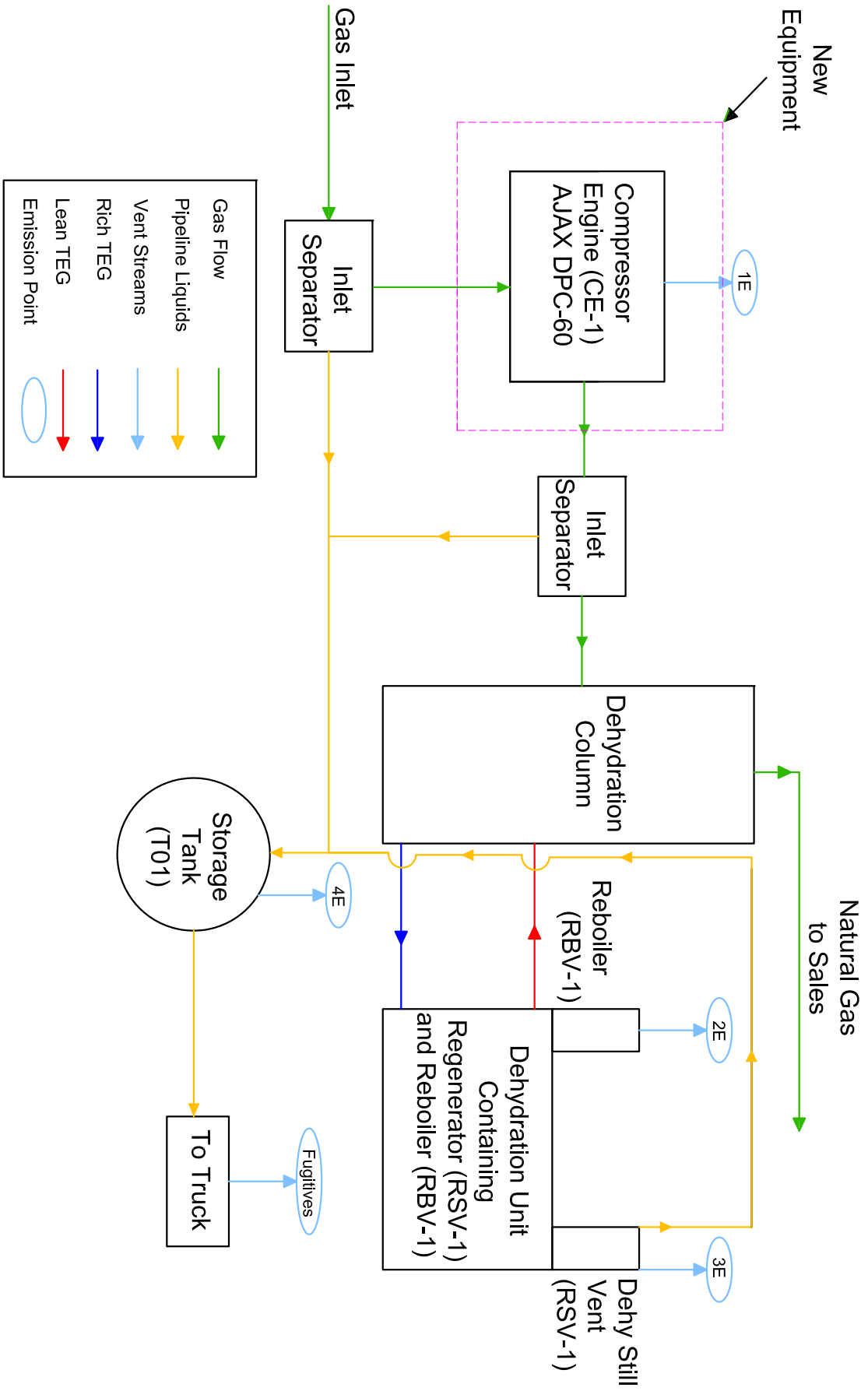
ATTACHMENT B

PROCESS FLOW DIAGRAM

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
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Process Flow Diagram
Cranberry Pipeline Corporation
Armstrong Compressor Station
Powellton, West Virginia

ATTACHMENT C

PROCESS DESCRIPTION

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
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Charleston, West Virginia 25301

PROCESS DESCRIPTION

Introduction

Cranberry Pipeline Corporation (Cranberry) is updating their records for the Armstrong Compressor Station. This station was constructed in the mid 1970's. At the time, no permits were required for this facility. Cranberry is proposing to downsize the facility's compressor engine by replacing its current ~154BHP unit with a smaller more efficient ~58BHP engine. This change is being proposed due to a decrease in gas production in the natural gas field from which the Armstrong Compressor Station draws.

Proposed Process Changes

This determination application involves the following changes to existing processes:

- Change out a 2SLB AJAX DPC 160 (154HP) with a relocated existing 2SLB AJAX DPC 60 (58HP)

Per the Permit Determination Application Form, this application's potential to emit (PTE) is listed for the existing facility's new equipment only. The only change to the Armstrong Compressor Station's existing process is the proposed exchange of engines referenced above. This modification will prove to reduce the site's PTE. The emissions from the engine were estimated using 2SLB factors from AP-42 and manufacturer's emission factors for CO and NOx.

Other Equipment Related to Facility PTE Estimates

This application's Supporting Calculations Section includes emission estimates from the following existing sources:

- Reboiler (RBV-1) – NATCO; Model SB12-6; 2.5 mmBtu/hr
- Dehydration Unit Still Column (RSV-1) – Sivals; 0.8 mmscf/day
- Aboveground Storage Tank (T01) – 1,050 gallon pipeline liquids tank
- Truck loading emissions (TL-1)
- Fugitive emissions (Fugitives)

It should be noted that the facility wide PTE has been evaluated here for Title V applicability. Additionally, to fully evaluate Title V applicability this site was screened to identify any other facilities located within a ½ mile radius. No other facilities operated by Cabot/Cranberry Pipelines were identified within a ½ mile radius from this site. Therefore with respect to the common sense notion of closely located sites there is no standalone facility to aggregate with the Armstrong Station.

Lastly, the relocated engine was evaluated with respect to NSPS OOOOa applicability and was not found to trigger a modification due to the unit being a lower horsepower replacement. Please see Federal Register / Vol. 81, No. 107 / Friday, June 3, 2016 / Rules and Regulations / Page # 35865 for additional details on non-applicability.

ATTACHMENT D

SAFETY DATA SHEETS (SDS)

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301

SAFETY DATA SHEET

Cabot Oil & Gas Corporation

Date Issued : 9 - 6 - 2013

SDS No : 0002WV

Date Revised : 9 - 6 - 2013

Revision No : 01

Sweet Produced Water (West Virginia)

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sweet Produced Water (West Virginia)

GENERAL USE: Water extracted from natural gas well production.

DISTRIBUTOR

Cabot Oil & Gas Corporation
P.O. Box 4544
Houston, TX 77210-4544

24 HR. EMERGENCY TELEPHONE NUMBERS

1-800-642-0300

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

FLAMMABLE LIMITS: 0

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.

Sweet Produced Water

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.

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

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.

Sweet Produced Water

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR: Salty.

APPEARANCE: Clear or opaque liquid.

pH: 7.26 to 7.75

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

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.

Sweet Produced Water

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: This product is not a listed hazardous waste.

EMPTY CONTAINER: Offer rinsed packaging material to local recycling facilities.

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.

CALIFORNIA PROPOSITION 65

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

Sweet Produced Water

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: SLR International Corporation

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

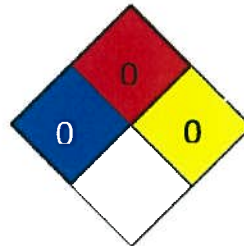
FIRE: 0- Minimal Hazard

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.

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

Cabot Oil & Gas Corporation

Date Issued : 10/26/2012

SDS No : CA201-006

Date Revised : 12/20/2012

Revision No : 1

Sweet Natural Gas

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Sweet Natural Gas

CHEMICAL FAMILY: Hydrocarbon Mixture; Aliphatic Hydrocarbon

ALTERNATE TRADE NAME(S): Well Head Gas, Casing Head Gas

DISTRIBUTOR

Cabot Oil & Gas Corporation
P.O. Box 4544
Houston, TX 77210-4544

24 HR. EMERGENCY TELEPHONE NUMBERS




(281) 589-4600

2. HAZARDS IDENTIFICATION

GHS CLASSIFICATIONS

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

GHS LABEL

	 Flame
WARNING	
H000: May displace oxygen and cause rapid suffocation.	
	DANGER
	H220: Extremely flammable gas.
 Gas cylinder	 Health hazard
WARNING	DANGER
H280: Contains gas under pressure; may explode if heated.	H350: May cause cancer.

PRECAUTIONARY STATEMENT(S)

Prevention:

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

Sweet Natural Gas

Disposal:

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

EMERGENCY OVERVIEW

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	EINECS	Classification
Methane	70 - 94	74-82-8	200-812-7	T+,N; R61, R26, R48/23, R50/53
Ethane	5 - 10	74-84-0	200-814-8	F+; R12
Propane	1 - 4	74-98-6	200-827-9	F+; R12
i-Butane	0.5 - 3	75-28-5	200-857-2	F+; R12
n-Butane	0.5 - 2	106-97-8	203-448-7	F+; R12
Carbon Dioxide	0.5 - 10	124-38-9	204-696-9	
Nitrogen	0.5 - 10	7727-37-9	231-783-9	
Benzene	may contain	71-43-2	200-753-7	F, T; R45, R46, R11, R36/38, R48/23/24/25, R65
Hydrogen Sulfide	may contain	7783-06-4	231-977-3	F+, T+, N; R12, R26, R50

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

(Full text of R-Phrases can be found under heading 16)

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 Number(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.

FLAMMABLE LIMITS: 1.0 to 15.0

Notes: Flammable Limits given as percentage volume in air at normal atmospheric temperature and pressure.

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 FIGHTING PROCEDURES:

PROTECTIVE ACTIONS TO TAKE DURING FIRE FIGHTING - DO NOT extinguish a leaking gas flame unless the leak can be stopped. In many cases it will be preferable to allow continued burning. 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. Use water spray or fog; do not use straight streams. Note: Use of water spray when fighting fire may be inefficient or cause a chemical reaction. Persons involved in fire fighting response involving 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.

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. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. Isolate for 1600 meters (1 mile) in all directions; also consider initial evacuation for 1600 meters (1 mile) in all directions. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

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.

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

Sweet Natural Gas

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.

GENERAL PROCEDURES: MATERIALS & METHODS (EQUIPMENT & TECHNIQUES) FOR CONTAINMENT & CLEANUP -

Call Emergency Telephone Number(s) provided in Section 1 of this SDS. As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions. Keep unauthorized personnel away. Stay upwind. Keep out of low areas. Ventilate closed spaces before entering.

RELEASE NOTES: ENVIRONMENTAL PRECAUTIONS - Prevent entry into waterways, sewers, basements or confined areas.

Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Avoid allowing water runoff to contact spilled material.

SPECIAL PROTECTIVE EQUIPMENT: EMERGENCY & NON-EMERGENCY RESPONDERS - Refer to Section 8 of this SDS for appropriate exposure controls and personal protective equipment (PPE).

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
n-Butane	TWA	N/E	N/E	1000	N/E
	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 can not 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)

Sweet Natural Gas

Notes: Based on methane.

EVAPORATION RATE: Not Established.

DENSITY: Not Established.

SPECIFIC GRAVITY: Not Established.

VISCOSITY: Not Applicable.

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.

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

Sweet Natural Gas

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.

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.

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

STATES WITH SPECIAL REQUIREMENTS

Chemical Name	Requirements
Ethane	Delaware Air Quality Management Massachusetts Hazardous Substance Minnesota Hazardous Substance New Jersey RTK Hazardous Substance New Jersey TCPA EHS Pennsylvania Hazardous Substance Washington PELs for Air Contaminants
Propane	Delaware Air Quality Management Massachusetts Hazardous Substance Minnesota Hazardous Substance New Jersey RTK Hazardous Substance Pennsylvania Hazardous Substance Washington PELs for Air Contaminants
	CA Hazardous Substance Delaware Air Quality Management Massachusetts Hazardous Substance

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n-Butane	Minnesota Hazardous Substance New Jersey RTK Hazardous Substance Pennsylvania Hazardous Substance Pennsylvania Hazardous Substance Washington PELs for Air Contaminants
Carbon Dioxide	CA Hazardous Substance Maine Hazardous Air Pollutant Massachusetts Hazardous Substance Minnesota Hazardous Substance Pennsylvania Hazardous Substance Washington PELs for Air Contaminants
Benzene	CA Hazardous Substance Delaware Air Quality Management Illinois Toxic Air Contaminant Maine Hazardous Air Pollutant Massachusetts Hazardous Substance Michigan Critical Material Minnesota Hazardous Substance New Jersey RTK Hazardous Substance New York Hazardous Substance North Carolina Toxic Air Contaminant Pennsylvania Hazardous Substance Washington PELs for Air Contaminants West Virginia Toxic Air Pollutant Wisconsin Hazardous Air Containment
Hydrogen Sulfide	CA Hazardous Substance Delaware Air Quality Management Idaho Air Pollutant Massachusetts Hazardous Substance Maine Hazardous Air Pollutant Minnesota Hazardous Substance New Jersey RTK Hazardous Substance New Jersey TCPA EHS New York Hazardous Substance North Carolina Toxic Air Contaminant Pennsylvania Hazardous Substance Washington PELs for Air Contaminants Wisconsin Hazardous Air Containment

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: Total Safety d/b/a EHS Services

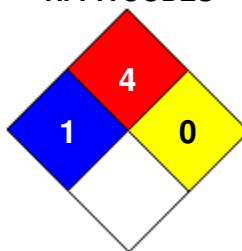
REVISION SUMMARY: This MSDS replaces the 10/26/2012 MSDS.

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HMIS RATING

HEALTH	1
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.

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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

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

Sweet Natural Gas

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.

ATTACHMENT E

SUPPORTING CALCULATIONS

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301

**Table 1. Annual Potential To Emit (PTE) Summary
Cranberry Pipeline Corporation - Armstrong Compressor Station**

Criteria Pollutants

Facility Wide PTE - Criteria Pollutants

Source	PM	PM10	PM2.5	SO2	NOx	CO	VOC	CO2e
Engines (ton/yr)	0.290	0.290	0.290	0.004	6.543	4.015	2.082	702.437
Reboiler (ton/yr)	0.002	0.002	0.002	0.001	0.107	0.090	0.006	128.126
Dehy Unit (ton/yr)	-	-	-	-	-	-	9.306	125.810
Tanks (ton/yr)	-	-	-	-	-	-	0.319	-
Truck Loading (ton/yr)	-	-	-	-	-	-	0.140	-
Fugitives (ton/yr)	-	-	-	-	-	-	0.708	16.452
Blowdowns (ton/yr)	-	-	-	-	-	-	0.089	-
Total Emissions (ton/yr)	0.292	0.292	0.292	0.005	6.650	4.105	12.561	972.825
Total Emissions (lb/hr)	0.067	0.067	0.067	0.001	1.518	0.937	2.868	222.106

Hazardous Air Pollutants (HAPs)

Facility Wide PTE - HAPs

Source	Acetaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	Total HAPs
Engines (ton/yr)	0.0466	0.0116	0.0058	0.0006	0.0016	0.0027	0.331	0.477
Reboiler (ton/yr)	-	0.0000	0.0000	-	-	0.0019	0.000	0.002
Dehy Unit (ton/yr)	-	0.4071	0.3285	0.0955	0.0992	0.6201	-	1.556
Tanks (ton/yr)	-	-	-	-	-	-	-	-
Truck Loading (ton/yr)	-	-	-	-	-	-	-	-
Fugitives (ton/yr)	-	-	-	-	-	0.0599	-	0.060
Blowdowns (ton/yr)	-	-	-	-	-	-	-	-
Total Emissions (ton/yr)	0.047	0.419	0.334	0.096	0.101	0.685	0.331	2.095
Total Emissions (lb/hr)	0.011	0.096	0.076	0.022	0.023	0.156	0.076	0.478

Criteria Pollutants

Proposed Facility Wide PTE for Title V Applicability Status Determination - Criteria Pollutants

Source	PM	PM10	PM2.5	SO2	NOx	CO	VOC	CO2e
Engines (ton/yr)	0.088	0.088	0.088	0.002	2.464	0.952	0.560	267.527
Reboiler (ton/yr)	0.002	0.002	0.002	0.001	0.107	0.090	0.006	128.126
Dehy Unit (ton/yr)	-	-	-	-	-	-	9.306	125.810
Tanks (ton/yr)	-	-	-	-	-	-	0.319	-
Truck Loading (ton/yr)	-	-	-	-	-	-	0.140	-
Fugitives (ton/yr)	-	-	-	-	-	-	0.708	16.452
Blowdowns (ton/yr)	-	-	-	-	-	-	0.089	-
Total Emissions (ton/yr)	0.090	0.090	0.090	0.002	2.572	1.042	11.039	537.915
Total Emissions (lb/hr)	0.021	0.021	0.021	0.001	0.587	0.238	2.520	122.812

Hazardous Air Pollutants (HAPs)

Proposed Facility Wide PTE for Title V Applicability Status Determination - HAPs

Source	Acetaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	n-Hexane	Formaldehyde	Total HAPs
Engines (ton/yr)	0.0177	0.0044	0.0022	0.0002	0.0006	0.0010	0.126	0.182
Reboiler (ton/yr)	-	0.0000	0.0000	-	-	0.0019	0.000	0.002
Dehy Unit (ton/yr)	-	0.4071	0.3285	0.0955	0.0992	0.6201	-	1.556
Tanks (ton/yr)	-	-	-	-	-	-	-	-
Truck Loading (ton/yr)	-	-	-	-	-	-	-	-
Fugitives (ton/yr)	-	-	-	-	-	0.0599	-	0.060
Blowdowns (ton/yr)	-	-	-	-	-	-	-	-
Total Emissions (ton/yr)	0.018	0.412	0.331	0.096	0.100	0.683	0.126	1.799
Total Emissions (lb/hr)	0.004	0.094	0.076	0.022	0.023	0.156	0.029	0.411

Proposed Difference in Emissions

Source	PM	PM10	PM2.5	SO2	NOx	CO	VOC	Total HAPs
Total Emissions (ton/yr)	-0.202	-0.202	-0.202	-0.003	-4.079	-3.063	-1.522	-0.296
Total Emissions (lb/hr)	-0.046	-0.046	-0.046	-0.001	-0.931	-0.699	-0.347	-0.067

Table 2. Reciprocating Engine / Integral Compressor Emissions
Ajax DPC-160, 2SLB
Cranberry Pipeline Corporation - Armstrong Compressor Station

Pollutant	Maximum Hourly Emissions			Annual Emissions		
	Emission Factor		PTE per Engine (lb/hr)	Emission Factor		PTE per Engine (tons/yr)
Criteria Pollutants						
PM/PM10/PM2.5	4.83E-02 lb/MMBtu	(1)	0.07 (a)	4.83E-02 lb/MMBtu	(1)	0.290 (c)
SO ₂	0.25 grains S / 100 ft ³	(2)	0.0010 (e)	0.25 grains S / 100 ft ³	(2)	0.004 (f)
NOx	4.40E+00 g/hp-hr	(3)	1.49 (b)	4.40E+00 g/hp-hr	(3)	6.54 (d)
CO	2.70E+00 g/hp-hr	(3)	0.92 (b)	2.70E+00 g/hp-hr	(3)	4.02 (d)
VOC	1.40E+00 g/hp-hr	(3)	0.48 (b)	1.40E+00 g/hp-hr	(3)	2.08 (d)
Hazardous Air Pollutants						
1,1,2,2-Tetrachloroethane	6.63E-05 lb/MMBtu	(1)	0.000 (a)	6.63E-05 lb/MMBtu	(1)	0.000 (c)
1,1,2-Trichloroethane	5.27E-05 lb/MMBtu	(1)	0.000 (a)	5.27E-05 lb/MMBtu	(1)	0.000 (c)
1,3-Butadiene	8.20E-04 lb/MMBtu	(1)	0.001 (a)	8.20E-04 lb/MMBtu	(1)	0.005 (c)
1,3-Dichloropropene	4.38E-05 lb/MMBtu	(1)	0.000 (a)	4.38E-05 lb/MMBtu	(1)	0.000 (c)
2-Methylnaphthalene	2.14E-05 lb/MMBtu	(1)	0.000 (a)	2.14E-05 lb/MMBtu	(1)	0.000 (c)
2,2,4-Trimethylpentane	8.46E-04 lb/MMBtu	(1)	0.001 (a)	8.46E-04 lb/MMBtu	(1)	0.005 (c)
Acetaldehyde	7.76E-03 lb/MMBtu	(1)	0.011 (a)	7.76E-03 lb/MMBtu	(1)	0.047 (c)
Acrolein	7.78E-03 lb/MMBtu	(1)	0.011 (a)	7.78E-03 lb/MMBtu	(1)	0.047 (c)
Benzene	1.94E-03 lb/MMBtu	(1)	0.003 (a)	1.94E-03 lb/MMBtu	(1)	0.012 (c)
Biphenyl	3.95E-06 lb/MMBtu	(1)	0.000 (a)	3.95E-06 lb/MMBtu	(1)	0.000 (c)
Carbon Tetrachloride	6.07E-05 lb/MMBtu	(1)	0.000 (a)	6.07E-05 lb/MMBtu	(1)	0.000 (c)
Chlorobenzene	4.44E-05 lb/MMBtu	(1)	0.000 (a)	4.44E-05 lb/MMBtu	(1)	0.000 (c)
Chloroform	4.71E-05 lb/MMBtu	(1)	0.000 (a)	4.71E-05 lb/MMBtu	(1)	0.000 (c)
Ethylbenzene	1.08E-04 lb/MMBtu	(1)	0.000 (a)	1.08E-04 lb/MMBtu	(1)	0.001 (c)
Ethylene Dibromide	7.34E-05 lb/MMBtu	(1)	0.000 (a)	7.34E-05 lb/MMBtu	(1)	0.000 (c)
Formaldehyde	5.52E-02 lb/MMBtu	(1)	0.076 (a)	5.52E-02 lb/MMBtu	(1)	0.331 (c)
Methanol	2.48E-03 lb/MMBtu	(1)	0.003 (a)	2.48E-03 lb/MMBtu	(1)	0.015 (c)
Methylene Chloride	1.47E-04 lb/MMBtu	(1)	0.000 (a)	1.47E-04 lb/MMBtu	(1)	0.001 (c)
n-Hexane	4.45E-04 lb/MMBtu	(1)	0.001 (a)	4.45E-04 lb/MMBtu	(1)	0.003 (c)
Naphthalene	9.63E-05 lb/MMBtu	(1)	0.000 (a)	9.63E-05 lb/MMBtu	(1)	0.001 (c)
PAH (POM)	1.34E-04 lb/MMBtu	(1)	0.000 (a)	1.34E-04 lb/MMBtu	(1)	0.001 (c)
Phenol	4.21E-05 lb/MMBtu	(1)	0.000 (a)	4.21E-05 lb/MMBtu	(1)	0.000 (c)
Styrene	5.48E-05 lb/MMBtu	(1)	0.000 (a)	5.48E-05 lb/MMBtu	(1)	0.000 (c)
Toluene	9.63E-04 lb/MMBtu	(1)	0.001 (a)	9.63E-04 lb/MMBtu	(1)	0.006 (c)
Vinyl Chloride	2.47E-05 lb/MMBtu	(1)	0.000 (a)	2.47E-05 lb/MMBtu	(1)	0.000 (c)
Xylenes	2.68E-04 lb/MMBtu	(1)	0.000 (a)	2.68E-04 lb/MMBtu	(1)	0.002 (c)
Total HAP			0.109			0.477
Greenhouse Gas Emissions						
CO ₂	116.89 lb/MMBtu	(4)	160.21 (a)	116.89 lb/MMBtu	(4)	701.71 (c)
CH ₄	2.2E-03 lb/MMBtu	(4)	0.00 (a)	2.2E-03 lb/MMBtu	(4)	0.01 (c)
N ₂ O	2.2E-04 lb/MMBtu	(4)	0.00 (a)	2.2E-04 lb/MMBtu	(4)	0.00 (c)
CO ₂ e ^(g)	-	-	160.37	-	-	702.44

Calculations:

Maximum Hourly Emissions - If emission factor note 1 or 4 is used, use calculation (a). If emission factor note 3 is used, use calculation (b).

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

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

Annual Emissions - If emission factor note 1 or 4 is used, use calculation (c). If emission factor note 3 is used, use calculation (d).

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

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

SO₂ Emissions - If emission factor note 2 is used, use calculations (e) and (f) for hourly and annual emissions, respectively.

(e) Maximum Hourly Emissions SO₂ Caclulation (lb/hr) = (0.25 grain S/100ft³) * Fuel throughput (ft³/hr) * (1lb/7000 grains) * (lbmol S/32.06 lb S) * (lbmol SO₂/ lbmol S) * (64.07 lb SO₂/lbmol SO₂)

(f) Annual Emissions SO₂ Caclulation (ton/yr) = (0.25 grain S/100ft³) * Fuel throughput (ft³/hr) * (1lb/7000 grains) * (lbmol S/32.06 lb S) * (lbmol SO₂/ lbmol S) * (64.07 lb SO₂/lbmol SO₂) * Annual hours of operation (hr/yr) * (1ton/2000lbs)

MAXIMUM HOURLY EMISSION INPUTS		
Engine Power Output (kW) =	115	
Engine Power Output (hp) =	154	
Number of Engines =	1	
Average BSFC (BTU/HP-hr) =	8,900	(5)
Heat Content Natural Gas(Btu/scf) =	1,020.0	(6)
Fuel Throughput (ft ³ /hr) =	1,343.7	(7)
PTE Hours of Operation =	1	

ANNUAL EMISSION INPUTS		
Engine Power Output (kW) =	115	
Engine Power Output (hp) =	154	
Number of Engines =	1	
Average BSFC (BTU/HP-hr) =	8,900	(5)
Heat Content Natural Gas(Btu/scf) =	1,020.0	(6)
Fuel Throughput (ft ³ /hr) =	1,343.7	(7)
PTE Hours of Operation =	8,760	

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

CO ₂	1	(8)
CH ₄	25	(8)
N ₂ O	298	(8)

Notes:

(1) AP-42, Chapter 3.2, Table 3.2-1. *Natural Gas-fired Reciprocating Engines (7/00)*. Uncontrolled Emission Factors for 2-Stroke Lean-Burn Engines.

(2) AP-42, Chapter 5.3, Section 5.3.1

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

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

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

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

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

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

Table 3. Reciprocating Engine / Integral Compressor Emissions
Ajax DPC-60, 2SLB
Cranberry Pipeline Corporation - Armstrong Compressor Station

Pollutant	Maximum Hourly Emissions				Annual Emissions			
	Emission Factor		PTE per Engine (lb/hr)		Emission Factor		PTE per Engine (tons/yr)	
Criteria Pollutants								
PM/PM10/PM2.5	3.84E-02 lb/MMBtu	(1)	0.02	(a)	3.84E-02 lb/MMBtu	(1)	0.088	(c)
SO ₂	0.25 grains S / 100 ft ³	(2)	0.000	(e)	0.25 grains S / 100 ft ³	(2)	0.002	(f)
NOx	4.40E+00 g/hp-hr	(3)	0.56	(b)	4.40E+00 g/hp-hr	(3)	2.46	(d)
CO	1.70E+00 g/hp-hr	(3)	0.22	(b)	1.70E+00 g/hp-hr	(3)	0.95	(d)
VOC	1.00E+00 g/hp-hr	(3)	0.13	(b)	1.00E+00 g/hp-hr	(3)	0.56	(d)
Hazardous Air Pollutants								
1,1,2,2-Tetrachloroethane	6.63E-05 lb/MMBtu	(1)	0.000	(a)	6.63E-05 lb/MMBtu	(1)	0.000	(c)
1,1,2-Trichloroethane	5.27E-05 lb/MMBtu	(1)	0.000	(a)	5.27E-05 lb/MMBtu	(1)	0.000	(c)
1,3-Butadiene	8.20E-04 lb/MMBtu	(1)	0.000	(a)	8.20E-04 lb/MMBtu	(1)	0.002	(c)
1,3-Dichloropropene	4.38E-05 lb/MMBtu	(1)	0.000	(a)	4.38E-05 lb/MMBtu	(1)	0.000	(c)
2-Methylnaphthalene	2.14E-05 lb/MMBtu	(1)	0.000	(a)	2.14E-05 lb/MMBtu	(1)	0.000	(c)
2,2,4-Trimethylpentane	8.46E-04 lb/MMBtu	(1)	0.000	(a)	8.46E-04 lb/MMBtu	(1)	0.002	(c)
Acetaldehyde	7.76E-03 lb/MMBtu	(1)	0.004	(a)	7.76E-03 lb/MMBtu	(1)	0.018	(c)
Acrolein	7.78E-03 lb/MMBtu	(1)	0.004	(a)	7.78E-03 lb/MMBtu	(1)	0.018	(c)
Benzene	1.94E-03 lb/MMBtu	(1)	0.001	(a)	1.94E-03 lb/MMBtu	(1)	0.004	(c)
Biphenyl	3.95E-06 lb/MMBtu	(1)	0.000	(a)	3.95E-06 lb/MMBtu	(1)	0.000	(c)
Carbon Tetrachloride	6.07E-05 lb/MMBtu	(1)	0.000	(a)	6.07E-05 lb/MMBtu	(1)	0.000	(c)
Chlorobenzene	4.44E-05 lb/MMBtu	(1)	0.000	(a)	4.44E-05 lb/MMBtu	(1)	0.000	(c)
Chloroform	4.71E-05 lb/MMBtu	(1)	0.000	(a)	4.71E-05 lb/MMBtu	(1)	0.000	(c)
Ethylbenzene	1.08E-04 lb/MMBtu	(1)	0.000	(a)	1.08E-04 lb/MMBtu	(1)	0.000	(c)
Ethylene Dibromide	7.34E-05 lb/MMBtu	(1)	0.000	(a)	7.34E-05 lb/MMBtu	(1)	0.000	(c)
Formaldehyde	5.52E-02 lb/MMBtu	(1)	0.029	(a)	5.52E-02 lb/MMBtu	(1)	0.126	(c)
Methanol	2.48E-03 lb/MMBtu	(1)	0.001	(a)	2.48E-03 lb/MMBtu	(1)	0.006	(c)
Methylene Chloride	1.47E-04 lb/MMBtu	(1)	0.000	(a)	1.47E-04 lb/MMBtu	(1)	0.000	(c)
n-Hexane	4.45E-04 lb/MMBtu	(1)	0.000	(a)	4.45E-04 lb/MMBtu	(1)	0.001	(c)
Naphthalene	9.63E-05 lb/MMBtu	(1)	0.000	(a)	9.63E-05 lb/MMBtu	(1)	0.000	(c)
PAH (POM)	1.34E-04 lb/MMBtu	(1)	0.000	(a)	1.34E-04 lb/MMBtu	(1)	0.000	(c)
Phenol	4.21E-05 lb/MMBtu	(1)	0.000	(a)	4.21E-05 lb/MMBtu	(1)	0.000	(c)
Styrene	5.48E-05 lb/MMBtu	(1)	0.000	(a)	5.48E-05 lb/MMBtu	(1)	0.000	(c)
Toluene	9.63E-04 lb/MMBtu	(1)	0.001	(a)	9.63E-04 lb/MMBtu	(1)	0.002	(c)
Vinyl Chloride	2.47E-05 lb/MMBtu	(1)	0.000	(a)	2.47E-05 lb/MMBtu	(1)	0.000	(c)
Xylenes	2.68E-04 lb/MMBtu	(1)	0.000	(a)	2.68E-04 lb/MMBtu	(1)	0.001	(c)
Total HAP			0.042				0.182	
Greenhouse Gas Emissions								
CO ₂	116.89 lb/MMBtu	(4)	61.02	(a)	116.89 lb/MMBtu	(4)	267.25	(c)
CH ₄	2.2E-03 lb/MMBtu	(4)	0.00	(a)	2.2E-03 lb/MMBtu	(4)	0.01	(c)
N ₂ O	2.2E-04 lb/MMBtu	(4)	0.00	(a)	2.2E-04 lb/MMBtu	(4)	0.00	(c)
CO ₂ e ^(g)	-	-	61.08		-	-	267.53	

Calculations:

Maximum Hourly Emissions - If emission factor note 1 or 4 is used, use calculation (a). If emission factor note 3 is used, use calculation (b).

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

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

Annual Emissions - If emission factor note 1 or 4 is used, use calculation (c). If emission factor note 3 is used, use calculation (d).

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

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

SO₂ Emissions - If emission factor note 2 is used, use calculations (e) and (f) for hourly and annual emissions, respectively.

(e) Maximum Hourly Emissions SO₂ Calculation (lb/hr) = (0.25 grain S/100ft³) * Fuel throughput (ft³/hr) * (1lb/7000 grains) * (lbmol S/32.06 lb S) * (lbmol SO₂/ lbmol S) * (64.07 lb SO₂/lbmol SO₂)

(f) Annual Emissions SO₂ Calculation (ton/yr) = (0.25 grain S/100ft³) * Fuel throughput (ft³/hr) * (1lb/7000 grains) * (lbmol S/32.06 lb S) * (lbmol SO₂/ lbmol S) * (64.07 lb SO₂/lbmol SO₂) * Annual hours of operation (hr/yr) * (1ton/2000lbs)

MAXIMUM HOURLY EMISSION INPUTS	
Engine Power Output (kW) =	43
Engine Power Output (hp) =	58
Number of Engines =	1
Average BSFC (BTU/HP-hr) =	9,000 (5)
Heat Content Natural Gas(Btu/scf) =	1,020.0 (6)
Fuel Throughput (ft ³ /hr) =	511.8 (7)
PTE Hours of Operation =	1

ANNUAL EMISSION INPUTS	
Engine Power Output (kW) =	43
Engine Power Output (hp) =	58
Number of Engines =	1
Average BSFC (BTU/HP-hr) =	9,000 (5)
Heat Content Natural Gas(Btu/scf) =	1,020.0 (6)
Fuel Throughput (ft ³ /hr) =	511.8 (7)
PTE Hours of Operation =	8,760

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

CO ₂	1	(8)
CH ₄	25	(8)
N ₂ O	298	(8)

Notes:

(1) AP-42, Chapter 3.2, Table 3.2-1. *Natural Gas-fired Reciprocating Engines (7/00)*. Uncontrolled Emission Factors for 2-Stroke Lean-Burn Engines.

(2) AP-42, Chapter 5.3, Section 5.3.1

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

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

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

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

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

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

Table 4. TEG Dehydrator Reboiler Emissions
NATCO; Model # SB12-6
Cranberry Pipeline Corporation - Armstrong Compressor Station

Pollutant	Emission Factor	PTE per Burner (lb/hr)	PTE per Burner (ton/yr)
Criteria Pollutants			
PM/PM10/PM2.5	1.9 lb/MMcf (1)	0.0005 (a)	0.00 (b)
SO ₂	0.25 grains S / 100ft ³ (5)	0.000 (e)	0.00 (f)
NO _x	100 lb/MMcf (2)	0.02 (a)	0.11 (b)
CO	84 lb/MMcf (2)	0.02 (a)	0.09 (b)
VOC	5.5 lb/MMcf (1)	0.0013 (a)	0.01 (b)
Hazardous Air Pollutants			
Arsenic	2.00E-04 lb/MMcf (3)	0.00 (a)	0.000 (b)
Benzene	2.10E-03 lb/MMcf (4)	0.00 (a)	0.000 (b)
Beryllium	1.20E-05 lb/MMcf (3)	0.00 (a)	0.000 (b)
Cadmium	1.10E-03 lb/MMcf (3)	0.00 (a)	0.000 (b)
Chromium	1.40E-03 lb/MMcf (3)	0.00 (a)	0.000 (b)
Cobalt	8.40E-05 lb/MMcf (3)	0.00 (a)	0.000 (b)
Dichlorobenzene	1.20E-03 lb/MMcf (4)	0.00 (a)	0.000 (b)
Formaldehyde	7.50E-02 lb/MMcf (4)	0.00 (a)	0.000 (b)
Hexane	1.80E+00 lb/MMcf (4)	0.00 (a)	0.002 (b)
Lead	5.00E-04 lb/MMcf (3)	0.00 (a)	0.000 (b)
Manganese	3.80E-04 lb/MMcf (3)	0.00 (a)	0.000 (b)
Mercury	2.60E-04 lb/MMcf (3)	0.00 (a)	0.000 (b)
Naphthalene	6.10E-04 lb/MMcf (4)	0.00 (a)	0.000 (b)
Nickel	2.10E-03 lb/MMcf (3)	0.00 (a)	0.000 (b)
PAH/POM	1.29E-03 lb/MMcf (4)	0.00 (a)	0.000 (b)
Selenium	2.40E-05 lb/MMcf (3)	0.00 (a)	0.000 (b)
Toluene	3.40E-03 lb/MMcf (4)	0.00 (a)	0.000 (b)
Total HAP		0.00	0.002
Greenhouse Gas Emissions			
CO ₂	116.89 lb/MMBtu (6)	29.22 (c)	127.99 (d)
CH ₄	2.2E-03 lb/MMBtu (6)	0.00 (c)	0.00 (d)
N ₂ O	2.2E-04 lb/MMBtu (6)	0.00 (c)	0.00 (d)
CO ₂ e ^(g)	-	29.25	128.13

Calculations:

LB/MMCF

(a) Hourly emissions (lb/hr) = Emission Factor (lb/MMcf) * Fuel Use (MMCF/yr) / Annual hours of operation (hr/yr)

(b) Annual emissions (ton/yr) = Emission Factor (lb/MMcf) * Fuel Use (MMcf/yr) * (1ton/2000lbs)

LB/MMBTU

(c) Hourly Emissions (lb/hr) = Emission Factor (lb/MMBtu) * Fuel Use (MMBtu/hr)

(d) Annual Emissions (ton/yr) = Emission Factor (lb/MMBtu) * Fuel Use (MMBtu/yr) * Hours of operation (hr/yr) * (1ton/2000lbs)

SO₂

(e) Hourly Emissions SO₂ Caclulation (lb/hr) = (0.25 grain S/100ft³) * Fuel throughput (MMft³/yr) * (1000000ft³/1MMft³) / annual hours of operation (hr/yr) * (1lb/7000 grains) * (lbmol S/32.06 lb S) * (lbmol SO₂/ lbmol S) * (64.07 lb SO₂/lbmol SO₂)

(f) Annual Emissions SO₂ Caclulation (ton/yr) = (0.25 grain S/100ft³) * Fuel throughput (MMft³/yr) * (1000000ft³/1MMft³) * (1lb/7000 grains) * (lbmol S/32.06 lb S) * (lbmol SO₂/ lbmol S) * (64.07 lb SO₂/lbmol SO₂) * (1ton/2000lbs)

EMISSION INPUTS TABLE	
Fuel Use (MMBtu/hr) =	0.25
Number of Reboilers =	1
Hours of Operation (hr/yr) =	8760
MMBtu/MMcf =	1020
PTE Fuel Use (MMft ³ /yr) =	2.15

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

CO ₂	1	(7)
CH ₄	25	(7)
N ₂ O	298	(7)

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) AP-42, Chapter 5.3, Section 5.3.1

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

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

Table 5. Dehydration Unit Still Vent Emissions
Sivalls
Cranberry Pipeline Corporation - Armstrong Compressor Station

Source	PTE per unit (lb/hr)	PTE per unit (lb/day)	PTE ⁽¹⁾ per unit (tons/yr)
Criteria Pollutants			
VOC	2.125	50.992	9.306
Hazardous Air Pollutants			
Benzene	0.093	2.231	0.407
Toluene	0.075	1.800	0.329
Ethylbenzene	0.022	0.523	0.096
Xylenes	0.023	0.544	0.099
n-Hexane	0.142	3.398	0.620
Total HAP	0.3552	8.5238	1.5556
Greenhouse Gas Emissions			
CO ₂			-
CH ₄	1.1489	27.5748	5.0324
N ₂ O	-	-	-
CO ₂ e ^(a)	28.72	689.37	125.81

Calculations:

EMISSION INPUTS	
Dehy Rating (MMscf/d) =	0.8
Number of Units =	1
Hours of Operation =	8760

(a) CO₂ equivalent = [(CO₂ emissions)*(GWP_{CO2})]+[(CH₄ emissions)*(GWP_{CH4})]+[(N₂O emissions)*(GWP_{N2O})]

Global Warming Potential (GWP)

CO ₂	1	(2)
CH ₄	25	(2)
N ₂ O	298	(2)

Notes:

(1) Emissions Calculated utilizing GRI-GLYCalc and reflect the controlled regenerator emissions

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

**Table 6. Tank Emissions
Cranberry Pipeline Corporation - Armstrong Compressor Station**

Emission Point	Tank Capacity (gal)	Tank Contents	Control Devices	Tank Throughput (bbls/day)	VOC Emission Factor (lbs/bbls)	VOC Emissions (lbs/yr) ^(a)	VOC Emissions (lb/hr) ^(b)	VOC Emissions (tons/yr) ^(c)
T1	1050	Pipeline Liquids	None	5.00	3.50E-01 (2)	638.75	0.073	0.319
Totals						638.75	0.07	0.32

Calculations:

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

(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 Working/Breathing losses as calculated from TANKS 4.0.9.d

(2) VOC emission factor includes Flashing/Working/Breathing losses calculated from pressurized liquid sample (GOR= 0.35 lb VOC/bbl) direct flash measurement. The pressurized liquid sample was taken from the Putnam B6 site on 4/25/2013 and is considered to be worst case representative with respect to gas composition and pressure at the Station

**Table 7. Truck Loading (TL) VOC Emissions
Cranberry Pipeline Corporation - Armstrong Compressor Station**

Contents	Volume Transferred ³	Loading Loss ^(a) (lb VOC/1000gal)	PTE VOC Emissions (lb/hr)	PTE VOC Emissions (ton/yr) ^(b)
Pipeline Liquids	76,650 gal/yr	3.659	0.032	0.140
Total			0.032	0.140

Calculations:

(a) Loading Loss (lbs/1000 gal) = 12.46x[Saturation Factor] x [True Vapor Pressure of Liquid Loaded (psia)] x[Molecular Weight of Vapors(lbs/lbmole)]/ [Temperature of Bulk Liquid Loaded(*R)]

(b) Annual Emissions(tons/yr) = [Loading Loss (lb VOC/ 1000 gal)]*[Volume Transferred(gal/yr)]/1000/2000

	<u>Pipeline liquids</u>	
Saturation factor	0.60	Note ⁽¹⁾
Pvap (psia)	7.70	Note ⁽²⁾
Molecular Weight Vap (lb/lbmol)	33.37	Note ⁽²⁾
Bulk Liquid Temperature (F)	65.00	Note ⁽²⁾

Notes:

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

(2) Putnam B6 Compressor Station Pressurized Separator Sampling and Emission Estimation Report, August 2013

(3) Annual rates based on maximum throughput of 5 bbls/d

**Table 8. Fugitive Leak Emissions
Cranberry Pipeline Corporation - Armstrong Compressor Station**

Pollutant	Emission Factor			PTE ^(a) Gas Service (tons/yr)
Valves	9.9E-03 lb/hr/source	(1)		3.08
Low Bleed Pneumatic Valves	9.9E-03 lb/hr/source	(1)		1.56
Flanges	8.6E-04 lb/hr/source	(1)		1.13
Connector	4.4E-04 lb/hr/source	(1)		0.58
Other Points in Gas Service	1.9E-02 lb/hr/source	(1)		1.50
Total Gas Released	-	-		7.86
Total VOC Released (gas service)			(b)	0.71
Total n-Hexane Released (gas service)			(2)	0.06
Calculations:				CO2e 16.45

(a) Annual emissions (tons/yr) = [Emission Factor (lb/hr/source)] x [Number of Sources] x [Hours of Operation per Year] x [0.0005 tons/ lb]

(b) Gas sample from station's gas analysis assumed to be worst case at 9 wt % VOC
Number of Components in Gas Service

Valves=	71	(3)
Low Bleed Pneumatic Valves=	36	(3)
Connectors=	301	(3)
Other Points in Gas Service =	8	(3)

Maximum Hour of Operation = 8,760

Global Warming Potential (GWP)

CO ₂	1	(4)
CH ₄	25	(4)
N ₂ O	298	(4)

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

(2) Wt % for individual HAP taken from station's gas analysis

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

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

**Table 9. Reciprocating Engine / Integral Compressor Emissions (CE-1) Blowdown Venting
 Ajax DPC-60, 2SLB
 Cranberry Pipeline Corporation - Armstrong Compressor Station**

Pollutant	Maximum Hourly Emissions		Annual Emissions	
	Emission Factor	PTE per Engine Event (lb/hr)	Emission Factor	Annual PTE (tons/yr)
Criteria Pollutants				
VOC	2.98E+00 lb/Event (1)	2.98 (a)	2.98E+00 lb/Event (1)	0.09 (a)

(1) 2.975 lbs VOC / Engine blowdown event; based on 717 scf/event of 17.75 MW gas with 9 wt % VOC

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

ATTACHMENT F

SUPPORTING DOCUMENTS

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301

GLY-Calc 4.0 Reporting

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301

GRI-GLYCalc VERSION 4.0 - SUMMARY OF INPUT VALUES

Case Name: Armstrong Compressor Station - PTE for Permit Determinations
 File Name: N:\West Virginia\Cabot\Projects\2016\Air Permits\Permit
 Determinations\Armstrong\GlyCalc\Armstrong GlyCalc_Armstrong_PTE_1.2 Flow.ddf
 Date: January 17, 2017

DESCRIPTION:

 Description: Armstrong Compressor Station
 1.2 x's Annual Flow

Annual Hours of Operation: 8760.0 hours/yr

WET GAS:

 Temperature: 74.17 deg. F
 Pressure: 83.33 psig
 Wet Gas Water Content: Saturated

Component	Conc. (vol %)
-----	-----
Carbon Dioxide	0.1400
Nitrogen	0.5200
Methane	93.0650
Ethane	4.2900
Propane	0.7750
Isobutane	0.1190
n-Butane	0.1840
Isopentane	0.0690
n-Pentane	0.0540
Cyclopentane	0.0009
n-Hexane	0.1570
Cyclohexane	0.0320
Other Hexanes	0.3040
Heptanes	0.2100
Methylcyclohexane	0.0390
2,2,4-Trimethylpentane	0.0009
Benzene	0.0070
Toluene	0.0040
Ethylbenzene	0.0009
Xylenes	0.0009
C8+ Heavies	0.0310

DRY GAS:

 Flow Rate: 0.2 MMSCF/day
 Water Content: 7.0 lbs. H2O/MMSCF

LEAN GLYCOL:

 Glycol Type: TEG
 Water Content: 1.5 wt% H2O
 Flow Rate: 0.8 gpm

PUMP:

Glycol Pump Type: Gas Injection
Gas Injection Pump Volume Ratio: 0.080 acfm gas/gpm glycol

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Armstrong Compressor Station - PTE for Permit Determinations
 File Name: N:\West Virginia\Cabot\Projects\2016\Air Permits\Permit
 Determinations\Armstrong\GlyCalc\Armstrong GlyCalc_Armstrong_PTE_1.2 Flow.ddf
 Date: January 17, 2017

DESCRIPTION:

Description: Armstrong Compressor Station
 1.2 x's Annual Flow

Annual Hours of Operation: 8760.0 hours/yr

EMISSIONS REPORTS:

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	1.1490	27.575	5.0324
Ethane	0.1476	3.541	0.6463
Propane	0.0608	1.460	0.2664
Isobutane	0.0182	0.436	0.0796
n-Butane	0.0364	0.874	0.1596
Isopentane	0.0207	0.498	0.0908
n-Pentane	0.0207	0.497	0.0907
Cyclopentane	0.0012	0.030	0.0054
n-Hexane	0.1416	3.398	0.6201
Cyclohexane	0.1065	2.557	0.4666
Other Hexanes	0.2027	4.865	0.8879
Heptanes	0.5016	12.038	2.1970
Methylcyclohexane	0.2061	4.947	0.9029
2,2,4-Trimethylpentane	0.0012	0.029	0.0052
Benzene	0.0930	2.231	0.4071
Toluene	0.0750	1.800	0.3285
Ethylbenzene	0.0218	0.523	0.0955
Xylenes	0.0226	0.543	0.0992
C8+ Heavies	0.5944	14.266	2.6035
Total Emissions	3.4212	82.109	14.9849
Total Hydrocarbon Emissions	3.4212	82.109	14.9849
Total VOC Emissions	2.1247	50.992	9.3061
Total HAP Emissions	0.3552	8.524	1.5556
Total BTEX Emissions	0.2124	5.098	0.9303

EQUIPMENT REPORTS:

ABSORBER

NOTE: Because the Calculated Absorber Stages was below the minimum allowed, GRI-GLYCalc has set the number of Absorber Stages to 1.25 and has calculated a revised Dry Gas Dew Point.

Calculated Absorber Stages: 1.25
 Calculated Dry Gas Dew Point: 6.96 lbs. H2O/MMSCF
 Temperature: 74.2 deg. F
 Pressure: 83.3 psig
 Dry Gas Flow Rate: 0.2300 MMSCF/day
 Glycol Losses with Dry Gas: 0.0004 lb/hr
 Wet Gas Water Content: Saturated
 Calculated Wet Gas Water Content: 207.84 lbs. H2O/MMSCF
 Calculated Lean Glycol Recirc. Ratio: 25.86 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	3.33%	96.67%
Carbon Dioxide	99.23%	0.77%
Nitrogen	99.96%	0.04%
Methane	99.96%	0.04%
Ethane	99.81%	0.19%
Propane	99.56%	0.44%
Isobutane	99.22%	0.78%
n-Butane	98.91%	1.09%
Isopentane	98.61%	1.39%
n-Pentane	98.16%	1.84%
Cyclopentane	92.52%	7.48%
n-Hexane	96.12%	3.88%
Cyclohexane	84.62%	15.38%
Other Hexanes	97.20%	2.80%
Heptanes	90.84%	9.16%
Methylcyclohexane	78.97%	21.03%
2,2,4-Trimethylpentane	95.67%	4.33%
Benzene	33.04%	66.96%
Toluene	19.79%	80.21%
Ethylbenzene	10.02%	89.98%
Xylenes	6.58%	93.42%
C8+ Heavies	55.78%	44.22%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	78.31%	21.69%
Carbon Dioxide	0.00%	100.00%
Nitrogen	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%
Isobutane	0.00%	100.00%
n-Butane	0.00%	100.00%
Isopentane	0.42%	99.58%
n-Pentane	0.44%	99.56%
Cyclopentane	0.48%	99.52%
n-Hexane	0.47%	99.53%
Cyclohexane	3.15%	96.85%
Other Hexanes	0.92%	99.08%
Heptanes	0.49%	99.51%

Methylcyclohexane	3.95%	96.05%
2,2,4-Trimethylpentane	1.42%	98.58%
Benzene	4.98%	95.02%
Toluene	7.87%	92.13%
Ethylbenzene	10.37%	89.63%
Xylenes	12.87%	87.13%
C8+ Heavies	11.87%	88.13%

STREAM REPORTS:

WET GAS STREAM

Temperature: 74.17 deg. F
 Pressure: 98.03 psia
 Flow Rate: 9.64e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	4.38e-001	2.00e+000
Carbon Dioxide	1.39e-001	1.56e+000
Nitrogen	5.18e-001	3.68e+000
Methane	9.27e+001	3.77e+002
Ethane	4.27e+000	3.26e+001
Propane	7.72e-001	8.64e+000
Isobutane	1.18e-001	1.75e+000
n-Butane	1.83e-001	2.70e+000
Isopentane	6.87e-002	1.26e+000
n-Pentane	5.38e-002	9.85e-001
Cyclopentane	8.96e-004	1.60e-002
n-Hexane	1.56e-001	3.42e+000
Cyclohexane	3.19e-002	6.81e-001
Other Hexanes	3.03e-001	6.63e+000
Heptanes	2.09e-001	5.32e+000
Methylcyclohexane	3.88e-002	9.68e-001
2,2,4-Trimethylpentane	8.96e-004	2.60e-002
Benzene	6.97e-003	1.38e-001
Toluene	3.98e-003	9.32e-002
Ethylbenzene	8.96e-004	2.42e-002
Xylenes	8.96e-004	2.42e-002
C8+ Heavies	3.09e-002	1.34e+000
Total Components	100.00	4.51e+002

DRY GAS STREAM

Temperature: 74.17 deg. F
 Pressure: 98.03 psia
 Flow Rate: 9.58e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.47e-002	6.67e-002
Carbon Dioxide	1.39e-001	1.55e+000
Nitrogen	5.20e-001	3.68e+000
Methane	9.31e+001	3.77e+002

Ethane	4.29e+000	3.26e+001
Propane	7.72e-001	8.60e+000
Isobutane	1.18e-001	1.74e+000
n-Butane	1.82e-001	2.67e+000
Isopentane	6.81e-002	1.24e+000
n-Pentane	5.31e-002	9.67e-001
Cyclopentane	8.34e-004	1.48e-002
n-Hexane	1.51e-001	3.29e+000
Cyclohexane	2.71e-002	5.76e-001
Other Hexanes	2.96e-001	6.44e+000
Heptanes	1.91e-001	4.83e+000
Methylcyclohexane	3.08e-002	7.65e-001
2,2,4-Trimethylpentane	8.62e-004	2.49e-002
Benzene	2.32e-003	4.57e-002
Toluene	7.92e-004	1.84e-002
Ethylbenzene	9.03e-005	2.42e-003
Xylenes	5.93e-005	1.59e-003
C8+ Heavies	1.73e-002	7.45e-001

Total Components	100.00	4.47e+002

LEAN GLYCOL STREAM

Temperature: 74.17 deg. F
Flow Rate: 8.30e-001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.85e+001	4.60e+002
Water	1.50e+000	7.01e+000
Carbon Dioxide	2.57e-013	1.20e-012
Nitrogen	3.33e-014	1.55e-013
Methane	1.17e-018	5.46e-018
Ethane	6.30e-009	2.94e-008
Propane	3.33e-010	1.56e-009
Isobutane	8.74e-011	4.08e-010
n-Butane	1.56e-010	7.28e-010
Isopentane	1.88e-005	8.77e-005
n-Pentane	1.95e-005	9.12e-005
Cyclopentane	1.29e-006	6.01e-006
n-Hexane	1.43e-004	6.67e-004
Cyclohexane	7.41e-004	3.46e-003
Other Hexanes	4.01e-004	1.87e-003
Heptanes	5.25e-004	2.45e-003
Methylcyclohexane	1.82e-003	8.48e-003
2,2,4-Trimethylpentane	3.67e-006	1.71e-005
Benzene	1.04e-003	4.87e-003
Toluene	1.37e-003	6.41e-003
Ethylbenzene	5.40e-004	2.52e-003
Xylenes	7.16e-004	3.34e-003
C8+ Heavies	1.71e-002	8.00e-002

Total Components	100.00	4.67e+002

RICH GLYCOL AND PUMP GAS STREAM

Temperature: 74.17 deg. F

Pressure: 98.03 psia
 Flow Rate: 8.41e-001 gpm
 NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.74e+001	4.60e+002
Water	1.89e+000	8.95e+000
Carbon Dioxide	3.41e-003	1.61e-002
Nitrogen	2.37e-003	1.12e-002
Methane	2.43e-001	1.15e+000
Ethane	3.12e-002	1.48e-001
Propane	1.29e-002	6.08e-002
Isobutane	3.85e-003	1.82e-002
n-Butane	7.71e-003	3.64e-002
Isopentane	4.41e-003	2.08e-002
n-Pentane	4.40e-003	2.08e-002
Cyclopentane	2.63e-004	1.24e-003
n-Hexane	3.01e-002	1.42e-001
Cyclohexane	2.33e-002	1.10e-001
Other Hexanes	4.33e-002	2.05e-001
Heptanes	1.07e-001	5.04e-001
Methylcyclohexane	4.54e-002	2.15e-001
2,2,4-Trimethylpentane	2.56e-004	1.21e-003
Benzene	2.07e-002	9.78e-002
Toluene	1.72e-002	8.14e-002
Ethylbenzene	5.15e-003	2.43e-002
Xylenes	5.50e-003	2.60e-002
C8+ Heavies	1.43e-001	6.74e-001
Total Components	100.00	4.72e+002

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
 Pressure: 14.70 psia
 Flow Rate: 7.83e+001 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	5.23e+001	1.94e+000
Carbon Dioxide	1.77e-001	1.61e-002
Nitrogen	1.94e-001	1.12e-002
Methane	3.47e+001	1.15e+000
Ethane	2.38e+000	1.48e-001
Propane	6.68e-001	6.08e-002
Isobutane	1.52e-001	1.82e-002
n-Butane	3.04e-001	3.64e-002
Isopentane	1.39e-001	2.07e-002
n-Pentane	1.39e-001	2.07e-002
Cyclopentane	8.55e-003	1.24e-003
n-Hexane	7.96e-001	1.42e-001
Cyclohexane	6.14e-001	1.07e-001
Other Hexanes	1.14e+000	2.03e-001
Heptanes	2.43e+000	5.02e-001
Methylcyclohexane	1.02e+000	2.06e-001
2,2,4-Trimethylpentane	5.06e-003	1.19e-003
Benzene	5.77e-001	9.30e-002
Toluene	3.95e-001	7.50e-002

Ethylbenzene	9.96e-002	2.18e-002
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Xylenes	1.03e-001	2.26e-002
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C8+ Heavies	1.69e+000	5.94e-001
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Total Components	100.00	5.39e+000
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Wet Gas Analysis

Permit Determination

**Armstrong Compressor Station
Powellton, West Virginia**

Cranberry Pipeline Corporation
c/o Cabot Oil & Gas Corporation
900 Lee Street East, Suite 1500
Charleston, West Virginia 25301

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

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

Sample: Cabot- Armstrong
 Pre-Dehy
 Sampled @ 5 psig & 58 °F

Date Sampled: 02/29/16

Job Number: 61668.101

CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2286

COMPONENT	MOL%	GPM
Nitrogen	0.520	
Carbon Dioxide	0.140	
Methane	93.065	
Ethane	4.290	1.141
Propane	0.775	0.212
Isobutane	0.119	0.039
n-Butane	0.173	0.054
2-2 Dimethylpropane	0.011	0.004
Isopentane	0.069	0.025
n-Pentane	0.054	0.019
Hexanes	0.461	0.189
Heptanes Plus	<u>0.323</u>	<u>0.136</u>
Totals	100.000	1.819

Computed Real Characteristics Of Heptanes Plus:

Specific Gravity ----- 3.367 (Air=1)
 Molecular Weight ----- 97.27
 Gross Heating Value ----- 5146 BTU/CF

Computed Real Characteristics Of Total Sample:

Specific Gravity ----- 0.614 (Air=1)
 Compressibility (Z) ----- 0.9975
 Molecular Weight ----- 17.75
 Gross Heating Value
 Dry Basis ----- 1088 BTU/CF
 Saturated Basis ----- 1070 BTU/CF

Base Conditions: 14.650 PSI & 60 Deg F

Sampled By: (SLR) RSJ
 Analyst: HB
 Processor: OA
 Cylinder ID: T-3694

Certified: FESCO, Ltd. - Alice, Texas

 David Dannhaus 361-661-7015

CHROMATOGRAPH EXTENDED ANALYSIS - GPA 2286
TOTAL REPORT

COMPONENT	MOL %	GPM	WT %
Nitrogen	0.520		0.821
Carbon Dioxide	0.140		0.347
Methane	93.065		84.124
Ethane	4.290	1.141	7.269
Propane	0.775	0.212	1.926
Isobutane	0.119	0.039	0.390
n-Butane	0.173	0.054	0.567
2,2 Dimethylpropane	0.011	0.004	0.045
Isopentane	0.069	0.025	0.281
n-Pentane	0.054	0.019	0.220
2,2 Dimethylbutane	0.028	0.012	0.136
Cyclopentane	0.000	0.000	0.000
2,3 Dimethylbutane	0.041	0.017	0.199
2 Methylpentane	0.147	0.061	0.714
3 Methylpentane	0.088	0.036	0.427
n-Hexane	0.157	0.064	0.762
Methylcyclopentane	0.028	0.010	0.133
Benzene	0.007	0.002	0.031
Cyclohexane	0.032	0.011	0.152
2-Methylhexane	0.041	0.019	0.232
3-Methylhexane	0.037	0.017	0.209
2,2,4 Trimethylpentane	0.000	0.000	0.000
Other C7's	0.059	0.026	0.330
n-Heptane	0.045	0.021	0.254
Methylcyclohexane	0.039	0.016	0.216
Toluene	0.004	0.001	0.021
Other C8's	0.026	0.012	0.161
n-Octane	0.004	0.002	0.026
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	0.007
n-Nonane	0.000	0.000	0.000
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	1.819	100.000

Computed Real Characteristics of Total Sample

Specific Gravity ----- 0.614 (Air=1)

Compressibility (Z) ----- 0.9975

Molecular Weight ----- 17.75

Gross Heating Value

Dry Basis ----- 1088 BTU/CF

Saturated Basis ----- 1070 BTU/CF

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

Sample: Cabot- Armstrong
 Pre-Dehy
 Sampled @ 5 psig & 58 °F

Date Sampled: 02/29/16

Job Number: 61668.101

GLYCALC FORMAT

COMPONENT	MOL%	GPM	Wt %
Carbon Dioxide	0.140		0.347
Hydrogen Sulfide	----		----
Nitrogen	0.520		0.821
Methane	93.065		84.124
Ethane	4.290	1.141	7.269
Propane	0.775	0.212	1.926
Isobutane	0.119	0.039	0.390
n-Butane	0.184	0.058	0.612
Isopentane	0.069	0.025	0.281
n-Pentane	0.054	0.019	0.220
Cyclopentane	0.000	0.000	0.000
n-Hexane	0.157	0.064	0.762
Cyclohexane	0.032	0.011	0.152
Other C6's	0.304	0.125	1.476
Heptanes	0.210	0.091	1.158
Methylcyclohexane	0.039	0.016	0.216
2,2,4 Trimethylpentane	0.000	0.000	0.000
Benzene	0.007	0.002	0.031
Toluene	0.004	0.001	0.021
Ethylbenzene	0.000	0.000	0.000
Xylenes	0.000	0.000	0.000
Octanes Plus	<u>0.031</u>	<u>0.015</u>	<u>0.194</u>
Totals	100.000	1.819	100.000

Real Characteristics Of Octanes Plus:

Specific Gravity ----- 3.851 (Air=1)
 Molecular Weight ----- 111.25
 Gross Heating Value ----- 5575 BTU/CF

Real Characteristics Of Total Sample:

Specific Gravity ----- 0.614 (Air=1)
 Compressibility (Z) ----- 0.9975
 Molecular Weight ----- 17.75
 Gross Heating Value
 Dry Basis ----- 1088 BTU/CF
 Saturated Basis ----- 1070 BTU/CF