Received
December 1, 2020
WV DEP/Div of Air Quality

Division of Air Quality Permit Application Submittal

Please find attached a permit application for : Columbia Gas Transmission, LLC; Lanham Compressor Station
[Company Name; Facility Location]

- DAQ Facility ID (for existing facilities only): 039-00047
- Current 45CSR13 and 45CSR30 (Title V) permits associated with this process (for existing facilities only): R13-3397; R30-03900047-2018

- Type of NSR Application (check all that apply):
  - ☐ Construction
  - ☐ Modification
  - ☐ Class I Administrative Update
  - ☐ Class II Administrative Update
  - ☐ Relocation
  - ☐ Temporary
  - ☐ Permit Determination

- Type of 45CSR30 (TITLE V) Application:
  - ☐ Title V Initial
  - ☑ Title V Renewal
  - ☐ Administrative Amendment**
  - ☐ Minor Modification**
  - ☐ Significant Modification**
  - ☐ Off Permit Change

****If the box above is checked, include the Title V revision information as ATTACHMENT S to the combined NSR/Title V application.**

- Payment Type:
  - ☐ Credit Card (Instructions to pay by credit card will be sent in the Application Status email.)
  - ☐ Check (Make checks payable to: WVDEP – Division of Air Quality)
    Mail checks to:
    WVDEP – DAQ – Permitting
    Attn: NSR Permitting Secretary
    601 57th Street, SE
    Charleston, WV 25304

Please wait until DAQ emails you the Facility ID Number and Permit Application Number. Please add these identifiers to your check or cover letter with your check.

- If the permit writer has any questions, please contact (all that apply):
  - ☐ Responsible Official/Authorized Representative
    - Name:
    - Email:
    - Phone Number:
  - ☑ Company Contact
    - Name: Trevor Galley
    - Email: trevor_galley@tcenergy.com
    - Phone Number: 304-357-2076
  - ☐ Consultant
    - Name:
    - Email:
    - Phone Number:

Columbia Gas Transmission, LLC
1700 MacCorkle Avenue SE
Charleston, WV 25314

December 1, 2020

Director
WV Department of Environmental Protection (WVDEP)
Division of Air Quality (DAQ)
601 57th Street SE
Charleston, WV 25304

Re: Columbia Gas Transmission, LLC (Columbia)
Lanham Compressor Station (WVDAQ Facility ID: 039-00047)
Title V Operating Permit Renewal Application

Dear Director,

In accordance with WV 45CSR30, please find the attached Title V permit renewal application for Columbia's Lanham Compressor Station, which is located in Kanawha County, West Virginia. Lanham Compressor Station currently operates under Permit to Construct No. R13-3397 and Title V Permit to Operate No. R30-03900047-2018. Title V Permit to Operate No. R30-03900047-2018 expires on June 27, 2021.

This package contains the general application forms along with all required attachments for a Title V renewal permit application. Lanham Compressor Station's potential to emit (PTE) exceeds 100 tons per year for nitrogen oxides (NOx) and carbon monoxide (CO); therefore, Lanham is considered a Title V source for permitting purposes.

Should there be questions regarding the application or if additional information is required, please contact me via email at trevor_galley@tcenergy.com.

Sincerely,

Trevor Galley
Environmental Analyst
TC Energy

Division of Air Quality Permit Application Submittal

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  - ☐ Modification
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  - ☑ Title V Renewal
  - ☐ Administrative Amendment**
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    Attn: NSR Permitting Secretary
    601 57th Street, SE
    Charleston, WV 25304

Please wait until DAQ emails you the Facility ID Number and Permit Application Number. Please add these identifiers to your check or cover letter with your check.

- If the permit writer has any questions, please contact (all that apply):
  - ☐ Responsible Official/Authorized Representative
    - Name:
    - Email:
    - Phone Number:
  - ☑ Company Contact
    - Name: Trevor Galley
    - Email: trevor_galley@tcenergy.com
    - Phone Number: 304-357-2076
  - ☐ Consultant
    - Name:
    - Email:
    - Phone Number:

RENEWAL APPLICATION FOR WV 45CSR 30 TITLE V PERMIT TO OPERATE

Columbia Gas Transmission, LLC
Lanham Compressor Station
Kanawha County, West Virginia

December 2020

Table of Contents

General Application Form
Attachment A: Area Map
Attachment B: Plot Plan
Attachment C: Process Flow Diagram
Attachment D: Equipment Table
Attachment E: Emission Unit Forms
Appendix A: Emission Calculations

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

Received
December 1, 2020
WV DEP/Div of Air Quality

INITIAL/RENEWAL TITLE V PERMIT APPLICATION - GENERAL FORMS

Section 1: General Information

1. **Name of Applicant (As registered with the WV Secretary of State's Office):** Columbia Gas Transmission, LLC	**2. Facility Name or Location:** Lanham Compressor Station
3. DAQ Plant ID No.: 0 3 9 -- 0 0 0 4 7	**4. Federal Employer ID No. (FEIN):** 31-0802435-30

5. **Permit Application Type:**

- ☐ Initial Permit — When did operations commence? 1951
- ☑ Permit Renewal — What is the expiration date of the existing permit? June 27, 2021
- ☐ Update to Initial/Renewal Permit Application

6. Type of Business Entity:

☐ Corporation ☐ Governmental Agency ☑ LLC
☐ Partnership ☐ Limited Partnership

7. Is the Applicant the:

☐ Owner ☐ Operator ☑ Both

If the Applicant is not both the owner and operator, please provide the name and address of the other party.

8. Number of onsite employees: 10

9. Governmental Code:

- ☑ Privately owned and operated; 0
- ☐ Federally owned and operated; 1
- ☐ State government owned and operated; 2
- ☐ County government owned and operated; 3
- ☐ Municipality government owned and operated; 4
- ☐ District government owned and operated; 5

10. Business Confidentiality Claims

Does this application include confidential information (per 45CSR31)? ☐ Yes ☑ No

If yes, identify each segment of information on each page that is submitted as confidential, and provide justification for each segment claimed confidential, including the criteria under 45CSR§31-4.1, and in accordance with the DAQ's *"PRECAUTIONARY NOTICE-CLAIMS OF CONFIDENTIALITY"* guidance.

11. Mailing Address		
Street or P.O. Box: 1700 MacCorkle Avenue SE		
City: Charleston	State: WV	Zip: 25314 -
Telephone Number: ( ) -	Fax Number: ( ) -	

12. Facility Location		
Street: 221 Kellys Creek Road	City: Charleston	County: Kanawha
UTM Easting: 438.0 km	UTM Northing: 4,258.8 km	Zone: ☑ 17 or ☐ 18
Directions: Traveling on I-64, take exit for WV-622N toward Cross Lanes. Continue on Route 622 for 3.6 miles. Turn left onto WV-622N/Rocky Fork Rd/Sissonville and continue 4.5 miles. Turn left onto Kellys Creek Rd and the facility is located immediately on the left.		
Portable Source? ☐ Yes ☑ No		
Is facility located within a nonattainment area? ☐ Yes ☑ No		If yes, for what air pollutants?
Is facility located within 50 miles of another state? ☑ Yes ☐ No		If yes, name the affected state(s). OH, KY
Is facility located within 100 km of a Class I Area[1]? ☐ Yes ☑ No If no, do emissions impact a Class I Area[1]? ☐ Yes ☑ No		If yes, name the area(s).

[1] *Class I areas include Dolly Sods and Otter Creek Wilderness Areas in West Virginia, and Shenandoah National Park and James River Face Wilderness Area in Virginia.*

13. Contact Information		
Responsible Official: Richard Smith		**Title:** Operations Manager
Street or P.O. Box: 1700 MacCorkle Avenue SE		
City: Charleston	**State:** WV	**Zip:** 25314 -
Telephone Number: (304) 984 - 4603	**Fax Number:** ( ) -	
E-mail address: richard_smith@tcenergy.com		
Environmental Contact: Trevor Galley		**Title:** Environmental Analyst
Street or P.O. Box: 1700 MacCorkle Avenue SE - 4th Floor		
City: Charleston	**State:** WV	**Zip:** 25314 -
Telephone Number: (304) 357 - 2076	**Fax Number:** ( ) -	
E-mail address: trevor_galley@tcenergy.com		
Application Preparer: Trevor Galley		**Title:** Environmental Analyst
Company: TC Energy		
Street or P.O. Box: 1700 MacCorkle Avenue SE - 4th Floor		
City: Charleston	**State:** WV	**Zip:** 25314 -
Telephone Number: (304) 357 - 2076	**Fax Number:** ( ) -	
E-mail address: trevor_galley@tcenergy.com		

14. Facility Description

List all processes, products, NAICS and SIC codes for normal operation, in order of priority. Also list any process, products, NAICS and SIC codes associated with any alternative operating scenarios if different from those listed for normal operation.

Process	Products	NAICS	SIC
Natural Gas Transmission	Natural Gas	486210	4922

Provide a general description of operations.

Lanham Compressor Station is a natural gas transmission facility covered by Standard Industrial Classification (SIC) Code 4922. The station has the potential to operate twenty-four (24) hours per day, seven (7) days per week, fifty-two (52) weeks per year. The station consists of six (6) 1,100 hp two stroke lean burn reciprocating engines, two (2) 2,700 hp two stroke lean burn reciprocating engines, one (1) 35 hp emergency four stroke rich burn reciprocating engine, one (1) 306 hp four stroke rich burn reciprocating engine, one (1) 275 hp four stroke rich burn reciprocating engine, one (1) 0.54 MMBtu/hr natural gas line heater, and one (1) 3.897 MMBtu/hr heating system boiler.

15. Provide an **Area Map** showing plant location as **ATTACHMENT A**.

16. Provide a **Plot Plan(s)**, e.g. scaled map(s) and/or sketch(es) showing the location of the property on which the stationary source(s) is located as **ATTACHMENT B**.

    For instructions, refer to "Plot Plan - Guidelines."

17. Provide a detailed **Process Flow Diagram(s)** showing each process or emissions unit as **ATTACHMENT C**. Process Flow Diagrams should show all emission units, control equipment, emission points, and their relationships.

Section 2: Applicable Requirements

18. Applicable Requirements Summary	
Instructions: Mark all applicable requirements.	
☑ SIP	☐ FIP
☑ Minor source NSR (45CSR13)	☐ PSD (45CSR14)
☑ NESHAP (45CSR34)	☐ Nonattainment NSR (45CSR19)
☐ Section 111 NSPS	☑ Section 112(d) MACT standards
☐ Section 112(g) Case-by-case MACT	☐ 112(r) RMP
☐ Section 112(i) Early reduction of HAP	☐ Consumer/commercial prod. reqts., section 183(e)
☐ Section 129 Standards/Reqts.	☐ Stratospheric ozone (Title VI)
☐ Tank vessel reqt., section 183(f)	☐ Emissions cap 45CSR§30-2.6.1
☐ NAAQS, increments or visibility (temp. sources)	☐ 45CSR27 State enforceable only rule
☐ 45CSR4 State enforceable only rule	☐ Acid Rain (Title IV, 45CSR33)
☐ Emissions Trading and Banking (45CSR28)	☐ **C**ompliance **A**ssurance **M**onitoring (40CFR64)
☐ CAIR NO_x Annual Trading Program (45CSR39)	☐ CAIR NO_x Ozone Season Trading Program (45CSR40)
☐ CAIR SO_2 Trading Program (45CSR41)	

19. Non Applicability Determinations

List all requirements which the source has determined not applicable and for which a permit shield is requested. The listing shall also include the rule citation and the reason why the shield applies.

45CSR4 – To Prevent and Control the Discharge of Air Pollutants into the Open Air Which Causes or Contributes to an Objectionable Odor or Odors: According to 45CSR§4-7.1, this rule shall not apply to the following sources of objectionable odor until such time as feasible control methods are developed: Internal Combustion Engines
45CSR10 – To Prevent and Control Air Pollution from the Emission of Sulfur Oxides: 45CSR10 is not applicable to the facility's boiler and heater because their maximum design heat input (DHI) is less than 10 MMBtu/hr
45CSR21 – To Prevent and Control Air Pollution from the Emission of Volatile Organic Compounds: All storage tanks at the Lanham station, which are listed as insignificant sources, are below 40,000 gallons in capacity which exempts the facility from 45CSR§21-28. Lanham Station is not engaged in the extraction or fractionation of natural gas which exempts the facility from 45CSR§21-29
45CSR27 – To Prevent and Control the Emissions of Toxic Air Pollutants: 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."

☑ Permit Shield

19. Non Applicability Determinations *(Continued)* *- Attach additional pages as necessary.*

List all requirements which the source has determined not applicable and for which a permit shield is requested. The listing shall also include the rule citation and the reason why the shield applies.

40 CFR 60 Subpart Dc – Standards of Performance for Steam Generating Units: The heating system boiler and line heater at this facility are both less than 10 mmBtu/hr; Hence Subpart Dc is not applicable in accordance with 60.40c(a)

40 CFR 60 Subpart GG – Standards of Performance for Stationary Gas Turbines: There are no turbine engines at this facility.

40 CFR 60 Subparts K,Ka – Standards of Performance for Storage Vessels for Petroleum Liquids: All tanks at the facility are below 40,000 gallons in capacity as specified in 60.110a(a)

40 CFR 60 Subpart Kb – Standards of Performance for Volatile Organic Liquid Storage Vessels: All tanks at the facility are below 75m3 (19,813 gallons) in capacity as specified in 60.110b(a)

40 CFR 60 Subpart KKK – Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plant: The Lanham Station is not engaged in the extraction or fractionation of natural gas liquids from field gas, the fractionation of mixed natural gas liquids to natural gas products, or both.

40 CFR 60 Subpart IIII – Standards of Performance for Stationary compression Ignition Internal Combustion Engines: There are no compression ignition engines at this facility.

40 CFR 60 Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines: All engines at the facility were constructed, reconstructed, or modified prior to the June 12, 2006 applicability date listed in 60.4230(a)(4)

40 CFR 60 Subpart OOOO – Standards Of Performance For Crude Oil And Natural Gas Facilities For Which Construction, Modification, Or Reconstruction Commenced After August 23, 2011, And On Or Before September 18, 2015: This subpart does not apply to the facility since the facility is a transmission facility. So it is exempt from the requirements for gas wells, centrifugal compressors, reciprocating compressors, and/or pneumatic controllers. Although this applies to storage vessels located at transmission facilities, there have been no storage vessels constructed, modified, or reconstructed after August 23, 2011 in accordance with 60.5365(e).

40 CFR 60 Subpart OOOOa – Standards Of Performance For Crude Oil And Natural Gas Facilities For Which Construction, Modification, Or Reconstruction Commenced After September 18, 2015: There are no affected sources that have been constructed since the promulgation of this rule at Lanham Compressor Station. Therefore, the facility is exempt from the requirements of the rule.

40 CFR 60 Subpart KKKK – Standards of Performance for Stationary Combustion Turbines – There are no turbine engines at this facility.

40 CFR 63 Subpart HHH – National Emission Standards for Hazardous Air Pollutants from Natural Gas Transmission and Storage Facilities: The facility does not have a glycol dehydration unit and therefore is not subject to the requirements of this subpart.

40 CFR 63 Subpart YYYY – Turbine MACT: There are no turbines at this facility

40 CFR 64 – Compliance Assurance Monitoring (CAM): There are no add-on controls at this facility; therefore, in accordance with 40CFR§64.2(a), CAM is not applicable to this facility.

☑ Permit Shield

20. Facility-Wide Applicable Requirements

List all facility-wide applicable requirements. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*).

3.1.1 – 45 CSR 6-3.1 – Open burning prohibited
3.1.2 – 45 CSR 6-3.2 – Open burning exemption stipulations
3.1.3 – 40 CFR Part 61 and 45 CSR 34 – Asbestos inspection and removal
3.1.4 – 45 CSR 4 – No objectionable odors
3.1.5 – 45 CSR 11-5.2 – Standby plans for emergency episodes
3.1.6 – WV Code 22-5-4 (a) (14) – The annual emission inventory reporting
3.1.7 – 40 CFR Part 82 Subpart F – Ozone depleting substances
3.1.8 – 40 CFR Part 68 – Risk Management Plan
3.1.9 – 45 CSR 30-12.7 – Odor Control for Mercaptan
3.1.10 – 45 CSR 30-12.7 – Emergency Operating Conditions / unit replacement
3.3.1 – 45 CSR 22-5-4(a)(14-15) & 45CSR13 - Stack Testing - Conduct stack testing as required
3.4.1 – 45 CSR 30-5.1 - Monitoring information – general monitoring requirements
3.4.2 – 45 CSR 30-5.1 - Retention of records - Maintain records for a period of 5 years
3.4.3 – 45 CSR 30-5.1 - Odors - Maintain records of odor complaints and corrective actions
3.4.4 – 45 CSR 17.3 – Fugitive PM shall not cause statutory Air Pollution
3.5.1 – 45 CSR 30-4.4. and 5.1.c.3.D – All documents required by permit shall be certified by a Responsible Offi
3.5.2 – 45 CSR 30-5.1.c.3.E. - A permittee may request confidential treatment
3.5.3 – 45 CSR 30-5 - Communication required or permitted to be made to the DEP and/or USEPA
3.5.4 – 45 CSR 30-8 - Certified emissions statement – Operator will Submit a certified emissions statement and pay fees on an annual basis
3.5.5 – 45 CSR 30-5.3.e. - Compliance certification. The permittee shall certify compliance with the conditions of this permit on the forms provided by the DAQ
3.5.6 – 45 SR§30-5.1.c.3.A - Semi-annual monitoring reports.
3.5.7 – 45 CSR 30-5.7.a through e. - Emergencies
3.5.8 – 45 CSR 30-5.1.c.3.B. and C. - Deviations
3.5.9 – 45 CSR 30-4.3.h.1.B. New applicable requirements. If any requirement is promulgated, the permittee will meet such requirements on a timely basis

☑ Permit Shield

For all facility-wide applicable requirements listed above, provide monitoring/testing / recordkeeping / reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number and/or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

3.1.3 – 40 CFR Part 61 and 45 CSR 34 – Prior to demolition/construction buildings will be inspected for asbestos and documented accordingly
3.1.4 – 45 CSR 4 – Permittee shall maintain records of all odor complaints received
3.1.5 – 45 CSR 11 – Upon request by the Secretary, the permittee shall prepare a standby plan
3.1.6 – WV 22-5-4 – The permittee shall submit annual emission inventory reports
3.1.7 – 40 CFR Part 82 Subpart F – The permittee will prohibit maintenance, service, or repair of appliances containing ozone depleting substances without persons certified pursuant to 40 CFR 82.161
3.1.8 – 40 CFR Part 68 – Should the permittee become subject to 40 CFR Part 68, a RMP shall be submitted
3.1.10 – 45CSR§30-12.7 For emergency situations which interrupt the critical supply of natural gas to the public, and which pose a life threatening circumstance to the customer, the permittee is allowed to temporarily replace failed engine(s). Proper notice will be provided to the WVDAQ
3.3.1 – 45 CSR 22-5-4 Stack Testing – All protocols and reports will be submitted to the WVDAQ
3.4.1 & 3.4.2 – 45 CSR 30-5.1 Retention of Records - Maintain records of all information required by permit for 5 yrs.
3.4.3 – 45 CSR 30-5.1 Odors - Maintain records of all odor complaints and responses.
3.5.1 – 45 CSR 30-4.4 and 5.1 Responsible Official - Reports, certifications, etc. shall contain a certification by the responsible official.
3.5.4 – 45 CSR 30-8 Certified emissions statement – Operator will Submit a certified emissions statement and pay fees on an annual basis
3.5.5 – 45 SR§30-5.3.e Compliance Certification - Prepare and submit an emission inventory as requested
3.5.6 – 45 CSR§30-5.1.c.3.A. Semi-annual monitoring reports.
3.5.7 – 45 CSR30-5.7.a through e. - For reporting emergency situations, refer to Section 2.17 of this permit
3.5.8 – 45 CSR 30-5.1.c.3.B. and C. – Deviations, In addition to required monitoring reports, the permittee shall promptly submit supplemental reports and notices of deviations / include upset conditions, cause of deviation(s) and corrective actions.
3.5.9 – 45 CSR 30-4.3.h.1.B. New applicable requirements. If any requirement is promulgated, the permittee will meet such requirements on a timely basis

Are you in compliance with all facility-wide applicable requirements? ☑ Yes ☐ No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

20. Facility-Wide Applicable Requirements *(Continued)* - *Attach additional pages as necessary.*

List all facility-wide applicable requirements. For each applicable requirement, include the rule citation and/or permit with the condition number.

☐ Permit Shield

For all facility-wide applicable requirements listed above, provide monitoring/testing/recordkeeping/ reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number and/or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.)

Are you in compliance with all facility-wide applicable requirements? ☐ Yes ☐ No

If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

21. Active Permits/Consent Orders		
Permit or Consent Order Number	Date of Issuance MM/DD/YYYY	List any Permit Determinations that Affect the Permit *(if any)*
R13-3397	04/17/2018	

22. Inactive Permits/Obsolete Permit Conditions		
Permit Number	Date of Issuance	Permit Condition Number

Section 3: Facility-Wide Emissions

23. Facility-Wide Emissions Summary [Tons per Year]	
Criteria Pollutants	Potential Emissions
Carbon Monoxide (CO)	164.07
Nitrogen Oxides (NO_X)	1,841.29
Lead (Pb)	--
Particulate Matter ($PM_{2.5}$)[1]	21.10
Particulate Matter (PM_{10})[1]	21.10
Total Particulate Matter (TSP)	--
Sulfur Dioxide (SO_2)	0.32
Volatile Organic Compounds (VOC)	61.90
Hazardous Air Pollutants[2]	Potential Emissions
Total HAPs	34.88
Formaldehyde	23.94
Regulated Pollutants other than Criteria and HAP	Potential Emissions

[1]$PM_{2.5}$ and PM_{10} are components of TSP.
[2]For HAPs that are also considered PM or VOCs, emissions should be included in both the HAPs section and the Criteria Pollutants section.

Section 4: Insignificant Activities

24. Insignificant Activities (Check all that apply)		
☑	1.	Air compressors and pneumatically operated equipment, including hand tools.
☐	2.	Air contaminant detectors or recorders, combustion controllers or shutoffs.
☑	3.	Any consumer product used in the same manner as in normal consumer use, provided the use results in a duration and frequency of exposure which are not greater than those experienced by consumer, and which may include, but not be limited to, personal use items; janitorial cleaning supplies, office supplies and supplies to maintain copying equipment.
☐	4.	Bathroom/toilet vent emissions.
☑	5.	Batteries and battery charging stations, except at battery manufacturing plants.
☐	6.	Bench-scale laboratory equipment used for physical or chemical analysis, but not lab fume hoods or vents. Many lab fume hoods or vents might qualify for treatment as insignificant (depending on the applicable SIP) or be grouped together for purposes of description.
☐	7.	Blacksmith forges.
☐	8.	Boiler water treatment operations, not including cooling towers.
☑	9.	Brazing, soldering or welding equipment used as an auxiliary to the principal equipment at the source.
☐	10.	CO_2 lasers, used only on metals and other materials which do not emit HAP in the process.
☑	11.	Combustion emissions from propulsion of mobile sources, except for vessel emissions from Outer Continental Shelf sources.
☑	12.	Combustion units designed and used exclusively for comfort heating that use liquid petroleum gas or natural gas as fuel.
☑	13.	Comfort air conditioning or ventilation systems not used to remove air contaminants generated by or released from specific units of equipment.
☐	14.	Demineralized water tanks and demineralizer vents.
☐	15.	Drop hammers or hydraulic presses for forging or metalworking.
☐	16.	Electric or steam-heated drying ovens and autoclaves, but not the emissions from the articles or substances being processed in the ovens or autoclaves or the boilers delivering the steam.
☐	17.	Emergency (backup) electrical generators at residential locations.
☐	18.	Emergency road flares.
☑	19.	Emission units which do not have any applicable requirements and which emit criteria pollutants (CO, NO_x, SO_2, VOC and PM) into the atmosphere at a rate of less than 1 pound per hour and less than 10,000 pounds per year aggregate total for each criteria pollutant from all emission units. Please specify all emission units for which this exemption applies along with the quantity of criteria pollutants emitted on an hourly and annual basis:

Tank Emissions

Tank ID	Tank Type	VOC Emissions	
		lb/hr	tpy
A01	Lube Oil	7.49E-11	3.28E-10
A05	Wastewater	5.48E-13	2.40E-12
A07	Pipeline Liquids	0.10	0.45
A08	Pipeline Liquids	0.10	0.45
A13	Wastewater	4.41E-13	1.93E-12
A14	Lube Oil	6.52E-12	2.85E-11
A15	Lube Oil	2.59E-11	1.13E-10
A16	Pipeline Liquids	0.12	0.50
A17 - A21	Lube Oil	2.34E-12	1.02E-11
A22	Wastewater	8.39E-14	3.68E-13
A24	Glycol	2.16E-06	9.46E-06
B01	Glycol	3.81E-06	1.67E-05
B02	Glycol Water	1.87E-06	8.21E-06
		0.32	1.40

24. Insignificant Activities (Check all that apply)		
☑	20.	Emission units which do not have any applicable requirements and which emit hazardous air pollutants into the atmosphere at a rate of less than 0.1 pounds per hour and less than 1,000 pounds per year aggregate total for all HAPs from all emission sources. This limitation cannot be used for any source which emits dioxin/furans nor for toxic air pollutants as per 45CSR27. Please specify all emission units for which this exemption applies along with the quantity of hazardous air pollutants emitted on an hourly and annual basis:

Tank Emissions			
Tank ID	Tank Type	HAP Emissions	
		lb/hr	tpy
A07	Pipeline Liquids	0.01	0.06
A08	Pipeline Liquids	0.01	0.06
A16	Pipeline Liquids	0.01	0.07
		0.04	0.18

☐	21.	Environmental chambers not using hazardous air pollutant (HAP) gases.
☑	22.	Equipment on the premises of industrial and manufacturing operations used solely for the purpose of preparing food for human consumption.
☐	23.	Equipment used exclusively to slaughter animals, but not including other equipment at slaughterhouses, such as rendering cookers, boilers, heating plants, incinerators, and electrical power generating equipment.
☐	24.	Equipment used for quality control/assurance or inspection purposes, including sampling equipment used to withdraw materials for analysis.
☐	25.	Equipment used for surface coating, painting, dipping or spray operations, except those that will emit VOC or HAP.
☑	26.	Fire suppression systems.
☑	27.	Firefighting equipment and the equipment used to train firefighters.
☑	28.	Flares used solely to indicate danger to the public.
☑	29.	Fugitive emission related to movement of passenger vehicle provided the emissions are not counted for applicability purposes and any required fugitive dust control plan or its equivalent is submitted.
☐	30.	Hand-held applicator equipment for hot melt adhesives with no VOC in the adhesive formulation.
☑	31.	Hand-held equipment for buffing, polishing, cutting, drilling, sawing, grinding, turning or machining wood, metal or plastic.
☐	32.	Humidity chambers.
☐	33.	Hydraulic and hydrostatic testing equipment.
☐	34.	Indoor or outdoor kerosene heaters.
☑	35.	Internal combustion engines used for landscaping purposes.
☐	36.	Laser trimmers using dust collection to prevent fugitive emissions.
☐	37.	Laundry activities, except for dry-cleaning and steam boilers.
☐	38.	Natural gas pressure regulator vents, excluding venting at oil and gas production facilities.
☐	39.	Oxygen scavenging (de-aeration) of water.
☐	40.	Ozone generators.

24. Insignificant Activities (Check all that apply)		
☑	41.	Plant maintenance and upkeep activities (e.g., grounds-keeping, general repairs, cleaning, painting, welding, plumbing, re-tarring roofs, installing insulation, and paving parking lots) provided these activities are not conducted as part of a manufacturing process, are not related to the source's primary business activity, and not otherwise triggering a permit modification. (Cleaning and painting activities qualify if they are not subject to VOC or HAP control requirements. Asphalt batch plant owners/operators must still get a permit if otherwise requested.)
☑	42.	Portable electrical generators that can be moved by hand from one location to another. "Moved by Hand" means that it can be moved without the assistance of any motorized or non-motorized vehicle, conveyance, or device.
☐	43.	Process water filtration systems and demineralizers.
☐	44.	Repair or maintenance shop activities not related to the source's primary business activity, not including emissions from surface coating or de-greasing (solvent metal cleaning) activities, and not otherwise triggering a permit modification.
☐	45.	Repairs or maintenance where no structural repairs are made and where no new air pollutant emitting facilities are installed or modified.
☐	46.	Routing calibration and maintenance of laboratory equipment or other analytical instruments.
☐	47.	Salt baths using nonvolatile salts that do not result in emissions of any regulated air pollutants. Shock chambers.
☐	48.	Shock chambers.
☐	49.	Solar simulators.
☑	50.	Space heaters operating by direct heat transfer.
☐	51.	Steam cleaning operations.
☐	52.	Steam leaks.
☐	53.	Steam sterilizers.
☐	54.	Steam vents and safety relief valves.
☐	55.	Storage tanks, reservoirs, and pumping and handling equipment of any size containing soaps, vegetable oil, grease, animal fat, and nonvolatile aqueous salt solutions, provided appropriate lids and covers are utilized.
☐	56.	Storage tanks, vessels, and containers holding or storing liquid substances that will not emit any VOC or HAP. Exemptions for storage tanks containing petroleum liquids or other volatile organic liquids should be based on size limits such as storage tank capacity and vapor pressure of liquids stored and are not appropriate for this list.
☐	57.	Such other sources or activities as the Director may determine.
☐	58.	Tobacco smoking rooms and areas.
☐	59.	Vents from continuous emissions monitors and other analyzers.

Section 5: Emission Units, Control Devices, and Emission Points

25. Equipment Table
Fill out the **Title V Equipment Table** and provide it as **ATTACHMENT D**.
26. Emission Units
For each emission unit listed in the **Title V Equipment Table**, fill out and provide an **Emission Unit Form** as **ATTACHMENT E**.
For each emission unit not in compliance with an applicable requirement, fill out a **Schedule of Compliance Form** as **ATTACHMENT F**.
27. Control Devices
For each control device listed in the **Title V Equipment Table**, fill out and provide an **Air Pollution Control Device Form** as **ATTACHMENT G**.
For any control device that is required on an emission unit in order to meet a standard or limitation for which the potential pre-control device emissions of an applicable regulated air pollutant is greater than or equal to the Title V Major Source Threshold Level, refer to the **Compliance Assurance Monitoring (CAM) Form(s)** for CAM applicability. Fill out and provide these forms, if applicable, for each Pollutant Specific Emission Unit (PSEU) as **ATTACHMENT H**.

28. Certification of Truth, Accuracy and Completeness and Certification of Compliance

*Note: This Certification must be signed by a responsible official. The **original**, signed in **blue ink**, must be submitted with the application. Applications without an **original** signed certification will be considered as incomplete.*

a. Certification of Truth, Accuracy and Completeness

I certify that I am a responsible official (as defined at 45CSR§30-2.38) and am accordingly authorized to make this submission on behalf of the owners or operators of the source described in this document and its attachments. I certify under penalty of law that I have personally examined and am familiar with the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine and/or imprisonment.

b. Compliance Certification

Except for requirements identified in the Title V Application for which compliance is not achieved, I, the undersigned hereby certify that, based on information and belief formed after reasonable inquiry, all air contaminant sources identified in this application are in compliance with all applicable requirements.

Responsible official (type or print)

Name: Richard Smith	Title: Operations Manager

Responsible official's signature:

Signature: Richard L. Smith Signature Date: 12/1/20
(Must be signed and dated in blue ink)

Received
December 1, 2020
WV DEP/Div of Air Quality

Note: Please check all applicable attachments included with this permit application:

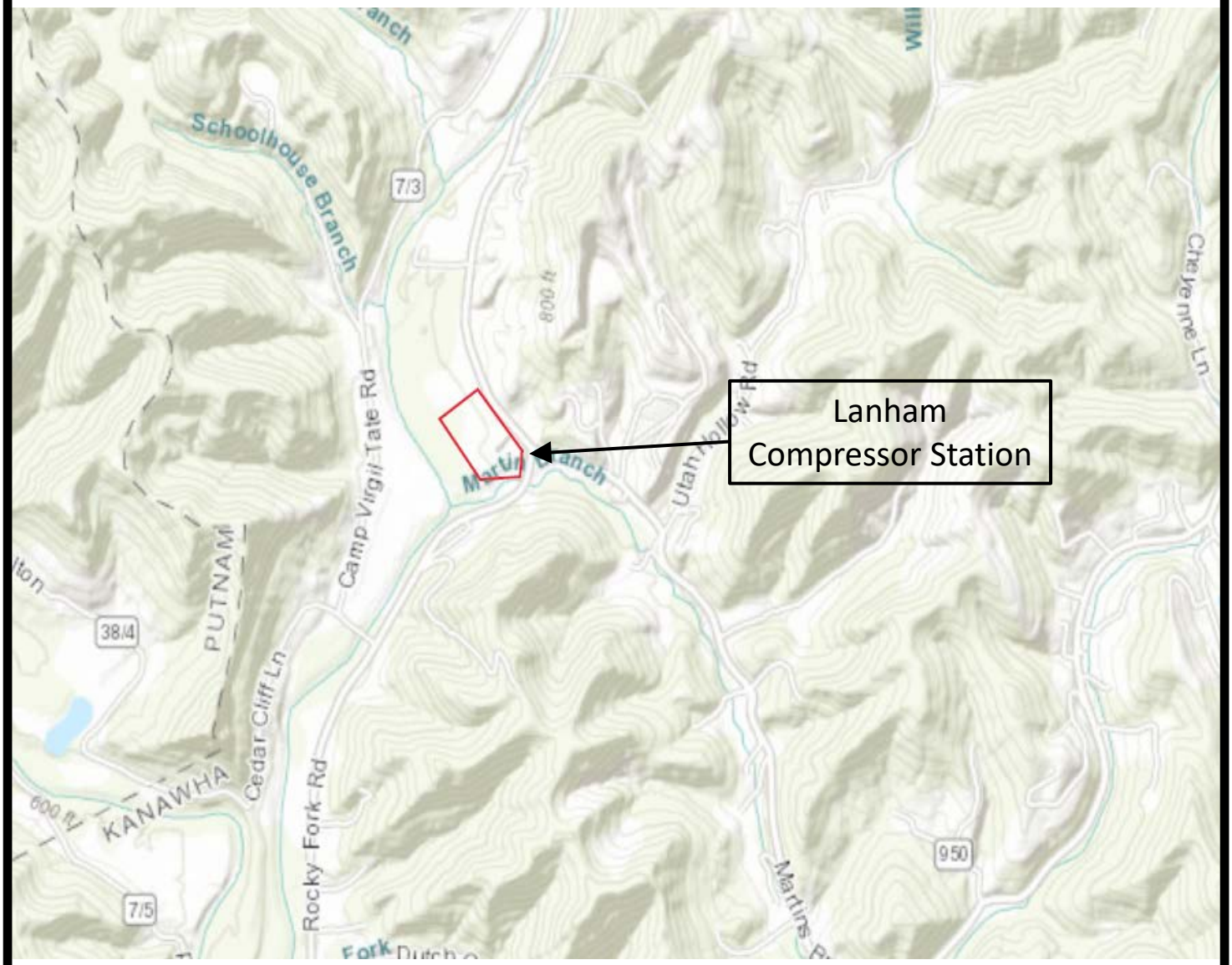
☑	ATTACHMENT A: Area Map
☑	ATTACHMENT B: Plot Plan(s)
☑	ATTACHMENT C: Process Flow Diagram(s)
☑	ATTACHMENT D: Equipment Table
☑	ATTACHMENT E: Emission Unit Form(s)
☐	ATTACHMENT F: Schedule of Compliance Form(s)
☐	ATTACHMENT G: Air Pollution Control Device Form(s)
☐	ATTACHMENT H: Compliance Assurance Monitoring (CAM) Form(s)

All of the required forms and additional information can be found and downloaded from, the DEP website at www.dep.wv.gov/daq, requested by phone (304) 926-0475, and/or obtained through the mail.

Attachment A

Area Map

Attachment A – Site Map



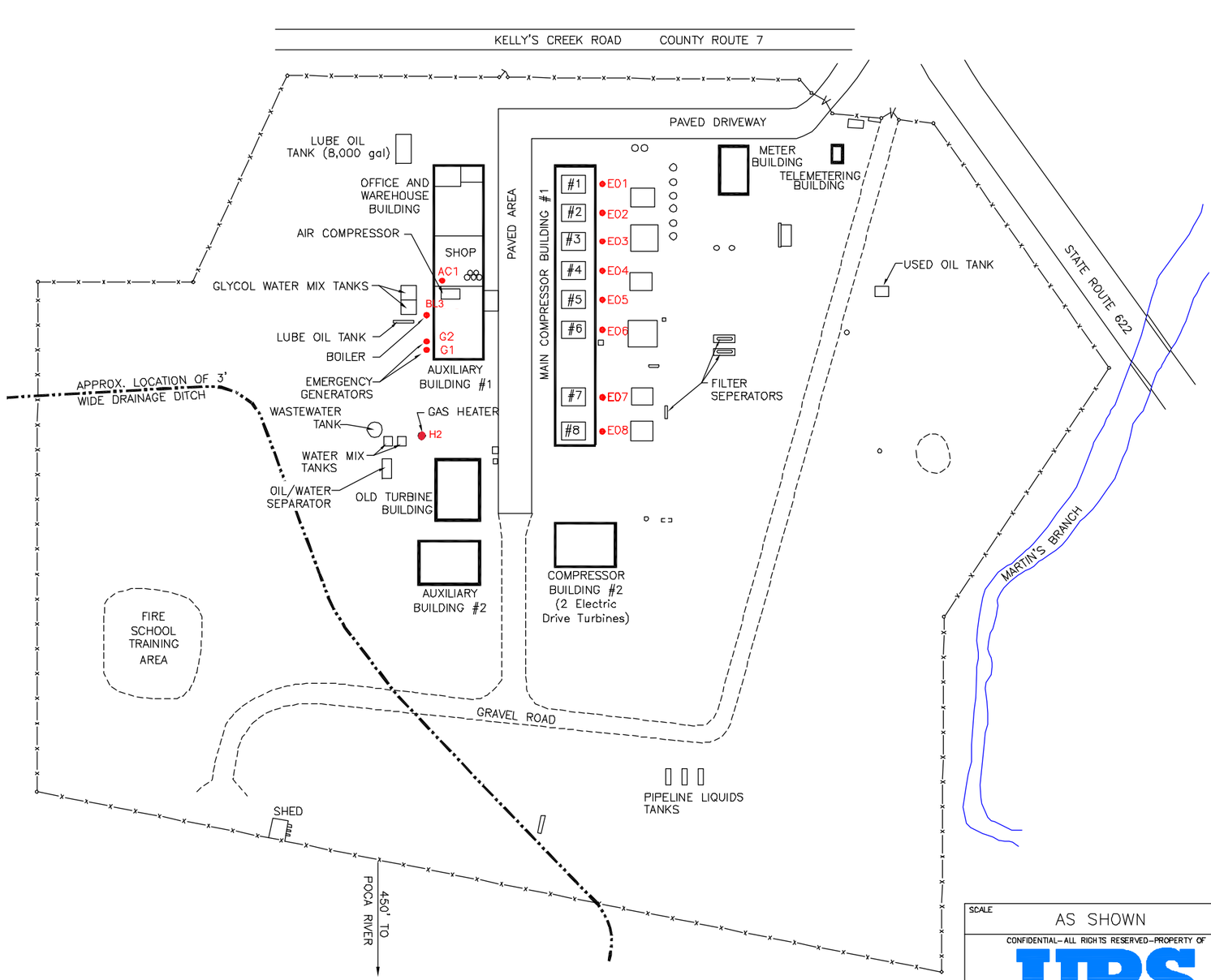
Traveling on I-64, take exit for WV-622N toward Cross Lanes. Continue on Route 622 for 3.6 miles. Turn left onto WV-622N/Rocky Fork Rd/Sissonville and continue 4.5 miles. Turn left onto Kellys Creek Rd and the facility is located immediately on the left.

Date: December 2020

Attachment A - Site Map
Lanham Compressor Station

Attachment B

Plot Plan



SIGNIFICANT EMISSION UNITS

Emission Point ID Number	Equipment Category
E01	Recip Engine/Integral Compressor No. 02301
E02	Recip Engine/Integral Compressor No. 02302
E03	Recip Engine/Integral Compressor No. 02303
E04	Recip Engine/Integral Compressor No. 02304
E05	Recip Engine/Integral Compressor No. 02305
E06	Recip Engine/Integral Compressor No. 02306
E07	Recip Engine/Integral Compressor No. 02307
E08	Recip Engine/Integral Compressor No. 02308
G1	Recip Engine/Generator No. 023G1
G2	Recip Engine/Generator No. 023G2
AC1	Recip Engine/Air Compressor No. 023A1
H2	Line Heater
BL3	Heating System Boiler

KEY

- FENCE LINE
- PROPERTY BOUNDARY
- NATURAL GAS PIPE LINE
- EMISSION POINT

ELEVATION = 600 FEET
LAT. 38°28'38" LONG. 81°42'39"

100 0 100

SCALE IN FEET

SCALE	DESIGNED BY	DATE	DRAWING TITLE
AS SHOWN			Site Plan Columbia Gas Transmission Corp. Lanham Station
	DRAWN BY TSH	DATE 22SEP10	
	CHECKED BY DW	DATE 22SEP10	CAD DRAWING FILE:
	APPROVED BY DW	DATE 22SEP10	CONTRACT NO. 31827062 / DRAWING NO. LANH-BM3 / REV. 0

CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF

URS

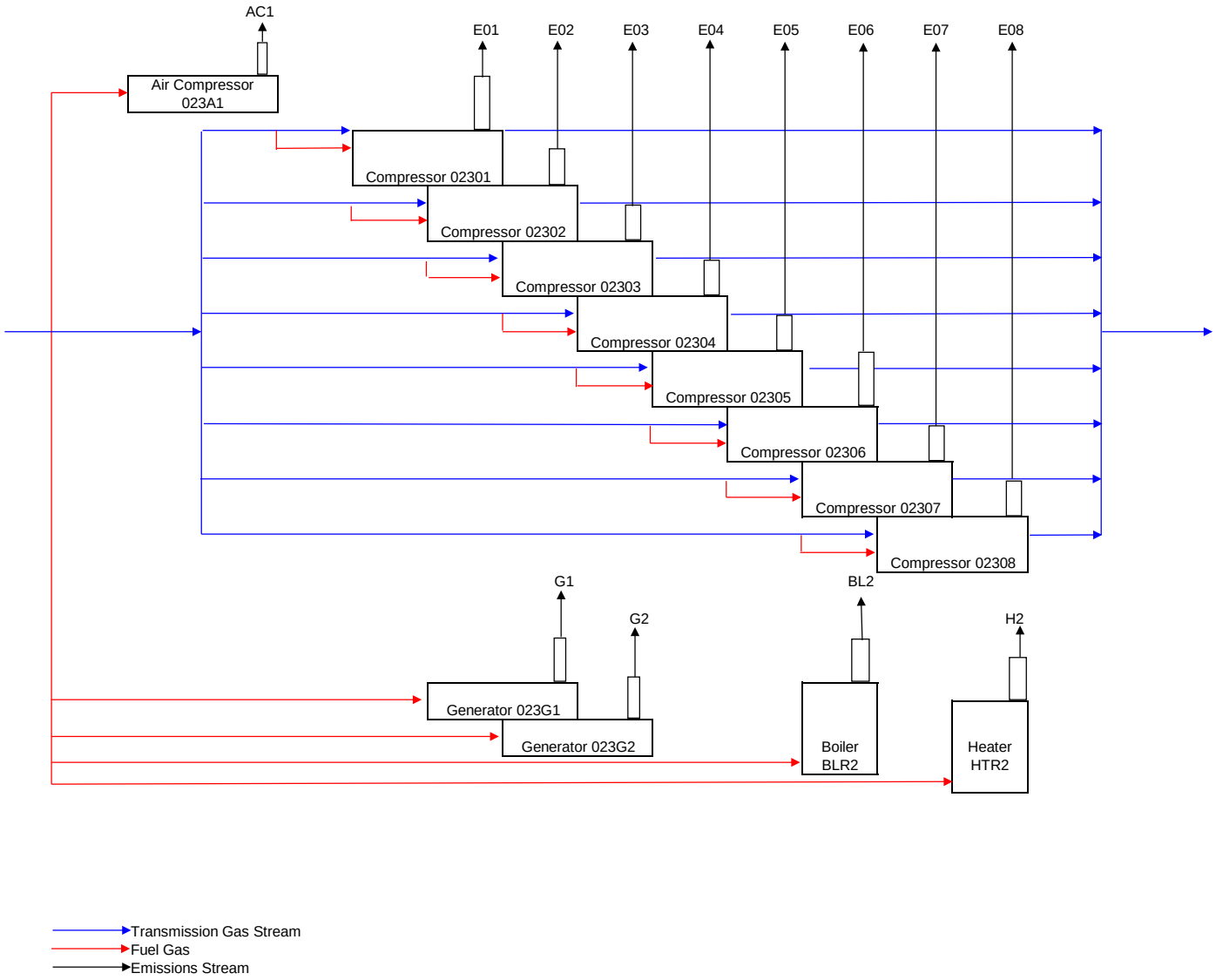
RDU, NORTH CAROLINA 27560

P:\Common Projects\COLUMBIA\GENERAL\CADD\Lanh-bm3.dwg September 23, 2010 - 3:01 PM

Attachment C

Process Flow Diagram

Attachment C - Process Flow Diagram
Lanham Compressor Station



Attachment D

Equipment Table

ATTACHMENT D - Title V Equipment Table (includes all emission units at the facility except those designated as insignificant activities in Section 4, Item 24 of the General Forms)

Emission Point ID[1]	Control Device[1]	Emission Unit ID[1]	Emission Unit Description	Design Capacity	Year Installed/ Modified
E01	N/A	02301	Reciprocating Engine/Integral Compressor; Cooper Bessemer GMV-8STF, 2SLB	1,100 hp	1951
E02	N/A	02302	Reciprocating Engine/Integral Compressor; Cooper Bessemer GMV-8STF, 2SLB	1,100 hp	1951
E03	N/A	02303	Reciprocating Engine/Integral Compressor; Cooper Bessemer GMV-8STF, 2SLB	1,100 hp	1951
E04	N/A	02304	Reciprocating Engine/Integral Compressor; Cooper Bessemer GMV-GMVA-8, 2SLB	1,100 hp	1954
E05	N/A	02305	Reciprocating Engine/Integral Compressor; Cooper Bessemer GMV-GMVA-8, 2SLB	1,100 hp	1954
E06	N/A	02306	Reciprocating Engine/Integral Compressor; Cooper Bessemer GMV-GMVA-8, 2SLB	1,100 hp	1954
E07	N/A	02307	Reciprocating Engine/Integral Compressor; Cooper Bessemer 8V-250, 2SLB	2,700 hp	1965
E08	N/A	02308	Reciprocating Engine/Integral Compressor; Cooper Bessemer 8V-250, 2SLB	2,700 hp	1968
AC1	N/A	023AC1	Reciprocating Engine/Air Compressor; Wisconsin W4-1770, 4SRB	35 hp	1983
BL3	N/A	BLR3	Heating System Boiler; Burnham Model BCCR-G-25	3.897 MMBtu/hr	2012
H2	N/A	HTR2	Natural Gas Line Heater; TERI 500	0.54 MMBtu/hr	2018
G1	N/A	023G1	Reciprocating Engine/Generator; Ingersoll-Rand PVG-6, 4SRB	275 hp	1951
G2	N/A	023G2	Reciprocating Engine/Generator; Ingersoll-Rand PVG-6, 4SRB	306 hp	1951

[1]For 45CSR13 permitted sources, the numbering system used for the emission points, control devices, and emission units should be consistent with the numbering system used in the 45CSR13 permit. For grandfathered sources, the numbering system should be consistent with registrations or emissions inventory previously submitted to DAQ. For emission points, control devices, and emissions units which have not been previously labeled, use the following 45CSR13 numbering system: 1S, 2S, 3S,... or other appropriate description for emission units; 1C, 2C, 3C,... or other appropriate designation for control devices; 1E, 2E, 3E, ... or other appropriate designation for emission points.

Attachment E

Emission Unit Forms

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02301	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	GMV-8STF	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1951	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 1,100 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760 hours/yr

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1,100 hp	**Type and Btu/hr rating of burners:** 8,800 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
10,439 scf/hr
83,132,400 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02301)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02302	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	GMV-8STF	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1951	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 1,100 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1,100 hp	**Type and Btu/hr rating of burners:** 8,800 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
10,439 scf/hr
83,132,400 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data

Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02302)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02303	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	GMV-8STF	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1951	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 1,100 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1,100 hp	**Type and Btu/hr rating of burners:** 8,800 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.
Natural Gas
10,439 scf/hr
83,132,400 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A.

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02303)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02304	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	GMVA-8	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1954	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 1,100 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1,100 hp	**Type and Btu/hr rating of burners:** 8,400 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
9,965 scf/hr
79,355,294 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02304)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02305	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	GMVA-8	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1954	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 1,100 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1,100 hp	**Type and Btu/hr rating of burners:** 8,400 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
9,965 scf/hr
79,355,294 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02305)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02306	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	GMVA-8	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1954	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 1,100 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 1,100 hp	**Type and Btu/hr rating of burners:** 8,400 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
9,965 scf/hr
79,355,294 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02306)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02307	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	8V-250	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1965	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 2,700 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 2,700 hp	**Type and Btu/hr rating of burners:** 7,800 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
22,712 scf/hr
180,868,235 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02307)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
02308	Reciprocating Engine/Integral Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

2-cycle, lean burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Cooper-Bessemer	8V-250	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1968	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 2,700 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 2,700 hp	**Type and Btu/hr rating of burners:** 7,800 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
22,712 scf/hr
180,868,235 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. There are no specific applicable requirements for this engine (Emission Unit ID: 02308)
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) None
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
023A1	Reciprocating Engine/Air Compressor	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):

4-cycle, rich burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Wisconsin	W4-1770	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1983	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 35 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 35 hp	**Type and Btu/hr rating of burners:** 10,600 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.

Natural Gas
364 scf/hr
181,863 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. 40 C.F.R. § 63.6602 and Table 2c (Line 6) – Maintenance Requirements 40 C.F.R. § 63.6605 - Operating Requirements 40 C.F.R. § 63.6625 (e)(2), (f), (h), and (j) – Monitoring Requirements 40 C.F.R. § 63.6640 and Table 6 (Line 9) – Continuous compliance requirements 40 C.F.R. § 63.6665 - General requirements/provisions
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) 40 C.F.R. § 63.6602 and Table 2c (Line 6) – Change oil and filter every 500 hours of operation, or annually whichever comes first; inspect spark plugs every 1000 hours of operation, or annually, whichever occurs first; inspect hoses every 500 hours of operation, or annually, whichever occurs first and replace as necessary 40 C.F.R. §§ 63.6605 & 63.6640 and Table 6 (Line 9) – Work or Management Practices: Operate and Maintain the RICE according to the manufacturer's instructions OR develop and follow your own maintenance plan 40 C.F.R. § 63.6625 (e) (2) – Operate and maintain the RICE according to the manufacturer's instructions OR develop and follow your own maintenance plan 40 C.F.R. § 63.6625 (f) – Install and monitor hours of operation 40 C.F.R. § 63.6625 (h) – Minimize Idle Time during Startup to not exceed 30 Minutes 40 C.F.R. § 63.6625 (j) – Oil Analysis Program in lieu of Oil change requirement in Table 2c 40 C.F.R. § 63.6655 (except b & c) – Keep records of maintenance conducted and operating schedule on the RICE
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
BLR3	Heating System Boiler	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Heating system boiler

Manufacturer:	**Model number:**	**Serial number:**
Burnham	BCCR3-G-25	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	2012	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 3.897 mmBtu/hr

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X_ Yes ___ No	**If yes, is it?** _X_ Indirect Fired __ Direct Fired
Maximum design heat input and/or maximum horsepower rating: 3.897 mmBtu/hr	**Type and Btu/hr rating of burners:** 3.897 mmBtu/hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.
Natural Gas
3,821 scf/hr
33,469,000 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. 45CSR§2-3.1. – Opacity Limit; shall not exceed ten (10) percent opacity 40 CFR 63.7500(a)(1) – Table 3, Item 1 – Tune Up every five (5) years 40 CFR 63.7500(a)(1) – Table 3, Item 4 – One time energy audit 40 CFR 63.7500(e) – Five (5) year tune up cycle
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) 45CSR§30-5.1.c – (Opacity) Compliance shall be determined using Method 22. If visible emissions observed using Method 22, conduct a Method 9 reading unless the cause for visible emissions is corrected within 24 hours. Records of observation will be kept for at least 5 years from date of observation. 40 CFR 63.7510(e) – Initial Compliance – Tune up by January 31, 2016 according to 63.7540(a)(10)(i)-(iv); Initial tune-up conducted on 11/9/2015. 40 CFR 63.7510(e) – Continuous Compliance – Energy assessment by January 31, 2016 according to Table 3, Item 4; Energy assessment conducted in May 2015. 40 CFR 63.7515(d) – Subsequent tune ups according to 63.7540(a)(12). 5-year tune-up scheduled for completion in November 2020. 40 CFR 63.7545(e) – Initial Reporting – Notification of compliance status report shall be submitted by March 31, 2016 and shall include information specified by (e)(1) and (e)(8). Initial notification submitted to WVDEP on March 16, 2016. 40 CFR 63.7550 (b)(5) – Ongoing reporting – Submit tune up report every five (5) years with T5 semi-annual reports. Report shall contain information specified in (63.7550(c)(1). Tune up report for the 5-year tune up scheduled for completion in November 2020 will be submitted by January 31, 2021.
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
HTR2	Natural Gas Line Heater	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
Line heater

Manufacturer:	**Model number:**	**Serial number:**
TERI	500	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	2018	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 0.54 mmBtu/hr

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	8,760

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? _X_ Yes ___ No	**If yes, is it?** _X_ Indirect Fired Direct Fired
Maximum design heat input and/or maximum horsepower rating: 0.54 mmBtu/hr	**Type and Btu/hr rating of burners:** 0.54 mmBtu/hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.
Natural Gas
529 scf/hr
4,637,647 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or <u>construction permit</u> with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. 45CSR§2-3.1. – Opacity Limit; shall not exceed ten (10) percent opacity 40 CFR 63.7500(a)(1) – Table 3, Item 1 – Tune Up every five (5) years 40 CFR 63.7500(a)(1) – Table 3, Item 4 – One time energy audit 40 CFR 63.7500(e) – Five (5) year tune up cycle
<u>X</u> Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) 45CSR§30-5.1.c – (Opacity) Compliance shall be determined using Method 22. If visible emissions observed using Method 22, conduct a Method 9 reading unless the cause for visible emissions is corrected within 24 hours. Records of observation will be kept for at least 5 years from date of observation. 40 CFR 63.7510(e) – Initial Compliance – Initial compliance tune up according to 63.7540(a)(10)(i)-(iv). 40 CFR 63.7510(e) – Continuous Compliance – Energy assessment according to Table 3, Item 4. 40 CFR 63.7515(d) – Subsequent tune ups according to 63.7540(a)(12). 40 CFR 63.7545(e) – Initial Reporting – Notification of compliance status report shall include information specified by (e)(1) and (e)(8). 40 CFR 63.7550 (b)(5) – Ongoing reporting – Submit tune up report every five (5) years with T5 semi-annual reports. Report shall contain information specified in (63.7550(c)(1).
Are you in compliance with all applicable requirements for this emission unit? <u>X</u> Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
023G1	Reciprocating Engine/Generator	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
4-cycle, rich burn reciprocating engine

Manufacturer:	**Model number:**	**Serial number:**
Ingersoll-Rand	PVG-6	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1951	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 275 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	500 hr/yr

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 275 hp	**Type and Btu/hr rating of burners:** 10,600 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.
Natural Gas
2,858 scf/hr
1,428,922 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A.	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. 40 C.F.R. § 63.6602 and Table 2c (Line 6) – Maintenance Requirements 40 C.F.R. § 63.6605 - Operating Requirements 40 C.F.R. § 63.6625 (e)(2), (f), (h), and (j) – Monitoring Requirements 40 C.F.R. § 63.6640 and Table 6 (Line 9) – Continuous compliance requirements 40 C.F.R. § 63.6665 - General requirements/provisions
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) 40 C.F.R. § 63.6602 and Table 2c (Line 6) – Change oil and filter every 500 hours of operation, or annually whichever comes first; inspect spark plugs every 1000 hours of operation, or annually, whichever occurs first; inspect hoses every 500 hours of operation, or annually, whichever occurs first and replace as necessary 40 C.F.R. §§ 63.6605 & 63.6640 and Table 6 (Line 9) – Work or Management Practices: Operate and Maintain the RICE according to the manufacturer's instructions OR develop and follow your own maintenance plan 40 C.F.R. § 63.6625 (e) (2) – Operate and maintain the RICE according to the manufacturer's instructions OR develop and follow your own maintenance plan 40 C.F.R. § 63.6625 (f) – Install and monitor hours of operation 40 C.F.R. § 63.6625 (h) – Minimize Idle Time during Startup to not exceed 30 Minutes 40 C.F.R. § 63.6625 (j) – Oil Analysis Program in lieu of Oil change requirement in Table 2c 40 C.F.R. § 63.6655 (except b & c) – Keep records of maintenance conducted and operating schedule on the RICE
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

ATTACHMENT E - Emission Unit Form

Emission Unit Description

Emission unit ID number	**Emission unit name:**	**List any control devices associated with this emission unit:**
023G2	Reciprocating Engine/Generator	NA

Provide a description of the emission unit (type, method of operation, design parameters, etc.):
4-cycle, rich burn reciprocating compressor

Manufacturer:	**Model number:**	**Serial number:**
Ingersoll-Rand	PVG-6	NA
Construction date:	**Installation date:**	**Modification date(s):**
NA	1951	NA

Design Capacity (examples: furnaces - tons/hr, tanks - gallons): 306 hp

Maximum Hourly Throughput:	**Maximum Annual Throughput:**	**Maximum Operating Schedule:**
NA	NA	500 hr/yr

Fuel Usage Data **(fill out all applicable fields)**

Does this emission unit combust fuel? X Yes ___ No	**If yes, is it?** __ Indirect Fired X Direct Fired
Maximum design heat input and/or maximum horsepower rating: 306 hp	**Type and Btu/hr rating of burners:** 10,600 Btu/hp-hr

List the primary fuel type(s) and if applicable, the secondary fuel type(s). For each fuel type listed, provide the maximum hourly and annual fuel usage for each.
Natural Gas
3,180 scf/hr
1,590,000 scf/yr

Describe each fuel expected to be used during the term of the permit.

Fuel Type	Max. Sulfur Content	Max. Ash Content	BTU Value
Natural Gas	Pipeline Quality		1,020 Btu/scf

Emissions Data		
Criteria Pollutants	Potential Emissions	
	PPH	TPY
Carbon Monoxide (CO)	See Appendix A	
Nitrogen Oxides (NO_X)		
Lead (Pb)		
Particulate Matter ($PM_{2.5}$)		
Particulate Matter (PM_{10})		
Total Particulate Matter (TSP)		
Sulfur Dioxide (SO_2)		
Volatile Organic Compounds (VOC)		
Hazardous Air Pollutants	Potential Emissions	
	PPH	TPY
	See Appendix A	
Regulated Pollutants other than Criteria and HAP	Potential Emissions	
	PPH	TPY

List the method(s) used to calculate the potential emissions (include dates of any stack tests conducted, versions of software used, source and dates of emission factors, etc.).

See Appendix A

Applicable Requirements
List all applicable requirements for this emission unit. For each applicable requirement, include the underlying rule/regulation citation and/or construction permit with the condition number. (*Note: Title V permit condition numbers alone are not the underlying applicable requirements*). If an emission limit is calculated based on the type of source and design capacity or if a standard is based on a design parameter, this information should also be included. 40 C.F.R. § 63.6602 and Table 2c (Line 6) – Maintenance Requirements 40 C.F.R. § 63.6605 - Operating Requirements 40 C.F.R. § 63.6625 (e)(2), (f), (h), and (j) – Monitoring Requirements 40 C.F.R. § 63.6640 and Table 6 (Line 9) – Continuous compliance requirements 40 C.F.R. § 63.6665 - General requirements/provisions
X Permit Shield
For all applicable requirements listed above, provide monitoring/testing/recordkeeping/reporting which shall be used to demonstrate compliance. If the method is based on a permit or rule, include the condition number or citation. (Note: Each requirement listed above must have an associated method of demonstrating compliance. If there is not already a required method in place, then a method must be proposed.) 40 C.F.R. § 63.6602 and Table 2c (Line 6) – Change oil and filter every 500 hours of operation, or annually whichever comes first; inspect spark plugs every 1000 hours of operation, or annually, whichever occurs first; inspect hoses every 500 hours of operation, or annually, whichever occurs first and replace as necessary 40 C.F.R. §§ 63.6605 & 63.6640 and Table 6 (Line 9) – Work or Management Practices: Operate and Maintain the RICE according to the manufacturer's instructions OR develop and follow your own maintenance plan 40 C.F.R. § 63.6625 (e) (2) – Operate and maintain the RICE according to the manufacturer's instructions OR develop and follow your own maintenance plan 40 C.F.R. § 63.6625 (f) – Install and monitor hours of operation 40 C.F.R. § 63.6625 (h) – Minimize Idle Time during Startup to not exceed 30 Minutes 40 C.F.R. § 63.6625 (j) – Oil Analysis Program in lieu of Oil change requirement in Table 2c 40 C.F.R. § 63.6655 (except b & c) – Keep records of maintenance conducted and operating schedule on the RICE
Are you in compliance with all applicable requirements for this emission unit? X Yes ___No If no, complete the **Schedule of Compliance Form** as **ATTACHMENT F**.

Appendix A

Emission Calculations

Columbia Gas Transmission, LLC
Lanham Compressor Station
Application Supplement - Facility Total PTE

Source	Rating	Annual Emissions (tpy)						
		NO_x	CO	$PM_{10}/PM_{2.5}$	VOC	SO_2	CH_2O	Total HAP
Compressor Engines (E01-E03)	1100 HP each	560.82	63.74	6.14	15.26	0.09	7.02	10.12
Compressor Engines (E04-E06)	1100 HP each	92.36	14.60	5.87	14.57	0.09	6.70	9.66
Compressor Engines (E07-E08)	2700 HP each	1,183	78.05	8.91	22.14	0.13	10.18	14.67
Emergency Generator (G1)	275 HP	1.61	2.71	0.01	0.02	5.20E-04	0.01	0.02
Emergency Generator (G2)	306 HP	1.79	3.02	0.02	0.02	5.79E-04	0.02	0.03
Air Compressor Engine (AC1)	35 HP	0.20	0.35	1.80E-03	2.75E-03	6.62E-05	1.90E-03	3.01E-03
Heating System Boiler (BL3)	3.897 MMBtu/hr	1.67	1.41	0.13	0.09	0.01	1.26E-03	0.03
Process Heater (HTR2)	0.54 MMBtu/hr	0.23	0.19	0.02	0.01	1.69E-03	1.74E-04	4.38E-03
Tanks		--	--	--	1.40	--	--	0.18
Equipment Leaks (Fugitive Emissions)		--	--	--	3.67	--	--	0.07
Pigging		--	--	--	0.13	--	--	2.43E-03
Blowdowns		--	--	--	8.24	--	--	0.16
Facility PTE[1]		1,841.29	164.07	21.10	61.90	0.32	23.94	34.88

Notes:
1. Excludes fugitive emissions (compressor stations are not one of the named soure categories that include fugitive emissions).
2. Fugitive emissions are not part of PSD applicability analysis.
3. Per 6-23-2014 Supreme Court decisions, applicability of PSD or Title V permitting cannot be triggered by GHG emissions.

Columbia Gas Transmission, LLC
Lanham Compressor Station
E01 through E03 - Cooper-Bessemer GMV-8STF 2SLB Reciprocating Engines

Horsepower	1100	HP
Maximum Horsepower	1210	HP
Brake Specific Fuel Consumption	8800	Btu/Bhp-hr
Total Heat Input	9.68	MMBtu/hr
Maximum Heat Input	10.65	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	83.13	MMscf/yr
	10,439	scf/hr based on maximum heat input
Quantity	3	

Pollutant	Emission Factor		Emission Rate			Emission Factor Reference
	lb/bhp-hr	lb/MMBtu	lb/hr[1]	ton/yr (1 engine)	ton/yr (3 engines)	
NO_x (Maximum Hourly)	7.75E-02		93.78			CGT Test
NO_x (Average Annual)	3.88E-02			186.94	560.82	CGT Test
CO (Maximum Hourly)	8.81E-03		10.66			CGT Test
CO (Average Annual)	4.41E-03			21.25	63.74	CGT Test
CO_2e		117.1	1,247	4,965	14,894	40 CFR 98 Subpart C
PM_{10}		0.048	0.51	2.05	6.14	AP-42 Table 3.2-1 (7/00) - 2SLB
$PM_{2.5}$		0.048	0.51	2.05	6.14	AP-42 Table 3.2-1 (7/00) - 2SLB
VOC		0.120	1.28	5.09	15.26	AP-42 Table 3.2-1 (7/00) - 2SLB
SO_2 (Maximum Hourly)		0.0571	0.61			20 grains S / 100 scf
SO_2 (Average Annual)		0.000714		0.03	0.09	0.25 grains S / 100 scf
Formaldehyde		0.0552	0.59	2.34	7.02	AP-42 Table 3.2-1 (7/00) - 2SLB
Total HAPs		0.07954	0.85	3.37	10.12	AP-42 Table 3.2-1 (7/00) - 2SLB

1. Maximum hourly emission rate based on maximum horsepower under optimum conditions (10% greater than site rating).

Columbia Gas Transmission, LLC
Lanham Compressor Station
E04 through E06 - Cooper-Bessemer GMVA-8 2SLB Reciprocating Engines

Horsepower	1100	HP
Maximum Horsepower	1210	HP
Brake Specific Fuel Consumption	8400	Btu/Bhp-hr
Total Heat Input	9.24	MMBtu/hr
Maximum Heat Input	10.16	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	79.36	MMscf/yr
	9,965	scf/hr based on maximum heat input
Quantity	3	

Pollutant	Emission Factor		Emission Rate			Emission Factor Reference
	lb/bhp-hr	lb/MMBtu	lb/hr[1]	ton/yr (1 engine)	ton/yr (3 engines)	
NO_x (Maximum Hourly)	9.25E-03		11.19			CGT Test
NO_x (Average Annual)	6.39E-03			30.79	92.36	CGT Test
CO (Maximum Hourly)	1.30E-03		1.57			CGT Test
CO (Average Annual)	1.01E-03			4.87	14.60	CGT Test
CO_2e		117.1	1,190	4,739	14,217	40 CFR 98 Subpart C
PM_{10}		0.048	0.49	1.96	5.87	AP-42 Table 3.2-1 (7/00) - 2SLB
$PM_{2.5}$		0.048	0.49	1.96	5.87	AP-42 Table 3.2-1 (7/00) - 2SLB
VOC		0.120	1.22	4.86	14.57	AP-42 Table 3.2-1 (7/00) - 2SLB
SO_2 (Maximum Hourly)		0.0571	0.58			20 grains S / 100 scf
SO_2 (Average Annual)		0.000714		0.03	0.09	0.25 grains S / 100 scf
Formaldehyde		0.0552	0.56	2.23	6.70	AP-42 Table 3.2-1 (7/00) - 2SLB
Total HAPs		0.07954	0.81	3.22	9.66	AP-42 Table 3.2-1 (7/00) - 2SLB

1. Maximum hourly emission rate based on maximum horsepower under optimum conditions (10% greater than site rating).

Columbia Gas Transmission, LLC
Lanham Compressor Station
E07 and E08 - Cooper-Bessemer 8V-250 2SLB Reciprocating Engines

Horsepower	2700	HP
Maximum Horsepower	2970	HP
Brake Specific Fuel Consumption	7800	Btu/Bhp-hr
Total Heat Input	21.06	MMBtu/hr
Maximum Heat Input	23.17	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	180.87	MMscf/yr
	22,712	scf/hr based on maximum heat input
Quantity	2	

Pollutant	Emission Factor		Emission Rate			Emission Factor Reference
	lb/bhp-hr	lb/MMBtu	lb/hr[1]	ton/yr (1 engine)	ton/yr (2 engines)	
NO_x (Maximum Hourly)	5.00E-02		148.50			CGT Test
NO_x (Average Annual)	5.00E-02			591.30	1,182.60	CGT Test
CO (Maximum Hourly)	6.61E-03		19.63			CGT Test
CO (Average Annual)	3.30E-03			39.03	78.05	CGT Test
CO_2e		117.1	2,713	10,801	21,603	40 CFR 98 Subpart C
PM_{10}		0.048	1.12	4.46	8.91	AP-42 Table 3.2-1 (7/00) - 2SLB
$PM_{2.5}$		0.048	1.12	4.46	8.91	AP-42 Table 3.2-1 (7/00) - 2SLB
VOC		0.120	2.78	11.07	22.14	AP-42 Table 3.2-1 (7/00) - 2SLB
SO_2 (Maximum Hourly)		0.0571	1.32			20 grains S / 100 scf
SO_2 (Average Annual)		0.000714		0.07	0.13	0.25 grains S / 100 scf
Formaldehyde		0.0552	1.28	5.09	10.18	AP-42 Table 3.2-1 (7/00) - 2SLB
Total HAPs		0.07954	1.84	7.34	14.67	AP-42 Table 3.2-1 (7/00) - 2SLB

1. Maximum hourly emission rate based on maximum horsepower under optimum conditions (10% greater than site rating).

Columbia Gulf Transmission, LLC
Lanham Compressor Station
Ingersoll-Rand PVG-6 Emergency Generator (G1)

Horsepower	275	HP
Maximum Horsepower	303	HP
Brake Specific Fuel Consumption	10600	Btu/Bhp-hr
Total Heat Input	2.92	MMBtu/hr
Maximum Heat Input	3.21	MMBtu/hr
Operating Hours	500	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	1.43	MMscf/yr
	2,858	scf/hr

Pollutant	Emission Factor	Emission Rate		Emission Factor Reference
	lb/MMBtu	lb/hr[1]	ton/yr	
NO_x	2.21	7.09	1.61	AP-42 Table 3.2-3 (7/00) - 4SRB
CO	3.72	11.93	2.71	AP-42 Table 3.2-3 (7/00) - 4SRB
CO_2e	117.1	375	85.34	40 CFR 98 Subpart C
PM_{10}	0.019	0.06	0.01	AP-42 Table 3.2-3 (7/00) - 4SRB
$PM_{2.5}$	0.019	0.06	0.01	AP-42 Table 3.2-3 (7/00) - 4SRB
VOC	0.0296	0.09	0.02	AP-42 Table 3.2-3 (7/00) - 4SRB
SO_2 (Maximum Hourly)	0.0571	0.18		20 grains S / 100 scf
SO_2 (Average Annual)	0.000714		5.20E-04	0.25 grains S / 100 scf
Formaldehyde	0.02050	0.07	0.01	AP-42 Table 3.2-3 (7/00) - 4SRB
Total HAPs	0.03242	0.10	0.02	AP-42 Table 3.2-3 (7/00) - 4SRB

1. Maximum hourly emission rate based on maximum horsepower under optimum conditions (10% greater than site rating).

Columbia Gulf Transmission, LLC
Lanham Compressor Station
Ingersoll-Rand PVG-6 Emergency Generator (G2)

Horsepower	306	HP
Maximum Horsepower	337	HP
Brake Specific Fuel Consumption	10600	Btu/Bhp-hr
Total Heat Input	3.24	MMBtu/hr
Maximum Heat Input	3.57	MMBtu/hr
Operating Hours	500	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	1.59	MMscf/yr
	3,180	scf/hr

Pollutant	Emission Factor	Emission Rate		Emission Factor Reference
	lb/MMBtu	lb/hr[1]	ton/yr	
NO_x	2.21	7.89	1.79	AP-42 Table 3.2-3 (7/00) - 4SRB
CO	3.72	13.27	3.02	AP-42 Table 3.2-3 (7/00) - 4SRB
CO_2e	117.1	418	94.95	40 CFR 98 Subpart C
PM_{10}	0.019	0.07	0.02	AP-42 Table 3.2-3 (7/00) - 4SRB
$PM_{2.5}$	0.019	0.07	0.02	AP-42 Table 3.2-3 (7/00) - 4SRB
VOC	0.0296	0.11	0.02	AP-42 Table 3.2-3 (7/00) - 4SRB
SO_2 (Maximum Hourly)	0.0571	0.20		20 grains S / 100 scf
SO_2 (Average Annual)	0.000714		5.79E-04	0.25 grains S / 100 scf
Formaldehyde	0.02050	0.07	0.02	AP-42 Table 3.2-3 (7/00) - 4SRB
Total HAPs	0.03242	0.12	0.03	AP-42 Table 3.2-3 (7/00) - 4SRB

1. Maximum hourly emission rate based on maximum horsepower under optimum conditions (10% greater than site rating).

Columbia Gulf Transmission, LLC
Lanham Compressor Station
Wisconsin W4-1770 Air Compressor Engine (AC1)

Horsepower	35	HP
Maximum Horsepower	39	HP
Brake Specific Fuel Consumption	10600	Btu/Bhp-hr
Total Heat Input	0.37	MMBtu/hr
Maximum Heat Input	0.41	MMBtu/hr
Operating Hours	500	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	0.18	MMscf/yr
	364	scf/hr

Pollutant	Emission Factor	Emission Rate		Emission Factor Reference
	lb/MMBtu	lb/hr[1]	ton/yr	
NO_x	2.21	0.90	0.20	AP-42 Table 3.2-3 (7/00) - 4SRB
CO	3.72	1.52	0.35	AP-42 Table 3.2-3 (7/00) - 4SRB
CO_2e	117.1	48	10.86	40 CFR 98 Subpart C
PM_{10}	0.019	0.01	1.80E-03	AP-42 Table 3.2-3 (7/00) - 4SRB
$PM_{2.5}$	0.019	0.01	1.80E-03	AP-42 Table 3.2-3 (7/00) - 4SRB
VOC	0.0296	0.01	2.75E-03	AP-42 Table 3.2-3 (7/00) - 4SRB
SO_2 (Maximum Hourly)	0.0571	0.02		20 grains S / 100 scf
SO_2 (Average Annual)	0.000714		6.62E-05	0.25 grains S / 100 scf
Formaldehyde	0.02050	0.01	1.90E-03	AP-42 Table 3.2-3 (7/00) - 4SRB
Total HAPs	0.03242	0.01	3.01E-03	AP-42 Table 3.2-3 (7/00) - 4SRB

1. Maximum hourly emission rate based on maximum horsepower under optimum conditions (10% greater than site rating).

Columbia Gas Transmission, LLC
Lanham Compressor Station
Heating System Boiler (BL3)

Heat Input	3.897	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	33.47	MMscf/yr
	3820.6	scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	lb/MMscf	lb/MMBtu	lb/hr	ton/yr	
NO_x	100	0.098	0.38	1.67	AP-42 Table 1.4-1 (7/98)
CO	84	0.082	0.32	1.41	AP-42 Table 1.4-1 (7/98)
CO_2e		117.1	456	1,999	40 CFR 98 Subpart C
PM_{10}	7.6	0.007	2.90E-02	0.13	AP-42 Table 1.4-2 (7/98)
$PM_{2.5}$	7.6	0.007	2.90E-02	0.13	AP-42 Table 1.4-2 (7/98)
VOC	5.5	0.005	2.10E-02	0.09	AP-42 Table 1.4-2 (7/98)
SO_2 (Maximum Hourly)		0.0571	0.22		20 grains S / 100 scf
SO_2 (Average Annual)		0.000714		0.01	0.25 grains S / 100 scf
Formaldehyde	0.075	0.00007	2.87E-04	1.26E-03	AP-42 Table 1.4-3 (7/98)
Total HAPs	1.89	0.00185	7.22E-03	0.03	AP-42 Table 1.4-3 & 4 (7/98)

Columbia Gas Transmission, LLC
Lanham Compressor Station
Line Heater (H2)

Heat Input	0.54	MMBtu/hr
Operating Hours	8760	hr/yr
Natural Gas Heat Content	1020	Btu/scf
Fuel Consumption	4.64	MMscf/yr
	529.4	scf/hr

Pollutant	Emission Factor		Emission Rate		Emission Factor Reference
	lb/MMscf	lb/MMBtu	lb/hr	ton/yr	
NO_x	100	0.098	0.05	0.23	AP-42 Table 1.4-1 (7/98)
CO	84	0.082	0.04	0.19	AP-42 Table 1.4-1 (7/98)
CO_2e		117.1	63	277	40 CFR 98 Subpart C
PM_{10}	7.6	0.007	0.00	0.02	AP-42 Table 1.4-2 (7/98)
$PM_{2.5}$	7.6	0.007	0.00	0.02	AP-42 Table 1.4-2 (7/98)
VOC	5.5	0.005	0.00	0.01	AP-42 Table 1.4-2 (7/98)
SO_2 (Maximum Hourly)		0.0571	0.03		20 grains S / 100 scf
SO_2 (Average Annual)		0.000714		1.69E-03	0.25 grains S / 100 scf
Formaldehyde	0.075	0.00007	3.97E-05	1.74E-04	AP-42 Table 1.4-3 (7/98)
Total HAPs	1.89	0.00185	1.00E-03	0.00	AP-42 Table 1.4-3 & 4 (7/98)

Columbia Gas Transmission, LLC
Lanham Compressor Station
Tank Emissions

Tank Emissions						
Tank ID	**Tank Type**	**Tank Capacity (gal)**	**VOC Emissions**		**HAP Emissions**	
			lb/hr	**tpy**	**lb/hr**	**tpy**
A01	Lube Oil	435	7.49E-11	3.28E-10	--	--
A05	Wastewater	2,000	5.48E-13	2.40E-12	--	--
A07	Pipeline Liquids	6,000	0.10	0.45	0.01	0.06
A08	Pipeline Liquids	6,000	0.10	0.45	0.01	0.06
A13	Wastewater	2,000	4.41E-13	1.93E-12	--	--
A14	Lube Oil	2,000	6.52E-12	2.85E-11	--	--
A15	Lube Oil	8,000	2.59E-11	1.13E-10	--	--
A16	Pipeline Liquids	6,000	0.12	0.50	0.01	0.07
A17 - A21	Lube Oil	75 each	2.34E-12	1.02E-11	--	--
A22	Wastewater	10,000	8.39E-14	3.68E-13	--	--
A24	Glycol	478	2.16E-06	9.46E-06	--	--
B01	Glycol	1,574	3.81E-06	1.67E-05	--	--
B02	Glycol Water	1,574	1.87E-06	8.21E-06	--	--
		Totals:	0.32	1.40	0.04	0.18

Notes:
- Working, Breathing, and Loading emissions for all tanks estimated utilizing AP-42 tank emission calculation methodologies via ProMax
- Tank A07, A08, and A16 flashing emissions estimated utilizing the Peng-Robinson equation of state via ProMax. ProMax calculations are attached.
- Representative pipeline liquid sample utilized to estimate Tank A07, A08, and A16 emissions. Representative sample is attached.
- HAPs/VOC weight ratio for representative pipeline liquids sample is 0.1290

Columbia Gas Transmission, LLC
Lanham Compressor Station
Blowdown Emissions

Component	Emission Rate (ton/yr)		
	CH_4 [1]	VOC [2]	HAPs [3]
Comprssor Blowdowns	272.42	7.75	0.15
Station Emergency Shutdown	17.20	0.49	0.01
Blowdown, Total	**289.62**	**8.24**	**0.16**

1. CH_4 emission rates based on 89.49 vol% CH_4 in annualized 2019 Lanham natural gas data
2. Based on a 0.028456 ratio of VOC to methane as calculated from Lanham gas composition data
3. Based on a 0.000547 ratio of HAPs to methane as calculated from Lanham gas composition data

Columbia Gas Transmission, LLC
Lanham Compressor Station
Blowdown Data

Lanham Facility Wide Emergency Shutdown (ESD) PTE Emission Calculations

Blowdown Emissions per Event (mscf/event): 908
Blowdown Events per Year: 1

Parameter	Gas Loss from ESD (mscf/yr)	CH4 Gas Loss (mscf/yr)	CO2 Gas Loss (mscf/yr)	CH4 Emissions (ton/yr)	CO2 Emissions (ton/yr)	CO2e Emissions (ton/yr)	VOC Emissions (ton/yr)	HAPs Emissions (ton/yr)
ESD Emissions	908	812.60	1.33	17.20	0.03	429.98	0.49	0.01

Notes:
- Gas loss volume based on TC Energy Engineering Department calculations using estimated facility piping volume, the average suction pressure, and discharge at MAOP. This volume would also be used when reporting ESD gas loss events at Lanham to PHMSA.

Compressor Startup/Shutdown PTE Emission Calculations

Unit	Startup/Shutdown Count	Average Gas Loss per Event for Unit (mscf/event)	Annual Gas Loss from Unit (mscf/yr)	CH4 Gas Loss (mscf/yr)	CO2 Gas Loss (mscf/yr)	CH4 Emissions (ton/yr)	CO2 Emissions (ton/yr)	CO2e Emissions (ton/yr)	VOC Emissions (ton/yr)	HAPs Emissions (ton/yr)
10	100	70.76	7,076	6,333	10.36	134.03	0.22	3351.03	3.81	0.07
11	100	73.06	7,306	6,539	10.70	138.39	0.23	3459.90	3.94	0.08
Total	--	--	14,383	12,872	21.06	272.42	0.45	6810.93	7.75	0.15

Notes:
- Reciprocating compressors at Lanham (Units E01-E08) have pressurized holds during startup and shutdown so do not have gas loss during the event

Columbia Gas Transmission, LLC
Lanham Compressor Station
Pigging Emissions

System	Emission Rate (ton/yr)		
	CH_4 [1]	VOC [2]	HAPs [3]
SM80 System	3.34	0.09	1.82E-03
X59 System	1.11	0.03	6.08E-04
Pigging, Total	**4.45**	**0.13**	**2.43E-03**

1. CH_4 emission rates based on 89.49 vol% CH_4 in annualized 2019 Lanham natural gas data
2. Based on a 0.028456 ratio of VOC to methane as calculated from Lanham gas composition data
3. Based on a 0.000547 ratio of HAPs to methane as calculated from Lanham gas composition data

Columbia Gas Transmission, LLC
Lanham Compressor Station
Pigging Data

System	Volume per Event[1] (Mcf)	Pigging Events per Year[2]	Annual Gas Loss from System (mscf/yr)	CH4 Gas Loss[3] (mscf/yr)	CO2 Gas Loss[3] (mscf/yr)	CH4 Emissions[4] (ton/yr)	CO2 Emissions[4] (ton/yr)	CO2e Emissions[5] (ton/yr)	VOC Emissions[6] (ton/yr)	HAPs Emissions[7] (ton/yr)
SM80 System	29.37	6	176.22	157.71	0.26	3.34	0.01	83.45	0.09	1.82E-03
X59 System	29.37	2	58.74	52.57	0.09	1.11	1.82E-03	27.82	0.03	6.08E-04
Total:			234.96	210.27	0.34	4.45	0.01	111.27	0.13	2.43E-03

Notes:

1. Representative gas loss volume per event at other WV facility with 36" diameter launcher/receiver. The launcher/receivers at Lanham are 30" diameter so this gas loss should be conservative.
2. Conservative estimate on number of pigging events per year from Lanham Operations for each pipeline system at Lanham.
3. CH4 and CO2 emission rates based on 89.49 vol% CH4 and 0.15 vol% CO2 in annualized 2019 Lanham natural gas data
4. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
5. Based on 40 CFR 98 Subpart A Global Warming Potentials
6. Based on a 0.028456 ratio of VOC to methane as calculated from Lanham gas composition data
7. Based on a 0.000547 ratio of HAPs to methane as calculated from Lanham gas composition data

Columbia Gas Transmission, LLC
Lanham Compressor Station
Equipment Leaks

Component	Emission Rate (ton/yr)		
	CH_4 [1]	VOC [2]	HAPs [3]
Equipment Leaks	129.07	3.67	0.07

1. CH_4 emission rates based on 89.49 vol% CH_4 in annualized 2019 Lanham natural gas data
2. Based on a 0.028456 ratio of VOC to methane as calculated from Lanham gas composition data
3. Based on a 0.000547 ratio of HAPs to methane as calculated from Lanham gas composition data

Columbia Gas Transmission, LLC
Lanham Compressor Station
Equipment Leaks

Component	Number of Components at Lanham[1]	Estimated Number of Leaking Components at Lanham[2]	Emission Factor[3]	Fugitive Emissions							
				Total	CH_4[4]	CO_2[4]	CH_4[5]	CO_2[5]	CO_2e[6]	VOC[7]	HAPs[8]
			scf/hr / component	scf/yr	scf/yr	scf/yr	ton/yr	ton/yr	ton/yr	ton/yr	ton/yr
Compressor Service											
Valve	588	12	14.84	1,559,981	1,396,082	2,284	29.55	0.13	738.81	0.84	1.62E-02
Connector	4073	82	5.59	4,015,409	3,593,531	5,879	76.05	0.34	1901.71	2.16	4.16E-02
Open-Ended Line	0	0	17.27	0	0	0	0.00	0.00	0.00	0.00	0.00E+00
Pressure Relief Valve	17	1	39.66	347,422	310,920	509	6.58	0.03	164.54	0.19	3.60E-03
Meter	0	0	19.33	0	0	0	0.00	0.00	0.00	0.00	0.00E+00
Non-Compressor Service											
Valve	161	4	6.42	224,957	201,322	329	4.26	0.02	106.54	0.12	2.33E-03
Connector	533	11	5.71	550,216	492,407	806	10.42	0.05	260.58	0.30	5.70E-03
Open-Ended Line	2	1	11.27	98,725	88,353	145	1.87	0.01	46.76	0.05	1.02E-03
Pressure Relief Valve	6	1	2.01	17,608	15,758	26	0.33	0.00	8.34	0.01	1.82E-04
Meter	0	0	2.93	0	0	0	0.00	0.00	0.00	0.00	0.00E+00
						Total:	129.07	0.58	3227.28	3.67	0.07

Notes:

1. Number of fugitive components at Lanham Compressor Station per Columbia Gas Transmission facility inventory data.
2. Estimated number of leaking components at Lanham utilizing a 2% component leak rate factor throughout the Columbia pipeline system obtained from fugitive leak survey results at Columbia facilities.
3. Emission factors from 40 CFR 98 Subpart W Table W-3
4. CH4 and CO2 emission rates based on 89.49 vol% CH4 and 0.15 vol% CO2 in annualized 2019 Lanham natural gas data
5. Conversion based on densities of GHG as provided in 40 CFR 98.233(v)
6. Based on 40 CFR 98 Subpart A Global Warming Potentials
7. Based on a 0.028456 ratio of VOC to methane as calculated from Lanham gas composition data
8. Based on a 0.000547 ratio of HAPs to methane as calculated from Lanham gas composition data

Columbia Gas Transmission, LLC
Lanham Compressor Station
Gas Analysis - 2019 Annualized Lanham Gas Data

			Mol %										
Date	**BTU**	**SG**	**CO2&N2**	**CO2**	**N2**	**Methane**	**Ethane**	**Propane**	**I-Butane**	**N-Butane**	**I-Pentane**	**N-Pentane**	**C6+**
2019 Annualized Average	1092.703201	0.613412614	0.618134189	0.146419344	0.471714845	89.49352964	9.065994924	0.616634415	0.042692434	0.089697406	0.017237949	0.016175006	0.039904

Compound	**GRI GLYCALC Estimated Speciation - Transmission (Co-efficient)**	**Lanham C6+ Result (Mol %)**	**Lanham Estimated Result (Mol %)**
Other hexanes	0.644	0.039904041	0.025698203
n-hexane	0.1883	0.039904041	0.007513931
heptane	0.0816	0.039904041	0.00325617
2,2,4 - Trimethylpentane	0.0111	0.039904041	0.000442935
Octanes +	0.0504	0.039904041	0.002011164
Benzene	0.0121	0.039904041	0.000482839
Toluene	0.0081	0.039904041	0.000323223
Ethylbenzene	0.0005	0.039904041	1.9952E-05
Xylenes	0.004	0.039904041	0.000159616

Totals	**Mol %**	**Weight %**
Total VOCs	0.822341252	2.309618649
Total HAPs	0.008942496	0.044366907

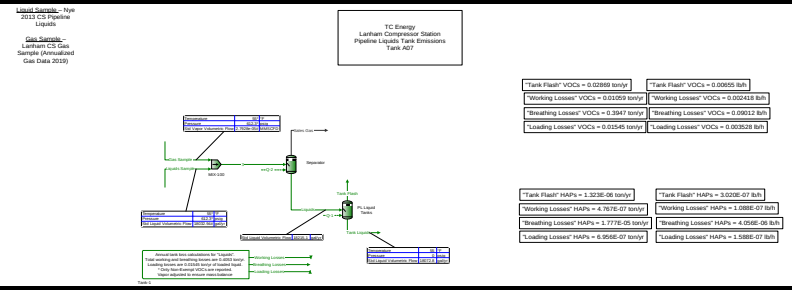
Ratios	**Mol**	**Weight**
VOC/Methane Ratio	0.009188835	0.028456002
HAPs/Methane Ratio	9.99234E-05	0.000546629

Mass Fraction Conversion Data

Compound	**Mol Weight (g/mol)**	**Mass in Gas Sample (g)**	**Mass Fraction**	**Mass %**
CO2	44.01	6.44	0.0036	0.3644
N2	28.02	13.22	0.0075	0.7473
Methane	16.04	1435.48	0.8116	81.1646
Ethane	30.07	272.61	0.1541	15.4141
Propane	44.09	27.19	0.0154	1.5372
I-Butane	58.12	2.48	0.0014	0.1403
N-Butane	58.12	5.21	0.0029	0.2948
I-Pentane	72.15	1.24	0.0007	0.0703
N-Pentane	72.15	1.17	0.0007	0.0660
Other hexanes	86.18	2.21	0.0013	0.1252
n-hexane	86.18	0.65	0.0004	0.0366
heptane	100.21	0.33	0.0002	0.0184
2,2,4 - Trimethylpentane	114.23	0.05	0.00003	0.0029
Octanes +	114.23	0.23	0.0001	0.0130
Benzene	78.11	0.04	0.00002	0.0021
Toluene	92.14	0.03	0.00002	0.0017
Ethylbenzene	106.17	0.002	0.000001	0.0001
Xylenes	106.17	0.02	0.00001	0.0010

Pipeline Liquids
Plant Schematic

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	



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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Connections

	Breathing Losses	Gas Sample	Liquids	Liquids Sample	Loading Losses
From Block	--	--	Separator	--	--
To Block	--	MIX-100	PL Liquid Tanks	MIX-100	--

Stream Composition

Mole Fraction	Breathing Losses %	Gas Sample %	Liquids %	Liquids Sample %	Loading Losses %
Carbon Dioxide	0.117674 *	0.146419 *	0.0036822	0 *	0.117674 *
Nitrogen	0.0610067 *	0.471715 *	0.0118628	0 *	0.0610067 *
Methane	30.6044 *	89.4935 *	2.25061	0 *	30.6044 *
Ethane	10.4837 *	9.06599 *	0.227995	0 *	10.4837 *
Propane	1.01635 *	0.616634 *	0.0155073	0 *	1.01635 *
i-Butane	0.0513828 *	0.0426924 *	0.00107364	0 *	0.0513828 *
n-Butane	0.0741808 *	0.0896974 *	0.00225574	0 *	0.0741808 *
i-Pentane	0.0048879 *	0.0172379 *	0.000433506	0 *	0.0048879 *
n-Pentane	0.00335483 *	0.016175 *	0.000406775	0 *	0.00335483 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	0.00316217 *	0.039904 *	0.00100352	0 *	0.00316217 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	57.5799 *	0 *	97.4852	100 *	57.5799 *

Molar Flow	Breathing Losses lbmol/h	Gas Sample lbmol/h	Liquids lbmol/h	Liquids Sample lbmol/h	Loading Losses lbmol/h
Carbon Dioxide	1.75166E-06 *	4.48994E-06 *	4.48994E-06	0 *	6.85771E-08 *
Nitrogen	9.08127E-07 *	1.44651E-05 *	1.44651E-05	0 *	3.55529E-08 *
Methane	0.000455568 *	0.00274431 *	0.00274431	0 *	1.78353E-05 *
Ethane	0.000156058 *	0.000278008 *	0.000278008	0 *	6.10961E-06 *
Propane	1.51291E-05 *	1.89091E-05 *	1.89091E-05	0 *	5.92301E-07 *
i-Butane	7.64869E-07 *	1.30916E-06 *	1.30916E-06	0 *	2.99444E-08 *
n-Butane	1.10423E-06 *	2.75057E-06 *	2.75057E-06	0 *	4.32304E-08 *
i-Pentane	7.27598E-08 *	5.28601E-07 *	5.28601E-07	0 *	2.84852E-09 *
n-Pentane	4.99389E-08 *	4.96006E-07 *	4.96006E-07	0 *	1.95509E-09 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	4.70712E-08 *	1.22366E-06 *	1.22366E-06	0 *	1.84282E-09 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Molar Flow	Breathing Losses lbmol/h	Gas Sample lbmol/h	Liquids lbmol/h	Liquids Sample lbmol/h	Loading Losses lbmol/h
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	0.000857116 *	0 *	0.11887	0.11887 *	3.35558E-05 *

Mass Fraction	Breathing Losses %	Gas Sample %	Liquids %	Liquids Sample %	Loading Losses %
Carbon Dioxide	0.0754106	0.364327 *	0.00158796	0 *	0.0754106
Nitrogen	0.0248856	0.747123 *	0.00325641	0 *	0.0248856
Methane	7.14923	81.1726 *	0.353799	0 *	7.14923
Ethane	4.59029	15.4128 *	0.0671782	0 *	4.59029
Propane	0.652596	1.53734 *	0.00670065	0 *	0.652596
i-Butane	0.0434875	0.140294 *	0.000611486	0 *	0.0434875
n-Butane	0.0627824	0.29476 *	0.00128474	0 *	0.0627824
i-Pentane	0.00513518	0.0703172 *	0.000306484	0 *	0.00513518
n-Pentane	0.00352455	0.0659812 *	0.000287585	0 *	0.00352455
i-Hexane	0	0 *	0	0 *	0
Heptane	0	0 *	0	0 *	0
Octane	0	0 *	0	0 *	0
Nonane	0	0 *	0	0 *	0
Benzene	0	0 *	0	0 *	0
Toluene	0	0 *	0	0 *	0
Ethylbenzene	0	0 *	0	0 *	0
m-Xylene	0	0 *	0	0 *	0
n-Hexane	0.00396801	0.194423 *	0.00084741	0 *	0.00396801
2,2,4-Trimethylpentane	0	0 *	0	0 *	0
Neopentane	0	0 *	0	0 *	0
Decanes Plus	0	0 *	0	0 *	0
Water	0	0 *	0	0 *	0
Helium	0	0 *	0	0 *	0
Hydrogen	0	0 *	0	0 *	0
Oxygen	0	0 *	0	0 *	0
Liquids Sample	87.3887	0 *	99.5641	100 *	87.3887

Mass Flow	Breathing Losses lb/h	Gas Sample lb/h	Liquids lb/h	Liquids Sample lb/h	Loading Losses lb/h
Carbon Dioxide	7.70898E-05 *	0.0001976 *	0.0001976	0 *	3.01804E-06 *
Nitrogen	2.54397E-05 *	0.000405217 *	0.000405217	0 *	9.95957E-07 *
Methane	0.00730843 *	0.0440256 *	0.0440256	0 *	0.000286123 *
Ethane	0.0046925 *	0.00835944 *	0.00835944	0 *	0.00018371 *
Propane	0.000667128 *	0.000833807 *	0.000833807	0 *	2.61179E-05 *
i-Butane	4.44559E-05 *	7.60913E-05 *	7.60913E-05	0 *	1.74043E-06 *
n-Butane	6.41805E-05 *	0.000159869 *	0.000159869	0 *	2.51264E-06 *
i-Pentane	5.24953E-06 *	3.81379E-05 *	3.81379E-05	0 *	2.05517E-07 *
n-Pentane	3.60303E-06 *	3.57862E-05 *	3.57862E-05	0 *	1.41058E-07 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	4.05637E-06 *	0.000105449 *	0.000105449	0 *	1.58806E-07 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *

* User Specified Values
? Extrapolated or Approximate Values

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Mass Flow	Breathing Losses lb/h	Gas Sample lb/h	Liquids lb/h	Liquids Sample lb/h	Loading Losses lb/h
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	0.0893346 *	0 *	12.3894	12.3894 *	0.00349742 *

Stream Properties

Property	Units	Breathing Losses	Gas Sample	Liquids	Liquids Sample	Loading Losses
Temperature	°F	70.4419	55 *	55	55 *	70.4419
Pressure	psia	1.02235	626.996 *	626.996	626.996 *	1.02235
Mole Fraction Vapor	%	100	100	0	0	100
Mole Fraction Light Liquid	%	0	0	100	100	0
Mole Fraction Heavy Liquid	%	0	0	0	0	0
Molecular Weight	lb/lbmol	68.6745	17.687	102.051	104.227	68.6745
Mass Density	lb/ft^3	0.0123726	2.28641	45.3044	45.4671	0.0123726
Molar Flow	lbmol/h	0.00148857	0.00306649	0.121936	0.11887	5.8277E-05
Mass Flow	lb/h	0.102227	0.054237	12.4437	12.3894	0.00400215
Vapor Volumetric Flow	ft^3/h	8.26238	0.0237215	0.274668	0.272493	0.32347
Liquid Volumetric Flow	gpm	1.03011	0.00295748	0.0342444	0.0339731	0.0403287
Std Vapor Volumetric Flow	MMSCFD	1.35573E-05	2.79285E-05 *	0.00111055	0.00108262	5.30765E-07
Std Liquid Volumetric Flow	sgpm	0.00032574	0.000346552	0.0346558	0.0343092 *	1.27526E-05
Compressibility		0.997482	0.878155	0.25571	0.260229	0.997482
Specific Gravity		2.37115	0.610685	0.726396	0.729004	2.37115
API Gravity				63.9295	63.2193	
Enthalpy	Btu/h	-82.233	-102.032	-10503.3	-10395.3	-3.21939
Mass Enthalpy	Btu/lb	-804.417	-1881.22	-844.067	-839.043	-804.417
Mass Cp	Btu/(lb*°F)	0.38186	0.59475	0.465238	0.463769	0.38186
Ideal Gas CpCv Ratio		1.082	1.28996	1.05738	1.05622	1.082
Dynamic Viscosity	cP	0.00713612	0.0115808	0.515199	0.53843	0.00713612
Kinematic Viscosity	cSt	36.0066	0.316201	0.709927	0.739285	36.0066
Thermal Conductivity	Btu/(h*ft*°F)	0.00979028	0.0201617	0.0642001	0.064265	0.00979028
Surface Tension	lbf/ft			0.0011822 ?	0.00154741	
Net Ideal Gas Heating Value	Btu/ft^3	3489.8	981.884	5127.53	5234.47	3489.8
Net Liquid Heating Value	Btu/lb	19136.2	21039.6	18908	18898.7	19136.2
Gross Ideal Gas Heating Value	Btu/ft^3	3756.84	1087.39	5499.37	5613.19	3756.84
Gross Liquid Heating Value	Btu/lb	20612	23303.6	20290.8	20277.6	20612

Remarks

* User Specified Values
? Extrapolated or Approximate Values

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Connections

	Sales Gas	Tank Flash	Tank Liquids	Working Losses	3
From Block	Separator	PL Liquid Tanks	PL Liquid Tanks	--	MIX-100
To Block	--	--	--	--	Separator

Stream Composition

Mole Fraction	Sales Gas %	Tank Flash %	Tank Liquids %	Working Losses %	3 %
Carbon Dioxide		0.100575	0.0017582	0.117674 *	0.0036822
Nitrogen		0.564054	0.000897951	0.0610067 *	0.0118628
Methane		92.5654	0.457227	30.6044 *	2.25061
Ethane		4.068	0.151744	10.4837 *	0.227995
Propane		0.090471	0.0140188	1.01635 *	0.0155073
i-Butane		0.00259022	0.00104353	0.0513828 *	0.00107364
n-Butane		0.00369156	0.00222723	0.0741808 *	0.00225574
i-Pentane		0.000235891	0.00043743	0.0048879 *	0.000433506
n-Pentane		0.000160359	0.000411668	0.00335483 *	0.000406775
i-Hexane		0	0	0 *	0
Heptane		0	0	0 *	0
Octane		0	0	0 *	0
Nonane		0	0	0 *	0
Benzene		0	0	0 *	0
Toluene		0	0	0 *	0
Ethylbenzene		0	0	0 *	0
m-Xylene		0	0	0 *	0
n-Hexane		0.000147613	0.00102052	0.00316217 *	0.00100352
2,2,4-Trimethylpentane		0	0	0 *	0
Neopentane		0	0	0 *	0
Decanes Plus		0	0	0 *	0
Water		0	0	0 *	0
Helium		0	0	0 *	0
Hydrogen		0	0	0 *	0
Oxygen		0	0	0 *	0
Liquids Sample		2.60471	99.3692	57.5799 *	97.4852

Molar Flow	Sales Gas lbmol/h	Tank Flash lbmol/h	Tank Liquids lbmol/h	Working Losses lbmol/h	3 lbmol/h
Carbon Dioxide	0	2.3878E-06	2.10214E-06	4.70002E-08 *	4.48994E-06
Nitrogen	0	1.33915E-05	1.07361E-06	2.43666E-08 *	1.44651E-05
Methane	0	0.00219764	0.00054667	1.22237E-05 *	0.00274431
Ethane	0	9.65805E-05	0.000181428	4.1873E-06 *	0.000278008
Propane	0	2.14792E-06	1.67611E-05	4.05941E-07 *	1.89091E-05
i-Butane	0	6.14958E-08	1.24767E-06	2.05228E-08 *	1.30916E-06
n-Butane	0	8.76432E-08	2.66292E-06	2.96285E-08 *	2.75057E-06
i-Pentane	0	5.60041E-09	5.23E-07	1.95227E-09 *	5.28601E-07
n-Pentane	0	3.80717E-09	4.92199E-07	1.33995E-09 *	4.96006E-07
i-Hexane	0	0	0	0 *	0
Heptane	0	0	0	0 *	0
Octane	0	0	0	0 *	0
Nonane	0	0	0	0 *	0
Benzene	0	0	0	0 *	0
Toluene	0	0	0	0 *	0
Ethylbenzene	0	0	0	0 *	0
m-Xylene	0	0	0	0 *	0
n-Hexane	0	3.50457E-09	1.22015E-06	1.263E-09 *	1.22366E-06
2,2,4-Trimethylpentane	0	0	0	0 *	0
Neopentane	0	0	0	0 *	0
Decanes Plus	0	0	0	0 *	0

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Molar Flow	Sales Gas lbmol/h	Tank Flash lbmol/h	Tank Liquids lbmol/h	Working Losses lbmol/h	3 lbmol/h
Water	0	0	0	0 *	0
Helium	0	0	0	0 *	0
Hydrogen	0	0	0	0 *	0
Oxygen	0	0	0	0 *	0
Liquids Sample	0	6.18398E-05	0.118808	2.29979E-05 *	0.11887

Mass Fraction	Sales Gas %	Tank Flash %	Tank Liquids %	Working Losses %	3 %
Carbon Dioxide		0.232544	0.000746174	0.0754106	0.00158796
Nitrogen		0.830149	0.000242573	0.0248856	0.00325641
Methane		78.017	0.0707339	7.14923	0.353799
Ethane		6.42643	0.0440002	4.59029	0.0671782
Propane		0.209592	0.00596115	0.652596	0.00670065
i-Butane		0.00790949	0.000584886	0.0434875	0.000611486
n-Butane		0.0112725	0.00124834	0.0627824	0.00128474
i-Pentane		0.000894149	0.000304342	0.00513518	0.000306484
n-Pentane		0.000607845	0.000286418	0.00352455	0.000287585
i-Hexane		0	0	0	0
Heptane		0	0	0	0
Octane		0	0	0	0
Nonane		0	0	0	0
Benzene		0	0	0	0
Toluene		0	0	0	0
Ethylbenzene		0	0	0	0
m-Xylene		0	0	0	0
n-Hexane		0.000668311	0.000848062	0.00396801	0.00084741
2,2,4-Trimethylpentane		0	0	0	0
Neopentane		0	0	0	0
Decanes Plus		0	0	0	0
Water		0	0	0	0
Helium		0	0	0	0
Hydrogen		0	0	0	0
Oxygen		0	0	0	0
Liquids Sample		14.2629	99.875	87.3887	99.5641

Mass Flow	Sales Gas lb/h	Tank Flash lb/h	Tank Liquids lb/h	Working Losses lb/h	3 lb/h
Carbon Dioxide	0	0.000105086	9.25143E-05	2.06846E-06 *	0.0001976
Nitrogen	0	0.000375142	3.00754E-05	6.82593E-07 *	0.000405217
Methane	0	0.0352556	0.00876994	0.000196098 *	0.0440256
Ethane	0	0.00290408	0.00545536	0.000125908 *	0.00835944
Propane	0	9.47139E-05	0.000739093	1.79002E-05 *	0.000833807
i-Butane	0	3.57427E-06	7.25171E-05	1.19283E-06 *	7.60913E-05
n-Butane	0	5.09402E-06	0.000154775	1.72208E-06 *	0.000159869
i-Pentane	0	4.04063E-07	3.77338E-05	1.40854E-07 *	3.81379E-05
n-Pentane	0	2.74683E-07	3.55115E-05	9.66758E-08 *	3.57862E-05
i-Hexane	0	0	0	0 *	0
Heptane	0	0	0	0 *	0
Octane	0	0	0	0 *	0
Nonane	0	0	0	0 *	0
Benzene	0	0	0	0 *	0
Toluene	0	0	0	0 *	0
Ethylbenzene	0	0	0	0 *	0
m-Xylene	0	0	0	0 *	0
n-Hexane	0	3.02007E-07	0.000105147	1.0884E-07 *	0.000105449
2,2,4-Trimethylpentane	0	0	0	0 *	0
Neopentane	0	0	0	0 *	0
Decanes Plus	0	0	0	0 *	0

* User Specified Values
? Extrapolated or Approximate Values

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Mass Flow	Sales Gas lb/h	Tank Flash lb/h	Tank Liquids lb/h	Working Losses lb/h	3 lb/h
Water	0	0	0	0 *	0
Helium	0	0	0	0 *	0
Hydrogen	0	0	0	0 *	0
Oxygen	0	0	0	0 *	0
Liquids Sample	0	0.00644537	12.383	0.00239701 *	12.3894

Stream Properties

Property	Units	Sales Gas	Tank Flash	Tank Liquids	Working Losses	3
Temperature	°F	55 *	55 *	55	70.4419	56.0344
Pressure	psia	626.996 *	14.6959 *	14.6959	1.02235	626.996
Mole Fraction Vapor	%		100	0	100	0
Mole Fraction Light Liquid	%		0	100	0	100
Mole Fraction Heavy Liquid	%		0	0	0	0
Molecular Weight	lb/lbmol		19.034	103.699	68.6745	102.051
Mass Density	lb/ft^3		0.0508158	45.1369	0.0123726	45.2741
Molar Flow	lbmol/h	0	0.00237415	0.119562	3.9941E-05	0.121936
Mass Flow	lb/h	0	0.0451897	12.3985	0.00274293	12.4437
Vapor Volumetric Flow	ft^3/h	0	0.889284	0.274686	0.221694	0.274852
Liquid Volumetric Flow	gpm	0	0.110872	0.0342466	0.0276398	0.0342673
Std Vapor Volumetric Flow	MMSCFD	0	2.16229E-05	0.00108893	3.63767E-07	0.00111055
Std Liquid Volumetric Flow	sgpm	0	0.000270774	0.034385	8.74017E-06	0.0346558
Compressibility			0.996637	0.00611291	0.997482	0.255368
Specific Gravity			0.657195	0.723711	2.37115	0.72591
API Gravity				64.6661		63.9295
Enthalpy	Btu/h	0	-79.3724	-10441	-2.20646	-10497.3
Mass Enthalpy	Btu/lb		-1756.43	-842.118	-804.417	-843.585
Mass Cp	Btu/(lb*°F)		0.491279	0.466172	0.38186	0.465915
Ideal Gas CpCv Ratio			1.27085	1.05649	1.082	1.05727
Dynamic Viscosity	cP		0.0104797	0.50159	0.00713612	0.511965
Kinematic Viscosity	cSt		12.8744	0.693738	36.0066	0.705943
Thermal Conductivity	Btu/(h*ft*°F)		0.0175967	0.0642423	0.00979028	0.0641637
Surface Tension	lbf/ft			0.00153247 ?		0.00117954 ?
Net Ideal Gas Heating Value	Btu/ft^3		1046.3	5208.57	3489.8	5127.53
Net Liquid Heating Value	Btu/lb		20827.1	18901	19136.2	18908
Gross Ideal Gas Heating Value	Btu/ft^3		1155.61	5585.62	3756.84	5499.37
Gross Liquid Heating Value	Btu/lb		23006.7	20280.9	20612	20290.8

Remarks

* User Specified Values
? Extrapolated or Approximate Values

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Energy Stream Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Energy Streams

Energy Stream	Energy Rate		Power		From Block	To Block
Q-1	-17.0618	Btu/h	-0.00670553	hp	--	PL Liquid Tanks
Q-2	-5.99298	Btu/h	-0.00235533	hp	--	Separator

Remarks

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Blocks
MIX-100
Mixer/Splitter Report

Client Name:	TC Energy	Job: Pipeline Liquids A07	
Location:	Lanham Compressor Station	Modified: 10:22 AM, 10/16/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 2:59 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Gas Sample	Inlet		Liquids Sample	Inlet	
3	Outlet	Separator			

Block Parameters

Pressure Drop	0	psi	Fraction to Stream 3	100	%
Flow Multiplier	100	%			

Remarks

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Blocks
PL Liquid Tanks
Separator Report

Client Name:	TC Energy	Job: Pipeline Liquids A07	
Location:	Lanham Compressor Station	Modified: 9:08 AM, 8/25/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 2:59 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Liquids	Inlet	Separator	Tank Flash	Vapor Outlet	
Tank Liquids	Light Liquid Outlet		Q-1	Energy	

Block Parameters

Pressure Drop	612.3	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	1.94704	%	Heat Duty	-17.0618	Btu/h
Mole Fraction Light Liquid	98.053	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	

Remarks

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Blocks
Separator
Separator Report

Client Name:	TC Energy	Job: Pipeline Liquids A07	
Location:	Lanham Compressor Station	Modified: 9:09 AM, 8/25/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 2:59 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	MIX-100	Sales Gas	Vapor Outlet	
Liquids	Light Liquid Outlet	PL Liquid Tanks	Q-2	Energy	

Block Parameters

Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty	-5.99298	Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	

Remarks

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Flowsheet Environment
Environment1

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

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 Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Carbon Dioxide	False	False	Benzene	False	False
Nitrogen	False	False	Toluene	False	False
Methane	False	False	Ethylbenzene	False	False
Ethane	False	False	m-Xylene	False	False
Propane	False	False	n-Hexane	False	False
i-Butane	False	False	2,2,4-Trimethylpentane	False	False
n-Butane	False	False	Neopentane	False	False
i-Pentane	False	False	Decanes Plus	False	False
n-Pentane	False	False	Water	False	True
i-Hexane	False	False	Helium	False	False
Heptane	False	False	Hydrogen	False	False
Octane	False	False	Oxygen	False	False
Nonane	False	False	Liquids Sample	False	False

Physical Property Method Sets

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

Remarks

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Environments Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Project-Wide Constants

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

Environment [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 Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Carbon Dioxide	False	False	Benzene	False	False
Nitrogen	False	False	Toluene	False	False
Methane	False	False	Ethylbenzene	False	False
Ethane	False	False	m-Xylene	False	False
Propane	False	False	n-Hexane	False	False
i-Butane	False	False	2,2,4-Trimethylpentane	False	False
n-Butane	False	False	Neopentane	False	False
i-Pentane	False	False	Decanes Plus	False	False
n-Pentane	False	False	Water	False	True
i-Hexane	False	False	Helium	False	False
Heptane	False	False	Hydrogen	False	False
Octane	False	False	Oxygen	False	False
Nonane	False	False	Liquids Sample	False	False

Physical Property Method Sets

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

Remarks

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Single Oil Report
Decanes Plus

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Properties

Volume Average Boiling Point	240.832	°F	Low Temperature Viscosity	0.441651	cP
* Molecular Weight	108.848	lb/lbmol	Temperature of High T Viscosity	210	°F
* Specific Gravity	0.7432		High Temperature Viscosity	0.256204	cP
API Gravity	58.8929		Watson K	11.9499	
Critical Temperature	563.715	°F	ASTM D86 10-90% Slope	0	°F/%
Critical Pressure	421.397	psia	ASTM D93 Flash Point	47.9739	°F
Critical Volume	6.98262	ft^3/lbmol	? Pour Point	-22.4869	°F
Acentric Factor	0.350921		Paraffinic Fraction	56.3105	%
Carbon to Hydrogen Ratio	5.84021		Naphthenic Fraction	29.8859	%
Refractive Index	1.41346		Aromatic Fraction	13.8037	%
Temperature of Low T Viscosity	100	°F	Ideal Gas Heat Capacity	38.2665	Btu/(lbmol*°F)

Warnings

ProMax:ProMax!Project!Oils!Decanes Plus!Properties!Pour Point

Warning: Pour Point calculation: The value of 240.832 °F for Volume Average Boiling Point should be between 340.33 °F and 1040.33 °F.

Remarks

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Single Oil Report
Liquids Sample

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Properties

Volume Average Boiling Point	221.237	°F	Low Temperature Viscosity	0.389635	cP
* Molecular Weight	104.227	lb/lbmol	Temperature of High T Viscosity	210	°F
* Specific Gravity	0.721862		High Temperature Viscosity	0.231388	cP
API Gravity	64.5208		Watson K	12.1873	
Critical Temperature	536.86	°F	ASTM D86 10-90% Slope	0	°F/%
Critical Pressure	417.121	psia	ASTM D93 Flash Point	34.4537	°F
Critical Volume	6.79544	ft^3/lbmol	? Pour Point	-14.04	°F
Acentric Factor	0.339064		Paraffinic Fraction	64.4262	%
Carbon to Hydrogen Ratio	5.57819		Naphthenic Fraction	26.0787	%
Refractive Index	1.40218		Aromatic Fraction	9.49512	%
Temperature of Low T Viscosity	100	°F	Ideal Gas Heat Capacity	37.6486	Btu/(lbmol*°F)

Warnings

ProMax:ProMax!Project!Oils!Liquids Sample!Properties!Pour Point

Warning: Pour Point calculation: The value of 221.237 °F for Volume Average Boiling Point should be between 340.33 °F and 1040.33 °F.

Remarks

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Calculator Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Gas Solver

Source Code

Residual Error (for CV1) = LiquidsSample - 99

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Gas Sample!Phases!Total!Properties!Std Vapor Volumetric Flow
Value	2.79285E-05
Unit	

Measured Variable [LiquidsSample]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Liquids!Phases!Total!Composition!Std Liquid Volumetric Fraction!Liquids Sample
Value	99
Unit	

Solver Properties

Status: Solved

Error	1.77995E-05		Weighting	1
Calculated Value	2.79285E-05	MMSCFD	Priority	0
Lower Bound		MMSCFD	Solver State	Active
Upper Bound		MMSCFD	Group	
Step Size		MMSCFD	Skip Dependency Check	False
Is Minimizer	False		Block Dependencies	2
Algorithm	Default		Recycle Dependencies	0
Iterations	2		Solver Dependencies	1
Max Iterations	20			

Remarks

Liquid Solver

Source Code

Residual Error (for CV1) = Liquids -18000

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Liquids Sample!Phases!Total!Properties!Std Liquid Volumetric Flow
Value	0.0343092
Unit	

Measured Variable [Liquids]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Tank Liquids!Phases!Total!Properties!Liquid Volumetric Flow
Value	18000
Unit	

Solver Properties

Status: Solved

Error	-0.000291377		Max Iterations	20
Calculated Value	0.0343092	sgpm	Weighting	1
Lower Bound		sgpm	* Solver State	Active
Upper Bound		sgpm	* Skip Dependency Check	True
Step Size		sgpm	Block Dependencies	3
Is Minimizer	False		Recycle Dependencies	0
Algorithm	Default		Solver Dependencies	0
Iterations	3			

Remarks

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Calculator Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tank-1

User Value [BlockReady]

* Parameter	1		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [ShellLength]

* Parameter	16	ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [ShellDiam]

* Parameter	8	ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [BreatherVP]

* Parameter	0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [BreatherVacP]

* Parameter	-0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [DomeRadius]

Parameter		ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [OpPress]

* Parameter	0	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [AvgPercentLiq]

* Parameter	50	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxPercentLiq]

* Parameter	90	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MinPercentLiq]

* Parameter	10	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [AnnNetTP]

* Parameter	1.17882	bbl/day	Upper Bound	bbl/day
Lower Bound		bbl/day	* Enforce Bounds	False

User Value [OREff]

* Parameter	0	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxAvgT]

* Parameter	65.4	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [MinAvgT]

* Parameter	45.5	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

User Value [BulkLiqT]

* Parameter	58.7899	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [AvgP]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [Therml]

* Parameter	1237	Btu/ft^2/day	Upper Bound	Btu/ft^2/day
Lower Bound		Btu/ft^2/day	* Enforce Bounds	False

User Value [AvgWindSpeed]

* Parameter	4	mi/h	Upper Bound	mi/h
Lower Bound		mi/h	* Enforce Bounds	False

User Value [MaxHourlyLoadingRate]

Parameter		bbl/hr	Upper Bound	bbl/hr
Lower Bound		bbl/hr	* Enforce Bounds	False

User Value [SumLiqLevelInc]

Parameter		ft/yr	Upper Bound	ft/yr
Lower Bound		ft/yr	* Enforce Bounds	False

User Value [FlashingT]

* Parameter	70.4419	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [EntrainedOilFrac]

* Parameter	1	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [TurnoverRate]

* Parameter	1.47432		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [LLossSatFactor]

* Parameter	1.45		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [AtmPressure]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [TVP]

* Parameter	13.5778	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MaxVP]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MinVP]

* Parameter	13.0133	psia	Upper Bound	psia

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

User Value [MinVP]

Lower Bound		psia	* Enforce Bounds	False

User Value [AvgLiqSurfaceT]

* Parameter	61.8642	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [MaxLiqSurfaceT]

* Parameter	70.4419	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [TotalLosses]

* Parameter	0.405332	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WorkingLosses]

* Parameter	0.00529579	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [StandingLosses]

* Parameter	0.19737	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [RimSealLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WithdrawalLoss]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [LoadingLosses]

* Parameter	0.015454	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [MaxHourlyLoadingLoss]

* Parameter	0	lb/hr	Upper Bound	lb/hr
Lower Bound		lb/hr	* Enforce Bounds	False

User Value [PStar]

Parameter			Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [AllCTotalLosses]

* Parameter	0.459767	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [AllCLoadingLosses]

* Parameter	0.0175294	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [AllCMaxHLoadingLoss]

* Parameter	0	lb/hr	Upper Bound	lb/hr
Lower Bound		lb/hr	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

User Value [AllCFlashingLosses]

* Parameter	0.224695	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckFittingLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckSeamLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [FlashingLosses]

* Parameter	0.049119	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [TotalResidual]

* Parameter	53.8188	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [GasMoleWeight]

* Parameter	0.0198248	kg/mol	Upper Bound	kg/mol
Lower Bound		kg/mol	* Enforce Bounds	False

User Value [VapReportableFrac]

* Parameter	88.1602	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [LiqReportableFrac]

* Parameter	99.8959	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [FlashReportableFrac]

* Parameter	21.8604	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CD98EEA3-8B3E-47D7-BCC0-B760573420A8}

Sum Component Flow/Frac

User Value [CompSum]

* Parameter	0.0286878	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={5CABC249-2E47-44D4-A833-4F3D1AF2547A}

Sum Component Flow/Frac.177

User Value [CompSum]

* Parameter	0.0105916	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Remarks
This User Value Set was programmatically generated. GUID={0BEE6B58-A118-4655-88B1-C3178E914D1F}

Sum Component Flow/Frac.178

User Value [CompSum]

* Parameter	0.39474	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={1FCF7A22-53BB-4D85-B4D2-98034DCCEAC5}

Sum Component Flow/Frac.179

User Value [CompSum]

* Parameter	0.015454	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={844D69D0-5266-4B81-8111-87B14F6F1BDC}

Sum Component Flow/Frac.186

User Value [CompSum]

* Parameter	0.00654974	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={16314887-EB06-407D-A4B5-D174F0939D1D}

Sum Component Flow/Frac.187

User Value [CompSum]

* Parameter	1.32279E-06	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={9AFAA5FF-7014-420C-88AF-1F950D754536}

Sum Component Flow/Frac.188

User Value [CompSum]

* Parameter	3.02007E-07	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={8AF72F6D-9B6B-4084-A5B9-70157C63A6B1}

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Sum Component Flow/Frac.189

User Value [CompSum]

* Parameter	0.00241817	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={9CB8D542-8D75-4E89-8AB7-442949EE109B}

Sum Component Flow/Frac.190

User Value [CompSum]

* Parameter	0.0901233	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={23E8E7AB-B99D-4098-A3AE-61C1D7D4BA2E}

Sum Component Flow/Frac.191

User Value [CompSum]

* Parameter	1.77669E-05	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={63883334-AB8B-4092-A4D0-1E7AED13AEE9}

Sum Component Flow/Frac.192

User Value [CompSum]

* Parameter	4.05637E-06	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={51B0EE06-A063-4115-9274-E1D15BF915CA}

Sum Component Flow/Frac.193

User Value [CompSum]

* Parameter	4.76718E-07	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={55E10691-B7DA-4FAA-9B9E-0B68D87CB072}

Sum Component Flow/Frac.194

User Value [CompSum]

* Parameter	6.95569E-07	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

This User Value Set was programmatically generated. GUID={75C56AB5-55B0-40BE-BD77-0FEA32ACB487}

Sum Component Flow/Frac.195

User Value [CompSum]

* Parameter	0.0035283	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={DFB150C3-5EE6-4635-8FEF-CAC33DC58C42}

Sum Component Flow/Frac.196

User Value [CompSum]

* Parameter	1.0884E-07	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CA38BC43-757A-43DF-B7AE-5B8482D705C9}

Sum Component Flow/Frac.197

User Value [CompSum]

* Parameter	1.58806E-07	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={D1DB11B0-87F0-46EA-90A6-6AC73B0D6340}

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Component Recoveries - Project Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
Carbon Dioxide	4.48994E-06	0	4.48994E-06	
Nitrogen	1.44651E-05	0	1.44651E-05	
Methane	0.00274431	0	0.00274431	
Ethane	0.000278008	0	0.000278008	
Propane	1.89091E-05	0	1.89091E-05	
i-Butane	1.30916E-06	0	1.30916E-06	
n-Butane	2.75057E-06	0	2.75057E-06	
i-Pentane	5.28601E-07	0	5.28601E-07	
n-Pentane	4.96006E-07	0	4.96006E-07	
i-Hexane	0	0	0	
Heptane	0	0	0	
Octane	0	0	0	
Nonane	0	0	0	
Benzene	0	0	0	
Toluene	0	0	0	
Ethylbenzene	0	0	0	
m-Xylene	0	0	0	
n-Hexane	1.22366E-06	0	1.22366E-06	
2,2,4-Trimethylpentane	0	0	0	
Neopentane	0	0	0	
Decanes Plus	0	0	0	
Water	0	0	0	
Helium	0	0	0	
Hydrogen	0	0	0	
Oxygen	0	0	0	
Liquids Sample	0	0.11887	0.11887	
Total	0.00306649	0.11887	0.121936	

Remarks

Component Recoveries - Project Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Carbon Dioxide		2.3878E-06	2.10214E-06	4.48994E-06
Nitrogen		1.33915E-05	1.07361E-06	1.44651E-05
Methane		0.00219764	0.00054667	0.00274431
Ethane		9.65805E-05	0.000181428	0.000278008
Propane		2.14792E-06	1.67611E-05	1.89091E-05
i-Butane		6.14958E-08	1.24767E-06	1.30916E-06
n-Butane		8.76432E-08	2.66292E-06	2.75057E-06
i-Pentane		5.60041E-09	5.23E-07	5.28601E-07
n-Pentane		3.80717E-09	4.92199E-07	4.96006E-07
i-Hexane		0	0	0
Heptane		0	0	0
Octane		0	0	0
Nonane		0	0	0
Benzene		0	0	0
Toluene		0	0	0
Ethylbenzene		0	0	0
m-Xylene		0	0	0
n-Hexane		3.50457E-09	1.22015E-06	1.22366E-06
2,2,4-Trimethylpentane		0	0	0
Neopentane		0	0	0
Decanes Plus		0	0	0
Water		0	0	0
Helium		0	0	0
Hydrogen		0	0	0
Oxygen		0	0	0
Liquids Sample		6.18398E-05	0.118808	0.11887
Total		0.00237415	0.119562	0.121936

Remarks

Component Recoveries - Project Losses

Status: Solved

Reference Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Summation Only
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Summary Table lbmol/h			
Carbon Dioxide	1.68065E-21			
Nitrogen	0			
Methane	-4.30246E-19			
Ethane	5.37808E-20			
Propane	0			

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tabulated Data

Index	Summary Table lbmol/h			
i-Butane	0			
n-Butane	4.20162E-22			
i-Pentane	0			
n-Pentane	1.05041E-22			
i-Hexane	0			
Heptane	0			
Octane	0			
Nonane	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
m-Xylene	0			
n-Hexane	2.10081E-22			
2,2,4-Trimethylpentane	0			
Neopentane	0			
Decanes Plus	0			
Water	0			
Helium	0			
Hydrogen	0			
Oxygen	0			
Liquids Sample	1.37679E-17			
Total	1.37679E-17			

Remarks

Component Recoveries - Project Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	True	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
Carbon Dioxide		53.181	46.819	100
Nitrogen		92.5779	7.42206	100
Methane		80.0799	19.9201	100
Ethane		34.7401	65.2599	100
Propane		11.3592	88.6408	100
i-Butane		4.69734	95.3027	100
n-Butane		3.18637	96.8136	100
i-Pentane		1.05948	98.9405	100
n-Pentane		0.767567	99.2324	100

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
i-Hexane				
Heptane				
Octane				
Nonane				
Benzene				
Toluene				
Ethylbenzene				
m-Xylene				
n-Hexane		0.286401	99.7136	100
2,2,4-Trimethylpentane				
Neopentane				
Decanes Plus				
Water				
Helium				
Hydrogen				
Oxygen				
Liquids Sample		0.0520231	99.948	100
Total		1.94704	98.053	100

Remarks

Component Recoveries - Pipeline Liquids Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
Carbon Dioxide	4.48994E-06	0	4.48994E-06	
Nitrogen	1.44651E-05	0	1.44651E-05	
Methane	0.00274431	0	0.00274431	
Ethane	0.000278008	0	0.000278008	
Propane	1.89091E-05	0	1.89091E-05	
i-Butane	1.30916E-06	0	1.30916E-06	
n-Butane	2.75057E-06	0	2.75057E-06	
i-Pentane	5.28601E-07	0	5.28601E-07	
n-Pentane	4.96006E-07	0	4.96006E-07	
i-Hexane	0	0	0	
Heptane	0	0	0	
Octane	0	0	0	
Nonane	0	0	0	
Benzene	0	0	0	
Toluene	0	0	0	
Ethylbenzene	0	0	0	
m-Xylene	0	0	0	
n-Hexane	1.22366E-06	0	1.22366E-06	

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
2,2,4-Trimethylpentane	0	0	0	
Neopentane	0	0	0	
Decanes Plus	0	0	0	
Water	0	0	0	
Helium	0	0	0	
Hydrogen	0	0	0	
Oxygen	0	0	0	
Liquids Sample	0	0.11887	0.11887	
Total	0.00306649	0.11887	0.121936	

Remarks

Component Recoveries - Pipeline Liquids Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Carbon Dioxide		2.3878E-06	2.10214E-06	4.48994E-06
Nitrogen		1.33915E-05	1.07361E-06	1.44651E-05
Methane		0.00219764	0.00054667	0.00274431
Ethane		9.65805E-05	0.000181428	0.000278008
Propane		2.14792E-06	1.67611E-05	1.89091E-05
i-Butane		6.14958E-08	1.24767E-06	1.30916E-06
n-Butane		8.76432E-08	2.66292E-06	2.75057E-06
i-Pentane		5.60041E-09	5.23E-07	5.28601E-07
n-Pentane		3.80717E-09	4.92199E-07	4.96006E-07
i-Hexane		0	0	0
Heptane		0	0	0
Octane		0	0	0
Nonane		0	0	0
Benzene		0	0	0
Toluene		0	0	0
Ethylbenzene		0	0	0
m-Xylene		0	0	0
n-Hexane		3.50457E-09	1.22015E-06	1.22366E-06
2,2,4-Trimethylpentane		0	0	0
Neopentane		0	0	0
Decanes Plus		0	0	0
Water		0	0	0
Helium		0	0	0
Hydrogen		0	0	0
Oxygen		0	0	0
Liquids Sample		6.18398E-05	0.118808	0.11887

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Total		0.00237415	0.119562	0.121936

Remarks

Component Recoveries - Pipeline Liquids Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Summation Only
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Summary Table lbmol/h			
Carbon Dioxide	1.68065E-21			
Nitrogen	0			
Methane	-4.30246E-19			
Ethane	5.37808E-20			
Propane	0			
i-Butane	0			
n-Butane	4.20162E-22			
i-Pentane	0			
n-Pentane	1.05041E-22			
i-Hexane	0			
Heptane	0			
Octane	0			
Nonane	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
m-Xylene	0			
n-Hexane	2.10081E-22			
2,2,4-Trimethylpentane	0			
Neopentane	0			
Decanes Plus	0			
Water	0			
Helium	0			
Hydrogen	0			
Oxygen	0			
Liquids Sample	1.37679E-17			
Total	1.37679E-17			

Remarks

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Component Recoveries - Pipeline Liquids Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	True	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
Carbon Dioxide		53.181	46.819	100
Nitrogen		92.5779	7.42206	100
Methane		80.0799	19.9201	100
Ethane		34.7401	65.2599	100
Propane		11.3592	88.6408	100
i-Butane		4.69734	95.3027	100
n-Butane		3.18637	96.8136	100
i-Pentane		1.05948	98.9405	100
n-Pentane		0.767567	99.2324	100
i-Hexane				
Heptane				
Octane				
Nonane				
Benzene				
Toluene				
Ethylbenzene				
m-Xylene				
n-Hexane		0.286401	99.7136	100
2,2,4-Trimethylpentane				
Neopentane				
Decanes Plus				
Water				
Helium				
Hydrogen				
Oxygen				
Liquids Sample		0.0520231	99.948	100
Total		1.94704	98.053	100

Remarks

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Energy Budgets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Power Budget - Project Power Budget

Status: Solved

Parameters

Net Power	0 hp	Total Power Required	0 hp
Total Power Supplied	0 hp	External Energy Only	True

Remarks

Heat Budget - Project Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Project

Flowsheet	Block	Flowsheet	Block
Pipeline Liquids	PL Liquid Tanks	Pipeline Liquids	Separator

Parameters

Net Duty	-23.0547 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	23.0547 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Pipeline Liquids:PL Liquid Tanks	-17.0618	55	55	
Pipeline Liquids:Separator	-5.99298	56.0344	55	

Remarks

Power Budget - Pipeline Liquids Power Budget

Status: Solved

Parameters

Net Power	0 hp	Total Power Required	0 hp
Total Power Supplied	0 hp	External Energy Only	True

Remarks

Heat Budget - Pipeline Liquids Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Pipeline Liquids	PL Liquid Tanks	Pipeline Liquids	Separator

Parameters

Net Duty	-23.0547 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	23.0547 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Pipeline Liquids:PL Liquid	-17.0618	55	55	

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Energy Budgets Report

Client Name:	TC Energy	Job: Pipeline Liquids A07
Location:	Lanham Compressor Station	

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Tanks				
Pipeline Liquids:Separator	-5.99298	56.0344	55	

Remarks

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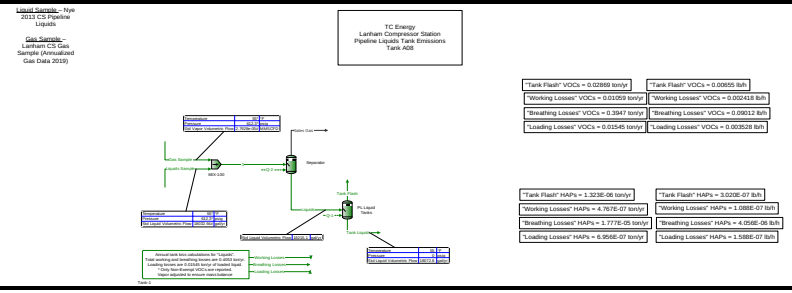
Pipeline Liquids
Plant Schematic

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	



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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Connections

	Breathing Losses	Gas Sample	Liquids	Liquids Sample	Loading Losses
From Block	--	--	Separator	--	--
To Block	--	MIX-100	PL Liquid Tanks	MIX-100	--

Stream Composition

Mole Fraction	Breathing Losses %	Gas Sample %	Liquids %	Liquids Sample %	Loading Losses %
Carbon Dioxide	0.117674 *	0.146419 *	0.0036822	0 *	0.117674 *
Nitrogen	0.0610067 *	0.471715 *	0.0118628	0 *	0.0610067 *
Methane	30.6044 *	89.4935 *	2.25061	0 *	30.6044 *
Ethane	10.4837 *	9.06599 *	0.227995	0 *	10.4837 *
Propane	1.01635 *	0.616634 *	0.0155073	0 *	1.01635 *
i-Butane	0.0513828 *	0.0426924 *	0.00107364	0 *	0.0513828 *
n-Butane	0.0741808 *	0.0896974 *	0.00225574	0 *	0.0741808 *
i-Pentane	0.0048879 *	0.0172379 *	0.000433506	0 *	0.0048879 *
n-Pentane	0.00335483 *	0.016175 *	0.000406775	0 *	0.00335483 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	0.00316217 *	0.039904 *	0.00100352	0 *	0.00316217 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	57.5799 *	0 *	97.4852	100 *	57.5799 *

Molar Flow	Breathing Losses lbmol/h	Gas Sample lbmol/h	Liquids lbmol/h	Liquids Sample lbmol/h	Loading Losses lbmol/h
Carbon Dioxide	1.75166E-06 *	4.48994E-06 *	4.48994E-06	0 *	6.85771E-08 *
Nitrogen	9.08127E-07 *	1.44651E-05 *	1.44651E-05	0 *	3.55529E-08 *
Methane	0.000455568 *	0.00274431 *	0.00274431	0 *	1.78353E-05 *
Ethane	0.000156058 *	0.000278008 *	0.000278008	0 *	6.10961E-06 *
Propane	1.51291E-05 *	1.89091E-05 *	1.89091E-05	0 *	5.92301E-07 *
i-Butane	7.64869E-07 *	1.30916E-06 *	1.30916E-06	0 *	2.99444E-08 *
n-Butane	1.10423E-06 *	2.75057E-06 *	2.75057E-06	0 *	4.32304E-08 *
i-Pentane	7.27598E-08 *	5.28601E-07 *	5.28601E-07	0 *	2.84852E-09 *
n-Pentane	4.99389E-08 *	4.96006E-07 *	4.96006E-07	0 *	1.95509E-09 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	4.70712E-08 *	1.22366E-06 *	1.22366E-06	0 *	1.84282E-09 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Molar Flow	Breathing Losses lbmol/h	Gas Sample lbmol/h	Liquids lbmol/h	Liquids Sample lbmol/h	Loading Losses lbmol/h
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	0.000857116 *	0 *	0.11887	0.11887 *	3.35558E-05 *

Mass Fraction	Breathing Losses %	Gas Sample %	Liquids %	Liquids Sample %	Loading Losses %
Carbon Dioxide	0.0754106	0.364327 *	0.00158796	0 *	0.0754106
Nitrogen	0.0248856	0.747123 *	0.00325641	0 *	0.0248856
Methane	7.14923	81.1726 *	0.353799	0 *	7.14923
Ethane	4.59029	15.4128 *	0.0671782	0 *	4.59029
Propane	0.652596	1.53734 *	0.00670065	0 *	0.652596
i-Butane	0.0434875	0.140294 *	0.000611486	0 *	0.0434875
n-Butane	0.0627824	0.29476 *	0.00128474	0 *	0.0627824
i-Pentane	0.00513518	0.0703172 *	0.000306484	0 *	0.00513518
n-Pentane	0.00352455	0.0659812 *	0.000287585	0 *	0.00352455
i-Hexane	0	0 *	0	0 *	0
Heptane	0	0 *	0	0 *	0
Octane	0	0 *	0	0 *	0
Nonane	0	0 *	0	0 *	0
Benzene	0	0 *	0	0 *	0
Toluene	0	0 *	0	0 *	0
Ethylbenzene	0	0 *	0	0 *	0
m-Xylene	0	0 *	0	0 *	0
n-Hexane	0.00396801	0.194423 *	0.00084741	0 *	0.00396801
2,2,4-Trimethylpentane	0	0 *	0	0 *	0
Neopentane	0	0 *	0	0 *	0
Decanes Plus	0	0 *	0	0 *	0
Water	0	0 *	0	0 *	0
Helium	0	0 *	0	0 *	0
Hydrogen	0	0 *	0	0 *	0
Oxygen	0	0 *	0	0 *	0
Liquids Sample	87.3887	0 *	99.5641	100 *	87.3887

Mass Flow	Breathing Losses lb/h	Gas Sample lb/h	Liquids lb/h	Liquids Sample lb/h	Loading Losses lb/h
Carbon Dioxide	7.70898E-05 *	0.0001976 *	0.0001976	0 *	3.01804E-06 *
Nitrogen	2.54397E-05 *	0.000405217 *	0.000405217	0 *	9.95957E-07 *
Methane	0.00730843 *	0.0440256 *	0.0440256	0 *	0.000286123 *
Ethane	0.0046925 *	0.00835944 *	0.00835944	0 *	0.00018371 *
Propane	0.000667128 *	0.000833807 *	0.000833807	0 *	2.61179E-05 *
i-Butane	4.44559E-05 *	7.60913E-05 *	7.60913E-05	0 *	1.74043E-06 *
n-Butane	6.41805E-05 *	0.000159869 *	0.000159869	0 *	2.51264E-06 *
i-Pentane	5.24953E-06 *	3.81379E-05 *	3.81379E-05	0 *	2.05517E-07 *
n-Pentane	3.60303E-06 *	3.57862E-05 *	3.57862E-05	0 *	1.41058E-07 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	4.05637E-06 *	0.000105449 *	0.000105449	0 *	1.58806E-07 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *

* User Specified Values
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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Mass Flow	Breathing Losses lb/h	Gas Sample lb/h	Liquids lb/h	Liquids Sample lb/h	Loading Losses lb/h
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	0.0893346 *	0 *	12.3894	12.3894 *	0.00349742 *

Stream Properties

Property	Units	Breathing Losses	Gas Sample	Liquids	Liquids Sample	Loading Losses
Temperature	°F	70.4419	55 *	55	55 *	70.4419
Pressure	psia	1.02235	626.996 *	626.996	626.996 *	1.02235
Mole Fraction Vapor	%	100	100	0	0	100
Mole Fraction Light Liquid	%	0	0	100	100	0
Mole Fraction Heavy Liquid	%	0	0	0	0	0
Molecular Weight	lb/lbmol	68.6745	17.687	102.051	104.227	68.6745
Mass Density	lb/ft^3	0.0123726	2.28641	45.3044	45.4671	0.0123726
Molar Flow	lbmol/h	0.00148857	0.00306649	0.121936	0.11887	5.8277E-05
Mass Flow	lb/h	0.102227	0.054237	12.4437	12.3894	0.00400215
Vapor Volumetric Flow	ft^3/h	8.26238	0.0237215	0.274668	0.272493	0.32347
Liquid Volumetric Flow	gpm	1.03011	0.00295748	0.0342444	0.0339731	0.0403287
Std Vapor Volumetric Flow	MMSCFD	1.35573E-05	2.79285E-05 *	0.00111055	0.00108262	5.30765E-07
Std Liquid Volumetric Flow	sgpm	0.00032574	0.000346552	0.0346558	0.0343092 *	1.27526E-05
Compressibility		0.997482	0.878155	0.25571	0.260229	0.997482
Specific Gravity		2.37115	0.610685	0.726396	0.729004	2.37115
API Gravity				63.9295	63.2193	
Enthalpy	Btu/h	-82.233	-102.032	-10503.3	-10395.3	-3.21939
Mass Enthalpy	Btu/lb	-804.417	-1881.22	-844.067	-839.043	-804.417
Mass Cp	Btu/(lb*°F)	0.38186	0.59475	0.465238	0.463769	0.38186
Ideal Gas CpCv Ratio		1.082	1.28996	1.05738	1.05622	1.082
Dynamic Viscosity	cP	0.00713612	0.0115808	0.515199	0.53843	0.00713612
Kinematic Viscosity	cSt	36.0066	0.316201	0.709927	0.739285	36.0066
Thermal Conductivity	Btu/(h*ft*°F)	0.00979028	0.0201617	0.0642001	0.064265	0.00979028
Surface Tension	lbf/ft			0.0011822 ?	0.00154741	
Net Ideal Gas Heating Value	Btu/ft^3	3489.8	981.884	5127.53	5234.47	3489.8
Net Liquid Heating Value	Btu/lb	19136.2	21039.6	18908	18898.7	19136.2
Gross Ideal Gas Heating Value	Btu/ft^3	3756.84	1087.39	5499.37	5613.19	3756.84
Gross Liquid Heating Value	Btu/lb	20612	23303.6	20290.8	20277.6	20612

Remarks

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Connections

	Sales Gas	Tank Flash	Tank Liquids	Working Losses	3
From Block	Separator	PL Liquid Tanks	PL Liquid Tanks	--	MIX-100
To Block	--	--	--	--	Separator

Stream Composition

Mole Fraction	Sales Gas %	Tank Flash %	Tank Liquids %	Working Losses %	3 %
Carbon Dioxide		0.100575	0.0017582	0.117674 *	0.0036822
Nitrogen		0.564054	0.000897951	0.0610067 *	0.0118628
Methane		92.5654	0.457227	30.6044 *	2.25061
Ethane		4.068	0.151744	10.4837 *	0.227995
Propane		0.090471	0.0140188	1.01635 *	0.0155073
i-Butane		0.00259022	0.00104353	0.0513828 *	0.00107364
n-Butane		0.00369156	0.00222723	0.0741808 *	0.00225574
i-Pentane		0.000235891	0.00043743	0.0048879 *	0.000433506
n-Pentane		0.000160359	0.000411668	0.00335483 *	0.000406775
i-Hexane		0	0	0 *	0
Heptane		0	0	0 *	0
Octane		0	0	0 *	0
Nonane		0	0	0 *	0
Benzene		0	0	0 *	0
Toluene		0	0	0 *	0
Ethylbenzene		0	0	0 *	0
m-Xylene		0	0	0 *	0
n-Hexane		0.000147613	0.00102052	0.00316217 *	0.00100352
2,2,4-Trimethylpentane		0	0	0 *	0
Neopentane		0	0	0 *	0
Decanes Plus		0	0	0 *	0
Water		0	0	0 *	0
Helium		0	0	0 *	0
Hydrogen		0	0	0 *	0
Oxygen		0	0	0 *	0
Liquids Sample		2.60471	99.3692	57.5799 *	97.4852

Molar Flow	Sales Gas lbmol/h	Tank Flash lbmol/h	Tank Liquids lbmol/h	Working Losses lbmol/h	3 lbmol/h
Carbon Dioxide	0	2.3878E-06	2.10214E-06	4.70002E-08 *	4.48994E-06
Nitrogen	0	1.33915E-05	1.07361E-06	2.43666E-08 *	1.44651E-05
Methane	0	0.00219764	0.00054667	1.22237E-05 *	0.00274431
Ethane	0	9.65805E-05	0.000181428	4.1873E-06 *	0.000278008
Propane	0	2.14792E-06	1.67611E-05	4.05941E-07 *	1.89091E-05
i-Butane	0	6.14958E-08	1.24767E-06	2.05228E-08 *	1.30916E-06
n-Butane	0	8.76432E-08	2.66292E-06	2.96285E-08 *	2.75057E-06
i-Pentane	0	5.60041E-09	5.23E-07	1.95227E-09 *	5.28601E-07
n-Pentane	0	3.80717E-09	4.92199E-07	1.33995E-09 *	4.96006E-07
i-Hexane	0	0	0	0 *	0
Heptane	0	0	0	0 *	0
Octane	0	0	0	0 *	0
Nonane	0	0	0	0 *	0
Benzene	0	0	0	0 *	0
Toluene	0	0	0	0 *	0
Ethylbenzene	0	0	0	0 *	0
m-Xylene	0	0	0	0 *	0
n-Hexane	0	3.50457E-09	1.22015E-06	1.263E-09 *	1.22366E-06
2,2,4-Trimethylpentane	0	0	0	0 *	0
Neopentane	0	0	0	0 *	0
Decanes Plus	0	0	0	0 *	0

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Molar Flow	Sales Gas lbmol/h	Tank Flash lbmol/h	Tank Liquids lbmol/h	Working Losses lbmol/h	3 lbmol/h
Water	0	0	0	0 *	0
Helium	0	0	0	0 *	0
Hydrogen	0	0	0	0 *	0
Oxygen	0	0	0	0 *	0
Liquids Sample	0	6.18398E-05	0.118808	2.29979E-05 *	0.11887

Mass Fraction	Sales Gas %	Tank Flash %	Tank Liquids %	Working Losses %	3 %
Carbon Dioxide		0.232544	0.000746174	0.0754106	0.00158796
Nitrogen		0.830149	0.000242573	0.0248856	0.00325641
Methane		78.017	0.0707339	7.14923	0.353799
Ethane		6.42643	0.0440002	4.59029	0.0671782
Propane		0.209592	0.00596115	0.652596	0.00670065
i-Butane		0.00790949	0.000584886	0.0434875	0.000611486
n-Butane		0.0112725	0.00124834	0.0627824	0.00128474
i-Pentane		0.000894149	0.000304342	0.00513518	0.000306484
n-Pentane		0.000607845	0.000286418	0.00352455	0.000287585
i-Hexane		0	0	0	0
Heptane		0	0	0	0
Octane		0	0	0	0
Nonane		0	0	0	0
Benzene		0	0	0	0
Toluene		0	0	0	0
Ethylbenzene		0	0	0	0
m-Xylene		0	0	0	0
n-Hexane		0.000668311	0.000848062	0.00396801	0.00084741
2,2,4-Trimethylpentane		0	0	0	0
Neopentane		0	0	0	0
Decanes Plus		0	0	0	0
Water		0	0	0	0
Helium		0	0	0	0
Hydrogen		0	0	0	0
Oxygen		0	0	0	0
Liquids Sample		14.2629	99.875	87.3887	99.5641

Mass Flow	Sales Gas lb/h	Tank Flash lb/h	Tank Liquids lb/h	Working Losses lb/h	3 lb/h
Carbon Dioxide	0	0.000105086	9.25143E-05	2.06846E-06 *	0.0001976
Nitrogen	0	0.000375142	3.00754E-05	6.82593E-07 *	0.000405217
Methane	0	0.0352556	0.00876994	0.000196098 *	0.0440256
Ethane	0	0.00290408	0.00545536	0.000125908 *	0.00835944
Propane	0	9.47139E-05	0.000739093	1.79002E-05 *	0.000833807
i-Butane	0	3.57427E-06	7.25171E-05	1.19283E-06 *	7.60913E-05
n-Butane	0	5.09402E-06	0.000154775	1.72208E-06 *	0.000159869
i-Pentane	0	4.04063E-07	3.77338E-05	1.40854E-07 *	3.81379E-05
n-Pentane	0	2.74683E-07	3.55115E-05	9.66758E-08 *	3.57862E-05
i-Hexane	0	0	0	0 *	0
Heptane	0	0	0	0 *	0
Octane	0	0	0	0 *	0
Nonane	0	0	0	0 *	0
Benzene	0	0	0	0 *	0
Toluene	0	0	0	0 *	0
Ethylbenzene	0	0	0	0 *	0
m-Xylene	0	0	0	0 *	0
n-Hexane	0	3.02007E-07	0.000105147	1.0884E-07 *	0.000105449
2,2,4-Trimethylpentane	0	0	0	0 *	0
Neopentane	0	0	0	0 *	0
Decanes Plus	0	0	0	0 *	0

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? Extrapolated or Approximate Values

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Mass Flow	Sales Gas lb/h	Tank Flash lb/h	Tank Liquids lb/h	Working Losses lb/h	3 lb/h
Water	0	0	0	0 *	0
Helium	0	0	0	0 *	0
Hydrogen	0	0	0	0 *	0
Oxygen	0	0	0	0 *	0
Liquids Sample	0	0.00644537	12.383	0.00239701 *	12.3894

Stream Properties

Property	Units	Sales Gas	Tank Flash	Tank Liquids	Working Losses	3
Temperature	°F	55 *	55 *	55	70.4419	56.0344
Pressure	psia	626.996 *	14.6959 *	14.6959	1.02235	626.996
Mole Fraction Vapor	%		100	0	100	0
Mole Fraction Light Liquid	%		0	100	0	100
Mole Fraction Heavy Liquid	%		0	0	0	0
Molecular Weight	lb/lbmol		19.034	103.699	68.6745	102.051
Mass Density	lb/ft^3		0.0508158	45.1369	0.0123726	45.2741
Molar Flow	lbmol/h	0	0.00237415	0.119562	3.9941E-05	0.121936
Mass Flow	lb/h	0	0.0451897	12.3985	0.00274293	12.4437
Vapor Volumetric Flow	ft^3/h	0	0.889284	0.274686	0.221694	0.274852
Liquid Volumetric Flow	gpm	0	0.110872	0.0342466	0.0276398	0.0342673
Std Vapor Volumetric Flow	MMSCFD	0	2.16229E-05	0.00108893	3.63767E-07	0.00111055
Std Liquid Volumetric Flow	sgpm	0	0.000270774	0.034385	8.74017E-06	0.0346558
Compressibility			0.996637	0.00611291	0.997482	0.255368
Specific Gravity			0.657195	0.723711	2.37115	0.72591
API Gravity				64.6661		63.9295
Enthalpy	Btu/h	0	-79.3724	-10441	-2.20646	-10497.3
Mass Enthalpy	Btu/lb		-1756.43	-842.118	-804.417	-843.585
Mass Cp	Btu/(lb*°F)		0.491279	0.466172	0.38186	0.465915
Ideal Gas CpCv Ratio			1.27085	1.05649	1.082	1.05727
Dynamic Viscosity	cP		0.0104797	0.50159	0.00713612	0.511965
Kinematic Viscosity	cSt		12.8744	0.693738	36.0066	0.705943
Thermal Conductivity	Btu/(h*ft*°F)		0.0175967	0.0642423	0.00979028	0.0641637
Surface Tension	lbf/ft			0.00153247 ?		0.00117954 ?
Net Ideal Gas Heating Value	Btu/ft^3		1046.3	5208.57	3489.8	5127.53
Net Liquid Heating Value	Btu/lb		20827.1	18901	19136.2	18908
Gross Ideal Gas Heating Value	Btu/ft^3		1155.61	5585.62	3756.84	5499.37
Gross Liquid Heating Value	Btu/lb		23006.7	20280.9	20612	20290.8

Remarks

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? Extrapolated or Approximate Values

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Energy Stream Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Energy Streams

Energy Stream	Energy Rate		Power		From Block	To Block
Q-1	-17.0618	Btu/h	-0.00670553	hp	--	PL Liquid Tanks
Q-2	-5.99298	Btu/h	-0.00235533	hp	--	Separator

Remarks

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Blocks
MIX-100
Mixer/Splitter Report

Client Name:	TC Energy	Job: Pipeline Liquids A08	
Location:	Lanham Compressor Station	Modified: 10:22 AM, 10/16/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 3:12 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Gas Sample	Inlet		Liquids Sample	Inlet	
3	Outlet	Separator			

Block Parameters

Pressure Drop	0	psi	Fraction to Stream 3	100	%
Flow Multiplier	100	%			

Remarks

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Blocks
PL Liquid Tanks
Separator Report

Client Name:	TC Energy	Job: Pipeline Liquids A08	
Location:	Lanham Compressor Station	Modified: 9:08 AM, 8/25/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 3:12 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Liquids	Inlet	Separator	Tank Flash	Vapor Outlet	
Tank Liquids	Light Liquid Outlet		Q-1	Energy	

Block Parameters

Pressure Drop	612.3	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	1.94704	%	Heat Duty	-17.0618	Btu/h
Mole Fraction Light Liquid	98.053	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	

Remarks

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Blocks
Separator
Separator Report

Client Name:	TC Energy	Job: Pipeline Liquids A08	
Location:	Lanham Compressor Station	Modified: 9:09 AM, 8/25/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 3:12 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	MIX-100	Sales Gas	Vapor Outlet	
Liquids	Light Liquid Outlet	PL Liquid Tanks	Q-2	Energy	

Block Parameters

Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty	-5.99298	Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	

Remarks

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Flowsheet Environment
Environment1

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

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 Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Carbon Dioxide	False	False	Benzene	False	False
Nitrogen	False	False	Toluene	False	False
Methane	False	False	Ethylbenzene	False	False
Ethane	False	False	m-Xylene	False	False
Propane	False	False	n-Hexane	False	False
i-Butane	False	False	2,2,4-Trimethylpentane	False	False
n-Butane	False	False	Neopentane	False	False
i-Pentane	False	False	Decanes Plus	False	False
n-Pentane	False	False	Water	False	True
i-Hexane	False	False	Helium	False	False
Heptane	False	False	Hydrogen	False	False
Octane	False	False	Oxygen	False	False
Nonane	False	False	Liquids Sample	False	False

Physical Property Method Sets

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

Remarks

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Environments Report

Client Name:	TC Energy	Job: Pipeline Liquids A08	
Location:	Lanham Compressor Station		

Project-Wide Constants

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

Environment [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 Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Carbon Dioxide	False	False	Benzene	False	False
Nitrogen	False	False	Toluene	False	False
Methane	False	False	Ethylbenzene	False	False
Ethane	False	False	m-Xylene	False	False
Propane	False	False	n-Hexane	False	False
i-Butane	False	False	2,2,4-Trimethylpentane	False	False
n-Butane	False	False	Neopentane	False	False
i-Pentane	False	False	Decanes Plus	False	False
n-Pentane	False	False	Water	False	True
i-Hexane	False	False	Helium	False	False
Heptane	False	False	Hydrogen	False	False
Octane	False	False	Oxygen	False	False
Nonane	False	False	Liquids Sample	False	False

Physical Property Method Sets

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

Remarks

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Single Oil Report
Decanes Plus

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Properties

Volume Average Boiling Point	240.832	°F	Low Temperature Viscosity	0.441651	cP
* Molecular Weight	108.848	lb/lbmol	Temperature of High T Viscosity	210	°F
* Specific Gravity	0.7432		High Temperature Viscosity	0.256204	cP
API Gravity	58.8929		Watson K	11.9499	
Critical Temperature	563.715	°F	ASTM D86 10-90% Slope	0	°F/%
Critical Pressure	421.397	psia	ASTM D93 Flash Point	47.9739	°F
Critical Volume	6.98262	ft^3/lbmol	? Pour Point	-22.4869	°F
Acentric Factor	0.350921		Paraffinic Fraction	56.3105	%
Carbon to Hydrogen Ratio	5.84021		Naphthenic Fraction	29.8859	%
Refractive Index	1.41346		Aromatic Fraction	13.8037	%
Temperature of Low T Viscosity	100	°F	Ideal Gas Heat Capacity	38.2665	Btu/(lbmol*°F)

Warnings

ProMax:ProMax!Project!Oils!Decanes Plus!Properties!Pour Point

Warning: Pour Point calculation: The value of 240.832 °F for Volume Average Boiling Point should be between 340.33 °F and 1040.33 °F.

Remarks

* User Specified Values
? Extrapolated or Approximate Values

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Single Oil Report
Liquids Sample

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Properties

Volume Average Boiling Point	221.237	°F	Low Temperature Viscosity	0.389635	cP
* Molecular Weight	104.227	lb/lbmol	Temperature of High T Viscosity	210	°F
* Specific Gravity	0.721862		High Temperature Viscosity	0.231388	cP
API Gravity	64.5208		Watson K	12.1873	
Critical Temperature	536.86	°F	ASTM D86 10-90% Slope	0	°F/%
Critical Pressure	417.121	psia	ASTM D93 Flash Point	34.4537	°F
Critical Volume	6.79544	ft^3/lbmol	? Pour Point	-14.04	°F
Acentric Factor	0.339064		Paraffinic Fraction	64.4262	%
Carbon to Hydrogen Ratio	5.57819		Naphthenic Fraction	26.0787	%
Refractive Index	1.40218		Aromatic Fraction	9.49512	%
Temperature of Low T Viscosity	100	°F	Ideal Gas Heat Capacity	37.6486	Btu/(lbmol*°F)

Warnings

ProMax:ProMax!Project!Oils!Liquids Sample!Properties!Pour Point

Warning: Pour Point calculation: The value of 221.237 °F for Volume Average Boiling Point should be between 340.33 °F and 1040.33 °F.

Remarks

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Calculator Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Gas Solver

Source Code

Residual Error (for CV1) = LiquidsSample - 99

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Gas Sample!Phases!Total!Properties!Std Vapor Volumetric Flow
Value	2.79285E-05
Unit	

Measured Variable [LiquidsSample]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Liquids!Phases!Total!Composition!Std Liquid Volumetric Fraction!Liquids Sample
Value	99
Unit	

Solver Properties

Status: Solved

Error	1.77995E-05		Weighting	1
Calculated Value	2.79285E-05	MMSCFD	Priority	0
Lower Bound		MMSCFD	Solver State	Active
Upper Bound		MMSCFD	Group	
Step Size		MMSCFD	Skip Dependency Check	False
Is Minimizer	False		Block Dependencies	2
Algorithm	Default		Recycle Dependencies	0
Iterations	2		Solver Dependencies	1
Max Iterations	20			

Remarks

Liquid Solver

Source Code

Residual Error (for CV1) = Liquids - 18000

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Liquids Sample!Phases!Total!Properties!Std Liquid Volumetric Flow
Value	0.0343092
Unit	

Measured Variable [Liquids]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Tank Liquids!Phases!Total!Properties!Liquid Volumetric Flow
Value	18000
Unit	

Solver Properties

Status: Solved

Error	-0.000291377		Max Iterations	20
Calculated Value	0.0343092	sgpm	Weighting	1
Lower Bound		sgpm	* Solver State	Active
Upper Bound		sgpm	* Skip Dependency Check	True
Step Size		sgpm	Block Dependencies	3
Is Minimizer	False		Recycle Dependencies	0
Algorithm	Default		Solver Dependencies	0
Iterations	3			

Remarks

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Calculator Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

ProMax 5.0.19263.0
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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tank-1

User Value [BlockReady]

* Parameter	1		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [ShellLength]

* Parameter	16	ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [ShellDiam]

* Parameter	8	ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [BreatherVP]

* Parameter	0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [BreatherVacP]

* Parameter	-0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [DomeRadius]

Parameter		ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [OpPress]

* Parameter	0	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [AvgPercentLiq]

* Parameter	50	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxPercentLiq]

* Parameter	90	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MinPercentLiq]

* Parameter	10	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [AnnNetTP]

* Parameter	1.17882	bbl/day	Upper Bound	bbl/day
Lower Bound		bbl/day	* Enforce Bounds	False

User Value [OREff]

* Parameter	0	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxAvgT]

* Parameter	65.4	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [MinAvgT]

* Parameter	45.5	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

User Value [BulkLiqT]

* Parameter	58.7899	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [AvgP]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [Therml]

* Parameter	1237	Btu/ft^2/day	Upper Bound	Btu/ft^2/day
Lower Bound		Btu/ft^2/day	* Enforce Bounds	False

User Value [AvgWindSpeed]

* Parameter	4	mi/h	Upper Bound	mi/h
Lower Bound		mi/h	* Enforce Bounds	False

User Value [MaxHourlyLoadingRate]

Parameter		bbl/hr	Upper Bound	bbl/hr
Lower Bound		bbl/hr	* Enforce Bounds	False

User Value [SumLiqLevelInc]

Parameter		ft/yr	Upper Bound	ft/yr
Lower Bound		ft/yr	* Enforce Bounds	False

User Value [FlashingT]

* Parameter	70.4419	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [EntrainedOilFrac]

* Parameter	1	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [TurnoverRate]

* Parameter	1.47432		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [LLossSatFactor]

* Parameter	1.45		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [AtmPressure]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [TVP]

* Parameter	13.5778	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MaxVP]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MinVP]

* Parameter	13.0133	psia	Upper Bound	psia

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

User Value [MinVP]

Lower Bound		psia	* Enforce Bounds	False

User Value [AvgLiqSurfaceT]

* Parameter	61.8642	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [MaxLiqSurfaceT]

* Parameter	70.4419	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [TotalLosses]

* Parameter	0.405332	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WorkingLosses]

* Parameter	0.00529579	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [StandingLosses]

* Parameter	0.19737	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [RimSealLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WithdrawalLoss]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [LoadingLosses]

* Parameter	0.015454	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [MaxHourlyLoadingLoss]

* Parameter	0	lb/hr	Upper Bound	lb/hr
Lower Bound		lb/hr	* Enforce Bounds	False

User Value [PStar]

Parameter			Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [AllCTotalLosses]

* Parameter	0.459767	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [AllCLoadingLosses]

* Parameter	0.0175294	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [AllCMaxHLoadingLoss]

* Parameter	0	lb/hr	Upper Bound	lb/hr
Lower Bound		lb/hr	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

User Value [AllCFlashingLosses]

* Parameter	0.224695	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckFittingLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckSeamLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [FlashingLosses]

* Parameter	0.049119	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [TotalResidual]

* Parameter	53.8188	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [GasMoleWeight]

* Parameter	0.0198248	kg/mol	Upper Bound	kg/mol
Lower Bound		kg/mol	* Enforce Bounds	False

User Value [VapReportableFrac]

* Parameter	88.1602	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [LiqReportableFrac]

* Parameter	99.8959	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [FlashReportableFrac]

* Parameter	21.8604	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CD98EEA3-8B3E-47D7-BCC0-B760573420A8}

Sum Component Flow/Frac

User Value [CompSum]

* Parameter	0.0286878	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={5CABC249-2E47-44D4-A833-4F3D1AF2547A}

Sum Component Flow/Frac.177

User Value [CompSum]

* Parameter	0.0105916	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Remarks
This User Value Set was programmatically generated. GUID={0BEE6B58-A118-4655-88B1-C3178E914D1F}

Sum Component Flow/Frac.178

User Value [CompSum]

* Parameter	0.39474	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={1FCF7A22-53BB-4D85-B4D2-98034DCCEAC5}

Sum Component Flow/Frac.179

User Value [CompSum]

* Parameter	0.015454	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={844D69D0-5266-4B81-8111-87B14F6F1BDC}

Sum Component Flow/Frac.186

User Value [CompSum]

* Parameter	0.00654974	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={16314887-EB06-407D-A4B5-D174F0939D1D}

Sum Component Flow/Frac.187

User Value [CompSum]

* Parameter	1.32279E-06	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={9AFAA5FF-7014-420C-88AF-1F950D754536}

Sum Component Flow/Frac.188

User Value [CompSum]

* Parameter	3.02007E-07	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={8AF72F6D-9B6B-4084-A5B9-70157C63A6B1}

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Sum Component Flow/Frac.189

User Value [CompSum]

* Parameter	0.00241817	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={9CB8D542-8D75-4E89-8AB7-442949EE109B}

Sum Component Flow/Frac.190

User Value [CompSum]

* Parameter	0.0901233	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={23E8E7AB-B99D-4098-A3AE-61C1D7D4BA2E}

Sum Component Flow/Frac.191

User Value [CompSum]

* Parameter	1.77669E-05	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={63883334-AB8B-4092-A4D0-1E7AED13AEE9}

Sum Component Flow/Frac.192

User Value [CompSum]

* Parameter	4.05637E-06	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={51B0EE06-A063-4115-9274-E1D15BF915CA}

Sum Component Flow/Frac.193

User Value [CompSum]

* Parameter	4.76718E-07	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={55E10691-B7DA-4FAA-9B9E-0B68D87CB072}

Sum Component Flow/Frac.194

User Value [CompSum]

* Parameter	6.95569E-07	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

This User Value Set was programmatically generated. GUID={75C56AB5-55B0-40BE-BD77-0FEA32ACB487}

Sum Component Flow/Frac.195

User Value [CompSum]

* Parameter	0.0035283	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={DFB150C3-5EE6-4635-8FEF-CAC33DC58C42}

Sum Component Flow/Frac.196

User Value [CompSum]

* Parameter	1.0884E-07	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CA38BC43-757A-43DF-B7AE-5B8482D705C9}

Sum Component Flow/Frac.197

User Value [CompSum]

* Parameter	1.58806E-07	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={D1DB11B0-87F0-46EA-90A6-6AC73B0D6340}

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Component Recoveries - Project Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
Carbon Dioxide	4.48994E-06	0	4.48994E-06	
Nitrogen	1.44651E-05	0	1.44651E-05	
Methane	0.00274431	0	0.00274431	
Ethane	0.000278008	0	0.000278008	
Propane	1.89091E-05	0	1.89091E-05	
i-Butane	1.30916E-06	0	1.30916E-06	
n-Butane	2.75057E-06	0	2.75057E-06	
i-Pentane	5.28601E-07	0	5.28601E-07	
n-Pentane	4.96006E-07	0	4.96006E-07	
i-Hexane	0	0	0	
Heptane	0	0	0	
Octane	0	0	0	
Nonane	0	0	0	
Benzene	0	0	0	
Toluene	0	0	0	
Ethylbenzene	0	0	0	
m-Xylene	0	0	0	
n-Hexane	1.22366E-06	0	1.22366E-06	
2,2,4-Trimethylpentane	0	0	0	
Neopentane	0	0	0	
Decanes Plus	0	0	0	
Water	0	0	0	
Helium	0	0	0	
Hydrogen	0	0	0	
Oxygen	0	0	0	
Liquids Sample	0	0.11887	0.11887	
Total	0.00306649	0.11887	0.121936	

Remarks

Component Recoveries - Project Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Carbon Dioxide		2.3878E-06	2.10214E-06	4.48994E-06
Nitrogen		1.33915E-05	1.07361E-06	1.44651E-05
Methane		0.00219764	0.00054667	0.00274431
Ethane		9.65805E-05	0.000181428	0.000278008
Propane		2.14792E-06	1.67611E-05	1.89091E-05
i-Butane		6.14958E-08	1.24767E-06	1.30916E-06
n-Butane		8.76432E-08	2.66292E-06	2.75057E-06
i-Pentane		5.60041E-09	5.23E-07	5.28601E-07
n-Pentane		3.80717E-09	4.92199E-07	4.96006E-07
i-Hexane		0	0	0
Heptane		0	0	0
Octane		0	0	0
Nonane		0	0	0
Benzene		0	0	0
Toluene		0	0	0
Ethylbenzene		0	0	0
m-Xylene		0	0	0
n-Hexane		3.50457E-09	1.22015E-06	1.22366E-06
2,2,4-Trimethylpentane		0	0	0
Neopentane		0	0	0
Decanes Plus		0	0	0
Water		0	0	0
Helium		0	0	0
Hydrogen		0	0	0
Oxygen		0	0	0
Liquids Sample		6.18398E-05	0.118808	0.11887
Total		0.00237415	0.119562	0.121936

Remarks

Component Recoveries - Project Losses

Status: Solved

Reference Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Summation Only
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Summary Table lbmol/h			
Carbon Dioxide	0			
Nitrogen	-3.3613E-21			
Methane	-8.60492E-19			
Ethane	-5.37808E-20			
Propane	0			

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tabulated Data

Index	Summary Table lbmol/h			
i-Butane	0			
n-Butane	4.20162E-22			
i-Pentane	0			
n-Pentane	0			
i-Hexane	0			
Heptane	0			
Octane	0			
Nonane	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
m-Xylene	0			
n-Hexane	2.10081E-22			
2,2,4-Trimethylpentane	0			
Neopentane	0			
Decanes Plus	0			
Water	0			
Helium	0			
Hydrogen	0			
Oxygen	0			
Liquids Sample	0			
Total	0			

Remarks

Component Recoveries - Project Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	True	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
Carbon Dioxide		53.181	46.819	100
Nitrogen		92.5779	7.42206	100
Methane		80.0799	19.9201	100
Ethane		34.7401	65.2599	100
Propane		11.3592	88.6408	100
i-Butane		4.69734	95.3027	100
n-Butane		3.18637	96.8136	100
i-Pentane		1.05948	98.9405	100
n-Pentane		0.767567	99.2324	100

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
i-Hexane				
Heptane				
Octane				
Nonane				
Benzene				
Toluene				
Ethylbenzene				
m-Xylene				
n-Hexane		0.286401	99.7136	100
2,2,4-Trimethylpentane				
Neopentane				
Decanes Plus				
Water				
Helium				
Hydrogen				
Oxygen				
Liquids Sample		0.0520231	99.948	100
Total		1.94704	98.053	100

Remarks

Component Recoveries - Pipeline Liquids Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
Carbon Dioxide	4.48994E-06	0	4.48994E-06	
Nitrogen	1.44651E-05	0	1.44651E-05	
Methane	0.00274431	0	0.00274431	
Ethane	0.000278008	0	0.000278008	
Propane	1.89091E-05	0	1.89091E-05	
i-Butane	1.30916E-06	0	1.30916E-06	
n-Butane	2.75057E-06	0	2.75057E-06	
i-Pentane	5.28601E-07	0	5.28601E-07	
n-Pentane	4.96006E-07	0	4.96006E-07	
i-Hexane	0	0	0	
Heptane	0	0	0	
Octane	0	0	0	
Nonane	0	0	0	
Benzene	0	0	0	
Toluene	0	0	0	
Ethylbenzene	0	0	0	
m-Xylene	0	0	0	
n-Hexane	1.22366E-06	0	1.22366E-06	

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
2,2,4-Trimethylpentane	0	0	0	
Neopentane	0	0	0	
Decanes Plus	0	0	0	
Water	0	0	0	
Helium	0	0	0	
Hydrogen	0	0	0	
Oxygen	0	0	0	
Liquids Sample	0	0.11887	0.11887	
Total	0.00306649	0.11887	0.121936	

Remarks

Component Recoveries - Pipeline Liquids Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Carbon Dioxide		2.3878E-06	2.10214E-06	4.48994E-06
Nitrogen		1.33915E-05	1.07361E-06	1.44651E-05
Methane		0.00219764	0.00054667	0.00274431
Ethane		9.65805E-05	0.000181428	0.000278008
Propane		2.14792E-06	1.67611E-05	1.89091E-05
i-Butane		6.14958E-08	1.24767E-06	1.30916E-06
n-Butane		8.76432E-08	2.66292E-06	2.75057E-06
i-Pentane		5.60041E-09	5.23E-07	5.28601E-07
n-Pentane		3.80717E-09	4.92199E-07	4.96006E-07
i-Hexane		0	0	0
Heptane		0	0	0
Octane		0	0	0
Nonane		0	0	0
Benzene		0	0	0
Toluene		0	0	0
Ethylbenzene		0	0	0
m-Xylene		0	0	0
n-Hexane		3.50457E-09	1.22015E-06	1.22366E-06
2,2,4-Trimethylpentane		0	0	0
Neopentane		0	0	0
Decanes Plus		0	0	0
Water		0	0	0
Helium		0	0	0
Hydrogen		0	0	0
Oxygen		0	0	0
Liquids Sample		6.18398E-05	0.118808	0.11887

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Total		0.00237415	0.119562	0.121936

Remarks

Component Recoveries - Pipeline Liquids Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Summation Only
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Summary Table lbmol/h			
Carbon Dioxide	0			
Nitrogen	-3.3613E-21			
Methane	-8.60492E-19			
Ethane	-5.37808E-20			
Propane	0			
i-Butane	0			
n-Butane	4.20162E-22			
i-Pentane	0			
n-Pentane	0			
i-Hexane	0			
Heptane	0			
Octane	0			
Nonane	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
m-Xylene	0			
n-Hexane	2.10081E-22			
2,2,4-Trimethylpentane	0			
Neopentane	0			
Decanes Plus	0			
Water	0			
Helium	0			
Hydrogen	0			
Oxygen	0			
Liquids Sample	0			
Total	0			

Remarks

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Component Recoveries - Pipeline Liquids Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	True	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
Carbon Dioxide		53.181	46.819	100
Nitrogen		92.5779	7.42206	100
Methane		80.0799	19.9201	100
Ethane		34.7401	65.2599	100
Propane		11.3592	88.6408	100
i-Butane		4.69734	95.3027	100
n-Butane		3.18637	96.8136	100
i-Pentane		1.05948	98.9405	100
n-Pentane		0.767567	99.2324	100
i-Hexane				
Heptane				
Octane				
Nonane				
Benzene				
Toluene				
Ethylbenzene				
m-Xylene				
n-Hexane		0.286401	99.7136	100
2,2,4-Trimethylpentane				
Neopentane				
Decanes Plus				
Water				
Helium				
Hydrogen				
Oxygen				
Liquids Sample		0.0520231	99.948	100
Total		1.94704	98.053	100

Remarks

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Energy Budgets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Power Budget - Project Power Budget

Status: Solved

Parameters

Net Power	0 hp	Total Power Required	0 hp
Total Power Supplied	0 hp	External Energy Only	True

Remarks

Heat Budget - Project Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Project

Flowsheet	Block	Flowsheet	Block
Pipeline Liquids	PL Liquid Tanks	Pipeline Liquids	Separator

Parameters

Net Duty	-23.0547 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	23.0547 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Pipeline Liquids:PL Liquid Tanks	-17.0618	55	55	
Pipeline Liquids:Separator	-5.99298	56.0344	55	

Remarks

Power Budget - Pipeline Liquids Power Budget

Status: Solved

Parameters

Net Power	0 hp	Total Power Required	0 hp
Total Power Supplied	0 hp	External Energy Only	True

Remarks

Heat Budget - Pipeline Liquids Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Pipeline Liquids	PL Liquid Tanks	Pipeline Liquids	Separator

Parameters

Net Duty	-23.0547 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	23.0547 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Pipeline Liquids:PL Liquid	-17.0618	55	55	

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Energy Budgets Report

Client Name:	TC Energy	Job: Pipeline Liquids A08
Location:	Lanham Compressor Station	

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Tanks				
Pipeline Liquids:Separator	-5.99298	56.0344	55	

Remarks

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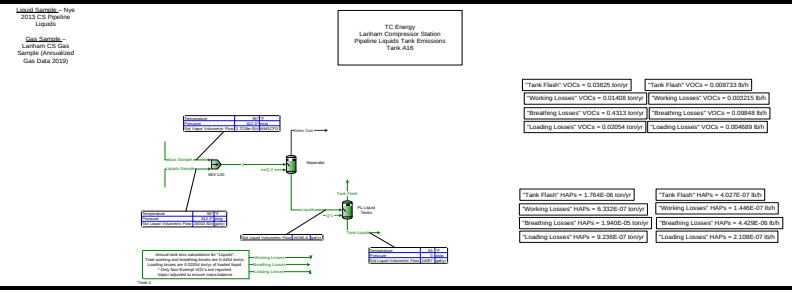
Pipeline Liquids
Plant Schematic

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	



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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Connections

	Breathing Losses	Gas Sample	Liquids	Liquids Sample	Loading Losses
From Block	--	--	Separator	--	--
To Block	--	MIX-100	PL Liquid Tanks	MIX-100	--

Stream Composition

Mole Fraction	Breathing Losses %	Gas Sample %	Liquids %	Liquids Sample %	Loading Losses %
Carbon Dioxide	0.130641 *	0.146419 *	0.0036822	0 *	0.130641 *
Nitrogen	0.067697 *	0.471715 *	0.0118628	0 *	0.067697 *
Methane	33.9703 *	89.4935 *	2.25061	0 *	33.9703 *
Ethane	11.6356 *	9.06599 *	0.227995	0 *	11.6356 *
Propane	1.12746 *	0.616634 *	0.0155073	0 *	1.12746 *
i-Butane	0.0473621 *	0.0426924 *	0.00107364	0 *	0.0473621 *
n-Butane	0.0683585 *	0.0896974 *	0.00225574	0 *	0.0683585 *
i-Pentane	0.00450124 *	0.0172379 *	0.000433506	0 *	0.00450124 *
n-Pentane	0.00308875 *	0.016175 *	0.000406775	0 *	0.00308875 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	0.00290973 *	0.039904 *	0.00100352	0 *	0.00290973 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	52.9421 *	0 *	97.4852	100 *	52.9421 *

Molar Flow	Breathing Losses lbmol/h	Gas Sample lbmol/h	Liquids lbmol/h	Liquids Sample lbmol/h	Loading Losses lbmol/h
Carbon Dioxide	2.30763E-06 *	5.98659E-06 *	5.98659E-06	0 *	1.09868E-07 *
Nitrogen	1.19579E-06 *	1.92868E-05 *	1.92868E-05	0 *	5.69326E-08 *
Methane	0.000600047 *	0.00365909 *	0.00365909	0 *	2.85688E-05 *
Ethane	0.000205529 *	0.000370678 *	0.000370678	0 *	9.78543E-06 *
Propane	1.99153E-05 *	2.52121E-05 *	2.52121E-05	0 *	9.48187E-07 *
i-Butane	8.36597E-07 *	1.74555E-06 *	1.74555E-06	0 *	3.98311E-08 *
n-Butane	1.20748E-06 *	3.66742E-06 *	3.66742E-06	0 *	5.7489E-08 *
i-Pentane	7.95092E-08 *	7.04801E-07 *	7.04801E-07	0 *	3.78551E-09 *
n-Pentane	5.45593E-08 *	6.61341E-07 *	6.61341E-07	0 *	2.59762E-09 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	5.13971E-08 *	1.63154E-06 *	1.63154E-06	0 *	2.44706E-09 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Molar Flow	Breathing Losses lbmol/h	Gas Sample lbmol/h	Liquids lbmol/h	Liquids Sample lbmol/h	Loading Losses lbmol/h
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	0.000935161 *	0 *	0.158493	0.158493 *	4.45239E-05 *

Mass Fraction	Breathing Losses %	Gas Sample %	Liquids %	Liquids Sample %	Loading Losses %
Carbon Dioxide	0.0887576	0.364327 *	0.00158796	0 *	0.0887576
Nitrogen	0.0292761	0.747123 *	0.00325641	0 *	0.0292761
Methane	8.41296	81.1726 *	0.353799	0 *	8.41296
Ethane	5.40114	15.4128 *	0.0671783	0 *	5.40114
Propane	0.767495	1.53734 *	0.00670065	0 *	0.767495
i-Butane	0.0424963	0.140294 *	0.000611486	0 *	0.0424963
n-Butane	0.0613356	0.29476 *	0.00128474	0 *	0.0613356
i-Pentane	0.00501348	0.0703172 *	0.000306484	0 *	0.00501348
n-Pentane	0.00344025	0.0659812 *	0.000287586	0 *	0.00344025
i-Hexane	0	0 *	0	0 *	0
Heptane	0	0 *	0	0 *	0
Octane	0	0 *	0	0 *	0
Nonane	0	0 *	0	0 *	0
Benzene	0	0 *	0	0 *	0
Toluene	0	0 *	0	0 *	0
Ethylbenzene	0	0 *	0	0 *	0
m-Xylene	0	0 *	0	0 *	0
n-Hexane	0.00387092	0.194423 *	0.00084741	0 *	0.00387092
2,2,4-Trimethylpentane	0	0 *	0	0 *	0
Neopentane	0	0 *	0	0 *	0
Decanes Plus	0	0 *	0	0 *	0
Water	0	0 *	0	0 *	0
Helium	0	0 *	0	0 *	0
Hydrogen	0	0 *	0	0 *	0
Oxygen	0	0 *	0	0 *	0
Liquids Sample	85.1842	0 *	99.5641	100 *	85.1842

Mass Flow	Breathing Losses lb/h	Gas Sample lb/h	Liquids lb/h	Liquids Sample lb/h	Loading Losses lb/h
Carbon Dioxide	0.000101558 *	0.000263467 *	0.000263467	0 *	4.83526E-06 *
Nitrogen	3.34981E-05 *	0.00054029 *	0.00054029	0 *	1.59488E-06 *
Methane	0.00962623 *	0.0587008 *	0.0587008	0 *	0.000458313 *
Ethane	0.00618006 *	0.0111459 *	0.0111459	0 *	0.000294238 *
Propane	0.000878179 *	0.00111174 *	0.00111174	0 *	4.18109E-05 *
i-Butane	4.86249E-05 *	0.000101455 *	0.000101455	0 *	2.31507E-06 *
n-Butane	7.01811E-05 *	0.000213159 *	0.000213159	0 *	3.34139E-06 *
i-Pentane	5.73649E-06 *	5.08506E-05 *	5.08506E-05	0 *	2.7312E-07 *
n-Pentane	3.93639E-06 *	4.7715E-05 *	4.7715E-05	0 *	1.87415E-07 *
i-Hexane	0 *	0 *	0	0 *	0 *
Heptane	0 *	0 *	0	0 *	0 *
Octane	0 *	0 *	0	0 *	0 *
Nonane	0 *	0 *	0	0 *	0 *
Benzene	0 *	0 *	0	0 *	0 *
Toluene	0 *	0 *	0	0 *	0 *
Ethylbenzene	0 *	0 *	0	0 *	0 *
m-Xylene	0 *	0 *	0	0 *	0 *
n-Hexane	4.42916E-06 *	0.000140599 *	0.000140599	0 *	2.10876E-07 *
2,2,4-Trimethylpentane	0 *	0 *	0	0 *	0 *
Neopentane	0 *	0 *	0	0 *	0 *
Decanes Plus	0 *	0 *	0	0 *	0 *

* User Specified Values
? Extrapolated or Approximate Values

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Mass Flow	Breathing Losses lb/h	Gas Sample lb/h	Liquids lb/h	Liquids Sample lb/h	Loading Losses lb/h
Water	0 *	0 *	0	0 *	0 *
Helium	0 *	0 *	0	0 *	0 *
Hydrogen	0 *	0 *	0	0 *	0 *
Oxygen	0 *	0 *	0	0 *	0 *
Liquids Sample	0.097469 *	0 *	16.5193	16.5193 *	0.00464059 *

Stream Properties

Property	Units	Breathing Losses	Gas Sample	Liquids	Liquids Sample	Loading Losses
Temperature	°F	70.2328	55 *	55	55 *	70.2328
Pressure	psia	1.10552	626.996 *	626.996	626.996 *	1.10552
Mole Fraction Vapor	%	100	100	0	0	100
Mole Fraction Light Liquid	%	0	0	100	100	0
Mole Fraction Heavy Liquid	%	0	0	0	0	0
Molecular Weight	lb/lbmol	64.7772	17.687	102.051	104.227	64.7772
Mass Density	lb/ft^3	0.0126238	2.28641	45.3044	45.4671	0.0126238
Molar Flow	lbmol/h	0.00176639	0.00408866	0.162582	0.158493	8.40992E-05
Mass Flow	lb/h	0.114421	0.072316	16.5916	16.5193	0.00544771
Vapor Volumetric Flow	ft^3/h	9.06397	0.0316286	0.366224	0.363323	0.431544
Liquid Volumetric Flow	gpm	1.13005	0.00394331	0.0456591	0.0452975	0.0538029
Std Vapor Volumetric Flow	MMSCFD	1.60876E-05	3.7238E-05 *	0.00148073	0.00144349	7.65943E-07
Std Liquid Volumetric Flow	sgpm	0.000373015	0.000462069	0.0462077	0.0457457 *	1.77596E-05
Compressibility		0.997566	0.878155	0.25571	0.260229	0.997566
Specific Gravity		2.23659	0.610685	0.726396	0.729004	2.23659
API Gravity				63.9295	63.2193	
Enthalpy	Btu/h	-94.5371	-136.042	-14004.4	-13860.4	-4.501
Mass Enthalpy	Btu/lb	-826.218	-1881.22	-844.067	-839.043	-826.218
Mass Cp	Btu/(lb*°F)	0.384148	0.59475	0.465238	0.463769	0.384148
Ideal Gas CpCv Ratio		1.0868	1.28996	1.05738	1.05622	1.0868
Dynamic Viscosity	cP	0.00731726	0.0115808	0.515199	0.53843	0.00731726
Kinematic Viscosity	cSt	36.1858	0.316201	0.709927	0.739285	36.1858
Thermal Conductivity	Btu/(h*ft*°F)	0.0102039	0.0201617	0.0642001	0.064265	0.0102039
Surface Tension	lbf/ft			0.0011822 ?	0.00154741	
Net Ideal Gas Heating Value	Btu/ft^3	3298.53	981.884	5127.53	5234.47	3298.53
Net Liquid Heating Value	Btu/lb	19178.1	21039.6	18908	18898.7	19178.1
Gross Ideal Gas Heating Value	Btu/ft^3	3553.33	1087.39	5499.37	5613.19	3553.33
Gross Liquid Heating Value	Btu/lb	20670.9	23303.6	20290.8	20277.6	20670.9

Remarks

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Connections

	Sales Gas	Tank Flash	Tank Liquids	Working Losses	3
From Block	Separator	PL Liquid Tanks	PL Liquid Tanks	--	MIX-100
To Block	--	--	--	--	Separator

Stream Composition

Mole Fraction	Sales Gas %	Tank Flash %	Tank Liquids %	Working Losses %	3 %
Carbon Dioxide		0.100575	0.0017582	0.130641 *	0.0036822
Nitrogen		0.564054	0.000897951	0.067697 *	0.0118628
Methane		92.5654	0.457227	33.9703 *	2.25061
Ethane		4.068	0.151744	11.6356 *	0.227995
Propane		0.090471	0.0140188	1.12746 *	0.0155073
i-Butane		0.00259022	0.00104353	0.0473621 *	0.00107364
n-Butane		0.00369156	0.00222723	0.0683585 *	0.00225574
i-Pentane		0.000235891	0.00043743	0.00450124 *	0.000433506
n-Pentane		0.000160359	0.000411668	0.00308875 *	0.000406775
i-Hexane		0	0	0 *	0
Heptane		0	0	0 *	0
Octane		0	0	0 *	0
Nonane		0	0	0 *	0
Benzene		0	0	0 *	0
Toluene		0	0	0 *	0
Ethylbenzene		0	0	0 *	0
m-Xylene		0	0	0 *	0
n-Hexane		0.000147613	0.00102052	0.00290973 *	0.00100352
2,2,4-Trimethylpentane		0	0	0 *	0
Neopentane		0	0	0 *	0
Decanes Plus		0	0	0 *	0
Water		0	0	0 *	0
Helium		0	0	0 *	0
Hydrogen		0	0	0 *	0
Oxygen		0	0	0 *	0
Liquids Sample		2.60471	99.3692	52.9421 *	97.4852

Molar Flow	Sales Gas lbmol/h	Tank Flash lbmol/h	Tank Liquids lbmol/h	Working Losses lbmol/h	3 lbmol/h
Carbon Dioxide	0	3.18373E-06	2.80286E-06	7.53244E-08 *	5.98659E-06
Nitrogen	0	1.78553E-05	1.43148E-06	3.90323E-08 *	1.92868E-05
Methane	0	0.00293019	0.000728894	1.95864E-05 *	0.00365909
Ethane	0	0.000128774	0.000241904	6.70876E-06 *	0.000370678
Propane	0	2.8639E-06	2.23482E-05	6.50065E-07 *	2.52121E-05
i-Butane	0	8.19945E-08	1.66355E-06	2.73077E-08 *	1.74555E-06
n-Butane	0	1.16858E-07	3.55057E-06	3.94137E-08 *	3.66742E-06
i-Pentane	0	7.46722E-09	6.97334E-07	2.59529E-09 *	7.04801E-07
n-Pentane	0	5.07624E-09	6.56265E-07	1.78089E-09 *	6.61341E-07
i-Hexane	0	0	0	0 *	0
Heptane	0	0	0	0 *	0
Octane	0	0	0	0 *	0
Nonane	0	0	0	0 *	0
Benzene	0	0	0	0 *	0
Toluene	0	0	0	0 *	0
Ethylbenzene	0	0	0	0 *	0
m-Xylene	0	0	0	0 *	0
n-Hexane	0	4.67276E-09	1.62687E-06	1.67767E-09 *	1.63154E-06
2,2,4-Trimethylpentane	0	0	0	0 *	0
Neopentane	0	0	0	0 *	0
Decanes Plus	0	0	0	0 *	0

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Molar Flow	Sales Gas lbmol/h	Tank Flash lbmol/h	Tank Liquids lbmol/h	Working Losses lbmol/h	3 lbmol/h
Water	0	0	0	0 *	0
Helium	0	0	0	0 *	0
Hydrogen	0	0	0	0 *	0
Oxygen	0	0	0	0 *	0
Liquids Sample	0	8.24531E-05	0.158411	3.0525E-05 *	0.158493

Mass Fraction	Sales Gas %	Tank Flash %	Tank Liquids %	Working Losses %	3 %
Carbon Dioxide		0.232544	0.000746174	0.0887576	0.00158796
Nitrogen		0.830149	0.000242573	0.0292761	0.00325641
Methane		78.017	0.0707339	8.41296	0.353799
Ethane		6.42643	0.0440002	5.40114	0.0671783
Propane		0.209592	0.00596116	0.767495	0.00670065
i-Butane		0.00790949	0.000584887	0.0424963	0.000611486
n-Butane		0.0112725	0.00124834	0.0613356	0.00128474
i-Pentane		0.000894149	0.000304342	0.00501348	0.000306484
n-Pentane		0.000607845	0.000286418	0.00344025	0.000287586
i-Hexane		0	0	0	0
Heptane		0	0	0	0
Octane		0	0	0	0
Nonane		0	0	0	0
Benzene		0	0	0	0
Toluene		0	0	0	0
Ethylbenzene		0	0	0	0
m-Xylene		0	0	0	0
n-Hexane		0.000668311	0.000848063	0.00387092	0.00084741
2,2,4-Trimethylpentane		0	0	0	0
Neopentane		0	0	0	0
Decanes Plus		0	0	0	0
Water		0	0	0	0
Helium		0	0	0	0
Hydrogen		0	0	0	0
Oxygen		0	0	0	0
Liquids Sample		14.2629	99.875	85.1842	99.5641

Mass Flow	Sales Gas lb/h	Tank Flash lb/h	Tank Liquids lb/h	Working Losses lb/h	3 lb/h
Carbon Dioxide	0	0.000140115	0.000123352	3.31499E-06 *	0.000263467
Nitrogen	0	0.000500189	4.01006E-05	1.09343E-06 *	0.00054029
Methane	0	0.0470075	0.0116933	0.000314214 *	0.0587008
Ethane	0	0.00387211	0.00727382	0.000201726 *	0.0111459
Propane	0	0.000126285	0.000985458	2.8665E-05 *	0.00111174
i-Butane	0	4.7657E-06	9.66895E-05	1.58718E-06 *	0.000101455
n-Butane	0	6.79203E-06	0.000206367	2.29081E-06 *	0.000213159
i-Pentane	0	5.38751E-07	5.03118E-05	1.87247E-07 *	5.08506E-05
n-Pentane	0	3.66244E-07	4.73487E-05	1.28489E-07 *	4.7715E-05
i-Hexane	0	0	0	0 *	0
Heptane	0	0	0	0 *	0
Octane	0	0	0	0 *	0
Nonane	0	0	0	0 *	0
Benzene	0	0	0	0 *	0
Toluene	0	0	0	0 *	0
Ethylbenzene	0	0	0	0 *	0
m-Xylene	0	0	0	0 *	0
n-Hexane	0	4.02677E-07	0.000140196	1.44574E-07 *	0.000140599
2,2,4-Trimethylpentane	0	0	0	0 *	0
Neopentane	0	0	0	0 *	0
Decanes Plus	0	0	0	0 *	0

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Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Mass Flow	Sales Gas lb/h	Tank Flash lb/h	Tank Liquids lb/h	Working Losses lb/h	3 lb/h
Water	0	0	0	0 *	0
Helium	0	0	0	0 *	0
Hydrogen	0	0	0	0 *	0
Oxygen	0	0	0	0 *	0
Liquids Sample	0	0.00859384	16.5107	0.00318153 *	16.5193

Stream Properties

Property	Units	Sales Gas	Tank Flash	Tank Liquids	Working Losses	3
Temperature	°F	55 *	55 *	55	70.2328	56.0344
Pressure	psia	626.996 *	14.6959 *	14.6959	1.10552	626.996
Mole Fraction Vapor	%		100	0	100	0
Mole Fraction Light Liquid	%		0	100	0	100
Mole Fraction Heavy Liquid	%		0	0	0	0
Molecular Weight	lb/lbmol		19.034	103.699	64.7772	102.051
Mass Density	lb/ft^3		0.0508158	45.1369	0.0126238	45.2741
Molar Flow	lbmol/h	0	0.00316554	0.159416	5.76573E-05	0.162582
Mass Flow	lb/h	0	0.0602529	16.5313	0.00373488	16.5916
Vapor Volumetric Flow	ft^3/h	0	1.18571	0.366248	0.295861	0.366469
Liquid Volumetric Flow	gpm	0	0.147829	0.0456621	0.0368866	0.0456897
Std Vapor Volumetric Flow	MMSCFD	0	2.88305E-05	0.0014519	5.25121E-07	0.00148073
Std Liquid Volumetric Flow	sgpm	0	0.000361032	0.0458467	1.21757E-05	0.0462077
Compressibility			0.996637	0.00611291	0.997566	0.255368
Specific Gravity			0.657195	0.723711	2.23659	0.72591
API Gravity				64.6661		63.9295
Enthalpy	Btu/h	0	-105.83	-13921.3	-3.08583	-13996.4
Mass Enthalpy	Btu/lb		-1756.43	-842.118	-826.218	-843.585
Mass Cp	Btu/(lb*°F)		0.491279	0.466172	0.384148	0.465915
Ideal Gas CpCv Ratio			1.27085	1.05649	1.0868	1.05727
Dynamic Viscosity	cP		0.0104797	0.50159	0.00731726	0.511965
Kinematic Viscosity	cSt		12.8744	0.693738	36.1858	0.705943
Thermal Conductivity	Btu/(h*ft*°F)		0.0175967	0.0642423	0.0102039	0.0641637
Surface Tension	lbf/ft			0.00153247 ?		0.00117954 ?
Net Ideal Gas Heating Value	Btu/ft^3		1046.3	5208.57	3298.53	5127.53
Net Liquid Heating Value	Btu/lb		20827.1	18901	19178.1	18908
Gross Ideal Gas Heating Value	Btu/ft^3		1155.61	5585.62	3553.33	5499.37
Gross Liquid Heating Value	Btu/lb		23006.7	20280.9	20670.9	20290.8

Remarks

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? Extrapolated or Approximate Values

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Energy Stream Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

Energy Streams

Energy Stream	Energy Rate		Power		From Block	To Block
Q-1	-22.749	Btu/h	-0.0089407	hp	--	PL Liquid Tanks
Q-2	-7.99065	Btu/h	-0.00314044	hp	--	Separator

Remarks

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Blocks
MIX-100
Mixer/Splitter Report

Client Name:	TC Energy	Job: Pipeline Liquids A16	
Location:	Lanham Compressor Station	Modified: 10:22 AM, 10/16/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 3:21 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Gas Sample	Inlet		Liquids Sample	Inlet	
3	Outlet	Separator			

Block Parameters

Pressure Drop	0	psi	Fraction to Stream 3	100	%
Flow Multiplier	100	%			

Remarks

ProMax 5.0.19263.0
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Blocks
PL Liquid Tanks
Separator Report

Client Name:	TC Energy	Job: Pipeline Liquids A16	
Location:	Lanham Compressor Station	Modified: 9:08 AM, 8/25/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 3:22 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Liquids	Inlet	Separator	Tank Flash	Vapor Outlet	
Tank Liquids	Light Liquid Outlet		Q-1	Energy	

Block Parameters

Pressure Drop	612.3	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	1.94705	%	Heat Duty	-22.749	Btu/h
Mole Fraction Light Liquid	98.053	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	

Remarks

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Blocks
Separator
Separator Report

Client Name:	TC Energy	Job: Pipeline Liquids A16	
Location:	Lanham Compressor Station	Modified: 9:09 AM, 8/25/2020	
Flowsheet:	Pipeline Liquids	Status: Solved 3:21 PM, 11/17/2020	

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	MIX-100	Sales Gas	Vapor Outlet	
Liquids	Light Liquid Outlet	PL Liquid Tanks	Q-2	Energy	

Block Parameters

Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty	-7.99065	Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	

Remarks

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Flowsheet Environment
Environment1

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	
Flowsheet:	Pipeline Liquids	

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 Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Carbon Dioxide	False	False	Benzene	False	False
Nitrogen	False	False	Toluene	False	False
Methane	False	False	Ethylbenzene	False	False
Ethane	False	False	m-Xylene	False	False
Propane	False	False	n-Hexane	False	False
i-Butane	False	False	2,2,4-Trimethylpentane	False	False
n-Butane	False	False	Neopentane	False	False
i-Pentane	False	False	Decanes Plus	False	False
n-Pentane	False	False	Water	False	True
i-Hexane	False	False	Helium	False	False
Heptane	False	False	Hydrogen	False	False
Octane	False	False	Oxygen	False	False
Nonane	False	False	Liquids Sample	False	False

Physical Property Method Sets

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

Remarks

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Environments Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Project-Wide Constants

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

Environment [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 Name	Henry's Law Component	Phase Initiator	Component Name	Henry's Law Component	Phase Initiator
Carbon Dioxide	False	False	Benzene	False	False
Nitrogen	False	False	Toluene	False	False
Methane	False	False	Ethylbenzene	False	False
Ethane	False	False	m-Xylene	False	False
Propane	False	False	n-Hexane	False	False
i-Butane	False	False	2,2,4-Trimethylpentane	False	False
n-Butane	False	False	Neopentane	False	False
i-Pentane	False	False	Decanes Plus	False	False
n-Pentane	False	False	Water	False	True
i-Hexane	False	False	Helium	False	False
Heptane	False	False	Hydrogen	False	False
Octane	False	False	Oxygen	False	False
Nonane	False	False	Liquids Sample	False	False

Physical Property Method Sets

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

Remarks

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Single Oil Report
Decanes Plus

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Properties

Volume Average Boiling Point	240.832	°F	Low Temperature Viscosity	0.441651	cP
* Molecular Weight	108.848	lb/lbmol	Temperature of High T Viscosity	210	°F
* Specific Gravity	0.7432		High Temperature Viscosity	0.256204	cP
API Gravity	58.8929		Watson K	11.9499	
Critical Temperature	563.715	°F	ASTM D86 10-90% Slope	0	°F/%
Critical Pressure	421.397	psia	ASTM D93 Flash Point	47.9739	°F
Critical Volume	6.98262	ft^3/lbmol	? Pour Point	-22.4869	°F
Acentric Factor	0.350921		Paraffinic Fraction	56.3105	%
Carbon to Hydrogen Ratio	5.84021		Naphthenic Fraction	29.8859	%
Refractive Index	1.41346		Aromatic Fraction	13.8037	%
Temperature of Low T Viscosity	100	°F	Ideal Gas Heat Capacity	38.2665	Btu/(lbmol*°F)

Warnings

ProMax:ProMax!Project!Oils!Decanes Plus!Properties!Pour Point

Warning: Pour Point calculation: The value of 240.832 °F for Volume Average Boiling Point should be between 340.33 °F and 1040.33 °F.

Remarks

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Single Oil Report
Liquids Sample

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Properties

Volume Average Boiling Point	221.237	°F	Low Temperature Viscosity	0.389635	cP
* Molecular Weight	104.227	lb/lbmol	Temperature of High T Viscosity	210	°F
* Specific Gravity	0.721862		High Temperature Viscosity	0.231388	cP
API Gravity	64.5208		Watson K	12.1873	
Critical Temperature	536.86	°F	ASTM D86 10-90% Slope	0	°F/%
Critical Pressure	417.121	psia	ASTM D93 Flash Point	34.4537	°F
Critical Volume	6.79544	ft^3/lbmol	? Pour Point	-14.04	°F
Acentric Factor	0.339064		Paraffinic Fraction	64.4262	%
Carbon to Hydrogen Ratio	5.57819		Naphthenic Fraction	26.0787	%
Refractive Index	1.40218		Aromatic Fraction	9.49512	%
Temperature of Low T Viscosity	100	°F	Ideal Gas Heat Capacity	37.6486	Btu/(lbmol*°F)

Warnings

ProMax:ProMax!Project!Oils!Liquids Sample!Properties!Pour Point

Warning: Pour Point calculation: The value of 221.237 °F for Volume Average Boiling Point should be between 340.33 °F and 1040.33 °F.

Remarks

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Calculator Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Gas Solver

Source Code

Residual Error (for CV1) = LiquidsSample - 99

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Gas Sample!Phases!Total!Properties!Std Vapor Volumetric Flow
Value	3.7238E-05
Unit	

Measured Variable [LiquidsSample]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Liquids!Phases!Total!Composition!Std Liquid Volumetric Fraction!Liquids Sample
Value	99
Unit	

Solver Properties

Status: Solved

Error	1.73089E-05		Weighting	1
Calculated Value	3.7238E-05	MMSCFD	Priority	0
Lower Bound		MMSCFD	Solver State	Active
Upper Bound		MMSCFD	Group	
Step Size		MMSCFD	Skip Dependency Check	False
Is Minimizer	False		Block Dependencies	2
Algorithm	Default		Recycle Dependencies	0
Iterations	2		Solver Dependencies	1
Max Iterations	20			

Remarks

Liquid Solver

Source Code

Residual Error (for CV1) = Liquids - 24000

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Liquids Sample!Phases!Total!Properties!Std Liquid Volumetric Flow
Value	0.0457457
Unit	

Measured Variable [Liquids]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Pipeline Liquids!PStreams!Tank Liquids!Phases!Total!Properties!Liquid Volumetric Flow
Value	24000
Unit	

Solver Properties

Status: Solved

Error	6.6017E-06		Max Iterations	20
Calculated Value	0.0457457	sgpm	Weighting	1
Lower Bound		sgpm	* Solver State	Active
Upper Bound		sgpm	* Skip Dependency Check	True
Step Size		sgpm	Block Dependencies	3
Is Minimizer	False		Recycle Dependencies	0
Algorithm	Default		Solver Dependencies	0
Iterations	3			

Remarks

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Calculator Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

ProMax 5.0.19263.0
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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tank-1

User Value [BlockReady]

* Parameter	1		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [ShellLength]

* Parameter	21	ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [ShellDiam]

* Parameter	6.98	ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [BreatherVP]

* Parameter	0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [BreatherVacP]

* Parameter	-0.03	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [DomeRadius]

Parameter		ft	Upper Bound	ft
Lower Bound		ft	* Enforce Bounds	False

User Value [OpPress]

* Parameter	0	psig	Upper Bound	psig
Lower Bound		psig	* Enforce Bounds	False

User Value [AvgPercentLiq]

* Parameter	50	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxPercentLiq]

* Parameter	90	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MinPercentLiq]

* Parameter	10	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [AnnNetTP]

* Parameter	1.57159	bbl/day	Upper Bound	bbl/day
Lower Bound		bbl/day	* Enforce Bounds	False

User Value [OREff]

* Parameter	0	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [MaxAvgT]

* Parameter	65.4	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [MinAvgT]

* Parameter	45.5	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

User Value [BulkLiqT]

* Parameter	58.7899	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [AvgP]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [Therml]

* Parameter	1237	Btu/ft^2/day	Upper Bound	Btu/ft^2/day
Lower Bound		Btu/ft^2/day	* Enforce Bounds	False

User Value [AvgWindSpeed]

* Parameter	4	mi/h	Upper Bound	mi/h
Lower Bound		mi/h	* Enforce Bounds	False

User Value [MaxHourlyLoadingRate]

Parameter		bbl/hr	Upper Bound	bbl/hr
Lower Bound		bbl/hr	* Enforce Bounds	False

User Value [SumLiqLevelInc]

Parameter		ft/yr	Upper Bound	ft/yr
Lower Bound		ft/yr	* Enforce Bounds	False

User Value [FlashingT]

* Parameter	70.2328	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [EntrainedOilFrac]

* Parameter	1	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [TurnoverRate]

* Parameter	1.96723		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [LLossSatFactor]

* Parameter	1.45		Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [AtmPressure]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [TVP]

* Parameter	13.5803	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MaxVP]

* Parameter	14.16	psia	Upper Bound	psia
Lower Bound		psia	* Enforce Bounds	False

User Value [MinVP]

* Parameter	13.018	psia	Upper Bound	psia

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

User Value [MinVP]

Lower Bound		psia	* Enforce Bounds	False

User Value [AvgLiqSurfaceT]

* Parameter	61.6921	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [MaxLiqSurfaceT]

* Parameter	70.2328	°F	Upper Bound	°F
Lower Bound		°F	* Enforce Bounds	False

User Value [TotalLosses]

* Parameter	0.445423	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WorkingLosses]

* Parameter	0.00703982	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [StandingLosses]

* Parameter	0.215671	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [RimSealLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [WithdrawalLoss]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [LoadingLosses]

* Parameter	0.0205366	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [MaxHourlyLoadingLoss]

* Parameter	0	lb/hr	Upper Bound	lb/hr
Lower Bound		lb/hr	* Enforce Bounds	False

User Value [PStar]

Parameter			Upper Bound	
Lower Bound			* Enforce Bounds	False

User Value [AllCTotalLosses]

* Parameter	0.517525	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [AllCLoadingLosses]

* Parameter	0.023861	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [AllCMaxHLoadingLoss]

* Parameter	0	lb/hr	Upper Bound	lb/hr
Lower Bound		lb/hr	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

User Value [AllCFlashingLosses]

* Parameter	0.299092	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckFittingLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [DeckSeamLosses]

* Parameter	0	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [FlashingLosses]

* Parameter	0.0650694	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [TotalResidual]

* Parameter	71.8545	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

User Value [GasMoleWeight]

* Parameter	0.0198082	kg/mol	Upper Bound	kg/mol
Lower Bound		kg/mol	* Enforce Bounds	False

User Value [VapReportableFrac]

* Parameter	86.0679	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [LiqReportableFrac]

* Parameter	99.8958	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

User Value [FlashReportableFrac]

* Parameter	21.7557	%	Upper Bound	%
Lower Bound		%	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CD98EEA3-8B3E-47D7-BCC0-B760573420A8}

Sum Component Flow/Frac

User Value [CompSum]

* Parameter	0.0382505	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={5CABC249-2E47-44D4-A833-4F3D1AF2547A}

Sum Component Flow/Frac.177

User Value [CompSum]

* Parameter	0.0140796	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Remarks
This User Value Set was programmatically generated. GUID={0BEE6B58-A118-4655-88B1-C3178E914D1F}

Sum Component Flow/Frac.178

User Value [CompSum]

* Parameter	0.431343	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={1FCF7A22-53BB-4D85-B4D2-98034DCCEAC5}

Sum Component Flow/Frac.179

User Value [CompSum]

* Parameter	0.0205366	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={844D69D0-5266-4B81-8111-87B14F6F1BDC}

Sum Component Flow/Frac.186

User Value [CompSum]

* Parameter	0.00873299	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={16314887-EB06-407D-A4B5-D174F0939D1D}

Sum Component Flow/Frac.187

User Value [CompSum]

* Parameter	1.76372E-06	ton/yr	Upper Bound		ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={9AFAA5FF-7014-420C-88AF-1F950D754536}

Sum Component Flow/Frac.188

User Value [CompSum]

* Parameter	4.02677E-07	lb/h	Upper Bound		lb/h
Lower Bound		lb/h	* Enforce Bounds	False	

Remarks
This User Value Set was programmatically generated. GUID={8AF72F6D-9B6B-4084-A5B9-70157C63A6B1}

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Sum Component Flow/Frac.189

User Value [CompSum]

* Parameter	0.00321453	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={9CB8D542-8D75-4E89-8AB7-442949EE109B}

Sum Component Flow/Frac.190

User Value [CompSum]

* Parameter	0.0984801	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={23E8E7AB-B99D-4098-A3AE-61C1D7D4BA2E}

Sum Component Flow/Frac.191

User Value [CompSum]

* Parameter	1.93997E-05	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={63883334-AB8B-4092-A4D0-1E7AED13AEE9}

Sum Component Flow/Frac.192

User Value [CompSum]

* Parameter	4.42916E-06	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={51B0EE06-A063-4115-9274-E1D15BF915CA}

Sum Component Flow/Frac.193

User Value [CompSum]

* Parameter	6.33234E-07	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={55E10691-B7DA-4FAA-9B9E-0B68D87CB072}

Sum Component Flow/Frac.194

User Value [CompSum]

* Parameter	9.23638E-07	ton/yr	Upper Bound	ton/yr
Lower Bound		ton/yr	* Enforce Bounds	False

Remarks

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User Value Sets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

This User Value Set was programmatically generated. GUID={75C56AB5-55B0-40BE-BD77-0FEA32ACB487}

Sum Component Flow/Frac.195

User Value [CompSum]

* Parameter	0.00468873	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={DFB150C3-5EE6-4635-8FEF-CAC33DC58C42}

Sum Component Flow/Frac.196

User Value [CompSum]

* Parameter	1.44574E-07	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={CA38BC43-757A-43DF-B7AE-5B8482D705C9}

Sum Component Flow/Frac.197

User Value [CompSum]

* Parameter	2.10876E-07	lb/h	Upper Bound	lb/h
Lower Bound		lb/h	* Enforce Bounds	False

Remarks
This User Value Set was programmatically generated. GUID={D1DB11B0-87F0-46EA-90A6-6AC73B0D6340}

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Component Recoveries - Project Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
Carbon Dioxide	5.98659E-06	0	5.98659E-06	
Nitrogen	1.92868E-05	0	1.92868E-05	
Methane	0.00365909	0	0.00365909	
Ethane	0.000370678	0	0.000370678	
Propane	2.52121E-05	0	2.52121E-05	
i-Butane	1.74555E-06	0	1.74555E-06	
n-Butane	3.66742E-06	0	3.66742E-06	
i-Pentane	7.04801E-07	0	7.04801E-07	
n-Pentane	6.61341E-07	0	6.61341E-07	
i-Hexane	0	0	0	
Heptane	0	0	0	
Octane	0	0	0	
Nonane	0	0	0	
Benzene	0	0	0	
Toluene	0	0	0	
Ethylbenzene	0	0	0	
m-Xylene	0	0	0	
n-Hexane	1.63154E-06	0	1.63154E-06	
2,2,4-Trimethylpentane	0	0	0	
Neopentane	0	0	0	
Decanes Plus	0	0	0	
Water	0	0	0	
Helium	0	0	0	
Hydrogen	0	0	0	
Oxygen	0	0	0	
Liquids Sample	0	0.158493	0.158493	
Total	0.00408866	0.158493	0.162582	

Remarks

Component Recoveries - Project Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Carbon Dioxide		3.18373E-06	2.80286E-06	5.98659E-06
Nitrogen		1.78553E-05	1.43148E-06	1.92868E-05
Methane		0.00293019	0.000728894	0.00365909
Ethane		0.000128774	0.000241904	0.000370678
Propane		2.8639E-06	2.23482E-05	2.52121E-05
i-Butane		8.19945E-08	1.66355E-06	1.74555E-06
n-Butane		1.16858E-07	3.55057E-06	3.66742E-06
i-Pentane		7.46722E-09	6.97334E-07	7.04801E-07
n-Pentane		5.07624E-09	6.56265E-07	6.61341E-07
i-Hexane		0	0	0
Heptane		0	0	0
Octane		0	0	0
Nonane		0	0	0
Benzene		0	0	0
Toluene		0	0	0
Ethylbenzene		0	0	0
m-Xylene		0	0	0
n-Hexane		4.67276E-09	1.62687E-06	1.63154E-06
2,2,4-Trimethylpentane		0	0	0
Neopentane		0	0	0
Decanes Plus		0	0	0
Water		0	0	0
Helium		0	0	0
Hydrogen		0	0	0
Oxygen		0	0	0
Liquids Sample		8.24531E-05	0.158411	0.158493
Total		0.00316554	0.159416	0.162582

Remarks

Component Recoveries - Project Losses

Status: Solved

Reference Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Summation Only
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Summary Table lbmol/h			
Carbon Dioxide	0			
Nitrogen	0			
Methane	-4.30246E-19			
Ethane	-5.37808E-20			
Propane	0			

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tabulated Data

Index	Summary Table lbmol/h			
i-Butane	-4.20162E-22			
n-Butane	-8.40325E-22			
i-Pentane	0			
n-Pentane	-1.05041E-22			
i-Hexane	0			
Heptane	0			
Octane	0			
Nonane	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
m-Xylene	0			
n-Hexane	-4.20162E-22			
2,2,4-Trimethylpentane	0			
Neopentane	0			
Decanes Plus	0			
Water	0			
Helium	0			
Hydrogen	0			
Oxygen	0			
Liquids Sample	-2.75358E-17			
Total	-2.75358E-17			

Remarks

Component Recoveries - Project Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	True	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
Carbon Dioxide		53.1811	46.8189	100
Nitrogen		92.5779	7.42206	100
Methane		80.0799	19.9201	100
Ethane		34.7402	65.2598	100
Propane		11.3592	88.6408	100
i-Butane		4.69734	95.3027	100
n-Butane		3.18637	96.8136	100
i-Pentane		1.05948	98.9405	100
n-Pentane		0.767567	99.2324	100

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
i-Hexane				
Heptane				
Octane				
Nonane				
Benzene				
Toluene				
Ethylbenzene				
m-Xylene				
n-Hexane		0.286402	99.7136	100
2,2,4-Trimethylpentane				
Neopentane				
Decanes Plus				
Water				
Helium				
Hydrogen				
Oxygen				
Liquids Sample		0.0520231	99.948	100
Total		1.94705	98.053	100

Remarks

Component Recoveries - Pipeline Liquids Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
Carbon Dioxide	5.98659E-06	0	5.98659E-06	
Nitrogen	1.92868E-05	0	1.92868E-05	
Methane	0.00365909	0	0.00365909	
Ethane	0.000370678	0	0.000370678	
Propane	2.52121E-05	0	2.52121E-05	
i-Butane	1.74555E-06	0	1.74555E-06	
n-Butane	3.66742E-06	0	3.66742E-06	
i-Pentane	7.04801E-07	0	7.04801E-07	
n-Pentane	6.61341E-07	0	6.61341E-07	
i-Hexane	0	0	0	
Heptane	0	0	0	
Octane	0	0	0	
Nonane	0	0	0	
Benzene	0	0	0	
Toluene	0	0	0	
Ethylbenzene	0	0	0	
m-Xylene	0	0	0	
n-Hexane	1.63154E-06	0	1.63154E-06	

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Gas Sample lbmol/h	Pipeline Liquids:Liquids Sample lbmol/h	Summary Table lbmol/h	
2,2,4-Trimethylpentane	0	0	0	
Neopentane	0	0	0	
Decanes Plus	0	0	0	
Water	0	0	0	
Helium	0	0	0	
Hydrogen	0	0	0	
Oxygen	0	0	0	
Liquids Sample	0	0.158493	0.158493	
Total	0.00408866	0.158493	0.162582	

Remarks

Component Recoveries - Pipeline Liquids Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Carbon Dioxide		3.18373E-06	2.80286E-06	5.98659E-06
Nitrogen		1.78553E-05	1.43148E-06	1.92868E-05
Methane		0.00293019	0.000728894	0.00365909
Ethane		0.000128774	0.000241904	0.000370678
Propane		2.8639E-06	2.23482E-05	2.52121E-05
i-Butane		8.19945E-08	1.66355E-06	1.74555E-06
n-Butane		1.16858E-07	3.55057E-06	3.66742E-06
i-Pentane		7.46722E-09	6.97334E-07	7.04801E-07
n-Pentane		5.07624E-09	6.56265E-07	6.61341E-07
i-Hexane		0	0	0
Heptane		0	0	0
Octane		0	0	0
Nonane		0	0	0
Benzene		0	0	0
Toluene		0	0	0
Ethylbenzene		0	0	0
m-Xylene		0	0	0
n-Hexane		4.67276E-09	1.62687E-06	1.63154E-06
2,2,4-Trimethylpentane		0	0	0
Neopentane		0	0	0
Decanes Plus		0	0	0
Water		0	0	0
Helium		0	0	0
Hydrogen		0	0	0
Oxygen		0	0	0
Liquids Sample		8.24531E-05	0.158411	0.158493

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tabulated Data

Index	Pipeline Liquids:Sales Gas lbmol/h	Pipeline Liquids:Tank Flash lbmol/h	Pipeline Liquids:Tank Liquids lbmol/h	Summary Table lbmol/h
Total		0.00316554	0.159416	0.162582

Remarks

Component Recoveries - Pipeline Liquids Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Parameters

Composition Basis	Molar Flow	Summation Option	Summation Only
Calculate Ratios	False	Atomic Basis	False

Tabulated Data

Index	Summary Table lbmol/h			
Carbon Dioxide	0			
Nitrogen	0			
Methane	-4.30246E-19			
Ethane	-5.37808E-20			
Propane	0			
i-Butane	-4.20162E-22			
n-Butane	-8.40325E-22			
i-Pentane	0			
n-Pentane	-1.05041E-22			
i-Hexane	0			
Heptane	0			
Octane	0			
Nonane	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
m-Xylene	0			
n-Hexane	-4.20162E-22			
2,2,4-Trimethylpentane	0			
Neopentane	0			
Decanes Plus	0			
Water	0			
Helium	0			
Hydrogen	0			
Oxygen	0			
Liquids Sample	-2.75358E-17			
Total	-2.75358E-17			

Remarks

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Recoveries Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Component Recoveries - Pipeline Liquids Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Gas Sample	Pipeline Liquids	Liquids Sample

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Pipeline Liquids	Sales Gas	Pipeline Liquids	Tank Liquids
Pipeline Liquids	Tank Flash		

Parameters

Composition Basis	Molar Flow	Summation Option	Streams and Summation
Calculate Ratios	True	Atomic Basis	False

Tabulated Data

Index	Pipeline Liquids:Sales Gas %	Pipeline Liquids:Tank Flash %	Pipeline Liquids:Tank Liquids %	Summary Table %
Carbon Dioxide		53.1811	46.8189	100
Nitrogen		92.5779	7.42206	100
Methane		80.0799	19.9201	100
Ethane		34.7402	65.2598	100
Propane		11.3592	88.6408	100
i-Butane		4.69734	95.3027	100
n-Butane		3.18637	96.8136	100
i-Pentane		1.05948	98.9405	100
n-Pentane		0.767567	99.2324	100
i-Hexane				
Heptane				
Octane				
Nonane				
Benzene				
Toluene				
Ethylbenzene				
m-Xylene				
n-Hexane		0.286402	99.7136	100
2,2,4-Trimethylpentane				
Neopentane				
Decanes Plus				
Water				
Helium				
Hydrogen				
Oxygen				
Liquids Sample		0.0520231	99.948	100
Total		1.94705	98.053	100

Remarks

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Energy Budgets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Power Budget - Project Power Budget

Status: Solved

Parameters

Net Power	0 hp	Total Power Required	0 hp
Total Power Supplied	0 hp	External Energy Only	True

Remarks

Heat Budget - Project Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Project

Flowsheet	Block	Flowsheet	Block
Pipeline Liquids	PL Liquid Tanks	Pipeline Liquids	Separator

Parameters

Net Duty	-30.7397 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	30.7397 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Pipeline Liquids:PL Liquid Tanks	-22.749	55	55	
Pipeline Liquids:Separator	-7.99065	56.0344	55	

Remarks

Power Budget - Pipeline Liquids Power Budget

Status: Solved

Parameters

Net Power	0 hp	Total Power Required	0 hp
Total Power Supplied	0 hp	External Energy Only	True

Remarks

Heat Budget - Pipeline Liquids Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Pipeline Liquids	PL Liquid Tanks	Pipeline Liquids	Separator

Parameters

Net Duty	-30.7397 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	30.7397 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Pipeline Liquids:PL Liquid	-22.749	55	55	

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Energy Budgets Report

Client Name:	TC Energy	Job: Pipeline Liquids A16
Location:	Lanham Compressor Station	

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Tanks				
Pipeline Liquids:Separator	-7.99065	56.0344	55	

Remarks

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FAX (337) 896-3077

Certificate of Analysis : 13100277-001A

Company:	Gas Analytical Services	**For:**	Gas Analytical Services
Well:	1-7 Liquid Sample		Alan Ball
Field:	Columbia Gas St. Albans		PO Box 1028
Sample of:	Liquid-Spot		
Conditions:	N.G. psi @ N.G.° F		Bridgeport, WV, 26330
Sampled by:	GAS		
Sample date:	10/23/2013	**Report Date:**	10/25/2013
Remarks:			
Remarks:			

Analysis: (*GPA 2186M*)	**Mol. %**	**MW**	**Wt. %**	**Sp. Gravity**	**L.V. %**
Nitrogen	0.000	28.013	0.000	0.8094	0.000
Methane	0.000	16.043	0.000	0.3000	0.000
Carbon Dioxide	0.011	44.010	0.004	0.8180	0.004
Ethane	0.000	30.070	0.000	0.3562	0.000
Propane	0.086	44.097	0.035	0.5070	0.051
Iso-butane	0.062	58.123	0.033	0.5629	0.044
N-butane	0.668	58.123	0.357	0.5840	0.454
Iso-pentane	1.994	72.150	1.322	0.6244	1.573
N-pentane	3.746	72.150	2.483	0.6311	2.924
I-Hexanes	5.670	86.177	4.421	0.6795	4.967
n-Hexane	6.568	85.597	5.203	0.6640	5.774
2,2,4 trimethylpentane	0.083	114.231	0.087	0.6967	0.094
Benzene	1.135	78.114	0.855	0.8846	0.689
Heptanes	21.887	95.386	19.305	0.7174	20.192
Toluene	3.102	92.141	2.755	0.8719	2.254
Octanes	22.825	106.755	22.673	0.7492	22.967
E-benzene	0.553	106.167	0.435	0.8718	0.463
M-,O-,P-xylene	3.799	106.167	3.701	0.8731	3.185
Nonanes	12.042	120.608	14.029	0.7715	13.850
Decanes Plus	15.769	153.940	22.302	0.8079	20.515
	---		---		---
	100.000		100.000		100.000

Calculated Values	**Total Sample**	**Decanes Plus**
Specific Gravity at 60 °F	0.7432	0.8079
Api Gravity at 60 °F	58.903	43.644
Molecular Weight	108.848	153.940
Pounds per Gallon (in Vacuum)	6.196	6.736
Pounds per Gallon (in Air)	6.189	6.728
Cu. Ft. Vapor per Gallon @ 14.73 psia	21.652	16.567

Brian Gaspard

Southern Petroleum Laboratories, Inc.