

Tomko, Devin

From: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>
Sent: Monday, March 31, 2025 4:52 PM
To: Tomko, Devin
Cc: Garcia, Mario; Frisco, Doug; Guerrieri, Sheri; Nick Pezich; Ian Donaldson
Subject: RE: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant
Attachments: 2025-0326 Response to Technical Deficiency Letter.pdf; 2025-0328 Rev Cryo II Revised Plan Approval.pdf

Devin,

Please see the attached Response to Technical Deficiency Letter and the Revised Plan Approval Application. Please let us know if you have any questions. Thank you.

Lisa M. Garcia, P.E.

Sr. Manager – Engineering
E&C Environmental
Energy Transfer
O: 713.989.7762
M: 210.540.8853



From: Tomko, Devin <dtomko@pa.gov>
Sent: Tuesday, March 11, 2025 8:09 AM
To: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>
Cc: Garcia, Mario <mario.garcia@energytransfer.com>; Frisco, Doug <Doug.Frisco@energytransfer.com>; Guerrieri, Sheri <shguerrier@pa.gov>; Nick Pezich <Nick.Pezich@trinityconsultants.com>; Ian Donaldson <IDonaldson@trinityconsultants.com>
Subject: RE: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant

Good Morning Lisa,

Yes, that is fine. Please submit the responses and updated application by COB on March 31.

Thanks,
Devin

Devin P. Tomko, P.E. | Air Quality Engineer
Pennsylvania Department of Environmental Protection
Southwest Regional Office
400 Waterfront Drive | Pittsburgh, PA 15222
Phone: 412.442.5231 | Fax: 412.442.4194
www.depweb.state.pa.us

DEP accepts permit and authorization applications, as well as other documents and correspondence, electronically through ePermitting and Public Upload with Electronic Payment. Please use the link below to view the webpage, get instructions, and submit documents:

<https://www.pa.gov/agencies/dep/data-and-tools/electronic-submissions.html>

From: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>

Sent: Monday, March 10, 2025 5:09 PM

To: Tomko, Devin <dtomko@pa.gov>

Cc: Garcia, Mario <mario.garcia@energytransfer.com>; Frisco, Doug <Doug.Frisco@energytransfer.com>; Guerrieri, Sheri <shguerrier@pa.gov>; Nick Pezich <Nick.Pezich@trinityconsultants.com>; Ian Donaldson <IDonaldson@trinityconsultants.com>

Subject: RE: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant

Devin,

Trinity Consultants mentioned that they spoke to you this morning and that you indicated that it would be possible to have an additional 2 weeks to submit a revised application and response to the comment/response letter.

Please let us know if a revised deadline of March 31st is acceptable. Thank you.

Lisa M. Garcia, P.E.

Sr. Manager – Engineering
E&C Environmental
Energy Transfer
O: 713.989.7762
M: 210.540.8853



From: Tomko, Devin <dtomko@pa.gov>

Sent: Wednesday, February 5, 2025 12:47 PM

To: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>

Cc: Garcia, Mario <mario.garcia@energytransfer.com>; Frisco, Doug <Doug.Frisco@energytransfer.com>; Guerrieri, Sheri <shguerrier@pa.gov>

Subject: RE: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant

Hi Lisa,

Not a problem. Since 30 additional days lands on a Friday when I'm out of the office, please submit your responses by close of business on the following Monday, 17 March 2025.

Please let me know if I can be of additional assistance.

Thanks,
Devin

Devin P. Tomko, P.E. | Air Quality Engineer
Pennsylvania Department of Environmental Protection
Southwest Regional Office
400 Waterfront Drive | Pittsburgh, PA 15222
Phone: 412.442.5231 | Fax: 412.442.4194
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<https://www.pa.gov/agencies/dep/data-and-tools/electronic-submissions.html>

From: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>

Sent: Wednesday, February 5, 2025 10:05 AM

To: Tomko, Devin <dtomko@pa.gov>

Cc: Garcia, Mario <mario.garcia@energytransfer.com>; Frisco, Doug <Doug.Frisco@energytransfer.com>

Subject: RE: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant

Devin,

We are currently working through the deficiency letter, but we will need additional time to fully respond to all of the questions. We would like to request an additional 30 days to respond to the letter, if possible. I appreciate your help with this. Please let me know if you have any questions. Thank you.

Lisa M. Garcia, P.E.

Sr. Manager – Engineering

E&C Environmental

Energy Transfer

O: 713.989.7762

M: 210.540.8853



From: Tomko, Devin <dtomko@pa.gov>

Sent: Tuesday, January 21, 2025 10:09 AM

To: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>

Subject: RE: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant

Good Morning Lisa,

Thanks for letting me know; I will make the update. I'm also glad that I decided to CC Ian Donaldson. We don't normally do that and I just had a feeling that I should. I'll send the Tems invite for the requested time. Looking forward to talking with you.

Best,
Devin

Devin P. Tomko, P.E. | Air Quality Engineer
Pennsylvania Department of Environmental Protection
Southwest Regional Office
400 Waterfront Drive | Pittsburgh, PA 15222
Phone: 412.442.5231 | Fax: 412.442.4194
www.depweb.state.pa.us

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From: Garcia, Lisa M <Lisa.Garcia@energytransfer.com>

Sent: Friday, January 17, 2025 11:06 AM

To: Tomko, Devin <dtomko@pa.gov>

Cc: Frisco, Doug <Doug.Frisco@energytransfer.com>; Ian Donaldson <IDonaldson@trinityconsultants.com>; Nick Pezich <Nick.Pezich@trinityconsultants.com>; Shaffer, Valerie <valshaffer@pa.gov>; Guerrieri, Sheri <shguerrier@pa.gov>

Subject: [External] Application for PA-63-01001A - ETC Northeast Pipeline, LLC / Revolution Cryogenic Plant

ATTENTION: *This email message is from an external sender. Do not open links or attachments from unknown senders. To report suspicious email, use the [Report Phishing button in Outlook](#).*

Devin,

Trinity Consultants passed along your email with the deficiency letter and request for a call to me since Hanh Duong is no longer with Energy Transfer. Please update the technical contact for this application to me. My contact information is listed below.

Regarding your request for a call, we are available during the 1:30 to 2:30 pm timeslot, so please send a Teams meeting invite for this discussion.

Thank you.

Lisa M. Garcia, P.E.

Sr. Manager – Engineering

E&C Environmental

Energy Transfer

O: 713.989.7762

M: 210.540.8853



Private and confidential as detailed [here](#). If you cannot access hyperlink, please e-mail sender.

March 31, 2025

Mr. Mark Gorog
Air Quality Program
PA Department of Environmental Protection
Southwestern Regional Office
400 Waterfront Drive
Pittsburgh, PA 15222

RE: Response to Technical Review Deficiencies
ETC Northeast Pipeline, LLC
Revolution Cryo II Plan Approval Application
Smith Township, Washington County

Dear Mr. Gorog:

ETC Northeast Pipeline, LLC (ETC) is providing this response to address the Department's email received on January 13, 2025, which outlined deficiencies identified during technical review of the Revolution Cryo II plan approval application. The Department's comments are identified below in ***bold italics***, with ETC's response following in normal text.

- 1. Please provide specification sheets and safety data sheets (SDSs) for each product shipped offsite including but not limited to ethane, natural gas liquids (NGLs)/Y-grade NGLs, residue gas, and condensate. [25 Pa. Code §127.12(a)(2)]***

RESPONSE

See Attachment 1 for the requested SDSs.

- 2. The provided Process Flow Diagram should identify all existing and proposed sources and equipment. Please update the diagram to exhibit all air contamination sources, including but not limited to the following:***
 - a. Each compressor including the type, the type of process gas handled, and the associated prime mover.***
 - b. Pigging vessels and destination of venting emissions.***
 - c. Existing control device(s) and the emissions streams directed thereto.***
 - d. Each storage tank with the potential for VOC, HAP, and/or methane emissions, sources(s) of fluids received, destination(s) for fluids removed, and destination(s) of vapor losses.***

[25 Pa. Code §127.12(a)(2)]

RESPONSE

See Attachment 2 for the revised process flow diagram that depicts both the existing equipment as well as proposed equipment at the site.

- 3. Please provide the manufacturer, model number, specifications, and rod packing design leak rates for each proposed reciprocating compressor. [25 Pa. Code §127.12(a)(2)]***

RESPONSE

As discussed on the conference call between PADEP and ETC on January 23, 2025, ETC has not yet selected a final compressor manufacturer; nor is the equipment procured. As such, the default EPA Gas Start factors will be used to calculate emissions in lieu of having equipment-specific values.

- 4. Per 25 Pa. Code §127.12(a)(5), an application for plan approval must "[s]how that the emissions from a new source will be the minimum attainable through the use of the best available technology, where, per 25 Pa. Code §121.1, best available technology (BAT) is defined as the "equipment, devices, methods or techniques as determined by the Department which will prevent, reduce or control emissions of air contaminants to the maximum degree possible and which are available or may be made available.**
- a. ***Per the Department's General Plan Approval and/or General Operating Permit for Natural Gas Compression and/or Processing Facilities ("GP-5") (2700-PM- BAQ0267; 6/2018), open flares may only be approved for control of new and modified sources at remote locations and for infrequent operations. The proposed installation and operation of a new elevated flare (FLARE-002) for control of residue gas compressor blowdowns, purge gas, closed drain vapors, pressure relief valves, and miscellaneous blowdowns—operations that do not constitute "infrequent operation"—does not meet BAT. Based on the uses for the proposed flare, referring to the flare as an "emergency flare" also appears misrepresentative. Please note that the Department would consider an emergency to be comparable to a malfunction or "...any sudden, infrequent, and not reasonably preventable failure of air pollution control equipment, process equipment, or a process to operate in a normal or usual manner...[where] failures that are caused in part by poor maintenance or careless operation are not malfunctions..." as this term is defined in 40 CFR Part 60 Subpart A. [25 Pa. Code §127.12(a)(5)]***

RESPONSE

Emissions routed to FLARE-002, under the proposed revised control scheme, are either 1) first routed to a VRU and then to the flare in the event the VRU is down or 2) are streams not able to be controlled in a similar fashion due to safety concerns. See Attachment 3 for a summary of which streams are being sent to the VRU / other control devices.

- b. ***The Department's General Plan Approval and/or General Operating Permit for Coal-Mine Methane Flares ("GP-21") authorizes the use of enclosed flares to reduce atmospheric emissions of methane from mine ventilation systems. Additionally, the Department's Best Available Technology and Other Permitting Criteria (275-2101-007; February 23, 1996) ("BAT-TGD") specifies in Section 7.10 (Best Available Technology Criteria for Municipal Residue Landfills) that landfill gas from an active landfill gas collection system shall be processed by combustion an enclosed ground type flare or other enclosed combustion device or system. Given the similarity of the controlled emissions streams in the referenced scenarios to that present***

at a natural gas processing plant (e.g., methane, ethane, VOCs, and HAPs), using technology transfer, it is Department's position that the venting of gas from the proposed sources to a proposed new open flare does not constitute BAT. [25 Pa. Code §127.12(a)(5)]

RESPONSE

The composition and pressure of the streams associated with the proposed project are inherently different than those addressed by GP-21. For example, coal mine flares operate at low pressure with relatively constant / steady state flow rates. The facility flare will see pressurized gas, as well as non-steady state flow rates. Note that revised control scheme (see Attachment 3) has greatly reduced the volume of gases sent to the flare on a consistent basis. Rather than flaring or thermal oxidization, ETC has reevaluated and sent all streams to VRU systems where feasible.

- c. ***Per the Reciprocating Compressors Technical Guidance Document (TGD) available on the Oil and Gas Methane Partnership 2.0 (OGMP 2.0) website (<https://ogmpartnership.com/guidance-documents-and-templates/>), "[i]t is also possible to capture and redirect the [rod packing vent pipe] emitted gas stream to a useful outlet or to a flare." Per the Department's research and given the similarity of vapor recovery unit (VRU) system control of centrifugal compressor dry seal vents and storage tank vents, capturing reciprocating compressor rod packing emissions (and either directing back to the process or to a control device) is technically feasible. Please provide a thorough evaluation of the technical feasibility of capturing rod packing emissions since citing "engineering design concerns with routing the vapors to a control device" does not establish sufficient justification for technical infeasibility. [25 Pa. Code §127.12(a)(5)]***

RESPONSE

The reciprocating compressors at the plant will be sent back to the process via a VRU system. ETC has assumed that the rod packing vents will be routed to the facility flare (FLARE-002) during VRU downtime.

- d. ***Control of emissions from the moisture analyzer and "facility maintenance" were not included in the BAT analysis. Please evaluate. [25 Pa. Code §127.12(a)(5)]***

RESPONSE

Facility maintenance was addressed, although not specifically called out by name, under the Venting/Blowdowns discussions (Section 4 of the BAT) and the facility flare discussion. Under the revised control scheme, ETC has identified which venting/blowdown activities can be routed to each control option. Facility maintenance blowdowns are meant to address a small portion of blowdowns (i.e., less than 1%) that are unplanned and unable to be sent to a VRU or flare. Moisture analyzer emissions are exempt from Plan Approval permitting as trivial activities ("Equipment used for quality control/assurance or inspection purposes, including sampling equipment used to withdraw materials for analysis").

- e. ***The BAT analysis indicated that VRU systems are limited to consistent venting sources as intermittent venting episodes (e.g., blowdowns) are not handled well by VRUs, which operate best with consistent flow. Please be aware that pressure regulators and flow control devices are***

available that would provide consistent flow to the VRU system during equipment blowdowns. Additionally, during low VRU gas flow conditions, a recycle valve can be utilized to maintain operation of the VRU compressor at 100% load when vent gas flow to the VRU is less than 100%. (<https://www.zeeco.com/products/flare-gas-recovery>). Please evaluate. [25 Pa. Code §127.12(a)(5)]

RESPONSE

See Attachment 3 for streams that are being sent back to the process via VRU. ETC has assumed 5% VRU downtime, during which times the streams will be sent to FLARE-002.

- f. ***On April 28, 2022, the Department issued a plan approval for a project at the Texas Eastern Transmission, LP Holbrook Station (a major source of VOC emissions) that required the installation of a centrifugal compressor blowdown gas recompression system as BAT. The system reduces blowdown emissions by at least 95% and eliminates the combustion emissions associated with flaring. Although centrifugal compressors are not proposed in the subject application, please evaluate all available alternatives for control of emissions from facility equipment blowdown operations in the BAT analysis. [25 Pa. Code §127.12(a)(5)]***

RESPONSE

See Attachment 3 for streams that are being sent back to the process via VRU. ETC has assumed 5% VRU downtime, during which times the streams will be sent to FLARE-002.

5. ***The emissions estimates for the proposed amine unit presented in Table 2 - Amine-002 Amine Sweetening Unit Emissions of Attachment E – Detailed Emissions Calculations incorrectly indicate a control efficiency (emissions reduction) for CO₂ by the proposed thermal oxidizer which results in an artificial reduction in CO₂ and total GHG emissions. Please evaluate and correct the emissions estimates where necessary. [25 Pa. Code §127.12(a)(2)]***

RESPONSE

This was an inadvertent oversight, which has been corrected. Please find corrected estimates in the emissions summary included as part of Attachment 4.

6. ***A complete evaluation of project emissions aggregation and/or circumvention (25 Pa. Code §127.216) for the process equipment and controls proposed with those proposed and/or authorized at the Revolution Cryogenic Plant under GP5-63-01001A and GP1-63- 01001A was not conducted. Please fully evaluate all factors identified in 25 Pa. Code §127.216 and Clean Air Council v. DEP (2019 EHB 56; Case No. 2016073 available at <https://ehb.pa.gov/docket-search>). [25 Pa. Code §127.12(a)(2, 4, and 5)]***

RESPONSE

Now that the revised application is a minor source, this comment is rendered moot as per ETC and PADEP discussions in January 2025.

- 7. Since the proposed project will result in the Revolution Cryogenic Plant becoming a major facility (for VOC emissions) as this term is defined in 25 Pa. Code §121.1, please provide an evaluation of the applicable Nonattainment New Source Review requirements of 25 Pa. Code Chapter 127 Subchapter E pursuant to §127.203(e)(2). [25 Pa. Code §127.12(a)(4)]**

RESPONSE

Now that the revised application is a minor source with respect to Nonattainment New Source Review program, this comment is rendered moot as per ETC and PADEP discussions in January 2025.

- 8. Please provide tables that present estimates of VOC, HAP, and GHG emissions from the closed drain tank and condensate tanks. The estimates shall include all supporting data and assumptions; models and calculation methodology; include tank liquids composition and the method(s) of determination; and annual liquids production rates. [25 Pa. Code §127.12(a)(2)]**

RESPONSE

Please see updated PTE calculations provided as part of Attachment 4.

- 9. Please identify and describe all equipment, devices, methods, and techniques that will be implemented to ensure that all proposed process safety valves (PSVs) are fully seated during normal operation and fully reseated after opening to prevent excess gas from being sent to the flare (or other control device) and thus reduce emissions of air contaminants to the maximum degree possible. Please develop and provide an inspection and maintenance program to ensure that the valves, actuators, and seals/sealing surfaces are operated and maintained in a manner consistent with good air pollution control practice for minimizing emissions. [25 Pa. Code §127.12(a)(2, 4, 5, and 10)]**

RESPONSE

ETC's standard operating procedure is to inspect PSVs after a relief event. Valve companies are contacted to come to the site to retest/certify the PSV after the relief event.

- 10. Please identify how fuel gas usage and the composition(s) and volume(s) of waste gases sent to the control devices are determined and recorded. [25 Pa. Code §127.12(a)(3)]**

RESPONSE

Gas flow going to flare will be measured on both the high- and low-pressure side. ETC will utilize the facility's ProMax model to estimate compositions for the streams sent to flare.

- 11. For the purposes of the greenhouse gas (GHG) and volatile organic compound (VOC) standards in 40 CFR Part 60 Subpart OOOOb—Standards of**

Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification or Reconstruction Commenced After December 6, 2022, pursuant to §60.5365b(e)(3) for the storage vessel affected facilities specified in 40 CFR §60.5395b, for tank batteries not located at a well site or centralized production facility, including each tank battery at an onshore natural gas processing plant, a modification of a tank battery occurs when an existing tank battery receives additional fluids which cumulatively exceed the throughput used in the most recent determination of the potential for VOC or methane emissions. Please determine and provide the projected change in the volume of fluids that will be received and the resulting potential for VOC and methane emissions from the closed drain and condensate tanks in comparison to that of the most recent determination under 40 CFR Part 60 Subpart 0000a—Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification or Reconstruction Commenced After September 18, 2015 and On or Before December 6, 2022. [25 Pa. Code §127.12(a)(4)]

RESPONSE

The proposed project does not result in an increase of stabilized condensate that would be loaded out on trucks, rather additional processed liquids would leave the site via pipeline. Therefore, no additional tanks are going to be installed as part of this project. Furthermore, there is no increase in throughput from the existing tanks at Revolution. As such, there are no storage vessels that are potentially subject to NSPS 0000b.

12. Pursuant to 40 CFR Part 60 Subpart A, §60.14(a) states that:

"Except as provided under [§60.14(e and f)], any physical or operational change to an existing facility which results in an increase in the emission rate to the atmosphere of any pollutant to which a standard applies shall be considered a modification within the meaning of section 111 of the Act. Upon modification, an existing facility shall become an affected facility for each pollutant to which a standard applies and for which there is an increase in the emission rate to the atmosphere."

Per §60.14(e), "[a]n increase in production rate of an existing facility, if that increase can be accomplished without a capital expenditure on that facility" shall not be considered a modification under Part 60. However, since a capital expenditure is necessary to increase the production rate of the Revolution Cryogenic Plant, the proposed activity constitutes a modification. Since the Cryo II project may increase emissions and throughput rates of existing equipment, please evaluate whether a modification of any affected facilities under 40 CFR Part 60 Subpart 0000a—Standards of Performance for Crude Oil and Natural Gas Facilities for Which Construction, Modification or Reconstruction Commenced After September 18, 2015 and On or Before December 6, 2022 will occur with the proposed project. [25 Pa. Code §127.12(a)(4 and 5)]

RESPONSE

The Cryo II train is not going to impact the capacity of the existing cryogenic unit. Therefore, there are no impacts to existing emissions units at Revolution that would trigger NSPS 0000b.

If you have additional questions or require clarification on any of the items discussed in this letter, please contact Mario Garcia at (713) 989-4603 or by email at Mario.Garcia@energytransfer.com.

Sincerely,

Mario Garcia
Sr. Engineer - Environmental

cc:

ATTACHMENT 1: SDS INFORMATION

Natural Gas - Energy Transfer

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations
Revision Date: 02/25/2016 Date of issue: 10/07/2015

Version: 2.0

SECTION 1: IDENTIFICATION

1.1. Product Identifier

Product Form: Mixture

Product Name: Natural Gas - Energy Transfer

Synonyms: Natural Gas, Methane, Fuel Gas, Marsh Gas

1.2. Intended Use of the Product

No additional information available

1.3. Name, Address, and Telephone of the Responsible Party

Energy Transfer

1300 Main Street

Houston, Texas 77002

713-989-2665

1.4. Emergency Telephone Number

Emergency Number : 713-989-2665

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the Substance or Mixture

GHS-US classification

Simple Asphy

Flam. Gas 1 H220

Compressed gas H280

Full text of H-phrases: see section 16

2.2. Label Elements

GHS-US Labeling

Hazard Pictograms (GHS-US)



Signal Word (GHS-US)

: Danger

Hazard Statements (GHS-US)

: H220 - Extremely flammable gas.

H280 - Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary Statements (GHS-US)

: P210 - Keep away from extremely high or low temperatures, ignition sources, and incompatible materials. - No smoking.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
P403 - Store in a well-ventilated place.
P410+P403 - Protect from sunlight. Store in a well-ventilated place.

2.3. Other Hazards

Vapour in the headspace of tanks and containers may ignite and explode at temperatures exceeding auto-ignition temperature, where vapour concentrations are within the flammability range. May ignite on surfaces at temperatures above auto-ignition temperature. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. Repeated exposure may cause skin dryness or cracking. Exposure may aggravate those with pre-existing eye, skin, or respiratory conditions. Contact with gas escaping the container can cause frostbite.

2.4. Unknown Acute Toxicity (GHS-US)

No data available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance

Not applicable

3.2. Mixture

Name	Product Identifier	%	GHS-US classification
Methane	(CAS No) 74-82-8	> 90	Simple Asphy Flam. Gas 1, H220 Compressed gas, H280

Natural Gas - Energy Transfer

Safety Data Sheet

According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Ethane	(CAS No) 74-84-0	< 5	Simple Asphy Flam. Gas 1, H220 Compressed gas, H280
Propane	(CAS No) 74-98-6	< 1	Simple Asphy Flam. Gas 1, H220 Compressed gas, H280

Full text of H-phrases: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of First Aid Measures

First-aid Measures General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible). If frostbite or freezing occurs, immediately flush with plenty of lukewarm water to GENTLY warm the affected area. Do not use hot water. Do not rub affected area. Get immediate medical attention.

First-aid Measures After Inhalation: Obtain medical attention if breathing difficulty persists. First, take proper precautions to ensure your own safety before attempting rescue (e.g. wear appropriate respiratory protective equipment, use the buddy system), then remove the exposed person to fresh air. Keep at rest in a position comfortable for breathing.

First-aid Measures After Skin Contact: Remove contaminated clothing. Drench affected area with water for at least 15 minutes. Obtain medical attention if irritation develops or persists. Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice/attention.

First-aid Measures After Eye Contact: Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention.

First-aid Measures After Ingestion: Rinse mouth. Do NOT induce vomiting. Obtain medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/Injuries: Contact with gas escaping the container can cause frostbite. Asphyxia by lack of oxygen: risk of death.

Symptoms/Injuries After Inhalation: In elevated concentrations may cause asphyxiation, central nervous system effects, and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of the extremities, unconsciousness and death.

Symptoms/Injuries After Skin Contact: Contact with gas escaping the container can cause frostbite and freeze burns.

Symptoms/Injuries After Eye Contact: Contact with gas escaping the container can cause frostbite, freeze burns, and permanent eye damage.

Symptoms/Injuries After Ingestion: Not considered a potential route of exposure, but contact with gas escaping the container can cause freeze burns and frostbite.

4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention. If medical advice is needed, have product container or label at hand.

SECTION 5: FIRE-FIGHTING MEASURES

5.1. Extinguishing Media

Suitable Extinguishing Media: Do not extinguish burning gas if flow cannot be shut off immediately. Extinguish secondary FIRES with appropriate materials.

Unsuitable Extinguishing Media: Do not use a heavy water stream. Use of heavy stream of water may spread fire.

5.2. Special Hazards Arising From the Substance or Mixture

Fire Hazard: Extremely flammable gas.

Explosion Hazard: May form flammable/explosive vapor-air mixture. Container may explode in heat of fire.

Reactivity: Hazardous reactions will not occur under normal conditions.

5.3. Advice for Firefighters

Precautionary Measures Fire: Exercise caution when fighting any chemical fire.

Firefighting Instructions: Use water spray or fog for cooling exposed containers. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so. Fight fire remotely due to the risk of explosion.

Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.

Other Information: Use water spray to disperse vapors.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Eliminate every possible source of ignition. Do not get in eyes, on skin, or on clothing. Do not breathe vapors, mist, or spray.

6.1.1. For Non-emergency Personnel

Protective Equipment: Use appropriate personal protection equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel.

Natural Gas - Energy Transfer

Safety Data Sheet

According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

6.1.2. For Emergency Responders

Protective Equipment: Equip cleanup crew with proper protection.

Emergency Procedures: Upon arrival at the scene, a first responder is expected to recognize the presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit. Evacuate unnecessary personnel, isolate, and ventilate area.

6.2. Environmental Precautions

Prevent entry to sewers and public waters.

6.3. Methods and Material for Containment and Cleaning Up

For Containment: Stop leak, if possible without risk. As an immediate precautionary measure, isolate spill or leak area in all directions.

Methods for Cleaning Up: Clean up spills immediately and dispose of waste safely. Transfer spilled material to a suitable container for disposal. Contact competent authorities after a spill. Stop the source of the release, if safe to do so. Consider the use of water spray to disperse vapors. Isolate the area until gas has dispersed. Ventilate and gas test area before entering.

6.4. Reference to Other Sections

See Heading 8. Exposure controls and personal protection. See Section 13, Disposal Considerations.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Additional Hazards When Processed: Handle empty containers with care because residual vapors are flammable. Ruptured cylinders may rocket. Do not pressurize, cut, or weld containers. Asphyxiating gas at high concentrations.

Precautions for Safe Handling: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Avoid prolonged contact with eyes, skin and clothing. Do not breathe gas.

Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures.

7.2. Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed.

Storage Conditions: Keep container closed when not in use. Store in a dry, cool place. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials. Keep in fireproof place. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling.

Incompatible Products: Strong acids, strong bases, strong oxidizers.

7.3. Specific End Use(s)

No additional information available

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control Parameters

For substances listed in section 3 that are not listed here, there are no established exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), NIOSH (REL), or OSHA (PEL).

Propane (74-98-6)		
USA NIOSH	NIOSH REL (TWA) (mg/m ³)	1800 mg/m ³
USA NIOSH	NIOSH REL (TWA) (ppm)	1000 ppm
USA IDLH	US IDLH (ppm)	2100 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) (mg/m ³)	1800 mg/m ³
USA OSHA	OSHA PEL (TWA) (ppm)	1000 ppm

8.2. Exposure Controls

Appropriate Engineering Controls

: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure adequate ventilation, especially in confined areas. Ensure all national/local regulations are observed. Gas detectors should be used when flammable gases or vapors may be released. Use explosion-proof equipment. Oxygen detectors should be used when asphyxiating gases may be released.

Personal Protective Equipment

: Gloves. Protective clothing. Protective goggles. Insufficient ventilation: wear respiratory protection. Respiratory protection of the dependent type.



Materials for Protective Clothing

: Chemically resistant materials and fabrics. Wear fire/flame resistant/retardant clothing.

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Hand Protection	: Wear protective gloves. If material is cold, wear thermally resistant protective gloves.
Eye Protection	: Chemical safety goggles.
Skin and Body Protection	: Wear suitable protective clothing.
Respiratory Protection	: Use a NIOSH-approved self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limits.
Thermal Hazard Protection	: Wear thermally resistant protective clothing.
Other Information	: When using, do not eat, drink or smoke.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on Basic Physical and Chemical Properties

Physical State	: Gas
Appearance	: Colorless gas
Odor	: Odorless, If an odorant has been added by the local utility company, then an unpleasant smell resembling that of a rotten egg or garlic.
Odor Threshold	: No data available
pH	: No data available
Evaporation Rate	: No data available
Melting Point	: No data available
Freezing Point	: No data available
Boiling Point	: 162 °C (323.6 °F)
Flash Point	: 187.8 °C (370.04 °F)
Auto-ignition Temperature	: 540 °C (1004 °F)
Decomposition Temperature	: No data available
Flammability (solid, gas)	: Extremely flammable gas
Vapor Pressure	: No data available
Relative Vapor Density at 20 °C	: 0.6 (Air = 1)
Relative Density	: No data available
Solubility	: Water: Very slightly soluble
Partition Coefficient: N-Octanol/Water	: No data available
Viscosity	: No data available
Explosive Properties	: Contains gas under pressure; may explode if heated.
Lower Flammable Limit	: 5 %
Upper Flammable Limit	: 15 %

9.2. Other Information

Gas Group	: Compressed gas

SECTION 10: STABILITY AND REACTIVITY

- 10.1. Reactivity:** Hazardous reactions will not occur under normal conditions.
- 10.2. Chemical Stability:** Contains gas under pressure; may explode if heated.
- 10.3. Possibility of Hazardous Reactions:** Hazardous polymerization will not occur.
- 10.4. Conditions to Avoid:** Direct sunlight, extremely high or low temperatures, open flames, sources of ignition and incompatible materials.
- 10.5. Incompatible Materials:** Strong acids, strong bases, strong oxidizers.
- 10.6. Hazardous Decomposition Products:** Carbon oxides (CO₂).

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information On Toxicological Effects

Acute Toxicity: Not classified

Ethane (74-84-0)	
LC50 Inhalation Rat	658 mg/l/4h
Propane (74-98-6)	
LC50 Inhalation Rat	658 mg/l/4h

Skin Corrosion/Irritation: Not classified

Serious Eye Damage/Irritation: Not classified

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According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Carcinogenicity: Not classified

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Single Exposure): Not classified

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Aspiration Hazard: Not classified

Symptoms/Injuries After Inhalation: In elevated concentrations may cause asphyxiation, central nervous system effects, and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of the extremities, unconsciousness and death.

Symptoms/Injuries After Skin Contact: Contact with gas escaping the container can cause frostbite and freeze burns.

Symptoms/Injuries After Eye Contact: Contact with gas escaping the container can cause frostbite, freeze burns, and permanent eye damage.

Symptoms/Injuries After Ingestion: Not considered a potential route of exposure, but contact with gas escaping the container can cause freeze burns and frostbite.

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecology - General : Not classified.

12.2. Persistence and Degradability

Natural Gas - Energy Transfer	
Persistence and Degradability	Not established.

12.3. Bioaccumulative Potential

Natural Gas - Energy Transfer	
Bioaccumulative Potential	Not established.

Ethane (74-84-0)	
Log Pow	<= 2.8
Propane (74-98-6)	
Log Pow	2.3

12.4. Mobility in Soil No additional information available

12.5. Other Adverse Effects

Other Information : Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste Disposal Recommendations: Dispose of contents/container in accordance with local, regional, national, and international regulations.

Additional Information: Container may remain hazardous when empty. Continue to observe all precautions. Handle empty containers with care because residual vapors are flammable. Empty gas cylinders should be returned to the vendor for recycling or refilling. Do not puncture or incinerate container.

Ecology – Waste Materials: Avoid release to the environment.

SECTION 14: TRANSPORT INFORMATION

14.1. In Accordance with DOT

Proper Shipping Name : METHANE, COMPRESSED (with high methane content)
Hazard Class : 2.1
Identification Number : UN1971
Label Codes : 2.1
ERG Number : 115



14.2. In Accordance with IMDG

Proper Shipping Name : METHANE, COMPRESSED
Hazard Class : 2
Division : 2.1
Identification Number : UN1971
Label Codes : 2.1
EmS-No. (Fire) : F-D
EmS-No. (Spillage) : S-U



Natural Gas - Energy Transfer

Safety Data Sheet

According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

14.3. In Accordance with IATA

Proper Shipping Name : METHANE, COMPRESSED
Identification Number : UN1971
Hazard Class : 2
Label Codes : 2.1
Division : 2.1
ERG Code (IATA) : 10L



SECTION 15: REGULATORY INFORMATION

15.1 US Federal Regulations

Natural Gas - Energy Transfer	
SARA Section 311/312 Hazard Classes	Fire hazard Sudden release of pressure hazard Immediate (acute) health hazard
Methane (74-82-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Ethane (74-84-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Propane (74-98-6)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	

15.2 US State Regulations

Methane (74-82-8)	
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List	
Ethane (74-84-0)	
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List	
Propane (74-98-6)	
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List	

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Revision Date : 02/25/2016
Other Information : This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200.

GHS Full Text Phrases:

Compressed gas	Gases under pressure Compressed gas
Flam. Gas 1	Flammable gases Category 1
Simple Asphy	Simple Asphyxiant
H220	Extremely flammable gas
H280	Contains gas under pressure; may explode if heated
	May displace oxygen and cause rapid suffocation

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

SDS US (GHS HazCom)

SECTION 1: IDENTIFICATION

1.1. Product Identifier

Product Form: Substance

Product Name: Ethane

CAS-No.: 74-84-0

1.2. Intended Use of the Product

Feedstock, fuel gas

1.3. Name, Address, and Telephone of the Responsible Party

Company

Energy Transfer

8111 Westchester Drive

Dallas, TX 75225

214-840-5820

<https://energytransfer.com/>

1.4. Emergency Telephone Number

Emergency Number : CHEMTREC (800) 424-9300/ (703) 527-3887

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the Substance or Mixture

GHS-US/CA Classification

Simple Asphy

Flam. Gas 1 H220

Press. Gas (Liq.) H280

Full text of hazard classes and H-statements : see section 16

2.2. Label Elements

GHS-US/CA Labeling

Hazard Pictograms (GHS-US/CA)

:



GHS02



GHS04

Signal Word (GHS-US/CA)

: Danger

Hazard Statements (GHS-US/CA)

: H220 - Extremely flammable gas.

H280 - Contains gas under pressure; may explode if heated.

May displace oxygen and cause rapid suffocation.

Precautionary Statements (GHS-US/CA)

: P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P282 - Wear cold insulating gloves and either face shield or eye protection.

P336 - Thaw frosted parts with lukewarm water. Do not rub affected area.

P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.

P381 - In case of leakage, eliminate all ignition sources.

P403 - Store in a well-ventilated place.

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

2.3. Other Hazards

Contact with gas escaping the container can cause frostbite.

2.4. Unknown Acute Toxicity (GHS-US/CA)

No data available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance

Name : Ethane

Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

CAS-No. : 74-84-0

Name	Product Identifier	% *	GHS Ingredient Classification
Ethane	(CAS-No.) 74-84-0	95 - 100	Simple Asphy Flam. Gas 1, H220 Press. Gas (Liq.), H280
Propane	(CAS-No.) 74-98-6	< 3	Simple Asphy Flam. Gas 1, H220 Press. Gas (Liq.), H280
Methane	(CAS-No.) 74-82-8	< 3	Simple Asphy Flam. Gas 1, H220 Press. Gas (Liq.), H280

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

*Percentages are listed in weight by weight percentage (w/w%) for liquid and solid ingredients. Gas ingredients are listed in volume by volume percentage (v/v%).

SECTION 4: FIRST AID MEASURES

4.1. Description of First-aid Measures

General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible). If frostbite or freezing occurs, immediately flush with plenty of lukewarm water to GENTLY warm the affected area. Do not use hot water. Do not rub affected area. Get immediate medical attention.

Inhalation: First, take proper precautions to ensure your own safety before attempting rescue (e.g. wear appropriate respiratory protective equipment, use the buddy system), then remove the exposed person to fresh air. Keep at rest in a position comfortable for breathing. Obtain medical attention if breathing difficulty persists.

Skin Contact: Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice/attention.

Eye Contact: If frostbite or freezing occurs, immediately flush with plenty of lukewarm water to GENTLY warm the affected area. Do not use hot water. Do not rub affected area. Get immediate medical attention.

Ingestion: Not expected to be a primary route of exposure.

4.2. Most Important Symptoms and Effects Both Acute and Delayed

General: May cause frostbite on contact with the liquid. Asphyxia by lack of oxygen: risk of death.

Inhalation: In elevated concentrations may cause asphyxiation, central nervous system effects, and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of the extremities, unconsciousness and death.

Skin Contact: Contact with gas/liquid escaping the container can cause frostbite and freeze burns.

Eye Contact: Contact with gas/liquid escaping the container can cause frostbite, freeze burns, and permanent eye damage.

Ingestion: Not considered a potential route of exposure, but contact with gas/liquid escaping the container can cause freeze burns and frostbite.

Chronic Symptoms: None expected under normal conditions of use.

4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention. If medical advice is needed, have product container or label at hand.

SECTION 5: FIRE-FIGHTING MEASURES

5.1. Extinguishing Media

Suitable Extinguishing Media: Do not extinguish burning gas if flow cannot be shut off immediately. Extinguish secondary FIRES with appropriate materials.

Unsuitable Extinguishing Media: Do not use a heavy water stream. Use of heavy stream of water may spread fire.

5.2. Special Hazards Arising From the Substance or Mixture

Fire Hazard: Extremely flammable gas.

Explosion Hazard: May form flammable/explosive vapor-air mixture. Container may explode in heat of fire.

Reactivity: Hazardous reactions will not occur under normal conditions.

5.3. Advice for Firefighters

Precautionary Measures Fire: Exercise caution when fighting any chemical fire.

Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

Firefighting Instructions: Use water spray or fog for cooling exposed containers. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so. Fight fire remotely due to the risk of explosion.

Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.

Hazardous Combustion Products: Carbon oxides (CO, CO₂).

Other Information: Use water spray to disperse vapors.

Reference to Other Sections

Refer to Section 9 for flammability properties.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Eliminate every possible source of ignition. Do not get in eyes, on skin, or on clothing. Do not breathe gas.

6.1.1. For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protective equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel.

6.1.2. For Emergency Personnel

Protective Equipment: Equip cleanup crew with proper protection.

Emergency Procedures: Upon arrival at the scene, a first responder is expected to recognize the presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit. Evacuate unnecessary personnel, isolate, and ventilate area. Ventilate area.

6.2. Environmental Precautions

Prevent entry to sewers and public waters.

6.3. Methods and Materials for Containment and Cleaning Up

For Containment: Stop leak, if possible without risk. As an immediate precautionary measure, isolate spill or leak area in all directions.

Methods for Cleaning Up: Stop the source of the release, if safe to do so. Consider the use of water spray to disperse vapors. Isolate the area until gas has dispersed. Ventilate and gas test area before entering.

6.4. Reference to Other Sections

See Section 8 for exposure controls and personal protection and Section 13 for disposal considerations.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Additional Hazards When Processed: Handle empty containers with care because residual vapors are flammable. Ruptured cylinders may rocket. Do not pressurize, cut, or weld containers. Asphyxiating gas at high concentrations.

Precautions for Safe Handling: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Avoid prolonged contact with eyes, skin and clothing. Do not breathe gas.

Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures.

7.2. Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed.

Storage Conditions: Keep container closed when not in use. Store in a dry, cool place. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials. Keep in fireproof place. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling.

Incompatible Materials: Strong oxidizers.

7.3. Specific End Use(s)

Feedstock, fuel gas

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control Parameters

For substances listed in section 3 that are not listed here, there are no established Exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), AIHA (WEEL), NIOSH (REL), OSHA (PEL), or Canadian provincial governments.

Ethane (74-84-0)		
Alberta	OEL TWA (ppm)	1000 ppm
British Columbia	OEL TWA (ppm)	1000 ppm
Nunavut	OEL STEL (ppm)	1250 ppm
Nunavut	OEL TWA (ppm)	1000 ppm

Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

Northwest Territories	OEL STEL (ppm)	1250 ppm
Northwest Territories	OEL TWA (ppm)	1000 ppm
Saskatchewan	OEL STEL (ppm)	1250 ppm
Saskatchewan	OEL TWA (ppm)	1000 ppm
Propane (74-98-6)		
USA OSHA	OSHA PEL (TWA) (mg/m ³)	1800 mg/m ³
USA OSHA	OSHA PEL (TWA) (ppm)	1000 ppm
USA NIOSH	NIOSH REL (TWA) (mg/m ³)	1800 mg/m ³
USA NIOSH	NIOSH REL (TWA) (ppm)	1000 ppm
USA IDLH	US IDLH (ppm)	2100 ppm (10% LEL)
Alberta	OEL TWA (ppm)	1000 ppm
British Columbia	OEL TWA (ppm)	1000 ppm
Nunavut	OEL STEL (ppm)	1250 ppm
Nunavut	OEL TWA (ppm)	1000 ppm
Northwest Territories	OEL STEL (ppm)	1250 ppm
Northwest Territories	OEL TWA (ppm)	1000 ppm
Québec	VEMP (mg/m ³)	1800 mg/m ³
Québec	VEMP (ppm)	1000 ppm
Saskatchewan	OEL STEL (ppm)	1250 ppm
Saskatchewan	OEL TWA (ppm)	1000 ppm
Methane (74-82-8)		
British Columbia	OEL TWA (ppm)	1000 ppm
Nunavut	OEL STEL (ppm)	1250 ppm
Nunavut	OEL TWA (ppm)	1000 ppm
Northwest Territories	OEL STEL (ppm)	1250 ppm
Northwest Territories	OEL TWA (ppm)	1000 ppm
Saskatchewan	OEL STEL (ppm)	1250 ppm
Saskatchewan	OEL TWA (ppm)	1000 ppm

8.2. Exposure Controls

Appropriate Engineering Controls: Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure adequate ventilation, especially in confined areas. Ensure all national/local regulations are observed. Use explosion-proof equipment. Proper grounding procedures to avoid static electricity should be followed. Gas detectors should be used when flammable gases or vapors may be released. Oxygen detectors should be used when asphyxiating gases may be released.

Personal Protective Equipment: Gloves. Protective clothing. Protective goggles. Insufficient ventilation: wear respiratory protection. Respiratory protection of the dependent type.



Materials for Protective Clothing: Chemically resistant materials and fabrics. Wear fire/flammable resistant/retardant clothing.

Hand Protection: Wear protective gloves. If material is cold, wear thermally resistant protective gloves.

Eye and Face Protection: Chemical safety goggles.

Skin and Body Protection: Wear suitable protective clothing.

Respiratory Protection: Use a NIOSH-approved self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limits. See CSA Standard CAN/CSA-Z94.4-11 for more information.

Thermal Hazard Protection: Wear thermally resistant protective clothing.

Other Information: When using, do not eat, drink or smoke.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on Basic Physical and Chemical Properties

Physical State : Gas

Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

Appearance	: Colorless
Odor	: Odorless
Odor Threshold	: Not available
pH	: Not available
Evaporation Rate	: Not available
Melting Point	: -182.8 °C (-297.04 °F)
Freezing Point	: Not available
Boiling Point	: -89 °C (-128.2 °F)
Flash Point	: -152 °C (-241.6 °F) closed cup
Auto-ignition Temperature	: 510 °C (950 °F)
Decomposition Temperature	: Not available
Flammability (solid, gas)	: Extremely flammable gas
Lower Flammable Limit	: 2.9 %
Upper Flammable Limit	: 13 %
Vapor Pressure	: 3.85 mPa (548 psi) @ 25 °C (77 °F)
Relative Vapor Density at 20°C	: 1.04
Relative Density	: Not available
Specific Gravity	: 1.047
Solubility	: Water: Negligible
Partition Coefficient: N-Octanol/Water	: Not available
Viscosity	: Not available
Explosive Properties	: Contains gas under pressure; may explode if heated

SECTION 10: STABILITY AND REACTIVITY

- 10.1. Reactivity:** Hazardous reactions will not occur under normal conditions.
- 10.2. Chemical Stability:** Contains gas under pressure; may explode if heated.
- 10.3. Possibility of Hazardous Reactions:** Hazardous polymerization will not occur.
- 10.4. Conditions to Avoid:** Direct sunlight, extremely high or low temperatures, open flames, sources of ignition and incompatible materials.
- 10.5. Incompatible Materials:** Strong oxidizers.
- 10.6. Hazardous Decomposition Products:** None expected under normal conditions of use.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on Toxicological Effects - Product

Acute Toxicity (Oral): Not classified

Acute Toxicity (Dermal): Not classified

Acute Toxicity (Inhalation): Not classified

LD50 and LC50 Data: Not available

Skin Corrosion/Irritation: Not classified

Eye Damage/Irritation: Not classified

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Carcinogenicity: Not classified

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Single Exposure): Not classified

Aspiration Hazard: Not classified

Symptoms/Injuries After Inhalation: In elevated concentrations may cause asphyxiation, central nervous system effects, and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of the extremities, unconsciousness and death.

Symptoms/Injuries After Skin Contact: Contact with gas/liquid escaping the container can cause frostbite and freeze burns.

Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

Symptoms/Injuries After Eye Contact: Contact with gas/liquid escaping the container can cause frostbite, freeze burns, and permanent eye damage.

Symptoms/Injuries After Ingestion: Not considered a potential route of exposure, but contact with gas/liquid escaping the container can cause freeze burns and frostbite.

Chronic Symptoms: None expected under normal conditions of use.

11.2. Information on Toxicological Effects - Ingredient(s)

LD50 and LC50 Data:

Ethane (74-84-0)	
LC50 Inhalation Rat	658 mg/l/4h
Propane (74-98-6)	
LC50 Inhalation Rat	> 800000 ppm (Exposure time: 15 min)

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecology - General: Not classified.

12.2. Persistence and Degradability

Ethane (74-84-0)	
Persistence and Degradability	Not established.

12.3. Bioaccumulative Potential

Ethane (74-84-0)	
Bioaccumulative Potential	Not established.
Ethane (74-84-0)	
Log Pow	<= 2.8
Propane (74-98-6)	
Log Pow	2.3

12.4. Mobility in Soil Not available

12.5. Other Adverse Effects

Other Information: Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste Disposal Recommendations: Dispose of contents/container in accordance with local, regional, national, territorial, provincial, and international regulations.

Additional Information: Handle empty containers with care because residual vapors are flammable. Empty gas cylinders should be returned to the vendor for recycling or refilling. Do not puncture or incinerate container.

Ecology - Waste Materials: Avoid release to the environment.

SECTION 14: TRANSPORT INFORMATION

The shipping description(s) stated herein were prepared in accordance with certain assumptions at the time the SDS was authored, and can vary based on a number of variables that may or may not have been known at the time the SDS was issued.

14.1. In Accordance with DOT

Proper Shipping Name : ETHANE
Hazard Class : 2.1
Identification Number : UN1035
Label Codes : 2.1
ERG Number : 115



14.2. In Accordance with IMDG

Proper Shipping Name : ETHANE
Hazard Class : 2.1
Identification Number : UN1035
Label Codes : 2.1
EmS-No. (Fire) : F-D



Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

EmS-No. (Spillage) : S-U

14.3. In Accordance with IATA

Proper Shipping Name : ETHANE

Hazard Class : 2.1

Identification Number : UN1035

Label Codes : 2.1

ERG Code (IATA) : 10L



14.4. In Accordance with TDG

Proper Shipping Name : ETHANE

Hazard Class : 2.1

Identification Number : UN1035

Label Codes : 2.1



SECTION 15: REGULATORY INFORMATION

15.1. US Federal Regulations

Ethane (74-84-0)	
SARA Section 311/312 Hazard Classes	Health hazard - Simple asphyxiant Physical hazard - Flammable (gases, aerosols, liquids, or solids) Physical hazard - Gas under pressure
Ethane (74-84-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Propane (74-98-6)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Methane (74-82-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	

15.2. US State Regulations

Ethane (74-84-0)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List
Propane (74-98-6)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List
Methane (74-82-8)
U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

15.3. Canadian Regulations

Ethane (74-84-0)
Listed on the Canadian DSL (Domestic Substances List)
Propane (74-98-6)
Listed on the Canadian DSL (Domestic Substances List)
Methane (74-82-8)
Listed on the Canadian DSL (Domestic Substances List)

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Date of Preparation or Latest Revision : 11/15/2018

Ethane

Safety Data Sheet

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules And Regulations And According To The Hazardous Products Regulation (February 11, 2015).

Other Information

: This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200 and Canada's Hazardous Products Regulations (HPR) SOR/2015-17.

GHS Full Text Phrases:

Flam. Gas 1	Flammable gases Category 1
Press. Gas (Liq.)	Gases under pressure Liquefied gas
Simple Asphy	Simple Asphyxiant
H220	Extremely flammable gas
H280	Contains gas under pressure; may explode if heated

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

NA GHS SDS 2015 (Can, US)

SECTION 1: IDENTIFICATION

1.1. Product Identifier

Product Form: Mixture

Product Name: Propane Plus

1.2. Intended Use of the Product

Use of the Substance/Mixture: No use is specified.

1.3. Name, Address, and Telephone of the Responsible Party

Energy Transfer Partners

100 Green St.

Marcus Hook, PA

214-981-0700

1.4. Emergency Telephone Number

Emergency Number : CHEMTREC: (800) 424-9300/ (703) 527-3887

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the Substance or Mixture

GHS-US Classification

Simple Asphy

Flam. Gas 1 H220

Press. Gas (Liq.) H280

STOT SE 3 H336

Aquatic Acute 2 H401

Aquatic Chronic 2 H411

Full text of hazard classes and H-statements : see section 16

2.2. Label Elements

GHS-US Labeling

Hazard Pictograms (GHS-US) :



Signal Word (GHS-US) :

Danger

Hazard Statements (GHS-US) :

H220 - Extremely flammable gas.
H280 - Contains gas under pressure; may explode if heated.
H336 - May cause drowsiness or dizziness.
H401 - Toxic to aquatic life.
H411 - Toxic to aquatic life with long lasting effects.
May displace oxygen and cause rapid suffocation.

Precautionary Statements (GHS-US) :

P210 - Keep away from extremely high or low temperatures, ignition sources, and incompatible materials. - No smoking.
P261 - Avoid breathing gas.
P271 - Use only outdoors or in a well-ventilated area.
P273 - Avoid release to the environment.
P304+P340 - If inhaled: Remove person to fresh air and keep at rest in a position comfortable for breathing.
P312 - Call a poison center or doctor if you feel unwell.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
P391 - Collect spillage.
P403 - Store in a well-ventilated place.
P403+P233 - Store in a well-ventilated place. Keep container tightly closed.
P405 - Store locked up.
P410+P403 - Protect from sunlight. Store in a well-ventilated place.
P501 - Dispose of contents/container in accordance with local, regional, national, and international regulations.

Propane Plus

Safety Data Sheet

According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

2.3. Other Hazards

Vapor in the headspace of tanks and containers may ignite and explode at temperatures exceeding auto-ignition temperature, where vapor concentrations are within the flammability range. May ignite on surfaces at temperatures above auto-ignition temperature. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. Repeated exposure may cause skin dryness or cracking. Exposure may aggravate those with pre-existing eye, skin, or respiratory conditions. Contact with gas escaping the container can cause frostbite.

2.4. Unknown Acute Toxicity (GHS-US)

No data available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance

Not applicable

3.2. Mixture

Name	Product Identifier	%	GHS-US classification
Propane	(CAS-No.) 74-98-6	35 - 100	Simple Asphy Flam. Gas 1, H220 Press. Gas (Liq.), H280
Isobutane	(CAS-No.) 75-28-5	<= 45	Simple Asphy Flam. Gas 1, H220 Press. Gas (Liq.), H280
Butane	(CAS-No.) 106-97-8	<= 25	Simple Asphy Flam. Gas 1, H220 Press. Gas (Liq.), H280
Isopentane	(CAS-No.) 78-78-4	<= 15	Flam. Liq. 1, H224 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 2, H411
n-Pentane	(CAS-No.) 109-66-0	<= 10	Flam. Liq. 1, H224 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 2, H411

Full text of H-phrases: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of First-aid Measures

First-aid Measures General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible). If frostbite or freezing occurs, immediately flush with plenty of lukewarm water to GENTLY warm the affected area. Do not use hot water. Do not rub affected area. Get immediate medical attention.

First-aid Measures After Inhalation: First, take proper precautions to ensure your own safety before attempting rescue (e.g. wear appropriate respiratory protective equipment, use the buddy system), then remove the exposed person to fresh air. Keep at rest in a position comfortable for breathing. Obtain medical attention if breathing difficulty persists.

First-aid Measures After Skin Contact: For brief contact with a small amount: Rewarm with body heat. Get immediate medical advice/attention. For extensive contact or a large amount: Immediately call a poison center/doctor and follow their advice. Specific treatment is urgent, incorrect first-aid practices will aggravate the injury. Protect affected area with a loose cover until proper medical treatment is received.

First-aid Measures After Eye Contact: Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention if irritation develops or persists. If frostbite or freezing occurs, immediately flush with plenty of lukewarm water to GENTLY warm the affected area. Do not use hot water. Do not rub affected area. Get immediate medical attention.

First-aid Measures After Ingestion: Rinse mouth. Do NOT induce vomiting. Obtain medical attention.

4.2. Most Important Symptoms and Effects Both Acute and Delayed

Symptoms/Injuries: May cause frostbite on contact with the liquid. May cause drowsiness and dizziness. Asphyxia by lack of oxygen: risk of death.

Propane Plus

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According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Symptoms/Injuries After Inhalation: High concentrations may cause central nervous system depression such as dizziness, vomiting, numbness, drowsiness, headache, and similar narcotic symptoms. In elevated concentrations may cause asphyxiation, central nervous system effects, and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of the extremities, unconsciousness and death.

Symptoms/Injuries After Skin Contact: Contact with gas/liquid escaping the container can cause frostbite and freeze burns.

Symptoms/Injuries After Eye Contact: Contact with gas/liquid escaping the container can cause frostbite, freeze burns, and permanent eye damage.

Symptoms/Injuries After Ingestion: Not considered a potential route of exposure, but contact with gas/liquid escaping the container can cause freeze burns and frostbite.

Chronic Symptoms: None expected under normal conditions of use.

4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention. If medical advice is needed, have product container or label at hand.

SECTION 5: FIRE-FIGHTING MEASURES

5.1. Extinguishing Media

Suitable Extinguishing Media: Do not extinguish burning gas if flow cannot be shut off immediately. Extinguish secondary FIRES with appropriate materials.

Unsuitable Extinguishing Media: Do not use a heavy water stream. Use of heavy stream of water may spread fire.

5.2. Special Hazards Arising From the Substance or Mixture

Fire Hazard: Extremely flammable gas.

Explosion Hazard: May form flammable/explosive vapor-air mixture. Container may explode in heat of fire.

Reactivity: Hazardous reactions will not occur under normal conditions.

5.3. Advice for Firefighters

Precautionary Measures Fire: Exercise caution when fighting any chemical fire.

Firefighting Instructions: Use water spray or fog for cooling exposed containers. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so. Fight fire remotely due to the risk of explosion.

Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.

Hazardous Combustion Products: Carbon oxides (CO, CO₂).

Other Information: Use water spray to disperse vapors. Do not allow run-off from firefighting to enter drains or water courses.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Eliminate every possible source of ignition. Do not get in eyes, on skin, or on clothing. Do not breathe gas.

6.1.1. For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protective equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel.

6.1.2. For Emergency Personnel

Protective Equipment: Equip cleanup crew with proper protection.

Emergency Procedures: Evacuate unnecessary personnel, isolate, and ventilate area. Ventilate area. Upon arrival at the scene, a first responder is expected to recognize the presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit.

6.2. Environmental Precautions

Prevent entry to sewers and public waters. Avoid release to the environment. Collect spillage.

6.3. Methods and Materials for Containment and Cleaning Up

For Containment: Stop leak, if possible without risk. As an immediate precautionary measure, isolate spill or leak area in all directions.

Methods for Cleaning Up: Stop the source of the release, if safe to do so. Consider the use of water spray to disperse vapors. Isolate the area until gas has dispersed. Ventilate and gas test area before entering. Contact competent authorities after a spill.

6.4. Reference to Other Sections

See Section 8 for exposure controls and personal protection and Section 13 for disposal considerations.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Additional Hazards When Processed: Handle empty containers with care because residual vapors are flammable. Ruptured cylinders may rocket. Do not pressurize, cut, or weld containers. Asphyxiating gas at high concentrations.

Precautions for Safe Handling: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Avoid prolonged contact with eyes, skin and clothing. Do not breathe gas.

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Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures.

7.2. Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed.

Storage Conditions: Keep container closed when not in use. Store in a dry, cool place. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials. Keep in fireproof place. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Store locked up/in a secure area.

Incompatible Materials: Strong acids, strong bases, strong oxidizers. Oxygen.

7.3. Specific End Use(s)

No use is specified.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control Parameters

For substances listed in section 3 that are not listed here, there are no established exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), AIHA (WEEL), NIOSH (REL), or OSHA (PEL).

Propane (74-98-6)		
USA NIOSH	NIOSH REL (TWA) (mg/m ³)	1800 mg/m ³
USA NIOSH	NIOSH REL (TWA) (ppm)	1000 ppm
USA IDLH	US IDLH (ppm)	2100 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) (mg/m ³)	1800 mg/m ³
USA OSHA	OSHA PEL (TWA) (ppm)	1000 ppm
Isobutane (75-28-5)		
USA ACGIH	ACGIH STEL (ppm)	1000 ppm (explosion hazard)
USA NIOSH	NIOSH REL (TWA) (mg/m ³)	1900 mg/m ³
USA NIOSH	NIOSH REL (TWA) (ppm)	800 ppm
Butane (106-97-8)		
USA ACGIH	ACGIH STEL (ppm)	1000 ppm (explosion hazard)
USA NIOSH	NIOSH REL (TWA) (mg/m ³)	1900 mg/m ³
USA NIOSH	NIOSH REL (TWA) (ppm)	800 ppm
USA IDLH	US IDLH (ppm)	1600 ppm (>10% LEL)
Isopentane (78-78-4)		
USA ACGIH	ACGIH TWA (ppm)	1000 ppm
n-Pentane (109-66-0)		
USA ACGIH	ACGIH TWA (ppm)	1000 ppm
USA NIOSH	NIOSH REL (TWA) (mg/m ³)	350 mg/m ³
USA NIOSH	NIOSH REL (TWA) (ppm)	120 ppm
USA NIOSH	NIOSH REL (ceiling) (mg/m ³)	1800 mg/m ³
USA NIOSH	NIOSH REL (ceiling) (ppm)	610 ppm
USA IDLH	US IDLH (ppm)	1500 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) (mg/m ³)	2950 mg/m ³
USA OSHA	OSHA PEL (TWA) (ppm)	1000 ppm

8.2. Exposure Controls

Appropriate Engineering Controls

: Suitable eye/body wash equipment should be available in the vicinity of any potential exposure. Ensure adequate ventilation, especially in confined areas. Use explosion-proof equipment. Proper grounding procedures to avoid static electricity should be followed. Gas detectors should be used when flammable gases or vapors may be released. Oxygen detectors should be used when asphyxiating gases may be released. Ensure all national/local regulations are observed.

Personal Protective Equipment

: Gloves. Protective clothing. Protective goggles. Respiratory protection of the dependent type.



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According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Materials for Protective Clothing	: Chemically resistant materials and fabrics. Wear fire/flame resistant/retardant clothing.
Hand Protection	: Wear protective gloves. If material is cold, wear thermally resistant protective gloves.
Eye and Face Protection	: Chemical safety goggles.
Skin and Body Protection	: Wear suitable protective clothing.
Respiratory Protection	: Use a NIOSH-approved self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limits.
Thermal Hazard Protection	: Wear thermally resistant protective clothing.
Other Information	: When using, do not eat, drink or smoke.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on Basic Physical and Chemical Properties

Physical State	: Gas
Appearance	: Colorless gas
Odor	: Odorless
Odor Threshold	: No data available
pH	: No data available
Evaporation Rate	: No data available
Melting Point	: No data available
Freezing Point	: -279.5 °F (-173.06 °C)
Boiling Point	: -127.5 °F (-88.61 °C)
Flash Point	: -211 °F (-135 °C)
Auto-ignition Temperature	: 882 °F (472.22 °C)
Decomposition Temperature	: No data available
Flammability (solid, gas)	: Extremely flammable gas
Vapor Pressure	: 28856.83 mm Hg
Relative Vapor Density at 20°C	: 1.04
Relative Density	: No data available
Specific Gravity	: 0.45
Solubility	: Water: Negligible
Partition Coefficient: N-Octanol/Water	: No data available
Viscosity	: No data available
Explosive Properties	: Contains gas under pressure; may explode if heated.
Lower Flammable Limit	: -3 %
Upper Flammable Limit	: -12.4 %

9.2. Other Information

Gas Group	: Press. Gas (Liq.)

SECTION 10: STABILITY AND REACTIVITY

- 10.1. Reactivity:** Hazardous reactions will not occur under normal conditions.
- 10.2. Chemical Stability:** Contains gas under pressure; may explode if heated.
- 10.3. Possibility of Hazardous Reactions:** Hazardous polymerization will not occur.
- 10.4. Conditions to Avoid:** Direct sunlight, extremely high or low temperatures, open flames, sources of ignition and incompatible materials.
- 10.5. Incompatible Materials:** Strong acids, strong bases, strong oxidizers. Oxygen.
- 10.6. Hazardous Decomposition Products:** Carbon oxides (CO, CO₂).

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on Toxicological Effects

Acute Toxicity: Not classified

Propane (74-98-6)	
LC50 Inhalation Rat	> 800000 ppm (Exposure time: 15 min)
Isobutane (75-28-5)	
LC50 Inhalation Rat	658 mg/l/4h
LC50 Inhalation Rat	11000 ppm

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According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Butane (106-97-8)	
LC50 Inhalation Rat	30957 mg/m ³ (Exposure time: 4 h)
n-Pentane (109-66-0)	
LD50 Oral Rat	> 2000 mg/kg
LD50 Dermal Rabbit	3000 mg/kg
LC50 Inhalation Rat	364 g/m ³ (Exposure time: 4 h)
LC50 Inhalation Rat	> 20 mg/l/4h

Skin Corrosion/Irritation: Not classified

Serious Eye Damage/Irritation: Not classified

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Carcinogenicity: Not classified

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Single Exposure): May cause drowsiness or dizziness.

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Aspiration Hazard: Not classified

Symptoms/Injuries After Inhalation: High concentrations may cause central nervous system depression such as dizziness, vomiting, numbness, drowsiness, headache, and similar narcotic symptoms. In elevated concentrations may cause asphyxiation, central nervous system effects, and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of the extremities, unconsciousness and death.

Symptoms/Injuries After Skin Contact: Contact with gas/liquid escaping the container can cause frostbite and freeze burns.

Symptoms/Injuries After Eye Contact: Contact with gas/liquid escaping the container can cause frostbite, freeze burns, and permanent eye damage.

Symptoms/Injuries After Ingestion: Not considered a potential route of exposure, but contact with gas/liquid escaping the container can cause freeze burns and frostbite.

Chronic Symptoms: None expected under normal conditions of use.

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecology - General : Toxic to aquatic life with long lasting effects.

Isopentane (78-78-4)	
EC50 Daphnia 1	2.3 mg/l (Exposure time: 48 h - Species: Daphnia magna)
n-Pentane (109-66-0)	
LC50 Fish 1	9.87 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss)
EC50 Daphnia 1	9.74 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 Fish 2	11.59 mg/l (Exposure time: 96 h - Species: Pimephales promelas)
NOEC Chronic Algae	2 mg/l

12.2. Persistence and Degradability

Propane Plus	
Persistence and Degradability	May cause long-term adverse effects in the environment.

12.3. Bioaccumulative Potential

Propane Plus	
Bioaccumulative Potential	Not established.
Propane (74-98-6)	
Log Pow	2.3
Isobutane (75-28-5)	
BCF Fish 1	1.57 - 1.97
Log Pow	2.88 (at 20 °C)
Butane (106-97-8)	
Log Pow	2.89
Isopentane (78-78-4)	
Log Pow	3.2 - 3.3
n-Pentane (109-66-0)	

Propane Plus

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According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Log Pow

3.39

12.4. Mobility in Soil No additional information available

12.5. Other Adverse Effects

Other Information : Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste Treatment Methods

Waste Disposal Recommendations: Dispose of contents/container in accordance with local, regional, national, and international regulations.

Additional Information: Container may remain hazardous when empty. Continue to observe all precautions. Handle empty containers with care because residual vapors are flammable. Empty gas cylinders should be returned to the vendor for recycling or refilling. Do not puncture or incinerate container. EPA Hazardous Waste Number: D001 (Ignitability).

Ecology - Waste Materials: Avoid release to the environment. This material is hazardous to the aquatic environment. Keep out of sewers and waterways.

SECTION 14: TRANSPORT INFORMATION

The shipping description(s) stated herein were prepared in accordance with certain assumptions at the time the SDS was authored, and can vary based on a number of variables that may or may not have been known at the time the SDS was issued.

14.1. In Accordance with DOT

Proper Shipping Name : PETROLEUM GASES, LIQUEFIED
Hazard Class : 2.1
Identification Number : UN1075
Label Codes : 2.1
ERG Number : 115



14.2. In Accordance with IMDG

Proper Shipping Name : PETROLEUM GASES, LIQUEFIED
Hazard Class : 2
Division : 2.1
Identification Number : UN1075
Label Codes : 2.1
EmS-No. (Fire) : F-D
EmS-No. (Spillage) : S-U



14.3. In Accordance with IATA

Proper Shipping Name : PETROLEUM GASES, LIQUEFIED
Identification Number : UN1075
Hazard Class : 2
Label Codes : 2.1
Division : 2.1
ERG Code (IATA) : 10L



SECTION 15: REGULATORY INFORMATION

15.1. US Federal Regulations

Propane Plus	
SARA Section 311/312 Hazard Classes	Fire hazard Sudden release of pressure hazard Immediate (acute) health hazard
Propane (74-98-6)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Isobutane (75-28-5)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Butane (106-97-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
Isopentane (78-78-4)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	
n-Pentane (109-66-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory	

Propane Plus

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15.2. US State Regulations

Propane (74-98-6)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
Isobutane (75-28-5)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
Butane (106-97-8)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
Isopentane (78-78-4)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List
n-Pentane (109-66-0)
U.S. - Massachusetts - Right To Know List
U.S. - New Jersey - Right to Know Hazardous Substance List
U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Date of Preparation or Latest Revision	: 01/08/2018
Other Information	: This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200

GHS Full Text Phrases:

Aquatic Acute 2	Hazardous to the aquatic environment - Acute Hazard Category 2
Aquatic Chronic 2	Hazardous to the aquatic environment - Chronic Hazard Category 2
Asp. Tox. 1	Aspiration hazard Category 1
Flam. Gas 1	Flammable gases Category 1
Flam. Liq. 1	Flammable liquids Category 1
Press. Gas (Liq.)	Gases under pressure Liquefied gas
Simple Asphy	Simple Asphyxiant
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H220	Extremely flammable gas
H224	Extremely flammable liquid and vapor
H280	Contains gas under pressure; may explode if heated
H304	May be fatal if swallowed and enters airways
H336	May cause drowsiness or dizziness
H401	Toxic to aquatic life
H411	Toxic to aquatic life with long lasting effects

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

SDS US (GHS HazCom)

SECTION 1: IDENTIFICATION

1.1. Product Identifier

Product Form: Mixture

Product Name: Natural Gas Condensate - Marcellus/Utica

Synonyms: Natural Gas Liquids, Stabilized Liquid, HC Liquids, JT Liquids, KO Liquids

1.2. Intended Use of the Product

Use of the Substance/Mixture: For professional use only

1.3. Name, Address, and Telephone of the Responsible Party

Energy Transfer

1300 Main Street

Houston, Texas 77002

713-989-2665

1.4. Emergency Telephone Number

Emergency Number : CHEMTREC: (800) 424-9300/ (703) 527-3887

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the Substance or Mixture

GHS-US Classification

Flammable liquids Category 1	H224
Skin corrosion/irritation Category 2	H315
Germ cell mutagenicity Category 1B	H340
Carcinogenicity Category 1A	H350
Reproductive toxicity Category 2	H361
Specific target organ toxicity – Single exposure, Category 3, Narcosis	H336
Specific target organ toxicity (repeated exposure) Category 2	H373
Aspiration hazard Category 1	H304
Hazardous to the aquatic environment – Acute Hazard Category 1	H400
Hazardous to the aquatic environment – Chronic Hazard Category 1	H410

2.2. Label Elements

GHS-US Labeling

Hazard Pictograms (GHS-US)



Signal Word (GHS-US)

: Danger

Hazard Statements (GHS-US)

: H224 - Extremely flammable liquid and vapor.
H304 - May be fatal if swallowed and enters airways.
H315 - Causes skin irritation.
H336 - May cause drowsiness or dizziness.
H340 - May cause genetic defects (Inhalation, oral).
H350 - May cause cancer (Inhalation, oral).
H361 - Suspected of damaging fertility or the unborn child.
H373 - May cause damage to organs (central nervous system, hearing organs) through prolonged or repeated exposure (Inhalation).
H400 - Very toxic to aquatic life.
H410 - Very toxic to aquatic life with long lasting effects.

Precautionary Statements (GHS-US)

: P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P233 - Keep container tightly closed.
P240 - Ground/Bond container and receiving equipment.
P241 - Use explosion-proof electrical, ventilating, and lighting equipment.
P242 - Use only non-sparking tools.
P243 - Take precautionary measures against static discharge.
P260 - Do not breathe vapors, mist, or spray.

Natural Gas Condensate - Marcellus/Utica

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P264 - Wash hands, forearms, and other exposed areas thoroughly after handling.
P271 - Use only outdoors or in a well-ventilated area.
P273 - Avoid release to the environment.
P280 - Wear protective gloves, protective clothing, and eye protection.
P301+P310 - If swallowed: Immediately call a poison center or doctor.
P303+P361+P353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340 - If inhaled: Remove person to fresh air and keep at rest in a position comfortable for breathing.
P308+P313 - If exposed or concerned: Get medical advice/attention.
P321 - Specific treatment (see section 4 on this SDS).
P331 - Do NOT induce vomiting.
P332+P313 - If skin irritation occurs: Get medical advice/attention.
P362+P364 - Take off contaminated clothing and wash it before reuse.
P370+P378 - In case of fire: Use appropriate media (see section 5) to extinguish.
P391 - Collect spillage.
P403+P235 - Store in a well-ventilated place. Keep cool.
P405 - Store locked up.
P501 - Dispose of contents/container in accordance with local, regional, national, and international regulations.

2.3. Other Hazards

Vapor in the headspace of tanks and containers may ignite and explode at temperatures exceeding auto-ignition temperature, where vapor concentrations are within the flammability range. May ignite on surfaces at temperatures above auto-ignition temperature. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. Repeated exposure may cause skin dryness or cracking. Exposure may aggravate those with pre-existing eye, skin, or respiratory conditions. Contact with gas escaping the container can cause frostbite.

2.4. Unknown Acute Toxicity (GHS-US)

No data available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance

Not applicable

3.2. Mixture

Name	Synonyms	Product Identifier	%*	GHS US classification
n-Heptane	Heptane (n-) / Heptane / Normal heptane / Heptane, n- / HEPTANE	(CAS-No.) 142-82-5	< 30	Flam. Liq. 2, H225 Skin Irrit. 2, H315 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 1, H400 Aquatic Chronic 1, H410
n-hexane	Hexane, n- / HEXANE / Normal hexane / n-Hexane	(CAS-No.) 110-54-3	< 25	Flam. Liq. 2, H225 Skin Irrit. 2, H315 Repr. 2, H361 STOT SE 3, H336 STOT RE 2, H373 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 2, H411
n-Butane	Butane / BUTANE	(CAS-No.) 106-97-8	< 20	Flam. Gas 1, H220 Press. Gas (Liq.), H280 Simple Asphy, SIAS
n-Pentane	Pentane / Normal pentane / PENTANE / Pentane, n- / Pentane isopentane	(CAS-No.) 109-66-0	< 15	Flam. Liq. 1, H224 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 2, H411

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Octane	n-Octane / OCTANE / n-octane	(CAS-No.) 111-65-9	< 15	Flam. Liq. 2, H225 Skin Irrit. 2, H315 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 1, H400 Aquatic Chronic 1, H410
Propane	Normal propane / PROPANE / n-Propane / R290	(CAS-No.) 74-98-6	< 15	Flam. Gas 1, H220 Press. Gas (Liq.), H280 Simple Asphy, SIAS
Toluene	Benzene, methyl- / Methylbenzene / Phenylmethane / TOLUENE	(CAS-No.) 108-88-3	< 10	Flam. Liq. 2, H225 Skin Irrit. 2, H315 Repr. 2, H361 STOT SE 3, H336 STOT RE 2, H373 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 3, H412
Isopentane	Butane, 2-methyl- / 2-Methylbutane / ISOPENTANE / Methylbutane / isopentane	(CAS-No.) 78-78-4	< 10	Flam. Liq. 1, H224 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 2, H411
Isobutane	2-Methylpropane / Propane, 2-methyl- / ISOBUTANE / R600a / isobutane	(CAS-No.) 75-28-5	< 5	Flam. Gas 1, H220 Press. Gas (Liq.), H280 Simple Asphy, SIAS
Nonane	n-Nonane / NONANE	(CAS-No.) 111-84-2	< 1	Flam. Liq. 3, H226 Skin Irrit. 2, H315 STOT SE 3, H336 Asp. Tox. 1, H304 Aquatic Acute 1, H400 Aquatic Chronic 1, H410
Ethane	Ethyl hydride / ETHANE	(CAS-No.) 74-84-0	< 1	Flam. Gas 1, H220 Press. Gas (Liq.), H280 Simple Asphy, SIAS
Ethylbenzene	Phenylethane / Benzene, ethyl- / ETHYLBENZENE	(CAS-No.) 100-41-4	< 0.5	Flam. Liq. 2, H225 Acute Tox. 4 (Inhalation:dust,mist), H332 Carc. 2, H351 STOT RE 2, H373 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 3, H412
Benzene	Cyclohexatriene / Benzol	(CAS-No.) 71-43-2	< 0.25	Flam. Liq. 2, H225 Acute Tox. 4 (Oral), H302 Skin Irrit. 2, H315 Eye Irrit. 2A, H319 Muta. 1B, H340 Carc. 1A, H350 STOT SE 3, H336 STOT SE 3, H335 STOT RE 1, H372 Asp. Tox. 1, H304 Aquatic Acute 2, H401 Aquatic Chronic 3, H412

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Triethylene glycol	1,2-Bis(2-hydroxyethoxy)ethane / 3,6-Dioxaoctane-1,8-diol / 2,2'-(1,2-Ethanediylbis(oxy))bisethanol / Ethanol, 2,2'-(ethylenedioxy)di- / Ethanol, 2,2'-[1,2-ethanediylbis(oxy)]bis- / 2,2'-(Ethylenedioxy)diethanol / 2,2'-Ethylenedioxybis(ethanol) / 2,2'-Ethylenedioxydiethanol / 2,2'-Ethylenedioxyethanol / Glycol bis(hydroxyethyl) ether / Octane-1,8-diol, 3,6-dioxo- / Triglycol / TRIETHYLENE GLYCOL / Ethanol, 2,2'-(1,2-ethanediylbis(oxy))bis- / Triethyleneglycol	(CAS-No.) 112-27-6	< 0.01	Not classified.
Hydrogen sulfide	Hydrogen sulfide (H2S) / Hydrogen sulphide / Sulfur hydride / Dihydrogen sulphide / hydrogen sulfide / Hydrogen sulphide, hydrogen sulfide / Sulfane	(CAS-No.) 7783-06-4	< 0.001	Flam. Gas 1, H220 Acute Tox. 2 (Inhalation:gas), H330 Eye Irrit. 2A, H319 STOT SE 3, H335 Aquatic Acute 1, H400
Methane	Methane, compressed / Monomethylamine / Methyl hydride / Marsh gas	(CAS-No.) 74-82-8	< 0.001	Flam. Gas 1, H220 Press. Gas (Comp.), H280 Simple Asphy, SIAS
Carbon dioxide	CARBON DIOXIDE / Carbonic anhydride	(CAS-No.) 124-38-9	< 0.001	Press. Gas (Comp.), H280 Simple Asphy, SIAS
Nitrogen	Nitrogen gas / Nitrogen, liquefied / NITROGEN / Nitrogen, compressed / nitrogen	(CAS-No.) 7727-37-9	< 0.001	Press. Gas (Ref. Liq.), H281 Simple Asphy, SIAS
Ethylene glycol	1,2-Dihydroxyethane / Ethane-1,2-diol / 1,2-Ethanediol / Ethanediol / GLYCOL / Glycol / Monoethylene glycol	(CAS-No.) 107-21-1	< 0.001	Acute Tox. 4 (Oral), H302 STOT RE 2, H373
Methanol	Methyl alcohol / Carbinol / Methyl hydroxide / Wood alcohol / METHYL ALCOHOL	(CAS-No.) 67-56-1	< 0.001	Flam. Liq. 2, H225 Acute Tox. 3 (Oral), H301 Acute Tox. 3 (Dermal), H311 Acute Tox. 3 (Inhalation:vapor), H331 STOT SE 1, H370
Water	AQUA	(CAS-No.) 7732-18-5	< 0.001	Not classified.

Full text of H-phrases: see section 16

*This mixture has a variable composition.

SECTION 4: FIRST AID MEASURES

4.1. Description of First-aid Measures

First-aid Measures General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible). Hydrogen sulfide has a characteristic rotten egg “sulfurous” odor with an odor threshold of less than 10 parts per billion. However, this odor should not be used as a warning property of toxic levels because H2S can overwhelm and deaden the sense of smell. Therefore, the smell of H2S should not be used as an indicator of a hazardous condition – a H2S meter or colorimetric indicating tubes are typically used to determine the concentration of H2S.

First-aid Measures After Inhalation: When symptoms occur: go into open air and ventilate suspected area. Obtain medical attention if breathing difficulty persists.

First-aid Measures After Skin Contact: Immediately remove contaminated clothing. Immediately drench affected area with water for at least 15 minutes. If exposed or concerned: Get medical advice/attention.

First-aid Measures After Eye Contact: Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention if irritation develops or persists.

First-aid Measures After Ingestion: Do NOT induce vomiting. Turn affected person(s) on their side and maintain in that position to prevent aspiration. Rinse mouth. Immediately call a POISON CENTER or doctor/physician.

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4.2. Most Important Symptoms and Effects Both Acute and Delayed

Symptoms/Injuries: May be fatal if swallowed and enters airways. Causes skin irritation. May cause drowsiness and dizziness. May cause cancer (Inhalation, oral). May cause damage to organs (central nervous system, hearing organs) through prolonged or repeated exposure (Inhalation). May cause genetic defects (Inhalation, oral). Suspected of damaging fertility or the unborn child.

Symptoms/Injuries After Inhalation: High concentrations may cause central nervous system depression such as dizziness, vomiting, numbness, drowsiness, headache, and similar narcotic symptoms. Contains a small amount of Hydrogen Sulfide, symptoms of overexposure are headaches, dizziness, nausea, coughing, respiratory irritation, eye irritation, skin irritation, pain in the nose, and loss of consciousness. Heating of the product may release higher amounts of Hydrogen Sulfide (H₂S).

Symptoms/Injuries After Skin Contact: Redness, pain, swelling, itching, burning, dryness, and dermatitis.

Symptoms/Injuries After Eye Contact: May cause slight irritation to eyes.

Symptoms/Injuries After Ingestion: Aspiration into the lungs can occur during ingestion or vomiting and may cause lung injury.

Chronic Symptoms: May cause cancer (Inhalation, oral). Suspected of damaging fertility or the unborn child. May cause damage to organs (central nervous system, hearing organs) through prolonged or repeated exposure (Inhalation). May cause genetic defects (Inhalation, oral).

4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention. If medical advice is needed, have product container or label at hand.

SECTION 5: FIRE-FIGHTING MEASURES

5.1. Extinguishing Media

Suitable Extinguishing Media: Dry chemical powder, alcohol-resistant foam, carbon dioxide (CO₂). Water may be ineffective but water should be used to keep fire-exposed container cool.

Unsuitable Extinguishing Media: Do not use a heavy water stream. A heavy water stream may spread burning liquid.

5.2. Special Hazards Arising From the Substance or Mixture

Fire Hazard: Extremely flammable liquid and vapor. Vapors may travel to source of ignition and flash back.

Explosion Hazard: May form flammable or explosive vapor-air mixture.

Reactivity: Reacts violently with strong oxidizers. Increased risk of fire or explosion.

5.3. Advice for Firefighters

Precautionary Measures Fire: Exercise caution when fighting any chemical fire.

Firefighting Instructions: Use water spray or fog for cooling exposed containers. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.

Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.

Hazardous Combustion Products: Carbon oxides (CO, CO₂). Unidentified hydrocarbons.

Other Information: Do not allow run-off from fire fighting to enter drains or water courses.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Do not handle until all safety precautions have been read and understood. Keep away from heat, hot surfaces, sparks, open flames, and other ignition sources. No smoking. Use special care to avoid static electric charges. Do not breathe vapor, mist or spray. Do not get in eyes, on skin, or on clothing.

6.1.1. For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protective equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel. Stop leak if safe to do so.

6.1.2. For Emergency Personnel

Protective Equipment: Equip cleanup crew with proper protection.

Emergency Procedures: Eliminate ignition sources first, then ventilate the area. Upon arrival at the scene, a first responder is expected to recognize the presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit.

6.2. Environmental Precautions

Prevent entry to sewers and public waters. Avoid release to the environment. Collect spillage.

6.3. Methods and Materials for Containment and Cleaning Up

For Containment: As an immediate precautionary measure, isolate spill or leak area in all directions. Contain any spills with dikes or absorbents to prevent migration and entry into sewers or streams.

Methods for Cleaning Up: Clean up spills immediately and dispose of waste safely. Use only non-sparking tools. Absorb and/or contain spill with inert material. Do not take up in combustible material such as: saw dust or cellulosic material. Transfer spilled material to a suitable container for disposal. Contact competent authorities after a spill.

6.4. Reference to Other Sections

See Section 8 for exposure controls and personal protection and Section 13 for disposal considerations.

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SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Additional Hazards When Processed: Handle empty containers with care because residual vapors are flammable. Contains a small amount of hydrogen sulfide. Hydrogen sulfide is a fatal, and highly flammable gas with a rotten egg odor that quickly causes odor fatigue. Heating of this product and storage under elevated temperatures or over long periods of time may release higher amounts of hydrogen sulfide. Hydrogen sulfide is also an asphyxiant.

Precautions for Safe Handling: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use only non-sparking tools. Take precautionary measures against static discharge. Do not get in eyes, on skin, or on clothing. Do not breathe vapor, mist, or spray. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work.

Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures.

7.2. Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Use explosion-proof electrical, ventilating, and lighting equipment. Take action to prevent static discharges. Ground and bond container and receiving equipment. Comply with applicable regulations.

Storage Conditions: Store in a dry, cool place. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials. Store locked up/in a secure area. Store in a well-ventilated place. Keep container tightly closed. Keep in fireproof place.

Incompatible Materials: Strong acids, strong bases, strong oxidizers. Strong reducing agents.

7.3. Specific End Use(s)

For professional use only

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control Parameters

For substances listed in section 3 that are not listed here, there are no established exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), AIHA (WEEL), NIOSH (REL), or OSHA (PEL).

Methane (74-82-8)		
USA ACGIH	ACGIH chemical category	Simple asphyxiant See Appendix F: Minimal Oxygen Content
Propane (74-98-6)		
USA ACGIH	ACGIH chemical category	Simple asphyxiant See Appendix F: Minimal Oxygen Content
USA NIOSH	NIOSH REL (TWA)	1800 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	1000 ppm
USA IDLH	IDLH [ppm]	2100 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) [1]	1800 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	1000 ppm
Ethane (74-84-0)		
USA ACGIH	ACGIH chemical category	Simple asphyxiant See Appendix F: Minimal Oxygen Content
Isobutane (75-28-5)		
USA ACGIH	ACGIH OEL STEL [ppm]	1000 ppm (explosion hazard (Butane, isomers))
USA NIOSH	NIOSH REL (TWA)	1900 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	800 ppm
n-Butane (106-97-8)		
USA ACGIH	ACGIH OEL STEL [ppm]	1000 ppm (explosion hazard (Butane, isomers))
USA NIOSH	NIOSH REL (TWA)	1900 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	800 ppm
USA IDLH	IDLH [ppm]	1600 ppm (>10% LEL)
Isopentane (78-78-4)		
USA ACGIH	ACGIH OEL TWA [ppm]	1000 ppm (Pentane, all isomers)
n-Pentane (109-66-0)		
USA ACGIH	ACGIH OEL TWA [ppm]	1000 ppm (Pentane, all isomers)
USA NIOSH	NIOSH REL (TWA)	350 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	120 ppm
USA NIOSH	NIOSH REL (Ceiling)	1800 mg/m ³
USA NIOSH	NIOSH REL C [ppm]	610 ppm
USA IDLH	IDLH [ppm]	1500 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) [1]	2950 mg/m ³

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USA OSHA	OSHA PEL (TWA) [2]	1000 ppm
n-hexane (110-54-3)		
USA ACGIH	ACGIH OEL TWA [ppm]	50 ppm
USA ACGIH	ACGIH chemical category	Skin - potential significant contribution to overall exposure by the cutaneous route
USA ACGIH	BEI (BLV)	0.5 mg/l Parameter: 2,5-Hexanedione without hydrolysis - Medium: urine - Sampling time: end of shift
USA NIOSH	NIOSH REL (TWA)	180 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	50 ppm
USA IDLH	IDLH [ppm]	1100 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) [1]	1800 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	500 ppm
Benzene (71-43-2)		
USA ACGIH	ACGIH OEL TWA [ppm]	0.5 ppm
USA ACGIH	ACGIH OEL STEL [ppm]	2.5 ppm
USA ACGIH	ACGIH chemical category	Confirmed Human Carcinogen, Skin - potential significant contribution to overall exposure by the cutaneous route
USA ACGIH	BEI (BLV)	25 µg/g Kreatinin Parameter: S-Phenylmercapturic acid - Medium: urine - Sampling time: end of shift (background) 500 µg/g Kreatinin Parameter: t,t-Muconic acid - Medium: urine - Sampling time: end of shift (background)
USA NIOSH	NIOSH REL TWA [ppm]	0.1 ppm
USA NIOSH	NIOSH REL STEL [ppm]	1 ppm
USA IDLH	IDLH [ppm]	500 ppm
USA OSHA	OSHA PEL (TWA) [2]	10 ppm 1 ppm
USA OSHA	OSHA PEL (STEL) [2]	5 ppm (see 29 CFR 1910.1028)
USA OSHA	OSHA PEL C [ppm]	25 ppm
USA OSHA	Acceptable Maximum Peak Above The Acceptable Ceiling Concentration For An 8-Hr Shift	50 ppm Peak (10 minutes)
USA OSHA	OSHA Action Level/Excursion Limit	0.5 ppm (Action Level, see 29 CFR 1910.1028)
n-Heptane (142-82-5)		
USA ACGIH	ACGIH OEL TWA [ppm]	400 ppm (Heptane, all isomers)
USA ACGIH	ACGIH OEL STEL [ppm]	500 ppm (Heptane, all isomers)
USA NIOSH	NIOSH REL (TWA)	350 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	85 ppm
USA NIOSH	NIOSH REL (Ceiling)	1800 mg/m ³
USA NIOSH	NIOSH REL C [ppm]	440 ppm
USA IDLH	IDLH [ppm]	750 ppm
USA OSHA	OSHA PEL (TWA) [1]	2000 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	500 ppm
Toluene (108-88-3)		
USA ACGIH	ACGIH OEL TWA [ppm]	20 ppm
USA ACGIH	ACGIH chemical category	Not Classifiable as a Human Carcinogen
USA ACGIH	BEI (BLV)	0.02 mg/l Parameter: Toluene - Medium: blood - Sampling time: prior to last shift of workweek 0.03 mg/l Parameter: Toluene - Medium: urine - Sampling time: end of shift 0.3 mg/g Kreatinin Parameter: o-Cresol with hydrolysis - Medium: urine - Sampling time: end of shift (background)
USA NIOSH	NIOSH REL (TWA)	375 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	100 ppm
USA NIOSH	NIOSH REL (STEL)	560 mg/m ³
USA NIOSH	NIOSH REL STEL [ppm]	150 ppm

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USA IDLH	IDLH [ppm]	500 ppm
USA OSHA	OSHA PEL (TWA) [2]	200 ppm
USA OSHA	OSHA PEL C [ppm]	300 ppm
USA OSHA	Acceptable Maximum Peak Above The Acceptable Ceiling Concentration For An 8-Hr Shift	500 ppm Peak (10 minutes)
Ethylbenzene (100-41-4)		
USA ACGIH	ACGIH OEL TWA [ppm]	20 ppm
USA ACGIH	ACGIH chemical category	Confirmed Animal Carcinogen with Unknown Relevance to Humans
USA ACGIH	BEI (BLV)	0.15 g/g Kreatinin Parameter: Sum of mandelic acid and phenylglyoxylic acid - Medium: urine - Sampling time: end of shift (nonspecific)
USA NIOSH	NIOSH REL (TWA)	435 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	100 ppm
USA NIOSH	NIOSH REL (STEL)	545 mg/m ³
USA NIOSH	NIOSH REL STEL [ppm]	125 ppm
USA IDLH	IDLH [ppm]	800 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) [1]	435 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	100 ppm
Octane (111-65-9)		
USA ACGIH	ACGIH OEL TWA [ppm]	300 ppm
USA NIOSH	NIOSH REL (TWA)	350 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	75 ppm
USA NIOSH	NIOSH REL (Ceiling)	1800 mg/m ³
USA NIOSH	NIOSH REL C [ppm]	385 ppm
USA IDLH	IDLH [ppm]	1000 ppm (10% LEL)
USA OSHA	OSHA PEL (TWA) [1]	2350 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	500 ppm
Nonane (111-84-2)		
USA ACGIH	ACGIH OEL TWA [ppm]	200 ppm
USA NIOSH	NIOSH REL (TWA)	1050 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	200 ppm
Carbon dioxide (124-38-9)		
USA ACGIH	ACGIH OEL TWA [ppm]	5000 ppm
USA ACGIH	ACGIH OEL STEL [ppm]	30000 ppm
USA NIOSH	NIOSH REL (TWA)	9000 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	5000 ppm
USA NIOSH	NIOSH REL (STEL)	54000 mg/m ³
USA NIOSH	NIOSH REL STEL [ppm]	30000 ppm
USA IDLH	IDLH [ppm]	40000 ppm
USA OSHA	OSHA PEL (TWA) [1]	9000 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	5000 ppm
Nitrogen (7727-37-9)		
USA ACGIH	ACGIH chemical category	Simple asphyxiant See Appendix F: Minimal Oxygen Content
Ethylene glycol (107-21-1)		
USA ACGIH	ACGIH OEL TWA [ppm]	25 ppm (vapor fraction)
USA ACGIH	ACGIH OEL STEL	10 mg/m ³ (inhalable particulate matter, aerosol only)
USA ACGIH	ACGIH OEL STEL [ppm]	50 ppm (vapor fraction)
USA ACGIH	ACGIH chemical category	Not Classifiable as a Human Carcinogen
Octanes		
USA ACGIH	ACGIH OEL TWA [ppm]	300 ppm
Heptane isomers		
USA ACGIH	ACGIH OEL TWA [ppm]	400 ppm
USA ACGIH	ACGIH OEL STEL [ppm]	500 ppm

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Methanol (67-56-1)		
USA ACGIH	ACGIH OEL TWA [ppm]	200 ppm
USA ACGIH	ACGIH OEL STEL [ppm]	250 ppm
USA ACGIH	ACGIH chemical category	Skin - potential significant contribution to overall exposure by the cutaneous route
USA ACGIH	BEI (BLV)	15 mg/l Parameter: Methanol - Medium: urine - Sampling time: end of shift (background, nonspecific)
USA NIOSH	NIOSH REL (TWA)	260 mg/m ³
USA NIOSH	NIOSH REL TWA [ppm]	200 ppm
USA NIOSH	NIOSH REL (STEL)	325 mg/m ³
USA NIOSH	NIOSH REL STEL [ppm]	250 ppm
USA IDLH	IDLH [ppm]	6000 ppm
USA OSHA	OSHA PEL (TWA) [1]	260 mg/m ³
USA OSHA	OSHA PEL (TWA) [2]	200 ppm
Hydrogen sulfide (7783-06-4)		
USA ACGIH	ACGIH OEL TWA [ppm]	1 ppm
USA ACGIH	ACGIH OEL STEL [ppm]	5 ppm
USA NIOSH	NIOSH REL (Ceiling)	15 mg/m ³
USA NIOSH	NIOSH REL C [ppm]	10 ppm
USA IDLH	IDLH [ppm]	100 ppm
USA OSHA	OSHA PEL C [ppm]	20 ppm
USA OSHA	Acceptable Maximum Peak Above The Acceptable Ceiling Concentration For An 8-Hr Shift	50 ppm Peak (10 minutes once, only if no other measurable exposure occurs)

8.2. Exposure Controls

Appropriate Engineering Controls

: Ensure adequate ventilation, especially in confined areas. Use explosion-proof equipment. Proper grounding procedures to avoid static electricity should be followed. Gas detectors should be used when flammable gases or vapors may be released. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure all national/local regulations are observed.

Personal Protective Equipment

: Gloves. Protective clothing. Protective goggles. Insufficient ventilation: wear respiratory protection.



Materials for Protective Clothing

: Chemically resistant materials and fabrics. Wear fire/flamm resistant/retardant clothing.

Hand Protection

: Wear protective gloves.

Eye and Face Protection

: Chemical safety goggles.

Skin and Body Protection

: Wear suitable protective clothing.

Respiratory Protection

: If exposure limits are exceeded or irritation is experienced, approved respiratory protection should be worn. In case of inadequate ventilation, oxygen deficient atmosphere, or where exposure levels are not known wear approved respiratory protection.

Other Information

: When using, do not eat, drink or smoke.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on Basic Physical and Chemical Properties

Physical State	: Liquid
Appearance	: No data available
Odor	: No data available
Odor Threshold	: No data available
pH	: No data available
Evaporation Rate	: No data available

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Melting Point	: No data available
Freezing Point	: No data available
Boiling Point	: 93 – 100 °C (199 – 212 °F) (n-Heptane)
Flash Point	: -4 °C (25 °F) (n-Heptane)
Auto-ignition Temperature	: 204 °C (399 °F) (n-Heptane)
Decomposition Temperature	: No data available
Flammability (solid, gas)	: Not applicable
Vapor Pressure	: No data available
Relative Vapor Density at 20°C	: No data available
Relative Density	: No data available
Density	: 39 – 44 lb/ft³
Solubility	: No data available
Partition Coefficient: N-Octanol/Water	: No data available
Viscosity	: No data available
Lower Flammable Limit	: 1.1 % (n-Heptane)
Upper Flammable Limit	: 7 % (n-Heptane)

9.2. Other Information

No additional information available

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

Reacts violently with strong oxidizers. Increased risk of fire or explosion.

10.2. Chemical Stability

Extremely flammable liquid and vapor. May form flammable or explosive vapor-air mixture.

10.3. Possibility of Hazardous Reactions

Hazardous polymerization will not occur.

10.4. Conditions to Avoid

Direct sunlight, extremely high or low temperatures, heat, hot surfaces, sparks, open flames, incompatible materials, and other ignition sources.

10.5. Incompatible Materials

Strong acids, strong bases, strong oxidizers. Strong reducing agents.

10.6. Hazardous Decomposition Products

Thermal decomposition may produce: Carbon oxides (CO, CO₂). Unidentified organic compounds.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on Toxicological Effects

Acute Toxicity (Oral): Not classified.

Acute Toxicity (Dermal): Not classified.

Acute Toxicity (Inhalation): Not classified.

Methane (74-82-8)	
LD50 Dermal Rat	> 2000 mg/kg (Source: ECHA_API)
LC50 Inhalation Rat	539600 ppm (Exposure time: 2 h Source: ECHA_API)
Propane (74-98-6)	
LC50 Inhalation Rat	> 800000 ppm (Exposure time: 15 min Source: ECHA_API)
Ethane (74-84-0)	
LC50 Inhalation Rat	> 800000 ppm/4h
Isobutane (75-28-5)	
LC50 Inhalation Rat	> 800000 ppm (Exposure time: 15 min Source: ECHA_API)
n-Butane (106-97-8)	
LC50 Inhalation Rat	30957 mg/m³ (Exposure time: 4 h)
LC50 Inhalation Rat	276798.8 ppm
ATE (Vapors)	30.96 mg/l/4h
n-Pentane (109-66-0)	
LD50 Oral Rat	> 2000 mg/kg (Source: EU_RAR)
LD50 Dermal Rabbit	3000 mg/kg (Source: OECD_SIDS)
LC50 Inhalation Rat	364 g/m³ (Exposure time: 4 h Source: NLM_CIP)

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LC50 Inhalation Rat	> 20 mg/l/4h
n-hexane (110-54-3)	
LD50 Oral Rat	25 g/kg (Source: NLM_CIP)
LD50 Dermal Rabbit	3000 mg/kg (Source: NLM_CIP)
LC50 Inhalation Rat	48000 ppm/4h
ATE (Vapors)	169.00 mg/l/4h
Benzene (71-43-2)	
LD50 Oral Rat	810 mg/kg
LD50 Dermal Rabbit	> 8200 mg/kg (Source: JAPAN_GHS)
LC50 Inhalation Rat	44.66 mg/l/4h
n-Heptane (142-82-5)	
LD50 Oral Rat	> 5000 mg/kg
LD50 Dermal Rabbit	3000 mg/kg (Source: IUCLID)
LC50 Inhalation Rat	> 73.5 mg/l/4h
Toluene (108-88-3)	
LD50 Oral Rat	5580 mg/kg (Source: EU-RAR)
LD50 Dermal Rabbit	12000 mg/kg (Source: JAPAN_GHS)
LC50 Inhalation Rat	12.5 mg/l/4h
LC50 Inhalation Rat	25.7 mg/l/4h
ATE (Oral)	2,600.00 mg/kg body weight
Ethylbenzene (100-41-4)	
LD50 Oral Rat	3500 mg/kg (Source: JAPAN_GHS)
LD50 Dermal Rabbit	15400 mg/kg (Source: JAPAN_GHS)
LC50 Inhalation Rat	17.2 mg/l/4h (Exposure time: 4 h)
LC50 Inhalation Rat	27.5 mg/l/4h
ATE (Dust/Mist)	1.50 mg/l/4h
Octane (111-65-9)	
LD50 Oral Rat	> 5000 mg/kg
LD50 Dermal Rabbit	> 2000 mg/kg
LC50 Inhalation Rat	> 24.88 mg/l/4h
Nonane (111-84-2)	
LC50 Inhalation Rat	16.75 mg/l/4h
LC50 Inhalation Rat	3200 ppm/4h
LC50 Inhalation Rat	46.8 mg/l/4h
Carbon dioxide (124-38-9)	
LC50 Inhalation Rat	167857 ppm
Nitrogen (7727-37-9)	
LC50 Inhalation Rat	800000 ppm
Triethylene glycol (112-27-6)	
LD50 Oral Rat	17 g/kg (Source: NLM_CIP)
LD50 Dermal Rabbit	> 20 ml/kg (Source: NLM_CIP)
LC50 Inhalation Rat	> 5.2 mg/l/4h
Ethylene glycol (107-21-1)	
LD50 Oral Rat	4700 mg/kg (Source: NLM_CIP)
LD50 Dermal Rat	10600 mg/kg (Source: JAPAN_GHS)
LC50 Inhalation Rat	> 2.5 mg/l (Exposure time: 6 h)
ATE (Oral)	500.00 mg/kg body weight
Methanol (67-56-1)	
LD50 Oral Rat	6200 mg/kg (Source: JAPAN_GHS)
LD50 Dermal Rabbit	15840 mg/kg (Source: NLM_HSDB)
LC50 Inhalation Rat	22500 ppm (Exposure time: 8 h Source: JAPAN_GHS)
ATE (Oral)	100.00 mg/kg body weight
ATE (Dermal)	300.00 mg/kg body weight

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ATE (Vapors)	3.00 mg/l/4h
Water (7732-18-5)	
LD50 Oral Rat	> 90 ml/kg (Source: FOOD_JOURN)
Hydrogen sulfide (7783-06-4)	
LC50 Inhalation Rat	444 ppm/4h

Skin Corrosion/Irritation: Causes skin irritation.

Serious Eye Damage/Irritation: Not classified.

Respiratory or Skin Sensitization: Not classified.

Germ Cell Mutagenicity: May cause genetic defects (Inhalation, oral).

Carcinogenicity: May cause cancer (Inhalation, oral).

Benzene (71-43-2)	
IARC group	1
National Toxicology Program (NTP) Status	Known Human Carcinogens, Evidence of Carcinogenicity.
OSHA Hazard Communication Carcinogen List	In OSHA Hazard Communication Carcinogen list.
OSHA Specifically Regulated Carcinogen List	In OSHA Specifically Regulated Carcinogen list.
Toluene (108-88-3)	
IARC group	3
Ethylbenzene (100-41-4)	
IARC group	2B
National Toxicology Program (NTP) Status	Evidence of Carcinogenicity.
OSHA Hazard Communication Carcinogen List	In OSHA Hazard Communication Carcinogen list.

Reproductive Toxicity: Suspected of damaging fertility or the unborn child.

Specific Target Organ Toxicity (Single Exposure): May cause drowsiness or dizziness.

Specific Target Organ Toxicity (Repeated Exposure): May cause damage to organs (central nervous system, hearing organs) through prolonged or repeated exposure (Inhalation).

Aspiration Hazard: May be fatal if swallowed and enters airways.

Symptoms/Injuries After Inhalation: High concentrations may cause central nervous system depression such as dizziness, vomiting, numbness, drowsiness, headache, and similar narcotic symptoms.

Symptoms/Injuries After Skin Contact: Redness, pain, swelling, itching, burning, dryness, and dermatitis.

Symptoms/Injuries After Eye Contact: May cause slight irritation to eyes.

Symptoms/Injuries After Ingestion: Aspiration into the lungs can occur during ingestion or vomiting and may cause lung injury.

Chronic Symptoms: May cause cancer (Inhalation, oral). Suspected of damaging fertility or the unborn child. May cause damage to organs (central nervous system, hearing organs) through prolonged or repeated exposure (Inhalation). May cause genetic defects (Inhalation, oral).

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecology - General : Very toxic to aquatic life with long lasting effects.

Isopentane (78-78-4)	
EC50 - Crustacea [1]	2.3 mg/l (Exposure time: 48 h - Species: Daphnia magna)
n-Pentane (109-66-0)	
LC50 Fish 1	9.87 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss)
EC50 - Crustacea [1]	9.74 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 Fish 2	11.59 mg/l (Exposure time: 96 h - Species: Pimephales promelas)
NOEC Chronic Algae	2 mg/l
n-hexane (110-54-3)	
LC50 Fish 1	2.1 – 2.98 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through] Source: EPA)
EC50 - Crustacea [1]	3.88 mg/l
Benzene (71-43-2)	
LC50 Fish 1	10.7 – 14.7 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through] Source: EPA)
EC50 - Crustacea [1]	8.76 – 15.6 mg/l (Exposure time: 48 h - Species: Daphnia magna [Static])
LC50 Fish 2	5.3 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [flow-through] Source:

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	EPA)
EC50 - Crustacea [2]	10 mg/l (Exposure time: 48 h - Species: Daphnia magna)
ErC50 (Algae)	29 mg/l
NOEC Chronic Fish	0.8 mg/l
n-Heptane (142-82-5)	
LC50 Fish 1	375 mg/l (Exposure time: 96 h - Species: Cichlid fish)
EC50 - Crustacea [1]	0.1 mg/l
Toluene (108-88-3)	
LC50 Fish 1	15.22 (15.22 – 19.05) mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
EC50 - Crustacea [1]	5.46 (5.46 – 9.83) mg/l (Exposure time: 48 h - Species: Daphnia magna [Static])
LC50 Fish 2	12.6 mg/l (Exposure time: 96 h - Species: Pimephales promelas [static] Source: EPA)
EC50 - Crustacea [2]	11.5 mg/l (Exposure time: 48 h - Species: Daphnia magna)
NOEC Chronic Fish	1.4 mg/l (Oncorhynchus kisutch)
NOEC Chronic Crustacea	0.74 mg/l (Ceriodaphnia dubia)
Ethylbenzene (100-41-4)	
LC50 Fish 1	11 – 18 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [static] Source: EPA)
EC50 - Crustacea [1]	1.8 – 2.4 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 Fish 2	4.2 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [semi-static] Source: EPA)
NOEC Chronic Crustacea	0.956 mg/l
Octane (111-65-9)	
EC50 - Crustacea [1]	0.38 mg/l (Exposure time: 48 h - Species: water flea)
NOEC Chronic Fish	0.028 mg/l
Nonane (111-84-2)	
EC50 - Crustacea [1]	0.2 mg/l
Triethylene glycol (112-27-6)	
LC50 Fish 1	56200 – 63700 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through] Source: EPA)
EC50 - Crustacea [1]	42426 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 Fish 2	10000 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [static] Source: EPA)
Ethylene glycol (107-21-1)	
LC50 Fish 1	41000 mg/l (Exposure time: 96 h - Species: Oncorhynchus mykiss Source: IUCLID)
EC50 - Crustacea [1]	46300 mg/l (Exposure time: 48 h - Species: Daphnia magna)
LC50 Fish 2	14 – 18 ml/l (Exposure time: 96 h - Species: Oncorhynchus mykiss [static] Source: EPA)
NOEC Chronic Crustacea	4.2 mg/l
Methanol (67-56-1)	
LC50 Fish 1	28200 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through] Source: EPA)
EC50 - Crustacea [1]	1340 mg/l
LC50 Fish 2	> 100 mg/l (Exposure time: 96 h - Species: Pimephales promelas [static] Source: EPA)
Hydrogen sulfide (7783-06-4)	
LC50 Fish 1	0.0448 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [flow-through])
LC50 Fish 2	0.016 mg/l (Exposure time: 96 h - Species: Pimephales promelas [flow-through])
12.2. Persistence and Degradability	
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Persistence and Degradability	May cause long-term adverse effects in the environment.
12.3. Bioaccumulative Potential	
Natural Gas Condensate - Marcellus/Utica	
Bioaccumulative Potential	Not established.
Methane (74-82-8)	

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Partition coefficient n-octanol/water (Log Pow)	1.09
Propane (74-98-6)	
Partition coefficient n-octanol/water (Log Pow)	1.09 at 20 °C (at pH 7)
Ethane (74-84-0)	
Partition coefficient n-octanol/water (Log Pow)	1.09 – 2.8 at 20 °C (at pH 7)
Isobutane (75-28-5)	
BCF Fish 1	1.57 – 1.97
Partition coefficient n-octanol/water (Log Pow)	1.09 – 2.8 at 20 °C (at pH 7)
n-Butane (106-97-8)	
Partition coefficient n-octanol/water (Log Pow)	2.31 at 20 °C (at pH 7)
Isopentane (78-78-4)	
Partition coefficient n-octanol/water (Log Pow)	4 at 25 °C (at pH 6.6)
n-Pentane (109-66-0)	
Partition coefficient n-octanol/water (Log Pow)	3.45 at 25 °C (at pH 7)
n-hexane (110-54-3)	
Partition coefficient n-octanol/water (Log Pow)	4 at 20 °C (at pH 7)
Benzene (71-43-2)	
BCF Fish 1	3.5 – 4.4
Partition coefficient n-octanol/water (Log Pow)	2.13
n-Heptane (142-82-5)	
Partition coefficient n-octanol/water (Log Pow)	4.66
Toluene (108-88-3)	
Partition coefficient n-octanol/water (Log Pow)	2.73 at 20 °C (at pH 7)
Ethylbenzene (100-41-4)	
BCF Fish 1	15
Partition coefficient n-octanol/water (Log Pow)	3.6 at 20 °C (at pH 7.84)
Octane (111-65-9)	
Partition coefficient n-octanol/water (Log Pow)	5.18
Carbon dioxide (124-38-9)	
BCF Fish 1	no bioaccumulation
Partition coefficient n-octanol/water (Log Pow)	0.83
Triethylene glycol (112-27-6)	
Partition coefficient n-octanol/water (Log Pow)	-1.98 (at 25 °C)
Ethylene glycol (107-21-1)	
Partition coefficient n-octanol/water (Log Pow)	-1.36
Methanol (67-56-1)	
BCF Fish 1	10

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Partition coefficient n-octanol/water (Log Pow)	-0.77
Hydrogen sulfide (7783-06-4)	
BCF Fish 1	(no bioaccumulation expected)
Partition coefficient n-octanol/water (Log Pow)	0.45 (at 25 °C)

12.4. Mobility in Soil

No additional information available

12.5. Other Adverse Effects

Other Information : Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste Treatment Methods

Waste Disposal Recommendations: Dispose of contents/container in accordance with local, regional, national, and international regulations.

Additional Information: Handle empty containers with care because residual vapors are flammable.

Ecology - Waste Materials: Avoid release to the environment. This material is hazardous to the aquatic environment. Keep out of sewers and waterways.

SECTION 14: TRANSPORT INFORMATION

The shipping description(s) stated herein were prepared in accordance with certain assumptions at the time the SDS was authored, and can vary based on a number of variables that may or may not have been known at the time the SDS was issued.

14.1. In Accordance with DOT

Proper Shipping Name : HYDROCARBONS, LIQUID, N.O.S.

Hazard Class : 3

Identification Number : UN3295

Label Codes : 3

Packing Group : I

Marine Pollutant : Marine pollutant

ERG Number : 128



14.2. In Accordance with IMDG

Proper Shipping Name : HYDROCARBONS, LIQUID, N.O.S.

Hazard Class : 3

Identification Number : UN3295

Packing Group : I

Label Codes : 3

EmS-No. (Fire) : F-E

EmS-No. (Spillage) : S-D

Marine Pollutant : Marine pollutant



14.3. In Accordance with IATA

Proper Shipping Name : HYDROCARBONS, LIQUID, N.O.S.

Packing Group : I

Identification Number : UN3295

Hazard Class : 3

Label Codes : 3

ERG Code (IATA) : 3H



SECTION 15: REGULATORY INFORMATION

15.1. US Federal Regulations

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SARA Section 311/312 Hazard Classes	Health hazard - Specific target organ toxicity (single or repeated exposure) Health hazard - Carcinogenicity Health hazard - Reproductive toxicity Health hazard - Skin corrosion or Irritation Physical hazard - Flammable (gases, aerosols, liquids, or solids) Health hazard - Germ cell mutagenicity

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	Health hazard - Aspiration hazard
Methane (74-82-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Propane (74-98-6)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Ethane (74-84-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Isobutane (75-28-5)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
n-Butane (106-97-8)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Isopentane (78-78-4)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
n-Pentane (109-66-0)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
n-hexane (110-54-3)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	5000 lb
SARA Section 313 - Emission Reporting	1 %
Benzene (71-43-2)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	10 lb
SARA Section 313 - Emission Reporting	0.1 %
n-Heptane (142-82-5)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Toluene (108-88-3)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	1000 lb
SARA Section 313 - Emission Reporting	1 %
Ethylbenzene (100-41-4)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	1000 lb
SARA Section 313 - Emission Reporting	0.1 %
Octane (111-65-9)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Nonane (111-84-2)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
EPA TSCA Regulatory Flag	T - T - indicates a substance that is the subject of a final TSCA section 4 test rule.
Carbon dioxide (124-38-9)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Nitrogen (7727-37-9)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Triethylene glycol (112-27-6)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Ethylene glycol (107-21-1)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	5000 lb

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SARA Section 313 - Emission Reporting	1 %
Methanol (67-56-1)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	5000 lb
SARA Section 313 - Emission Reporting	1 %
Water (7732-18-5)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active	
Hydrogen sulfide (7783-06-4)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory - Status: Active Listed on the United States SARA Section 302 Subject to reporting requirements of United States SARA Section 313	
CERCLA RQ	100 lb
SARA Section 302 Threshold Planning Quantity (TPQ)	500 lb
SARA Section 313 - Emission Reporting	1 %

15.2. US State Regulations

Methane (74-82-8)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
Propane (74-98-6)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
Ethane (74-84-0)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
Isobutane (75-28-5)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
n-Butane (106-97-8)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
Isopentane (78-78-4)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
n-Pentane (109-66-0)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
n-hexane (110-54-3)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List	
Benzene (71-43-2)	
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Special Hazardous Substances U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List	

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n-Heptane (142-82-5)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Toluene (108-88-3)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
Ethylbenzene (100-41-4)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
Octane (111-65-9)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Nonane (111-84-2)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Carbon dioxide (124-38-9)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Nitrogen (7727-37-9)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List
Triethylene glycol (112-27-6)
U.S. - Pennsylvania - RTK (Right to Know) List
Ethylene glycol (107-21-1)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
Methanol (67-56-1)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List
Hydrogen sulfide (7783-06-4)
U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List

California Proposition 65

 **WARNING:** This product can expose you to Benzene, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Chemical Name (CAS No.)	Carcinogenicity	Developmental Toxicity	Female Reproductive Toxicity	Male Reproductive Toxicity
n-hexane (110-54-3)				X
Benzene (71-43-2)	X	X		X

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Toluene (108-88-3)		X		
Ethylbenzene (100-41-4)	X			
Ethylene glycol (107-21-1)		X		
Methanol (67-56-1)		X		

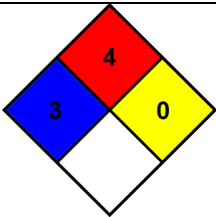
SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Date of Preparation or Latest Revision	: 05/17/2024
Other Information	: This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200

GHS Full Text Phrases:

H220	Extremely flammable gas
H224	Extremely flammable liquid and vapor
H225	Highly flammable liquid and vapor
H226	Flammable liquid and vapor
H280	Contains gas under pressure; may explode if heated
H281	Contains refrigerated gas; may cause cryogenic burns or injury
H301	Toxic if swallowed
H302	Harmful if swallowed
H304	May be fatal if swallowed and enters airways
H311	Toxic in contact with skin
H315	Causes skin irritation
H319	Causes serious eye irritation
H331	Toxic if inhaled
H332	Harmful if inhaled
H335	May cause respiratory irritation
H336	May cause drowsiness or dizziness
H340	May cause genetic defects
H350	May cause cancer
H351	Suspected of causing cancer
H361	Suspected of damaging fertility or the unborn child
H370	Causes damage to organs
H372	Causes damage to organs through prolonged or repeated exposure
H373	May cause damage to organs through prolonged or repeated exposure
H400	Very toxic to aquatic life
H401	Toxic to aquatic life
H410	Very toxic to aquatic life with long lasting effects
H411	Toxic to aquatic life with long lasting effects
H412	Harmful to aquatic life with long lasting effects

NFPA Health Hazard	: 3 - Materials that, under emergency conditions, can cause serious or permanent injury.
NFPA Fire Hazard	: 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.
NFPA Reactivity Hazard	: 0 - Material that in themselves are normally stable, even under fire conditions.



Glossary of Data Source Abbreviations

ATSDR: Agency for Toxic Substances and Disease Registry (U.S. Department of Health and Human Services)	FOOD_JOURN: Food Research Journal (1956)
AU_WES: Australia WES	IARC: The International Agency for Research on Cancer
CHEMVIEW: ChemView (U.S. Environmental Protection Agency)	IDLH: National Institute for Occupational Health and Safety Immediately Dangerous to Life or Health Value Profiles
EC_RAR: European Commission Renewal Assessment Report	IUCLID: International Uniform Chemical Information Database
EC_SCOEL: European Commission Scientific Committee on Occupational	JAPAN_GHS: Japan GHS Basis for Classification Data

Natural Gas Condensate - Marcellus/Utica

Safety Data Sheet

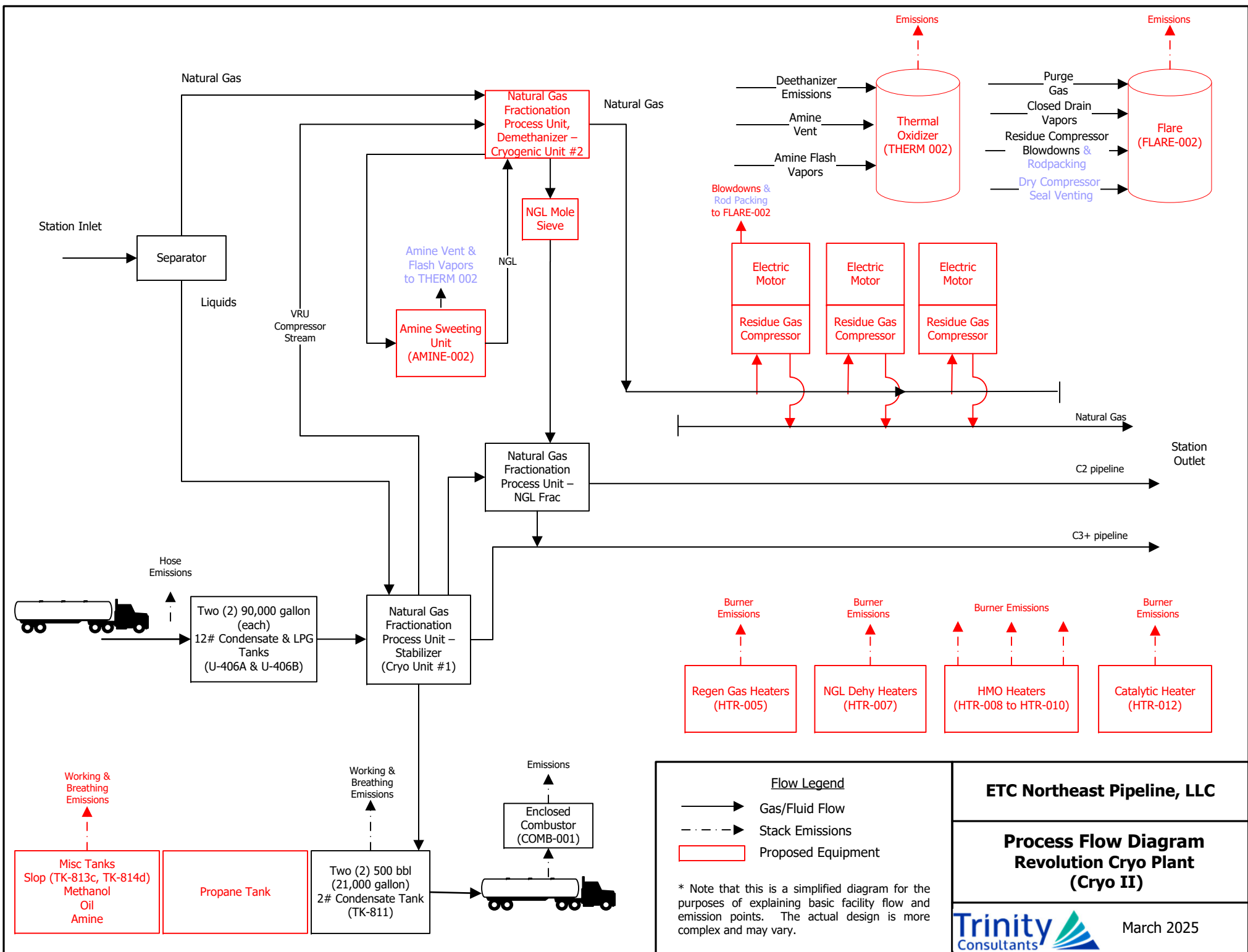
According to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Exposure Limits	JP_J-CHECK: Japan J-Check
ECETOC: European Centre for Ecotoxicology and Toxicology of Chemicals Reports	KR_NIER: South Korea National Institute of Environmental Research Evaluations
ECHA_API: European Chemicals Agency API	NICNAS: Australia National Industrial Chemicals Notification and Assessment Scheme
ECHA_RAC: ECHA Committee for Risk Assessment	NIOSH: National Institute for Occupational Health and Safety (U.S. Department of Health and Human Services)
EFSA: European Food Safety Authority	NLM_CIP: National Library of Medicine ChemID plus database
EPA: U.S. Environmental Protection Agency	NLM_HSDB: National Library of Medicine Hazardous Substance Data Bank
EPA_AEGL: Acute Exposure Guideline Levels (U.S. Environmental Protection Agency)	NLM_PUBMED: National Library of Medicine PubMed database
EPA_FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act Reregistration Eligibility Decision (U.S. Environmental Protection Agency)	NTP: National Toxicology Program
EPA_HPVC: High Production Volume Chemicals (U.S. Environmental Protection Agency)	NZ_CCID: New Zealand Chemical Classification and Information Database
EPA_TRED: Risk Assessment for Tolerance Reassessment Eligibility Decision (U.S. Environmental Protection Agency)	OECD_EHSP: Environment, Health, and Safety Publication (Organisation for Economic Co-operation and Development)
EU_CLH: European Union Harmonised Classification and Labelling Proposal	OECD_SIDS: Screening Information Data Sets (Organisation for Economic Co-operation and Development)
EU_RAR: European Union Risk Assessment Report	WHO: World Health Organization

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

SDS US (GHS HazCom)

ATTACHMENT 2: REVISED PROCESS FLOW DIAGRAM



ATTACHMENT 3: CONTROL DEVICE FLOW TABLE

Stream	Emission Unit	Control Type	Notes
Amine Regenerator Overheads	AMINE-002	THERM-002	Sent to TO, does not make sense to send to VRU as this would reintroduce CO2 back into the inlet stream
Amine Flash Gas	AMINE-002	VRU / FLARE-002	Calculations assume 5% VRU downtime
Purge Gas	Venting / Blowdowns	FLARE-002	Stream can contain oxygen, therefore not possible to route back to the inlet of the plant for processing
Residue Gas Compressor Blowdowns	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime
Closed Drain Vapors	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime
Residue Compressor Rod Packing	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime
Centrifugal Dry Compressor Seal	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime

ATTACHMENT 4: REVISED PTE CALCULATIONS

[Company Name:](#) **ETC Northeast Pipeline, LLC**
[Facility Name:](#) **Revolution Cryo II Plant**
[Project Description:](#) **Facility PTE**

Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																					
	VOC		NO _x		CO		CH ₃ OH		HCHO		Benzene		Total HAPs		PM ₁₀		PM _{2.5}		SO _x		GHG (CO ₂ e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Amine Vent (AMINE-002)	0.15	0.64	---	---	---	---	0.04	0.19	---	---	0.00	0.00	0.04	0.19	---	---	---	---	---	---	5,444	23,844
Flare (FLARE-002)	---	---	64.06	181.52	292.04	827.51	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.55	1.57	37,788	666
Thermal Oxidizer (THERM-002)	---	---	0.18	0.79	0.15	0.66	---	---	---	---	---	---	---	---	0.01	0.06	0.01	0.06	0.00	0.00	221	970
Fugitive Emissions - Component Leaks	1.32	5.79	---	---	---	---	---	---	---	---	---	---	0.03	0.13	---	---	---	---	---	---	37	164
Emissions - Blowdowns	---	3.37	---	---	---	---	---	---	---	---	---	---	---	0.11	---	---	---	---	---	---	---	322
Regen Gas Heater (HTR-006)	0.17	0.76	0.11	0.48	0.37	1.61	---	---	0.00	0.00	0.00	0.00	0.02	0.07	0.12	0.52	0.12	0.52	0.01	0.02	1,059	4,636
NGL Regen Heater (HTR-007)	0.13	0.56	0.08	0.35	0.27	1.18	---	---	0.00	0.00	0.00	0.00	0.01	0.05	0.09	0.38	0.09	0.38	0.00	0.02	778	3,406
HMO Heater (HTR-008)	0.67	2.91	0.42	1.82	1.41	6.18	---	---	0.00	0.01	0.00	0.00	0.07	0.29	0.46	2.00	0.46	2.00	0.02	0.09	4,057	17,772
HMO Heater (HTR-009)	0.67	2.91	0.42	1.82	1.41	6.18	---	---	0.00	0.01	0.00	0.00	0.07	0.29	0.46	2.00	0.46	2.00	0.02	0.09	4,057	17,772
HMO Heater (HTR-010)	0.67	2.91	0.42	1.82	1.41	6.18	---	---	0.00	0.01	0.00	0.00	0.07	0.29	0.46	2.00	0.46	2.00	0.02	0.09	4,057	17,772
Catalytic Heaters	0.00	0.02	0.08	0.37	0.07	0.31	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	31
Gas Venting	---	0.19	---	---	---	---	---	---	---	---	---	---	---	0.00	---	---	---	---	---	---	---	70
Total (Cryo II)	3.77	20.08	65.76	188.96	297.13	849.80	0.04	0.19	0.01	0.04	0.00	0.00	0.30	1.42	1.59	6.98	1.59	6.98	0.63	1.89	57,506	87,424
TOTAL (Cryo I)	3.19	29.09	68.30	30.60	287.44	35.30	0.01	0.03	0.01	0.05	0.00	0.01	0.37	2.51	1.85	8.09	1.85	8.09	0.62	0.38	94,484	80,998
TOTAL	6.96	49.16	134.06	219.56	584.57	885.11	0.05	0.21	0.02	0.08	0.00	0.02	0.67	3.93	3.44	15.06	3.44	15.06	1.24	2.27	151,990	168,422

- Notes:**
1. PM₁₀ and PM_{2.5} emissions are filterable + condensable.
 2. Emissions from loading and unloading of condensate are included in Storage Tanks totals.
 3. Short-term emissions rates from limited duration activities (ex. pigging, compressor blowdowns) are not included in the 'lb/hr' values. All potential emissions are, however, included in the 'tpy' values.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 1. Amine Sweetening Unit Vent Emissions Calculations

Amine Sweetening Unit Information:

Source ID:	AMINE-002
Max. Hours of Operation (hr/yr):	8,760
Control Device for Still Vent:	Thermal Oxidizer
Still Vent - Control Efficiency:	99%
Max Still Vent Flow Rate to Control (lb/hr):	5,517
Control Device for Flash Gas:	VRU / Flare
Flash Gas - Control Efficiency:	99.90%
Max Flash Flow Rate to Control (lb/hr):	115

Amine Unit Vent Emissions Data (each unit):

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	30.97	135.65	0.15	0.64	See Note 1 below
HAPs	4.40	19.26	0.04	0.19	See Note 1 below
CH ₃ OH	4.24	18.55	0.04	0.19	See Note 1 below
Benzene	0.08	0.37	0.00	0.00	See Note 1 below
NO _x	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
SO _x	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
CO	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
PM ₁₀	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
PM _{2.5}	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
GHG (CO ₂ e)	5,507.15	24,121.33	5,443.86	23,844.11	See Note 2 below

Notes:

- Controlled emissions are calculated by assuming specified control efficiencies for the combustion devices.
- GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265). CO₂ emissions represent the uncombusted CO₂ emissions.
- Emissions of NO_x, SO_x, CO, PM, and GHG pollutants are the products of combustion of the vent streams in the combustion devices. Based on Promax simulation of facility and process streams.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 1. Amine Sweetening Unit Vent Emissions Calculations

Promax Emissions Data - Amine Vent (pre-control, each unit):

Pollutant	Scaled Uncontrolled Still Vent	Uncontrolled Still Vent	Scaled Uncontrolled Flash Gas	Uncontrolled Flash Gas
	lbs/hr	lbs/hr	lbs/hr	lbs/hr
CO2	5,442.6165	4,947.8332	0.9887	0.8988
Methane	0.7605	0.6913	1.5091	1.3719
Ethane	60.4593	54.9630	94.1036	85.5487
Propane	7.3953	6.7230	15.3140	13.9218
Isobutane	0.2111	0.1919	0.6883	0.6257
n-Butane	0.8220	0.7473	1.8003	1.6367
Isopentane	0.0299	0.0272	0.1193	0.1084
n-Pentane	0.0451	0.0410	0.1490	0.1355
n-Hexane	0.0051	0.0046	0.0265	0.0241
Cyclohexane	0.0000	0.0000	0.0000	0.0000
Heptanes	0.0001	0.0001	0.0006	0.0005
2,2,4-Trimethylpentane	0.0000	0.0000	0.0000	0.0000
Benzene	0.0828	0.0752	0.0018	0.0016
Toluene	0.0283	0.0258	0.0007	0.0006
Ethylbenzene	0.0037	0.0034	0.0001	0.0001
Xylenes	0.0108	0.0098	0.0002	0.0002
Methanol	4.2356	3.8505	0.0006	0.0006
C8 + Heavier Hydrocarbons	0.0000	0.0000	0.0001	0.0001
Total Emissions	5,516.7059	5,015.1872	114.7029	104.2754
Total Hydrocarbon Emissions	74.0895	67.3541	113.7142	103.3765
Total VOC Emissions	12.8697	11.6997	18.1015	16.4559
Total HAP Emissions	4.3663	3.9694	0.0299	0.0272

Notes:

1. Based on ProMax simulation of facility and process stream scaled up as an engineering factor: 1.1
2. Methanol (CH₃OH) emissions are based on a site specific sample. ProMax is used to estimate methanol emissions.
3. Amine unit flash tank gas will either be used as fuel in the HMO heaters or be routed to the thermal oxidizer during VRU downtime. These calculations assume that all flash tank gas is sent to flare.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 2. Control Device Emissions Calculations - Maintenance Startup, Shutdown (MSS) Facility Flare

Control Device Information:

Source ID:	FLARE-002
Control Efficiency:	98%
Calculated Loading to flare (MMBtu/hr):	942
Calculated Loading to flare (MMBtu/yr):	5,334,292
Pilot Gas Rate (scf/hr):	507
Pilot Gas Rate (MMBtu/hr):	0.51
Pilot Gas Rate (MMBtu/yr):	4,468
Hours of Operation (hr/yr):	8,760
Pilot Hours of Operation (hr/yr):	8,760

Emissions from Combustion of Gas in Flare:

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.068	lb/MMBtu	64.06	181.52	AP-42, Table 13.5-1 (April-2015)
CO	0.310	lb/MMBtu	292.04	827.51	AP-42, Table 13.5-2 (April-2015)
SO _x	0.001	lb/MMBtu	0.55	1.57	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.000	lb/MMBtu	0.00	0.00	Nonsmoking Flare
PM _{2.5}	0.000	lb/MMBtu	0.00	0.00	Nonsmoking Flare
GHG (CO ₂ e)	See Table Below		37,787.98	666.16	40 CFR 98, Tables C-1 & C-2

1. Emissions factors converted by lb/MMscf to lb/MMBtu based on the HHV cited in AP-42 (1020 btu/scf).

Greenhouse Gas (GHG) Emissions - Pilot Gas:

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO ₂	53.06	kg/MMBtu	60.87	266.59	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			60.93	266.87	

Notes:

- PM₁₀ and PM_{2.5} are total values (filterable + condensable).
- GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
- Emissions of NO_x, SO_x, CO, PM, and GHG pollutants are the result of combustion of the streams in the flare.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 2. Control Device Emissions Calculations - Maintenance Startup, Shutdown (MSS) Facility Flare

Greenhouse Gas (GHG) Emissions - Controlled Streams

	Purge Gas	Residue Gas Compressor Blowdowns	Amine Unit Flash Gas	Closed Drain Vapors	Residue Compressor Rod Packing	Centrifugal Dry Compressor Seal
Composition	mol%	mol%	mol%	mol%	mol%	mol%
CO2	0.0149	0.0149	0.6127	0.0441	0.0149	0.0442
Methane	99.4401	99.4401	2.5656	77.1005	99.4401	77.2557
Ethane	0.0835	0.0835	85.3556	14.9833	0.0835	15.0134
Propane	0.0000	0.0000	9.4719	5.0333	0.0000	5.0434
Isobutane	0.0000	0.0000	0.3230	0.5073	0.0000	0.5083
n-Butane	0.0000	0.0000	0.8448	1.1607	0.0000	1.1630
Isopentane	0.0000	0.0000	0.0451	0.1972	0.0000	0.1976
n-Pentane	0.0000	0.0000	0.0563	0.2528	0.0000	0.2533
n-Hexane	0.0000	0.0000	0.0084	0.1410	0.0000	0.1413
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Heptanes	0.0000	0.0000	0.0002	0.0103	0.0000	0.0103
2,2,4-Trimethylpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0006	0.0011	0.0000	0.0011
Toluene	0.0000	0.0000	0.0002	0.0009	0.0000	0.0009
Ethylbenzene	0.0000	0.0000	0.0000	0.0003	0.0000	0.0003
Xylenes	0.0000	0.0000	0.0001	0.0006	0.0000	0.0006
C8 + Heavier Hydrocarbons	0.0000	0.0000	0.0000	0.1587	0.0000	0.1934
Flow Rate (scfh)	651	330,000	1,265	5.19	207	16
Flow (scf/yr)	5,702,760	198,000	554,057	2,273	90,666	7,096
Control Efficiency (%)	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%
VRU Control Efficiency (%):	--	95.00%	95.00%	95.00%	95.00%	95.00%
Annual Hours of Operation	8,760	12	8,760	8,760	8,760	8,760
Density of CO ₂ (kg/ft ³ at 60F & 14.7 psia)	0.0526	0.0526	0.0526	0.0526	0.0526	0.0526
Ea,CO ₂ (combusted) - scf/hr	635	322,129	2,565	7	202	21
Ea,CO ₂ (combusted) - scf/yr	5,566,744	193,278	1,123,517	2,955	88,504	9,255
Mass, CO ₂ (combusted) - lb/hr	74	37,355	297	1	23	2
Mass, CO ₂ (combusted) - tpy	323	11	65	0	5	1

1. Purge gas (required for operation of flare) is based on ProMax run at design conditions and facility operations.
2. Closed drain vapors based on ProMax run at design conditions and facility operations.
3. Amine unit flash tank gas is sent to a VRU. For VRU downtime, flash gas will be sent to the HMO heaters and the facility flare for back up. These calculations conservatively assume that all flash tank gas is sent to flare.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 2. Control Device Emissions Calculations - Maintenance Startup, Shutdown (MSS) Facility Flare

Heating Value - Controlled Streams

	Purge Gas	Residue Gas Compressor Blowdowns	Amine Unit Flash Gas	Closed Drain Vapors	Residue Compressor Rod Packing	Centrifugal Dry Compressor Seal	Total Vented to Flare	Lower Heating Value ²	Higher Heating Value ³	Weight Percent
Composition	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MJ/kg	btu/lb	Wt %
Water	0.00E+00	0.00E+00	1.12E+02	5.08E-04	0.00E+00	1.59E-03	1.12E+02	0.000	0	0.003
Carbon Dioxide	1.14E-02	5.77E+00	2.35E+02	2.73E-04	3.62E-03	8.30E-04	2.41E+02	0.000	0	0.006
Nitrogen	2.25E-01	1.14E+02	0.00E+00	1.41E-03	7.15E-02	4.28E-03	1.14E+02	0.000	0	0.003
Methane	2.77E+01	1.41E+04	3.58E+02	1.74E-01	8.82E+00	5.29E-01	1.45E+04	50.009	23,649	0.348
Ethane	4.36E-02	2.21E+01	2.23E+04	6.33E-02	1.39E-02	1.93E-01	2.24E+04	47.794	22,601	0.538
Propane	2.18E-07	1.11E-04	3.64E+03	3.12E-02	6.94E-08	9.49E-02	3.64E+03	46.357	21,922	0.087
Isobutane	1.14E-12	5.76E-10	1.63E+02	4.14E-03	3.61E-13	1.26E-02	1.63E+02	45.613	21,570	0.004
n-Butane	6.07E-13	3.08E-10	4.28E+02	9.48E-03	1.93E-13	2.88E-02	4.28E+02	45.752	21,636	0.010
Isopentane	0.00E+00	0.00E+00	2.83E+01	2.00E-03	0.00E+00	6.08E-03	2.83E+01	45.241	21,394	0.001
n-Pentane	0.00E+00	0.00E+00	3.54E+01	2.56E-03	0.00E+00	7.80E-03	3.54E+01	45.357	21,449	0.001
n-Hexane	0.00E+00	0.00E+00	6.29E+00	1.71E-03	0.00E+00	5.19E-03	6.30E+00	44.752	21,163	0.000
Cyclohexane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	43.450	20,547	0.000
Heptanes	0.00E+00	0.00E+00	1.39E-01	1.45E-04	0.00E+00	4.40E-04	1.40E-01	44.566	21,075	0.000
2,2,4-Trimethylpentane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	44.310	20,954	0.000
Benzene	0.00E+00	0.00E+00	5.75E-01	1.20E-05	0.00E+00	3.66E-05	5.75E-01	40.170	18,996	0.000
Toluene	0.00E+00	0.00E+00	1.69E-01	1.16E-05	0.00E+00	3.54E-05	1.69E-01	40.589	19,194	0.000
Ethylbenzene	0.00E+00	0.00E+00	2.65E-02	4.46E-06	0.00E+00	1.36E-05	2.65E-02	40.938	19,359	0.000
Xylenes	0.00E+00	0.00E+00	4.98E-02	8.93E-06	0.00E+00	2.72E-05	4.98E-02	40.961	19,370	0.000
C8 + Heavies	0.00E+00	0.00E+00	2.20E-02	1.60E-04	0.00E+00	4.86E-04	2.27E-02	44.264	20,932	0.000
Total	28	14,204	27,352	0	9	1	41,595			1.000

Each Stream

Gas Flow Rate (lb/hr)	28.02	14,204.45	27,352.36	0.29	8.91	0.88
Higher Heating Value (Btu/lb)	23,448	23,214	22,214	22,909	23,448	22,909
Max Loading to Flare (mmBtu/hr):	0.66	329.75	607.59	0.01	0.21	0.02
Hours to Flare	8,760	12	8,760	8,760	8,760	8,760
Max Loading to Flare (mmBtu/yr):	5,756	3,957	5,322,513	58	1,830	178

Combined

Gas Flow Rate (lb/hr)	41,595
Higher Heating Value (Btu/lb)	22,636
Max Loading to Flare (mmBtu/hr):	942
Max Loading to Flare (mmBtu/yr):	5,334,292

1. Published values from https://en.wikipedia.org/wiki/Heat_of_combustion

2. 1 MJ/kg = 429.9 Btu/lb. Converts LHV to HHV with a factor of 1.1.

3. Natural gas density at standard conditions: 0.05 lb/cf at 32F and 14.7 psia

4. Natural gas density: 379 scf/lb-mol

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC
Revolution Cryo II Plant
Facility PTE

TABLE 3. Control Device Emissions Calculations - Thermal Oxidizer Controlling Amine Vent and Flash Gas

Control Device Information:

Source ID:	THERM-002
Control Efficiency:	99%
Calculated Loading to oxidizer (MMBtu/hr):	1.56
Calculated Loading to oxidizer (MMBtu/yr):	13,697
Pilot Gas Rate (scf/hr):	266
Pilot Gas Rate (MMBtu/hr):	0.27
Pilot Gas Rate (MMBtu/yr):	2,344
Hours of Operation (hr/yr):	8,760
Pilot Hours of Operation (hr/yr):	8,760

Emissions from Combustion of Gas in Oxidizer (each unit):

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.098	lb/MMBtu	0.18	0.79	AP-42, Table 1.4-1 (Jul-1998)
CO	0.082	lb/MMBtu	0.15	0.66	AP-42, Table 1.4-1 (Jul-1998)
SO _x	0.001	lb/MMBtu	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.007	lb/MMBtu	0.01	0.06	AP-42, Table 1.4-2 (Jul-1998)
PM _{2.5}	0.007	lb/MMBtu	0.01	0.06	AP-42, Table 1.4-2 (Jul-1998)
GHG (CO ₂ e)	See Table Below		221.43	969.87	40 CFR 98, Tables C-1 & C-2

1. Emissions factors converted by lb/MMscf to lb/MMBtu based on the HHV cited in AP-42 (1020 btu/scf).

Greenhouse Gas (GHG) Pilot Gas and HAP Emissions (each unit):

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
HAP:					
HAP	0.002	lb/MMBtu	0.00	0.01	AP-42, Table 1.4-1 (Jul-1998)
GHGs:					
CO ₂	53.06	kg/MMBtu	31.93	139.86	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			31.96	140.00	

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Emissions of NO_x, SO_x, CO, PM, and GHG pollutants are the result of combustion of the streams in the oxidizer.

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 3. Control Device Emissions Calculations - Thermal Oxidizer Controlling Amine Vent and Flash Gas

Greenhouse Gas (GHG) Emissions - Controlled Vent Streams

Composition	Amine Vent Stream
	mol%
CO ₂	90.8748
Methane	0.0348
Ethane	1.4775
Propane	0.1232
Isobutane	0.0027
n-Butane	0.0104
Isopentane	0.0003
n-Pentane	0.0005
n-Hexane	0.0000
Cyclohexane	0.0000
Heptanes	0.0000
2,2,4-Trimethylpentane	0.0000
Benzene	0.0008
Toluene	0.0002
Ethylbenzene	0.0000
Xylenes	0.0001
C8 + Heavier Hydrocarbons	0.0000
Methanol	0.0971
Flow Rate (scfh)	46,906
Control Efficiency (%)	99%
VRU Control Efficiency (%)	--
Hours of Operation	8,760
Density of CO ₂ (kg/ft ³ at 60F & 14.7 psia)	0.0526
Ea,CO ₂ (combusted) - scf/hr	1,634
Mass, CO ₂ (combusted) - lb/hr	189
Mass, CO ₂ (combusted) - tpy	830

1. Based on ProMax run at design conditions and facility operations. Uncombusted CO₂ shown on the Amine Vent calculations.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 3. Control Device Emissions Calculations - Thermal Oxidizer Controlling Amine Vent and Flash Gas

Heating Value - Controlled Vent Streams

	Amine Vent Stream	Total Vented to Oxidizer	Lower Heating Value ²	Higher Heating Value ³	Weight Percent	Higher Heating Value
Composition	lb/hr	lb/hr	MJ/kg	btu/lb	Wt %	Btu/lb
CO2	5.44E+03	5.44E+03	0.000	0	0.987	0.00
Methane	7.60E-01	7.60E-01	50.009	23,649	0.000	3.26
Ethane	6.05E+01	6.05E+01	47.794	22,601	0.011	247.69
Propane	7.40E+00	7.40E+00	46.357	21,922	0.001	29.39
Isobutane	2.11E-01	2.11E-01	45.613	21,570	0.000	0.83
n-Butane	8.22E-01	8.22E-01	45.752	21,636	0.000	3.22
Isopentane	2.99E-02	2.99E-02	45.241	21,394	0.000	0.12
n-Pentane	4.51E-02	4.51E-02	45.357	21,449	0.000	0.18
n-Hexane	5.08E-03	5.08E-03	44.752	21,163	0.000	0.02
Cyclohexane	0.00E+00	0.00E+00	43.450	20,547	0.000	0.00
Heptanes	6.13E-05	6.13E-05	44.566	21,075	0.000	0.00
2,2,4-Trimethylpentane	0.00E+00	0.00E+00	44.310	20,954	0.000	0.00
Benzene	8.28E-02	8.28E-02	40.170	18,996	0.000	0.29
Toluene	2.83E-02	2.83E-02	40.589	19,194	0.000	0.10
Ethylbenzene	3.72E-03	3.72E-03	40.938	19,359	0.000	0.01
Xylenes	1.08E-02	1.08E-02	40.961	19,370	0.000	0.04
Methanol	4.24E+00	4.24E+00	19.900	9,888	0.001	7.59
C8 + Heavies	7.75E-06	7.75E-06	44.264	20,932	0.000	0.00
Total	5,517	5,517			1.000	293

Gas Flow Rate (lb/hr) 5,517

Higher Heating Value (Btu/lb) 283

Max Loading to Oxidizer (mmBtu/hr): 1.56

Hours to Oxidizer 8,760

Max Loading to Oxidizer (mmBtu/yr): 13,697

1. Published values from https://en.wikipedia.org/wiki/Heat_of_combustion

2. 1 MJ/kg = 429.9 Btu/lb. Converts LHV to HHV with a factor of 1.1.

3. Natural gas density at standard conditions: 0.05 lb/cf at 32F and 14.7 psia

http://www.engineeringtoolbox.com/gas-density-d_158.html

4. Natural gas density: 379 scf/lb-mol

Company Name:
Facility Name:
Project Description:

ETC Northeast Pipeline, LLC
Revolution Cryo II Plant
Facility PTE

TABLE 4. Fugitive Emissions from Component Leaks

Total Fugitive Emissions:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	1.32	5.79	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.03	0.13	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
CO ₂	0.00	0.02	40 CFR 98, Table W-1A & Site-Specific Gas Analysis
CH ₄	1.34	5.86	40 CFR 98, Table W-1A & Site-Specific Gas Analysis
GHG (CO ₂ e)	37	164	GWP: CO ₂ 1, CH ₄ 28

Fugitive Emissions from Component Leaks:

Component - Service	Stream	Estimated Component Count	Gas Leak Emission Factor (lb/hr/component)	Maximum Gas Leak Rate (lb/hr)	LDAR Control Efficiency %	Actual Gas Leak Rate (tpy)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions (tpy)	Potential CH ₄ Emissions (tpy)
Valves - Gas/Vapor	Inlet Gas	2,775	9.92E-03	27.53	97%	3.62	0.64	0.02	0.00	2.17
Valves - Gas/Vapor	Residue Gas	1,500	9.92E-03	14.88	97%	1.96	0.00	0.00	0.00	1.94
Valves - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Valves - Gas/Vapor	Refrigerant	660	9.92E-03	6.55	97%	0.86	0.86	0.00	0.00	0.00
Valves - Light Oil	Condensate	3,300	5.51E-03	18.19	97%	2.39	1.07	0.04	0.00	0.01
Valves - Water/Oil	---	---	---	---	---	---	---	---	---	---
Pump Seals - Gas	Inlet Gas	0	5.29E-03	0.00	0%	0.00	0.00	0.00	0.00	0.00
Pump Seals - Gas	Residue Gas	0	5.29E-03	0.00	0%	0.00	0.00	0.00	0.00	0.00
Pump Seals - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Pump Seals - Gas	Refrigerant	5	5.29E-03	0.03	75%	0.03	0.03	0.00	0.00	0.00
Pump Seals - Light Oil	Condensate	60	2.87E-02	1.72	75%	1.88	0.84	0.03	0.00	0.01
Pump Seals - Water/Oil	---	---	---	---	---	---	---	---	---	---
Other - Gas/Vapor	Inlet Gas	113	1.94E-02	2.19	97%	0.29	0.05	0.00	0.00	0.17
Other - Gas/Vapor	Residue Gas	60	1.94E-02	1.16	97%	0.15	0.00	0.00	0.00	0.15
Other - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Other - Gas/Vapor	Refrigerant	38	1.94E-02	0.74	75%	0.81	0.81	0.00	0.00	0.00
Other - Light Oil	Condensate	105	1.65E-02	1.74	75%	1.90	0.85	0.03	0.00	0.01
Other - Water/Oil	---	---	---	---	---	---	---	---	---	---
Connectors - Gas	Inlet Gas	1,224	4.41E-04	0.54	97%	0.07	0.01	0.00	0.00	0.04
Connectors - Gas	Residue Gas	1,224	4.41E-04	0.59	97%	0.08	0.00	0.00	0.00	0.08
Connectors - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Connectors - Light Oil	Refrigerant	---	4.63E-04	---	97%	---	---	---	---	---
Connectors - Light Oil	Condensate	---	4.63E-04	---	97%	---	---	---	---	---
Connectors - Water/Oil	---	---	---	---	---	---	---	---	---	---
Flanges - Gas/Vapor	Inlet Gas	9,881	8.60E-04	8.50	97%	1.12	0.20	0.01	0.00	0.67
Flanges - Gas/Vapor	Residue Gas	5,250	8.60E-04	4.51	97%	0.59	0.00	0.00	0.00	0.59
Flanges - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Flanges - Gas/Vapor	Refrigerant	2,190	8.60E-04	1.88	97%	0.25	0.25	0.00	0.00	0.00
Flanges - Light Oil	Condensate	12,750	2.43E-04	3.09	97%	0.41	0.18	0.01	0.00	0.00
Flanges - Water/Oil	---	---	---	---	---	---	---	---	---	---
Open-Ended Lines - Gas	Inlet Gas	0	4.41E-03	0.00	97%	0.00	0.00	0.00	0.00	0.00
Open-Ended Lines - Gas	Residue Gas	0	4.41E-03	0.00	97%	0.00	0.00	0.00	0.00	0.00
Open-Ended Lines - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Open-Ended Lines - Light Oil	Refrigerant	---	3.09E-03	---	97%	---	---	---	---	---
Open-Ended Lines - Light Oil	Condensate	---	3.09E-03	---	97%	---	---	---	---	---
Open-Ended Lines - Water/Oil	---	---	---	---	---	---	---	---	---	---
Total (Cryo 2)						16.40	5.79	0.13	0.02	5.82

1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
2. The component count is a preliminary estimate based on the proposed design of the facility.
3. 1995 Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017) Table 2-4.
4. Control Efficiencies from "TCEQ - Control Efficiencies for TCEQ Leak Detection and Repair Programs" (rev. 07/22). Accounts for NSPS LDAR and FLIR/AVO programs.
5. Assumes a 20% compliance margin on existing fugitive components from Cryo I.
6. VOC, HAP, CH₄, and CO₂ emissions are based on fractions of these pollutants as follows:

	Wt % VOC	Wt % HAP	Wt % CO ₂	Wt % CH ₄
Inlet Gas	17.72	0.60	0.09	59.89
Residue Gas	0.00	0.00	0.04	99.00
Refrigerant	100.00	0.00	0.00	0.00
Condensate	44.72	1.52	0.18	0.29

[Company Name:](#)
[Facility Name:](#)
[Project Description:](#)

ETC Northeast Pipeline, LLC
Revolution Cryo II Plant
Facility PTE

TABLE 4. Fugitive Emissions from Component Leaks

Rod Packing Emissions:

Type of Compressors	Number of Compressors	Number of Throws per Compressor	Leak Factor (scf/hr/throw)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions (tpy)	Potential CH ₄ Emissions (tpy)
Residue Compressor (Electric)	3	6	11.5	1,813	0.00	0.00	0.00	0.04
Centrifugal Dry Compressor Seal	1	1	16.2	142	0.00	0.00	0.00	0.00
Total					0.00	0.00	0.00	0.04

1. Emission factors from http://www.epa.gov/gasstar/documents/ll_rodpack.pdf

2. VRU control: 95%

3. MSS Flare Control: 98%

4. Centrifugal compressor vendor data for seal rate (scfm): 0.27

5. VOC, HAP, CH₄, and CO₂ emissions are based on fractions of these pollutants as follows:
- | | | | | | |
|-------------|----------|----------|-----------|----------|-------|
| | Wt % VOC | Wt % HAP | Wt. % CO2 | Wt % CH4 | MW |
| Inlet Gas | 17.72 | 0.60 | 0.09 | 59.89 | 20.69 |
| Residue Gas | 0.00 | 0.00 | 0.04 | 99.00 | 16.11 |

Company Name:

ETC Northeast Pipeline, LLC

Facility Name:

Revolution Cryo II Plant

Project Description:

Facility PTE

TABLE 5. Emissions from Blowdowns

Total Fugitive and Vented Emissions:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	---	3.37	Estimated Gas Volumes & Site-Specific Gas Analysis
HAPs	---	0.11	
CO ₂	---	0.02	
CH ₄	---	11.48	
GHG (CO ₂ e)	---	322	GWP: CO ₂ 1, CH ₄ 28

1. Hours/year (estimated at 10 min per event): 13.33333333 hr/yr

Vented Blowdown Emissions:

Blowdown Emissions Sources	Number of Units	Number of Annual Events	Gas Volume per Event (scf)	Controlled by Flare? (Y / N)	Total Potential Emitted Volume NG (scf/yr)	Total Actual Emitted Volume NG (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions ¹ (tpy)	Potential CH ₄ Emissions ¹ (tpy)
Residue Compressor (Electric)	3	72	55,000	Y	3,960,000	3,960	0.000	0.00	0.00	0.08
Moisture Analyzer	--	--	--	N	131,400	131,400	0.64	0.02	0.00	2.15
VRU Compressor Blowdowns	2	8	15,000	Y	120,000	120	0.00	0.00	0.00	0.00
Facility Maintenance	--	--	--	N	450,000	450,000	2.18	0.07	0.01	7.36
Miscellaneous Blowdowns	--	--	--	Y	115,740,000	115,740	0.56	0.02	0.00	1.89
Total							3.37	0.11	0.02	11.48

1. VOC, HAP, CH₄, and CO₂ emissions are based on fractions of these pollutants as follows:
- | | | | | | |
|---------------------|----------|----------|-----------|----------|-------|
| | Wt % VOC | Wt % HAP | Wt. % CO2 | Wt % CH4 | MW |
| Residue Gas | 0.00 | 0.00 | 0.04 | 99.00 | 16.11 |
| Stabilizer Overhead | 66.01 | 0.22 | 0.01 | 8.67 | 37.34 |
| Inlet Gas | 17.72 | 0.60 | 0.09 | 59.89 | 20.69 |
2. The gas volumes are estimated based on facility design and standard engineering calculations.
3. Controlled emissions include 5% VRU downtime.
4. Where applicable, emissions are calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.0.37%
5. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 25) + N₂O (GWP = 298).
6. Density as follows:
- | | | | | |
|-------------------|----------|---|------|--|
| CO ₂ : | 0.0526 | kg/ft ³ for CO ₂ at 60 °F and 14.7 psia | | |
| CH ₄ : | 0.0192 | kg/ft ³ for CH ₄ at 60 °F and 14.7 psia | | |
| VOC: | 3.31E-10 | lb VOC/ft ³ of total gas (residue gas) | HAP: | 0.00E+00 lb HAP/ft ³ of total gas (residue gas) |
| VOC: | 9.67E-03 | lb VOC/ft ³ of total gas (inlet gas) | HAP: | 3.26E-04 lb HAP/ft ³ of total gas (inlet gas) |
- Value for 'lb VOC/scf' of total gas = Sum of (vol%/100 * MW (lb/lb-mol) / 379 scf/lb-mol) for each VOC constituent

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 6. Inlet Gas Sieve Regen Heater

Heater Information:

Source ID:	HTR-006
Number of Units:	1

Heater Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006
Heat Input (MMBtu/hr)	9.04
Potential Fuel Consumption (MMBtu/yr):	79,190
Max. Fuel Consumption (MMscf/hr):	0.0090
Max. Fuel Consumption (MMscf/yr):	78.7
Max. Annual Hours of Operation (hr/yr):	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.012	lb/MMBtu	0.11	0.48	Manufacturer Guarantee
VOC	0.019	lb/MMBtu	0.17	0.76	Manufacturer Guarantee
CO	0.0407	lb/MMBtu	0.37	1.61	Manufacturer Guarantee
SO _x	0.6	lb/MMScf	0.01	0.02	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.013	lb/MMBtu	0.12	0.52	Manufacturer Guarantee
PM _{2.5}	0.013	lb/MMBtu	0.12	0.52	Manufacturer Guarantee
Formaldehyde (HCHO)	0.08	lb/MMScf	0.0007	0.0030	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		1,059	4,636	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.02	0.07	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name:
Facility Name:
Project Description:

ETC Northeast Pipeline, LLC
Revolution Cryo II Plant
Facility PTE

TABLE 6. Inlet Gas Sieve Regen Heater

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO ₂	53.06	kg/MMBtu	1057.47	4,632	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.02	0.09	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			1,059	4,636	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.02	0.07	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.017	0.074	

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 7. NGL Dehy Regenerator Gas Heater Emissions Calculations

Heater Information:

Source ID:	HTR-007
Number of Units:	1

Heater Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006
Heat Input (MMBtu/hr)	6.64
Potential Fuel Consumption (MMBtu/yr):	58,166
Max. Fuel Consumption (MMscf/hr):	0.0066
Max. Fuel Consumption (MMscf/yr):	57.8
Max. Annual Hours of Operation (hr/yr):	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.012	lb/MMBtu	0.08	0.35	Manufacturer Guarantee
VOC	0.019	lb/MMBtu	0.13	0.56	Manufacturer Guarantee
CO	0.041	lb/MMBtu	0.27	1.18	Manufacturer Guarantee
SO _x	0.6	lb/MMScf	0.00	0.02	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.0132	lb/MMBtu	0.09	0.38	Manufacturer Guarantee
PM _{2.5}	0.0132	lb/MMBtu	0.09	0.38	Manufacturer Guarantee
Formaldehyde (HCHO)	0.08	lb/MMScf	0.0005	0.0022	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		778	3,406	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.01	0.05	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 7. NGL Dehy Regenerator Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO ₂	53.06	kg/MMBtu	776.73	3,402	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.01	0.06	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			778	3,406	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.01	0.05	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.012	0.055	

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 8. HMO Heaters Emissions Calculations

Heater Information:

Source ID:	HTR-008 to HTR-010
Number of Units:	3

Heater Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006	1,006
Heat Input (MMBtu/hr)	34.65	103.95
Potential Fuel Consumption (MMBtu/yr):	303,534	910,602
Max. Fuel Consumption (MMscf/hr):	0.0344	0.1033
Max. Fuel Consumption (MMscf/yr):	301.8	905.3
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO _x	0.012	lb/MMBtu	0.42	1.82	1.25	5.46	Manufacturer Guarantee
VOC	0.0192	lb/MMBtu	0.67	2.91	2.00	8.74	Manufacturer Guarantee
CO	0.0407	lb/MMBtu	1.41	6.18	4.23	18.53	Manufacturer Guarantee
SO _x	0.6	lb/MMScf	0.02	0.09	0.06	0.27	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.013	lb/MMBtu	0.46	2.00	1.37	6.01	Manufacturer Guarantee
PM _{2.5}	0.013	lb/MMBtu	0.46	2.00	1.37	6.01	Manufacturer Guarantee
Formaldehyde (HCHO)	0.08	lb/MMScf	0.0026	0.0113	0.0078	0.0339	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		4,057	17,772	12,172	53,315	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.07	0.29	0.20	0.86	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 8. HMO Heaters Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO ₂	53.06	kg/MMBtu	4053.26	17,753	12159.79	53,260	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.08	0.33	0.23	1.00	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.01	0.03	0.02	0.10	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			4,057	17,772	12,172	53,315	
Organic HAPs:							
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.06	0.27	0.19	0.81	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:							
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.065	0.285	0.195	0.856	

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 9. Catalytic Heaters Emissions Calculations

Heater Information:

Source ID:	Catalytic Heaters
Number of Units:	15

Heater Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006	1,006
Heat Input (MMBtu/hr)	0.06	0.85
Potential Fuel Consumption (MMBtu/yr):	526	7,411
Max. Fuel Consumption (MMscf/hr):	0.0001	0.0008
Max. Fuel Consumption (MMscf/yr):	0.5	7.4
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO _x	100	lb/MMScf	0.01	0.03	0.08	0.37	AP-42, Table 1.4-2 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	0.00	0.02	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMBtu	5.04	22.08	0.07	0.31	AP-42, Table 1.4-2 (Jul-1998)
SO _x	0.6	lb/MMScf	0.0000	0.00	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	7.6	lb/MMScf	0.0005	0.00	0.01	0.03	AP-42, Table 1.4-2 (Jul-1998)
PM _{2.5}	7.6	lb/MMScf	0.0005	0.00	0.01	0.03	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.075	lb/MMScf	0.0000	0.0000	0.0001	0.0003	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		7	31	99	434	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	0.00	0.01	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

- PM₁₀ and PM_{2.5} are total values (filterable + condensable).
- GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
- Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
 Facility Name: Revolution Cryo II Plant
 Project Description: Facility PTE

TABLE 9. Catalytic Heaters Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO ₂	53.06	kg/MMBtu	7.02	31	98.98	434	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.00	0.00	0.00	0.01	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.00	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			7	31	99	434	
Organic HAPs:							
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	0.00	0.01	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:							
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.000	0.000	0.002	0.007	

Company Name:ETC Northeast Pipeline, LLC

Facility Name:Revolution Cryo II Plant

Project Description:Facility PTE

TABLE 10. Gas Venting Emissions Calculations

Total Vented Emissions:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	---	0.19	Estimated Gas Volumes & Site-Specific Gas Analysis
HAPs	---	0.00	
CO ₂	---	0.00	
CH ₄	---	2.51	
GHG (CO ₂ e)	---	70	GWP: CO ₂ 1, CH ₄ 28

Vented Emissions:

Blowdown Emissions Sources	Number of Annual Events	Gas Volume per Event (scf)	Total Mass per Event (lbs)	Controlled by Flare? (Y / N)	Total Volume NG (scf/yr)	Total Mass (lbs/yr)	Actual Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions ⁷ (tpy)	Potential CH ₄ Emissions ⁷ (tpy)
Flare Purge Gas	---	---	---	Y	5,702,760	---	114,055	0.00	0.00	0.00	2.40
Closed Drain Vapors	---	---	---	Y	45,464	---	45	0.00	0.00	0.00	0.00
GC Venting (AE-101)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.04
GC Venting (AE-102)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.05
GC Venting (AE-103)	---	---	---	N	928	---	928	0.02	0.00	0.00	0.00
GC Venting (AE-104)	---	---	---	N	464	---	464	0.01	0.00	0.00	0.00
GC Venting (AE-105)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.00
GC Venting (AE-106)	---	---	---	N	464	---	464	0.03	0.00	0.00	0.00
GC Venting (AE-107)	---	---	---	N	928	---	928	0.06	0.00	0.00	0.00
GC Venting (AE-108)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.00
GC Venting (AE-109)	---	---	---	N	---	---	---	---	---	---	---
GC Venting (AE-110)	---	---	---	N	928	---	928	0.06	0.00	0.00	0.00
GC Venting (AE-111)	---	---	---	N	928	---	928	0.01	0.00	0.00	0.02
Total								0.19	0.00	0.00	2.51

1. Uncombusted CH₄ and CO₂ emissions are based on fractions of these pollutants as follows:

	Vol % CO2	Vol % CH4
Residue Gas	0.015	99.440
Inlet Gas	0.044	77.256
C3+ Liquids	0.000	0.000
C2 Liquids	0.010	1.220

2. The gas volumes are estimated based on facility design and standard engineering calculations (utilizing Equation W-14B from 40 CR 98 Subpart W where appropriate).

3. Total purge gas to flare: 651 scfh

4. Where applicable, emissions are calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.

5. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).

6. Density as follows: C3+ and C2 liquid lines conservatively assume gas (vapor) composition is identical to liquid composition
Value for 'lb VOC/scf' of total gas = Sum of (vol%/100 * MW (lb/lb-mol) / 379 scf/lb-mol) for each VOC constituent

CO ₂ :	0.0526	kg/ft ³ for CO ₂ at 60 °F and 14.7 psia		
CH ₄ :	0.0192	kg/ft ³ for CH ₄ at 60 °F and 14.7 psia		
VOC:	3.31E-10	lb VOC/ft ³ of total gas (residue gas)	HAP:	0.00E+00 lb HAP/ft ³ of total gas (residue gas)
VOC:	9.67E-03	lb VOC/ft ³ of total gas (inlet gas)	HAP:	3.26E-04 lb HAP/ft ³ of total gas (inlet gas)
VOC:	1.43E-01	lb VOC/ft ³ of total gas (C3+ liquid vapors)	HAP:	1.21E-02 lb HAP/ft ³ of total gas (C3+ liquid vapors)

7. Mol sieve instrumentation vent data: 3 Number of Units 5 SCF/hr, per unit

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 11. Site-Specific Gas Analysis

Location:

HHV (Btu/scf):

Cryo Plant Residue/Fuel Gas

1,006

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.4615	0.8024	28.0100
METHANE	99.4401	99.0011	16.0400
CO2	0.0149	0.0406	44.0100
ETHANE	0.0835	0.1558	30.0700
PROPANE	0.0000	0.0000	44.1000
I-BUTANE	0.0000	0.0000	58.1200
N-BUTANE	0.0000	0.0000	58.1200
I-PENTANE	0.00E+00	0.0000	72.1500
N-PENTANE	0.00E+00	0.0000	72.1500
I-HEXANES	0.00E+00	0.0000	86.1800
N-HEXANE	0.00E+00	0.0000	86.1800
BENZENE	0.00E+00	0.0000	78.1100
CYCLOHEXANE	0.00E+00	0.0000	84.1600
HEPTANES	0.00E+00	0.0000	100.2100
TOLUENE	0.00E+00	0.0000	92.1400
2,2,4 Trimethylpentane	0.00E+00	0.0000	114.2300
N-OCTANE	0.00E+00	0.0000	114.2400
*E-BENZENE	0.00E+00	0.0000	106.1700
*m,o,&p-XYLENE	0.00E+00	0.0000	106.1600
I-NONANES	0.00E+00	0.0000	128.2000
N-NONANE	0.00E+00	0.0000	128.2000
I-DECANES	0.00E+00	0.0000	142.2900
N-DECANE	0.00E+00	0.0000	142.2900
I-UNDECANES +	0.00E+00	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.524	99.157	
VOC (Total)	0.000	0.000	
HAP (Total)	0.000	0.000	

C8+

0.000

0.000

Molecular Weight

16.111

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 12. Site-Specific Gas Analysis

Location:

HHV (Btu/scf):

Cryo Plant Inlet Gas

1,253

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.3579	0.4845	28.01
METHANE	77.2557	59.8889	16.04
CO2	0.0442	0.0940	44.01
ETHANE	15.0134	21.8145	30.07
PROPANE	5.0434	10.7464	44.1
I-BUTANE	0.5083	1.4275	58.12
N-BUTANE	1.1630	3.2665	58.12
I-PENTANE	0.1976	0.6888	72.15
N-PENTANE	0.2533	0.8830	72.15
I-HEXANES			86.18
N-HEXANE	0.1413	0.5882	86.18
BENZENE	0.0011	0.0042	78.11
CYCLOHEXANE	0.0000	0.0000	84.16
HEPTANES	0.0103	0.0498	100.21
TOLUENE	0.0009	0.0040	92.14
2,2,4 Trimethylpentane	0.0000	0.0000	114.23
N-OCTANE	0.0037	0.0204	114.24
*E-BENZENE	0.0003	0.0015	106.17
*m,o,&p-XYLENE			106.16
I-NONANES	0.0005	0.0031	128.2
N-NONANE			128.2
I-DECANES	0.0046	0.0316	142.29
N-DECANE			142.29
I-UNDECANES +			142.29
Totals	99.999	99.997	

	Vol %	Wt%	
TOC (Total)	99.597	99.418	
VOC (Total)	7.328	17.715	
HAP (Total)	0.144	0.598	

C8+

0.009

0.055

Molecular Weight

20.692

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

CG Composition

Location: AE-101 Sample
HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.3414	0.4653	28.0100
METHANE	77.5766	60.5506	16.0400
CO2	0.0459	0.0983	44.0100
ETHANE	14.9612	21.8919	30.0700
PROPANE	5.0127	10.7571	44.1000
I-BUTANE	0.4739	1.3402	58.1200
N-BUTANE	1.0990	3.1082	58.1200
I-PENTANE	0.1665	0.5847	72.1500
N-PENTANE	0.2100	0.7373	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.1112	0.4664	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.998	100.000	

TOC (Total)	99.611	99.436	
VOC (Total)	7.073	16.994	
HAP (Total)	0.111	0.466	

Molecular Weight 20.550

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-102 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.4403	0.7508	28.0100
METHANE	97.2527	94.9659	16.0400
CO2	0.0429	0.1150	44.0100
ETHANE	2.2374	4.0957	30.0700
PROPANE	0.0247	0.0664	44.1000
I-BUTANE	0.0006	0.0021	58.1200
N-BUTANE	0.0006	0.0021	58.1200
I-PENTANE	0.0002	0.0008	72.1500
N-PENTANE	0.0002	0.0008	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0001	0.0003	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.516	99.134	
VOC (Total)	0.026	0.073	
HAP (Total)	0.000	0.000	

Molecular Weight

16.426

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-103 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0002	0.0002	28.0100
METHANE	0.0394	0.0178	16.0400
CO2	0.1481	0.1840	44.0100
ETHANE	71.6983	60.8644	30.0700
PROPANE	20.3954	25.3917	44.1000
I-BUTANE	1.8431	3.0241	58.1200
N-BUTANE	4.0853	6.7031	58.1200
I-PENTANE	0.6149	1.2525	72.1500
N-PENTANE	0.7741	1.5767	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.4050	0.9854	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.004	100.000	

TOC (Total)	99.856	99.816	
VOC (Total)	28.118	38.934	
HAP (Total)	0.405	0.985	

Molecular Weight

35.422

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-104 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0588	0.0255	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	66.0788	53.8272	30.0700
PROPANE	22.4394	26.8075	44.1000
I-BUTANE	2.2738	3.5800	58.1200
N-BUTANE	6.2559	9.8496	58.1200
I-PENTANE	0.6758	1.3209	72.1500
N-PENTANE	1.5307	2.9918	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.6843	1.5976	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.997	100.000	

TOC (Total)	99.997	100.000	
VOC (Total)	33.860	46.147	
HAP (Total)	0.684	1.598	

Molecular Weight

36.914

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-105 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0834	0.0445	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	99.9112	99.9472	30.0700
PROPANE	0.0053	0.0078	44.1000
I-BUTANE	0.0000	0.0000	58.1200
N-BUTANE	0.0000	0.0000	58.1200
I-PENTANE	0.0002	0.0005	72.1500
N-PENTANE	0.0000	0.0000	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0000	0.0000	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	100.000	100.000	
VOC (Total)	0.006	0.008	
HAP (Total)	0.000	0.000	

Molecular Weight

30.059

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-106 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0000	0.0000	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	0.0511	0.0310	30.0700
PROPANE	69.2467	61.4573	44.1000
I-BUTANE	7.0174	8.2080	58.1200
N-BUTANE	16.1359	18.8736	58.1200
I-PENTANE	2.6105	3.7904	72.1500
N-PENTANE	3.2673	4.7442	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	1.6695	2.8955	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.998	100.000	

TOC (Total)	99.998	100.000	
VOC (Total)	99.947	99.969	
HAP (Total)	1.670	2.896	

Molecular Weight

49.689

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

CG Composition

Location: AE-107 Sample
HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0000	0.0000	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	0.1443	0.0871	30.0700
PROPANE	68.1228	60.3134	44.1000
I-BUTANE	7.3167	8.5373	58.1200
N-BUTANE	16.8752	19.6905	58.1200
I-PENTANE	2.6573	3.8491	72.1500
N-PENTANE	3.2840	4.7568	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	1.5986	2.7659	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.999	100.000	

TOC (Total)	99.999	100.000	
VOC (Total)	99.855	99.913	
HAP (Total)	1.599	2.766	

Molecular Weight 49.810

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-108 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0752	0.0401	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	99.9141	99.9513	30.0700
PROPANE	0.0059	0.0086	44.1000
I-BUTANE	0.0000	0.0000	58.1200
N-BUTANE	0.0000	0.0000	58.1200
I-PENTANE	0.0000	0.0000	72.1500
N-PENTANE	0.0000	0.0000	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0000	0.0000	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.995	100.000	

TOC (Total)	99.995	100.000	
VOC (Total)	0.006	0.009	
HAP (Total)	0.000	0.000	

Molecular Weight

30.059

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

CG Composition

Location: AE-109 Sample
HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	1.0000	0.2052	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	1.0000	0.3847	30.0700
PROPANE	1.0000	0.5641	44.1000
I-BUTANE	1.0000	0.7435	58.1200
N-BUTANE	5.9900	4.4534	58.1200
I-PENTANE	10.9800	10.1340	72.1500
N-PENTANE	20.0500	18.5052	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	58.9700	65.0100	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.990	100.000	

TOC (Total)	99.990	100.000	
VOC (Total)	97.990	99.410	
HAP (Total)	58.970	65.010	

Molecular Weight 78.173

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-110 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.6000	0.1842	16.0400
CO2	0.0200	0.0168	44.0100
ETHANE	14.2000	8.1706	30.0700
PROPANE	28.5800	24.1176	44.1000
I-BUTANE	10.4000	11.5662	58.1200
N-BUTANE	32.5000	36.1444	58.1200
I-PENTANE	4.6000	6.3508	72.1500
N-PENTANE	5.8000	8.0075	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	3.3000	5.4419	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.980	99.983	
VOC (Total)	85.180	91.628	
HAP (Total)	3.300	5.442	

Molecular Weight

52.260

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

CG Composition

Location: AE-111 Sample
HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.1000	0.0993	28.0100
METHANE	35.5000	20.1870	16.0400
CO2	0.1000	0.1560	44.0100
ETHANE	45.1000	48.0784	30.0700
PROPANE	16.5000	25.7966	44.1000
I-BUTANE	1.0000	2.0605	58.1200
N-BUTANE	1.5000	3.0907	58.1200
I-PENTANE	0.0800	0.2046	72.1500
N-PENTANE	0.0800	0.2046	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0400	0.1222	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.800	99.745	
VOC (Total)	19.200	31.479	
HAP (Total)	0.040	0.122	

Molecular Weight 28.207



PLAN APPROVAL APPLICATION

ETC Northeast Pipeline, LLC



ENERGY TRANSFER

Revolution Cryogenic Plant

Prepared By:

TRINITY CONSULTANTS

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March 2025

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1. PROJECT DESCRIPTION

With this application, ETC is proposing to install and operate the Cryo II unit, which includes the addition of the following equipment:

- ▶ One (1) 68.3 million standard cubic feet per day (MMSCFD) amine sweetening unit with a vent controlled by a 4.11 million British thermal units per hour (MMBtu/hr) thermal oxidizer;
- ▶ One (1) 334 MMBtu/hr emergency flare;
- ▶ One (1) 9.04 MMBtu/hr inlet gas sieve regen heater;
- ▶ One (1) 6.64 MMBtu/hr regen heater;
- ▶ Three (3) Heat Medium Oil (HMO) heaters rated at 34.65 MMBtu/hr;
- ▶ Fifteen (15) catalytic heaters rated at 0.06 MMBtu/hr; and
- ▶ Associated piping and components.

Operations are described below and depicted on a process flow diagram which is included in Attachment D.

2.1 Processing - Stabilization

The existing stabilizer unit processes natural gas condensates received from the inlet pipeline system as well as condensates received via truck. The existing system consists of two distillation columns that work in series, the first column takes the raw condensate feed stream and produces a stable condensate that will be used as a feedstock for the second column. The overhead vapors off this first column are compressed and sent to the cryogenic system inlet. The second column takes stable condensate from the first column and will be further distilled to produce a product that is a marketable stabilized condensate with an Reid Vapor Pressure (RVP) of approximately 7 pounds per square inch (psi). The overhead vapor from this column will be a propane-plus (C3+) product that will be condensed and pumped into the C3+ pipeline along with the main plant C3+ product.

2.2 Processing – Cryogenic Separation and Fractionation

The proposed new cryogenic process unit will mirror the existing cryogenic process unit. The gas stream entering the cryogenic process unit will include natural gas from the pipeline and flash vapors from the stabilizer unit. The gas will be chilled to cryogenic temperatures first by mechanical refrigeration and then by expansion (where the pressure drop causes further reduction in temperature). Chilling the gas stream causes natural gas liquids (NGL) to condense from the gas stream. The chilled gas/liquid stream will be sent to the deMethanizer tower.

The gas/liquid stream will then be feed to the deMethanizer tower where the NGL will be collected in the bottoms (and used as feed to the deEthanizer unit) and the vapor off the top of the deMethanizer tower is a marketable natural gas stream (residue gas) and will be routed to the compressors for delivery to the residue gas pipeline.

The deEthanizer will produce a marketable ethane product and a separate C3+ product. The bottoms stream from the deMethanizer will enter the deEthanizer tower where it will be separated such that the lighter ethane product leaves the top of the tower, gets condensed, and pumped into the ethane (C2) product pipeline. The heavier components (a propane+ mixture) will collect at the bottom of the deEthanizer tower and get pumped into the C3+ product pipeline.

The deMethanizer and deEthanizer are closed systems that do not have a direct vent to the atmosphere. The fractionation equipment does contain process safety vents (PSV) and maintenance depressurization vents which are routed to the flare. The HMO Heaters provide heat to the fractionation process.

Natural gas throughput rating of the existing cryogenic process unit is 200 MMSCFD (station design inlet), whereas the new Cryo II unit is designed with a rating of 300 MMSCFD. The existing cryogenic process unit is not impacted by this project.

The natural gas liquid (NGL) throughput capacity for each Cryo unit (new and existing) will be as follows:

- ▶ 8,420,112 gallons/year Condensate (7 psi RVP)
- ▶ 18,000 Barrels per Day (BPD) C2 (275 million gallons (MMgal)/year)
- ▶ 13,500 BPD C3+ (207 MMGal/year)

The new Cryogenic unit will not increase NGL production to the existing storage tanks.

2.3 Amine Units

The proposed project includes the construction of a new amine unit as part of the Cryo II unit. The proposed amine unit will operate identically to the existing amine unit. The unit will remove carbon dioxide (CO₂) from the NGLs by putting the NGLs in contact with a lean amine solution in a contactor tower. The lean amine solution absorbs the CO₂ from the NGLs through absorption. The rich amine solution leaving the contactor tower is sent to a flash tank followed by the amine regeneration system, where, through heat and distillation, the CO₂ is removed from the rich amine solution to regenerate the lean amine solution to be sent back to the contactor tower.

The amine unit operates very similarly to a TEG Dehydration unit, as both utilize a contactor tower, flash tank, and regenerator vent (with associated heater, sometimes called a reboiler). The amine unit uses an amine solution to remove CO₂ from the NGLs, similar to how a dehydration unit removes water from the wet gas stream. The amine is regenerated via distillation, the same way lean glycol is generated in a dehydration unit.

The amine regeneration system includes an amine stripper tower and a small reboiler, which uses heat from the HMO heaters. Note that a small amount of hydrocarbons will also be absorbed in the amine solution at the contactor tower and these hydrocarbons will be liberated from the rich amine by the amine regeneration system. The flash vapors will be controlled by a VRU compressor and the facility flare (FLARE-002) while the VRU is down. The regenerator vent will be controlled by the thermal oxidizer (THERM-002).

2.4 Compressors

As part of the proposed project, ETC will be installing three electric-driven reciprocating stabilizer overhead compressors. Associated maintenance blowdowns will be sent to the new facility flare (FLARE-002). Maintenance blowdowns emissions are included in Attachment E. The proposed compressors will compress stabilizer overheads gas. Additionally, there are two VRU compressors for the closed drain vapors.

2.5 Heaters

Natural gas-fired indirect heaters provide heat to the processing units as well as the condensate stabilizers. The heaters will have the ability to operate continuously (i.e. 8,760 hours per year). The heaters proposed as part of this project are as follows:

- ▶ NGL Dehy Regen Heater – 6.64 MMbtu/hr (HTR-007 new)

This heater is part of the NGL dehydration process where the NGL stream is stripped of water. The heater is used in the regeneration of the mole sieve beds where it heats the NGL stream as it circulates through the bed being regenerated. The heated NGL vaporizes the water in the bed where it is then condensed downstream and removed from the stream. Once the bed is free of water, the regeneration system goes into stand-by or switches to the next bed as needed to be regenerated.

- ▶ Regen Gas Heater – 9.04 MMbtu/hr (HTR-006 new)

This heater is part of the inlet gas mole sieve dehydration process where the gas stream will be stripped of water. The heater will be used in the regeneration of the mole sieve beds where it will heat the gas stream as it circulates through the bed being regenerated. The heated gas vaporizes the water in the bed which is then condensed downstream and removed from the stream. Once the bed is free of water, the regeneration system goes into stand-by or switches to the next bed as needed to be regenerated. The mole sieve dehydration process itself will be a closed system that does not vent to the atmosphere.

- ▶ HMO Heaters – 34.65 MMbtu/hr each (HTR-008 to 010 new)

These heaters are part of the hot oil system which will provide heat to various users throughout the two process units. The users include the inlet gas preheater, condensate stabilization system, deMethanizer trim reboiler, deEthanizer reboiler, and Amine regeneration reboiler.

2.6 Condensate Tanks and Loading Operations

Storage of stabilized condensate occurs in two (2) existing storage tanks (TK-811A and TK-811B). There are no new condensate tanks being proposed as part of this project. Load-out from the condensate storage tanks is controlled by an existing enclosed combustor (COMB-001).

2.7 Gas Venting

The facility includes sources of emissions related to general operations and activities at the site. These include gas venting due to normal compressor operation and planned blowdown events. No new pigging launchers or receivers are proposed as an element of this project.

The attached emissions calculations (Attachment E) detail miscellaneous vented sources at the facility, along with their corresponding calculations methodology, emissions estimates, and assumptions.

2.8 Process Fugitives

Emissions at the facility will also result from fugitive component leaks (flanges, connectors, valves, etc.). Please see the attached emissions calculations (Attachment E), which detail component types included, along with emissions estimates and calculations methodology and assumptions.

2.9 Facility Flare and Thermal Oxidizer

New combustion control devices for the proposed project include the following:

- ▶ FLARE-002 – This new flare will control various streams at the facility related to the new cryogenic process/stabilizer including new stabilizer overhead compressor blowdowns, purge gas, closed drain vapors, pressure relief valves, and miscellaneous blowdowns. The flare will control emissions from sources that utilize the VRU's in case the VRU is down.
- ▶ THERM-002 – This new thermal oxidizer will control emissions from the new amine regenerator vent

The attached emissions calculations (Attachment E) include emissions estimates and calculations methodology/assumptions related to these control devices.

2. APPLICABLE REGULATION REVIEW

Authorization to begin construction and initially operate a new or modified source must be obtained by complying with key regulatory elements:

- ▶ Title V of the 1990 Clean Air Act Amendments (as incorporated and implemented in the Pennsylvania SIP under 25 PA Code §127.501 – 127.543);
- ▶ Prevention of Significant Deterioration (PSD) and/or Nonattainment New Source Review programs (NNSR) [both parts of the federal New Source Review (NSR) as incorporated by reference under 25 PA Code §127.81 – 127.83 for PSD and implemented in the Pennsylvania SIP under 25 PA Code §127.201 – 127.218 for NNSR];
- ▶ Applicable federal and state emission standards and control programs contained in the Pennsylvania State Implementation Plan (SIP).

This section of the report addresses the conformity of the proposed project to these permitting programs and requirements. The proposed project is subject to 25 PA Code §127.11 – 127.51 plan approval requirements, as reflected by the application for a plan approval contained herein.

2.1 Title V Permitting Requirements

The Title V Operating Permit program applies to Title V facilities as defined in 25 PA Code §121.1, which are stationary sources with the potential to emit over 100 tons per year (tpy), or a lower major source threshold defined by nonattainment status, of any individual criteria air pollutant, 10 tpy of any individual Hazardous Air Pollutant (HAP), or 25 tpy of combined HAPs. Since Pennsylvania is in the Ozone Transport Region (OTR), a major source threshold of 50 tpy is applicable for volatile organic compounds (VOC) unless there is a more restrictive level based on nonattainment status of the area. After completion of the proposed project, emissions from the Revolution Cryo Plant will remain below the major source thresholds with respect to Title V. Additionally, the Revolution Cryo Plant will remain an area source with respect to HAP.

2.2 Major New Source Review

The federal NSR program applies to major stationary sources. The NSR permitting regulations are comprised of two programs: 1) PSD for projects located in areas where specified pollutant levels have met National Ambient Air Quality Standards (NAAQS); and 2) NNSR for projects located in areas where pollutant levels have not attained the corresponding NAAQS. The NSR program regulates the installation of new major sources or major modifications to existing major sources. The Revolution Cryogenic Plant is located in Washington county, which is classified as attainment with all NAAQS except for ozone.¹ The state of Pennsylvania is in the OTR and therefore the entire state is classified as moderate nonattainment for ozone.

The Revolution Cryogenic Plant is currently a minor source with respect to the PSD/NNSR programs as potential emissions are below the applicable major source thresholds. The proposed project is not considered a major source in and of itself for either program. Therefore, the proposed project does not

¹ [Pennsylvania Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants | Green Book | US EPA](#) as of February 28, 2025.

trigger major NSR review. Once the project is completed, the Revolution Cryogenic Plant will remain a minor source with respect to the PSD/NNSR program.

2.3 Potentially Applicable Federal Emissions Standards

Two (2) types of federal emissions standards could apply to certain operations being permitted as part of this project. These emissions standards are: New Source Performance Standards (NSPS) codified in 40 CFR 60 and National Emission Standards for Hazardous Air Pollutants (NESHAP) standards codified in 40 CFR 63.

2.3.1 New Source Performance Standards

Pennsylvania has received delegation from EPA to regulate facilities subject to NSPS. Regulatory requirements for facilities subject to NSPS are contained in Pennsylvania SIP in 25 Pa. Code §122 and 40 CFR Part 60.

The potentially applicable NSPS for the proposed project include:

- ▶ NSPS Subpart Dc – Steam Generating Units
- ▶ NSPS Subpart K, Ka, Kb, and Kc – Storage Vessels for Petroleum Liquids / Volatile Organic Liquids
- ▶ NSPS Subpart NNNa – Distillation Operations
- ▶ NSPS Subpart OOOO, OOOOa, and OOOOb – Crude Oil and Natural Gas Facilities

Applicability and requirements for these standards are included in the following subsections:

2.3.2.1 NSPS Subpart Dc– Steam Generating Units

NSPS Subpart Dc applies to all steam generating units with a heat input greater than or equal to 10 MMBtu/hr and less than 100 MMBtu/hr. The proposed project includes heaters that are categorically exempt (i.e. < 10 MMBtu/hr – which includes HTR-006 and HTR-007). As such, these heaters are not subject to NSPS Subpart Dc.

The proposed project also includes heaters that have a rating greater than 10 MMBtu/hr (HMO Heaters: HTR-008 – HTR-010). Since these heaters have a rating between 10 and 100 MMBtu/hr, they are potentially subject to NSPS Subpart Dc. As the heaters exclusively burn natural gas, the heaters are not subject to the emissions limitations in the rule and are only subject to the initial notification (60.48c(a)) and fuel recordkeeping requirements (40 CFR 60.48c(g)) as outlined in NSPS Subpart Dc.

2.3.1.2 NSPS Subpart K, Ka, and Kb– Storage Vessels for Petroleum Liquids / Volatile Organic Liquids

These subparts apply to storage tanks of certain sizes constructed, reconstructed, or modified during various time periods. NSPS Subpart K applies to storage tanks constructed, reconstructed or modified prior to 1978, and NSPS Subpart Ka to those constructed, reconstructed, or modified prior to 1984, and NSPS Subpart Kb applies to volatile organic liquid storage tanks constructed, reconstructed, or modified after July 23, 1994 with a capacity equal to or greater than 75 m³ (~19,813 gallons).

There are no storage vessels with a capacity over 19,000 gallons proposed as part of this project and the existing storage vessels at the Revolution Cryogenic Plant will not be modified as part of this project. Therefore, the proposed project will not trigger applicability of these rules.

2.3.1.3 NSPS Subpart NNNa – Distillation Operations

NSPS Subpart NNNa applies to sources that commenced construction, reconstruction, or modification after April 25, 2023. The proposed project does not include distillation operations that produce a listed chemical in 40 CFR 60.667a. Therefore, this subpart is not applicable.

2.3.1.3 NSPS Subpart OOOO, OOOOa, and OOOOb – Crude Oil and Natural Gas Facilities

NSPS Subpart OOOO applies to affected facilities that were constructed, reconstructed, or modified after August 23, 2011, and before September 15, 2015. As the proposed project will be constructed outside of these applicability dates, NSPS Subpart OOOO is not applicable.

NSPS Subpart OOOOa applies to affected facilities that were constructed, reconstructed, or modified after September 15, 2015, and before December 6, 2022. As the proposed project will be constructed outside of these applicability dates, NSPS Subpart OOOOa is not applicable.

NSPS Subpart OOOOb applies to affected facilities that were constructed, reconstructed, or modified on or after December 6, 2022. The following sections discuss the applicability of NSPS Subpart OOOOb to the proposed project.

Amine Sweetening Units

The amine unit that is part of the proposed project does not meet the definition of sweetening unit under NSPS Subpart OOOOb, which defines sweetening units as a process device that removes hydrogen sulfide (H₂S) and/or carbon dioxide (CO₂) from the sour natural gas stream. The proposed amine unit will remove CO₂ from the NGL stream, not H₂S or CO₂ from a sour natural gas stream. As such, the new amine unit is not an affected facility under NSPS Subpart OOOOb.

Reciprocating Compressors

As part of the proposed project three new reciprocating compressors will be installed that will be subject to NSPS Subpart OOOOb. ETC will comply with the requirements as outlined in 60.5385b by either:

- ▶ Making initial and periodic measurements of volumetric flow to show it does not exceed 2 standard cubic feet per minute (scfm) per individual cylinder or changing or replacing the packing within 90 days after a measurement that exceeds 2 scfm per cylinder and measuring flow to confirm repair; or
- ▶ Changing rod packing on or before 8,760 hours of operation after startup, or every 8,760 hours after the previous flow rate measurement, or on or before 8,760 hours of operation after the date of the most recent rod packing replacement.

Pneumatic Controllers And Pumps

There are no natural gas driven process controllers or pumps as part of the proposed project. Therefore, NSPS Subpart OOOOb is not applicable to this equipment category for the proposed project.

Storage Vessels

The proposed project does not include construction of new tanks and it will not result in an increase in condensate throughput through the existing condensate storage vessels. As such, the storage vessels are not affected facilities under NSPS Subpart OOOOb.

Fugitive Components

The NSPS Subpart OOOOb standards for equipment leaks at natural gas processing plants apply to the group of all equipment within a process unit that is located at an onshore natural gas processing plant and that commenced construction, reconstruction, or modification after December 6, 2022. As the Revolution Cryo Plant extracts natural gas liquids from field gas, the site is considered a natural gas processing plant. The proposed Cryo Plant II is a process unit subject to the leak detection and repair (LDAR) requirements of NSPS Subpart OOOOb. Since the proposed project will not result in a modification or reconstruction of the existing Cryo Plant I process unit group of equipment, the Cryo Plant I process unit will remain subject to NSPS Subpart OOOOa.

For the equipment subject to NSPS Subpart OOOOb, ETC can comply with the greenhouse gas (GHG) and VOC standards of 40 CFR §60.5400b:

- ▶ 40 CFR §60.5400b(a) outlines the general standards for the process unit equipment affected facilities.
- ▶ 40 CFR §60.5400b(b) outlines the monitoring requirements using optical gas imaging (OGI) as outlined in appendix K to Part 60.
- ▶ 40 CFR §60.5400b(c) includes the additional requirements for pumps in light liquid service.
- ▶ 40 CFR §60.5400b(d) includes the additional requirements for pressure relief devices in gas / vapor service. Cryo Plant II has pressure relief devices routed through a closed vent system to a control device that would be exempt from the requirements in §60.5400b(d).
- ▶ 40 CFR §60.5400b(e) outlines the open-ended valves or lines requirements.
- ▶ 40 CFR §60.5400b(f) provides the closed vent system and control devices requirements if used to comply with the equipment leak provisions.
- ▶ 40 CFR §60.5400b(g) outlines the pumps, valves, and connectors in heavy liquid service and pressure relief devices in light liquid or heavy liquid service requirements.
- ▶ 40 CFR §60.5400b(h) includes the repair requirements.
- ▶ The compliance, recordkeeping, and reporting requirements are included in 40 CFR §§60.5400b(i) through (l).

ETC may also elect to comply with the alternative GHG and VOC standards in §60.5401b:

- ▶ 40 CFR §60.5401b(a) outlines the general standards for the process unit equipment affected facilities.
- ▶ 40 CFR §60.5401b(b) includes the additional requirements for pumps in light liquid service.
- ▶ 40 CFR §60.5401b(c) includes the additional requirements for pressure relief devices in gas / vapor service. Cryo Plant II has pressure relief devices routed through a closed vent system to a control device that would be exempt from the requirements in §60.5401b(c).
- ▶ 40 CFR §60.5401b(d) outlines the open-ended valves or lines requirements.
- ▶ 40 CFR §60.5401b(e) provides the closed vent system and control devices requirements if used to comply with the equipment leak provisions. ETC will comply with the control device requirements as outline in 40 CFR §60.18. ETC will also comply with both the closed vent system requirements as outlined in 40 CFR §60.5411b and 40 CFR §60.5416b, as well as the control device requirements shown in 40 CFR §60.5421b, 40 CFR §60.5415b(f), and 40 CFR §60.5417b.
- ▶ 40 CFR §60.5401b(f) includes the requirements for valves in gas / vapor and light liquid service.
- ▶ 40 CFR §60.5401b(g) outlines the pumps, valves, and connectors in heavy liquid service and pressure relief devices in light liquid or heavy liquid service requirements.
- ▶ 40 CFR §60.5401b(h) gives the requirements for connectors in gas / vapor and in light liquid service.
- ▶ 40 CFR §60.5401b(i) includes the repair requirements.
- ▶ The compliance, recordkeeping, and reporting requirements are included in §§60.5401b(j) through (m).

FLARE-002

The proposed facility flare (FLARE-002) at the Revolution Cryo Plant controls the miscellaneous blowdowns from various sources as well as the emissions from PRVs. The blowdowns are not an affected facility under NSPS Subpart OOOOb, however, since the facility flare controls the PRVs, it is subject to the following:

- ▶ 40 CFR §60.18 outlines requirements for control devices. ETC will comply with the control device requirements as outlined in 40 CFR §60.18.
- ▶ 40 CFR §60.5411b and 40 CFR §60.5416b outline the closed vent system requirements for control devices. As such, ETC will comply with the regulations as applicable.
- ▶ 40 CFR §60.5421b, 40 CFR §60.5415b(f), and 40 CFR §60.5417b give the control device requirements; ETC will comply with these requirements as applicable.

Super Emitter Program

The Super Emitter Program is codified in NSPS Subparts OOOO, OOOOa, and OOOOb in 40 CFR 60.5371, 40 CFR 60.5371a, and 40 CFR 60.5371b. ETC will comply with the applicable provisions of the program if EPA provides a notification of a super emitter event regarding the Revolution Cryo Plant.

2.3.2 National Emission Standards for Hazardous Air Pollutants

Regulatory requirements for facilities subject to NESHAP standards are contained in 40 CFR Part 63. After the proposed project, the Revolution Cryo Plant will remain an area source with respect to HAPs as potential emissions will remain below major source thresholds. The potentially applicable NESHAP standards to the proposed project at the Revolution Cryo Plant are:

- ▶ NESHAP Subpart HH – Oil and Natural Gas Production Facilities
- ▶ NESHAP Subpart HHH – Natural Gas Transmission and Storage Facilities
- ▶ NESHAP Subpart DDDDD – Industrial, Commercial, and Institutional Boilers and Process Heaters
- ▶ NESHAP Subpart JJJJJ – Industrial, Commercial, and Institutional Boilers

2.3.2.1 NESHAP Subpart HH – Natural Gas Production Facilities

The Revolution Cryo Plant is potentially subject to NESHAP Subpart HH. This standard applies to dehydration units and other sources at oil and natural gas production facilities located upstream of custody transfer into the transmission segment that are both major and area sources of HAP emissions. The Revolution Cryo Plant is an area source of HAP. The affected sources under NESHAP Subpart HH are limited to triethylene glycol (TEG) dehydration units. The proposed project does not include the installation of a TEG dehydration unit; as such, this rule does not apply to the project.

2.3.2.2 NESHAP Subpart HHH – Natural Gas Transmission and Storage Facilities

This standard applies to natural gas transmission and storage facilities that are major sources of HAP emissions located downstream of the point of custody transfer (after processing and / or treatment in the production sector), but upstream of the distribution sector. As the Revolution Cryo Plant is neither a transmission / storage facility nor a major source of HAP, the requirements of this subpart do not apply to the facility.

2.3.2.3 NESHAP Subpart DDDDD– Industrial, Commercial, and Institutional Boilers and Process Heaters (Major Source Boiler NESHAP)

This standard applies to boilers and process heaters located at major sources of HAP. The Revolution Cryo Plant is and will continue to be an area source of HAP; therefore, this subpart does not apply.

2.3.2.4 NESHAP Subpart JJJJJ– Industrial, Commercial, and Institutional Boilers (Area Source Boiler NESHAP)

This standard applies to boilers located at area sources of HAP. Process heaters at area sources are not affected facilities under NESHAP Subpart JJJJJ. All potentially applicable boilers at this facility are natural gas-fired and are exempt from this subpart per §63.11195(2). Therefore, there are no sources subject to the requirements of NESHAP Subpart JJJJJ at the Revolution Cryo Plant.

2.4 Potentially Applicable State Standards

2.5.1 25 Pa Code §123.1 and 123.2

25 Pa Code §123.1 and 123.2 Prohibition of Certain Fugitive Emissions and Fugitive Particulate Matter, both state exceptions to fugitive emissions sources and methods for controlling fugitive emissions. This regulation applies to the facility in general.

2.5.2 25 Pa Code §123.11 and 123.13

25 Pa Code §123.11 Particulate Emissions: Combustion Units defines particulate matter emissions for combustion units. Combustion units are defined in §121.1 as stationary equipment used to burn fuel primarily for the purpose of producing power or heat by indirect heat transfer such as boilers, which includes the proposed heaters. Compliance with this will be assured through natural gas combustion.

The particulate matter emissions limitations for processes are found in 25 Pa Code §123.13 Particulate Emissions: Processes. The proposed project does not include any processes subject to this standard.

2.5.3 25 Pa Code §123.21

25 Pa Code §123.21 Sulfur Compound Emissions: General states that the concentration of sulfur oxides in the effluent gas may not exceed 500 ppmvd. The heaters will combust natural gas and the sulfur oxide emissions are well below this concentration level in the combustion exhaust.

2.5.4 25 Pa Code §123.22

25 Pa Code §123.22 states that a person may not permit the emission into the outdoor atmosphere of sulfur oxides, expressed as SO₂, from a combustion unit in excess of the rate of 4 pounds per million Btu of heat input over a 1-hour period. As all combustion sources at the facility will be fueled exclusively with natural gas, potential SO₂ emissions from all sources will comply with these requirements.

2.5.5 25 Pa Code §123.31

25 Pa Code §123.31 Odor Emissions prohibits the emission of malodorous air contaminants from any source that are detectable outside the facility fence line. This regulation applies to the facility in general. ETC will take measures to minimize odor from the Revolution Cryo Plant operations by combusting natural gas fuel only, implementing a leak detection and repair program, and controlling gas streams.

2.5.6 25 Pa Code §123.41 and 123.43

25 Pa Code §123.41 Visible Emissions: Limitations states that a facility may not emit visible emissions equal to or greater than 20% for a period or periods aggregating more than 3 minutes in any 1 hour, or equal to or greater than 60% at any time. 25 Pa Code §123.43 specifies measuring techniques for visible emissions. These standards apply to the proposed heaters at the Revolution Cryo Plant. The use of natural gas as fuel will facilitate compliance with this requirement.

2.5.7 25 Pa Code §129.56

25 Pa Code §129.56 applies to storage tanks with a capacity greater than 40,000 gallons of volatile organic compounds with a vapor pressure greater than 1.5 psia (10.5 kilopascals) under actual storage conditions. The two existing condensate tanks (U-406A and U-406B) have a capacity of > 40,000 gallons. However, 25 Pa. Code §129.56 does not apply as the bullet tanks are pressure tanks capable of maintaining working pressures sufficient at all times to prevent vapor or gas loss to the atmosphere.

2.5.8 25 Pa Code §129.57

25 Pa Code §129.57 contains requirements for storage vessels less than 40,000 gallons in capacity that contain VOCs. Under this section, above-ground storage tanks with a capacity greater than or equal to 2,000 gallons which contain VOCs with a vapor pressure greater than 1.5 psia must be equipped with pressure relief valves which are maintained in good operating condition and which are set to release at no less than 0.7 psig of pressure or 0.3 psig of vacuum (or the highest possible pressure and vacuum in accordance with state or local fire codes or the National Fire Prevention Association (NFPA) guidelines). The slop and stabilized condensate tanks at the Revolution Cryo Plant are 2,000 gallons or greater in capacity. The slop and stabilized condensate tanks are expected to store materials with a vapor pressure < 1.5 psia.

2.5.9 25 Pa Code §§129.91-129.95 and 25 Pa Code §§129.96-129.100

25 Pa Code §129.91 and §129.96 establish control standards for major stationary sources of NO_x and VOC under the Reasonably Available Control Technology (RACT) program. The applicability dates of these regulations preceded construction of the Revolution Cryo Plant. As such, the requirements will be superseded by RACT III, which is discussed in the following section.

2.5.10 25 Pa Code §129.111-129.115

25 Pa Code §129.111 establishes control standards for major stationary sources of NO_x and VOC under the RACT III program. The applicable major source thresholds for the Revolution Cryo Plant are 100 tons per year of NO_x and 50 tons per year of VOC. The Revolution Cryo Plant will remain a minor source with respect to NO_x and VOC; therefore, RACT will not apply.

2.5.11 25 Pa Code §129.121-129.130

25 Pa Code § 129.121—129.130 establishes the control of VOC Emissions from Unconventional Oil and Natural Gas sources for facilities constructed on or before December 10, 2022. As the proposed project will be constructed after December 10, 2022, the requirements of § 129.121—129.130 are not applicable. ETC will continue to comply with the applicable requirements for the existing sources at the Revolution Cryo Plant that are subject to the rule.

ATTACHMENT A – GENERAL INFORMATION FORM



GENERAL INFORMATION FORM – AUTHORIZATION APPLICATION

Before completing this General Information Form (GIF), read the step-by-step instructions provided in this application package. This form is used by the Department of Environmental Protection (DEP) to inform our programs regarding what other DEP permits or authorizations may be needed for the proposed project or activity. This version of the General Information Form (GIF) must be completed and returned with any program-specific application being submitted to the DEP.

Related ID#s (If Known)		DEP USE ONLY
Client ID# 321427	APS ID#	Date Received & General Notes
Site ID#	Auth ID# 1221468	
Facility ID# 805136		

CLIENT INFORMATION

DEP Client ID# 321427	Client Type/Code	Dun & Bradstreet ID#	
Legal Organization Name or Registered Fictitious Name ETC Northeast Pipeline, LLC	Employer ID# (EIN) 26-2863376-3	Is the EIN a SSN? ☒ Yes ☐ No	
State of Incorporation or Registration of Fictitious Name	☐ Corporation ☒ LLC ☐ Partnership ☐ LLP ☐ LP ☐ Sole Proprietorship ☐ Association/Organization ☐ Estate/Trust ☐ Other		
Individual Last Name	First Name	MI	Suffix
Additional Individual Last Name	First Name	MI	Suffix
Mailing Address Line 1 6051 Wallace Rd Extension, Suite 300		Mailing Address Line 2	
Address Last Line – City Wexford	State PA	ZIP+4 15090	Country US
Client Contact Last Name Laird	First Name Alyssa	MI	Suffix
Client Contact Title Sr. Specialist - Environmental	Phone 412-522-2846	Ext	Cell Phone
Email Address Alyssa.Laird@energytransfer.com	FAX		

SITE INFORMATION

DEP Site ID# 805136	Site Name Revolution Cryogenic Plant
EPA ID#	Estimated Number of Employees to be Present at Site
Description of Site Natural Gas Processing Facility	
Tax Parcel ID(s):	
County Name(s) Washington	Municipality(ies) Smith
City	Boro
Twp	State
PA	

	☐	☐	☐	
Site Location Line 1	Site Location Line 2			
Point Pleasant Road				
Site Location Last Line – City	State	ZIP+4		
Bulger	PA	15019		
Detailed Written Directions to Site				
From PADEP SWRO, take PA-28 S to get to I-279 S and then I-376 W. Take exit 60A for US-22 W/US-30 W. Take the exit toward Bavington, then a quick right onto Maple Grove Road and a quick left onto Steubenville Pike. Turn left onto Creek Road/T500 and continue straight onto Point Pleasant Road. The facility road will be on your left.				
Site Contact Last Name	First Name	MI	Suffix	
Laird	Alyssa			
Site Contact Title	Site Contact Firm			
Sr. Specialist - Environmental				
Mailing Address Line 1	Mailing Address Line 2			
6051 Wallace Rd Extension, Suite 300				
Mailing Address Last Line – City	State	ZIP+4		
Wexford	PA	15090		
Phone	Ext	FAX	Email Address	
412-522-2846			Alyssa.Laird@energytransfer.com	
NAICS Codes (Two- & Three-Digit Codes – List All That Apply)			6-Digit Code (Optional)	
21 & 23			211112 & 237120	
Client to Site Relationship				
Owner/Operator				

FACILITY INFORMATION

Modification of Existing Facility		Yes	No
1.	Will this project modify an existing facility, system, or activity?	☐	☒
2.	Will this project involve an addition to an existing facility, system, or activity?	☒	☐
<i>If "Yes", check all relevant facility types and provide DEP facility identification numbers below.</i>			
Facility Type	DEP Fac ID#	Facility Type	DEP Fac ID#
☒ Air Emission Plant	805136	☐ Industrial Minerals Mining Operation	
☐ Beneficial Use (water)		☐ Laboratory Location	
☐ Blasting Operation		☐ Land Recycling Cleanup Location	
☐ Captive Hazardous Waste Operation		☐ Mine Drainage Treatment / Land Recycling Project Location	
☐ Coal Ash Beneficial Use Operation		☐ Municipal Waste Operation	
☐ Coal Mining Operation		☐ Oil & Gas Encroachment Location	
☐ Coal Pillar Location		☐ Oil & Gas Location	
☐ Commercial Hazardous Waste Operation		☐ Oil & Gas Water Poll Control Facility	
☐ Dam Location		☐ Public Water Supply System	
☐ Deep Mine Safety Operation -Anthracite		☐ Radiation Facility	
☐ Deep Mine Safety Operation -Bituminous		☐ Residual Waste Operation	
☐ Deep Mine Safety Operation -Ind Minerals		☐ Storage Tank Location	
☐ Encroachment Location (water, wetland)		☐ Water Pollution Control Facility	
☐ Erosion & Sediment Control Facility		☐ Water Resource	
☐ Explosive Storage Location		☐ Other:	

Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
	40	24	43	-80	20	57
Horizontal Accuracy Measure	Feet			--or-- Meters		
Horizontal Reference Datum Code	☐ North American Datum of 1927 ☒ North American Datum of 1983 ☐ World Geodetic System of 1984					
Horizontal Collection Method Code						
Reference Point Code						
Altitude	Feet		1,140	--or--		Meters
Altitude Datum Name	☐ The National Geodetic Vertical Datum of 1929 ☐ The North American Vertical Datum of 1988 (NAVD88)					
Altitude (Vertical) Location Datum Collection Method Code						
Geometric Type Code						
Data Collection Date						
Source Map Scale Number	Inch(es)		=			Feet
	--or--		Centimeter(s)	=	Meters	

PROJECT INFORMATION

Project Name

Revolution Cryogenic Plant, Cryo II

Project Description

Application for Plan Approval to Construct, Modify or Reactivate an Air Contamination Source and/or Install an Air Cleaning Device

Project Consultant Last Name	First Name	MI	Suffix
Donaldson	Ian		
Project Consultant Title	Consulting Firm		
Principal Consultant	Trinity Consultants		
Mailing Address Line 1	Mailing Address Line 2		
4500 Brooktree Road	Suite 310		
Address Last Line – City	State	ZIP+4	
Wexford	PA	15090	
Phone	Ext	FAX	Email Address
(724) 442-6808			IDonaldson@trinityconsultants.com

Time Schedules	Project Milestone (Optional)
N/A	

1. Is the project located in or within a 0.5-mile radius of an Environmental Justice community as defined by DEP? ☒ Yes ☐ No

To determine if the project is located in or within a 0.5-mile radius of an environmental justice community, please use [the online PennEnviroScreen tool](#). To see specific EJ areas, select the appropriate year of your submittal from the themes box on the right.

2. Have you informed the surrounding community prior to submitting the application to the Department? ☒ Yes ☐ No

Method of notification: Municipal Notification

3. Have you addressed community concerns that were identified? ☐ Yes ☐ No ☒ N/A

If no, please briefly describe the community concerns that have been expressed and not addressed.

4. Is your project funded by state or federal grants? ☐ Yes ☒ No

Note: If "Yes", specify what aspect of the project is related to the grant and provide the grant source, contact person and grant expiration date.

Aspect of Project Related to Grant

Grant Source: _____

Grant Contact Person: _____

Grant Expiration Date: _____

5. Is this application for an authorization on Appendix A of the Land Use Policy? (For referenced list, see Appendix A of the Land Use Policy attached to GIF instructions) ☐ Yes ☒ No

Note: If "No" to Question 5, the application is not subject to the Land Use Policy.

If "Yes" to Question 5, the application is subject to this policy and the Applicant should answer the additional questions in the **Land Use Information** section.

LAND USE INFORMATION – *Not Applicable*

Note: Applicants should submit copies of local land use approvals or other evidence of compliance with local comprehensive plans and zoning ordinances.

1. Is there an adopted county or multi-county comprehensive plan? ☐ Yes ☐ No

2. Is there a county stormwater management plan? ☐ Yes ☐ No

3. Is there an adopted municipal or multi-municipal comprehensive plan? ☐ Yes ☐ No

4. Is there an adopted county-wide zoning ordinance, municipal zoning ordinance or joint municipal zoning ordinance? ☐ Yes ☐ No

Note: If the Applicant answers "No" to either Questions 1, 3 or 4, the provisions of the PA MPC are not applicable and the Applicant does not need to respond to questions 5 and 6 below.

If the Applicant answers "Yes" to questions 1, 3 and 4, the Applicant should respond to questions 5 and 6 below.

5. Does the proposed project meet the provisions of the zoning ordinance or does the proposed project have zoning approval? If zoning approval has been received, attach documentation. ☐ Yes ☐ No

6. Have you attached Municipal and County Land Use Letters for the project? ☐ Yes ☐ No

COORDINATION INFORMATION

Note: The PA Historical and Museum Commission must be notified of proposed projects in accordance with DEP Technical Guidance Document 012-0700-001 [at PHMC's online portal, PA-SHARE](#).

If the activity will be a mining project (i.e., mining of coal or industrial minerals, coal refuse disposal and/or the operation of a coal or industrial minerals preparation/processing facility), respond to questions 1.0 through 2.5 below.

If the activity will not be a mining project, skip questions 1.0 through 2.5 and begin with question 3.0.

1.0	Is this a coal mining project? If "Yes", respond to 1.1-1.6. If "No", skip to Question 2.0.	☐	Yes	☒	No
1.1	Will this coal mining project involve coal preparation/processing activities in which the total amount of coal prepared/processed will be equal to or greater than 200 tons/day?	☐	Yes	☐	No
1.2	Will this coal mining project involve coal preparation/processing activities in which the total amount of coal prepared/processed will be greater than 50,000 tons/year?	☐	Yes	☐	No
1.3	Will this coal mining project involve coal preparation/processing activities in which thermal coal dryers or pneumatic coal cleaners will be used?	☐	Yes	☐	No
1.4	For this coal mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?	☐	Yes	☐	No
1.5	Will this coal mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?	☐	Yes	☐	No
1.6	Will this coal mining project involve underground coal mining to be conducted within 500 feet of an oil or gas well?	☐	Yes	☐	No
2.0	Is this a non-coal (industrial minerals) mining project? If "Yes", respond to 2.1-2.6. If "No", skip to Question 3.0.	☐	Yes	☒	No
2.1	Will this non-coal (industrial minerals) mining project involve the crushing and screening of non-coal minerals other than sand and gravel?	☐	Yes	☐	No
2.2	Will this non-coal (industrial minerals) mining project involve the crushing and/or screening of sand and gravel with the exception of wet sand and gravel operations (screening only) and dry sand and gravel operations with a capacity of less than 150 tons/hour of unconsolidated materials?	☐	Yes	☐	No
2.3	Will this non-coal (industrial minerals) mining project involve the construction, operation and/or modification of a portable non-metallic (i.e., non-coal) minerals processing plant under the authority of the General Permit for Portable Non-metallic Mineral Processing Plants (i.e., BAQ-PGPA/GP-3)?	☐	Yes	☐	No
2.4	For this non-coal (industrial minerals) mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters?	☐	Yes	☐	No

2.5	Will this non-coal (industrial minerals) mining project involve the construction of a permanent impoundment meeting one or more of the following criteria: (1) a contributory drainage area exceeding 100 acres; (2) a depth of water measured by the upstream toe of the dam at maximum storage elevation exceeding 15 feet; (3) an impounding capacity at maximum storage elevation exceeding 50 acre-feet?	☐	Yes	☐	No
3.0	Will your project, activity, or authorization have anything to do with a well related to oil or gas production, have construction within 200 feet of, affect an oil or gas well, involve the waste from such a well, or string power lines above an oil or gas well? If "Yes", respond to 3.1-3.3. If "No", skip to Question 4.0.	☒	Yes	☐	No
3.1	Does the oil- or gas-related project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water (including wetlands)?	☐	Yes	☒	No
3.2	Will the oil- or gas-related project involve discharge of industrial wastewater or stormwater to a dry swale, surface water, ground water or an existing sanitary sewer system or storm water system? If "Yes", discuss in <i>Project Description</i> .	☐	Yes	☒	No
3.3	Will the oil- or gas-related project involve the construction and operation of industrial waste treatment facilities?	☐	Yes	☒	No
4.0	Will the project involve a construction activity that results in earth disturbance? If "Yes", specify the total disturbed acreage.	☒	Yes	☐	No
4.0.1	Total Disturbed Acreage				
4.0.2	Will the project discharge or drain to a special protection water (EV or HQ) or an EV wetland?	☐	Yes	☒	No
4.0.3	Will the project involve a construction activity that results in earth disturbance in the area of the earth disturbance that are contaminated at levels exceeding residential or non-residential medium-specific concentrations (MSCs) in 25 Pa. Code Chapter 250 at residential or non-residential construction sites, respectively?	☐	Yes	☒	No
5.0	Does the project involve any of the following: water obstruction and/or encroachment, wetland impacts, or floodplain project by the Commonwealth/political subdivision or public utility? If "Yes", respond to 5.1-5.7. If "No", skip to Question 6.0.	☐	Yes	☒	No
5.1	Water Obstruction and Encroachment Projects – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a watercourse, floodway or body of water?	☐	Yes	☐	No
5.2	Wetland Impacts – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a wetland?	☐	Yes	☐	No

5.3	Floodplain Projects by the Commonwealth, a Political Subdivision of the Commonwealth or a Public Utility – Does the project involve any of the following: placement of fill, excavation within or placement of a structure, located in, along, across or projecting into a floodplain?	☐	Yes	☐	No
5.4	Is your project an interstate transmission natural gas pipeline?	☐	Yes	☐	No
5.5	Does your project consist of linear construction activities which result in earth disturbance in two or more DEP regions AND three or more counties?	☐	Yes	☐	No
5.6	Does your project utilize Floodplain Restoration as a best management practice for Post Construction Stormwater Management?	☐	Yes	☐	No
5.7	Does your project utilize Class V Gravity / Injection Wells as a best management practice for Post Construction Stormwater Management?	☐	Yes	☐	No
6.0	Will the project involve discharge of construction related stormwater to a dry swale, surface water, ground water or separate storm water system?	☐	Yes	☒	No
6.1	Will the project involve discharge of industrial waste stormwater or wastewater from an industrial activity or sewage to a dry swale, surface water, ground water or an existing sanitary sewer system or separate storm water system?	☐	Yes	☐	No
7.0	Will the project involve the construction and operation of industrial waste treatment facilities?	☐	Yes	☒	No
8.0	Will the project involve construction of sewage treatment facilities, sanitary sewers, or sewage pumping stations? If “Yes”, indicate estimated proposed flow (gal/day). Also, discuss the sanitary sewer pipe sizes and the number of pumping stations/treatment facilities/name of downstream sewage facilities in the <i>Project Description</i>, where applicable.	☐	Yes	☒	No
8.0.1 Estimated Proposed Flow (gal/day)					
9.0	Will the project involve the subdivision of land, or the generation of 800 gpd or more of sewage on an existing parcel of land or the generation of an additional 400 gpd of sewage on an already-developed parcel, or the generation of 800 gpd or more of industrial wastewater that would be discharged to an existing sanitary sewer system?	☐	Yes	☒	No
9.0.1	Was Act 537 sewage facilities planning submitted and approved by DEP? If “Yes” attach the approval letter. Approval required prior to 105/NPDES approval.	☐	Yes	☐	No
10.0	Is this project for the beneficial use of biosolids for land application within Pennsylvania? If “Yes” indicate how much (i.e. gallons or dry tons per year).	☐	Yes	☒	No
10.0.1	Gallons Per Year (residential septage)				
10.0.2	Dry Tons Per Year (biosolids)				

11.0	Does the project involve construction, modification or removal of a dam? If "Yes", identify the dam.	☐ Yes	☒ No
11.0.1	Dam Name		
12.0	Will the project interfere with the flow from, or otherwise impact, a dam? If "Yes", identify the dam.	☐ Yes	☒ No
12.0.1	Dam Name		
13.0	Will the project involve operations (excluding during the construction period) that produce air emissions (i.e., NOX, VOC, etc.)?	☒ Yes	☐ No
13.0.1	If "Yes", is the operation subject to the agricultural exemption in 35 P.S. § 4004.1?	☐ Yes	☒ No
13.0.2	If the answer to 13.0.1 is "No", identify each type of emission followed by the estimated amount of that emission. Enter all types & amounts of emissions; See Emission Calcs separate each set with semicolons.		
14.0	Does the project include the construction or modification of a drinking water supply to serve 15 or more connections or 25 or more people, at least 60 days out of the year? If "Yes," check all proposed sub-facilities.	☐ Yes	☒ No
14.0.1	Number of Persons Served		
14.0.2	Number of Employee/Guests		
14.0.3	Number of Connections		
14.0.4	Sub-Fac: Distribution System	☐ Yes	☐ No
14.0.5	Sub-Fac: Water Treatment Plant	☐ Yes	☐ No
14.0.6	Sub-Fac: Source	☐ Yes	☐ No
14.0.7	Sub-Fac: Pump Station	☐ Yes	☐ No
14.0.8	Sub-Fac: Transmission Main	☐ Yes	☐ No
14.0.9	Sub-Fac: Storage Facility	☐ Yes	☐ No
15.0	Will your project include infiltration of storm water or waste water to ground water within one-half mile of a public water supply well, spring or infiltration gallery?	☐ Yes	☒ No
16.0	Is your project to be served by an existing public water supply? If "Yes", indicate name of supplier and attach letter from supplier stating that it will serve the project.	☐ Yes	☒ No
16.0.1	Supplier's Name		
16.0.2	Letter of Approval from Supplier is Attached	☐ Yes	☐ No
17.0	Will this project be served by on-lot drinking water wells?	☐ Yes	☒ No
18.0	Will this project involve a new or increased drinking water withdrawal from a river, stream, spring, lake, well or other water bod(ies)? If "Yes," reference Safe Drinking Water Program.	☐ Yes	☒ No
18.0.1	Source Name		

19.0	Will the construction or operation of this project involve treatment, storage, reuse, or disposal of waste? If "Yes," indicate what type (i.e., hazardous, municipal (including infectious & chemotherapeutic), residual) and the amount to be treated, stored, re-used or disposed.	☐	Yes	☒	No
19.0.1	Type & Amount				
20.0	Will your project involve the removal of coal, minerals, contaminated media, or solid waste as part of any earth disturbance activities?	☐	Yes	☒	No
21.0	Does your project involve installation of a field constructed underground storage tank? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐	Yes	☒	No
21.0.1	Enter all substances & capacity of each; separate each set with semicolons.				
22.0	Does your project involve installation of an aboveground storage tank greater than 21,000 gallons capacity at an existing facility? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐	Yes	☒	No
22.0.1	Enter all substances & capacity of each; separate each set with semicolons.				
23.0	Does your project involve installation of a tank greater than 1,100 gallons which will contain a highly hazardous substance as defined in DEP's Regulated Substances List, 2570-BK-DEP2724? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐	Yes	☒	No
23.0.1	Enter all substances & capacity of each; separate each set with semicolons.				
24.0	Does your project involve installation of a storage tank at a new facility with a total AST capacity greater than 21,000 gallons? If "Yes," list each Substance & its Capacity. Note: Applicant may need a Storage Tank Site Specific Installation Permit.	☐	Yes	☒	No
24.0.1	Enter all substances & capacity of each; separate each set with semicolons.				
NOTE: If the project includes the installation of a regulated storage tank system, including diesel emergency generator systems, the project may require the use of a Department Certified Tank Handler. For a full list of regulated storage tanks and substances, please go to www.dep.pa.gov search term storage tanks					
25.0	Will the intended activity involve the use of a radiation source?	☐	Yes	☒	No

CERTIFICATION

I certify that I have the authority to submit this application on behalf of the applicant named herein and that the information provided in this application is true and correct to the best of my knowledge and information.

For applicants supplying an EIN number: I am applying for a permit or authorization from the Pennsylvania Department of Environmental Protection (DEP). As part of this application, I will provide DEP with an accurate EIN number for the applicant entity. By filing this application with DEP, I hereby authorize DEP to confirm the accuracy of the EIN number provided with the Pennsylvania Department of Revenue. As applicant, I further consent to the Department of Revenue discussing the same with DEP prior to issuance of the Commonwealth permit or authorization.

Type or Print Name Stephen D. Schuman

VP Operations – East Division

Signature

Title

Date

ATTACHMENT B – COMPLIANCE REVIEW FORM



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR POLLUTION CONTROL ACT COMPLIANCE REVIEW FORM

Fully and accurately provide the following information, as specified. Attach additional sheets as necessary.

Type of Compliance Review Form Submittal (check all that apply)

- ☐ Original Filing
☒ Amended Filing

Date of Last Compliance Review Form Filing:
July 2023

Type of Submittal

- ☒ New Plan Approval ☐ New Operating Permit ☐ Renewal of Operating Permit
☐ Extension of Plan Approval ☐ Change of Ownership ☐ Periodic Submission (@ 6 mos)
☐ Other: _____

SECTION A. GENERAL APPLICATION INFORMATION

Name of Applicant/Permittee/("applicant") (non-corporations-attach documentation of legal name)
ETC Northeast Pipeline, LLC

Address 6051 Wallace Road Extension, Suite 300
Wexford, PA 15090

Telephone 724-934-0100 **Taxpayer ID#** 26-2863396

Permit, Plan Approval or Application ID# N/A

Identify the form of management under which the applicant conducts its business (check appropriate box)

- ☐ Individual ☐ Syndicate ☐ Government Agency
☐ Municipality ☐ Municipal Authority ☐ Joint Venture
☐ Proprietorship ☐ Fictitious Name ☐ Association
☐ Public Corporation ☐ Partnership ☐ Other Type of Business, specify below:
☒ Private Corporation ☐ Limited Partnership

Describe below the type(s) of business activities performed.

Applicant conducts non-FERC-regulated midstream natural gas gathering and processing business. Applicant's business activities include constructing and operating non-FERC-regulated, intrastate gathering lines and compression facilities; transporting natural gas from well sites to natural gas processing facilities or interconnections with interstate natural gas transmission pipelines; constructing and operating natural gas processing facilities; transporting natural gas to interconnection points on interstate transmission pipelines; transporting natural gas liquids to interstate liquid pipelines.

SECTION B. GENERAL INFORMATION REGARDING "APPLICANT"

If applicant is a corporation or a division or other unit of a corporation, provide the names, principal places of business, state of incorporation, and taxpayer ID numbers of all domestic and foreign parent corporations (including the ultimate parent corporation), and all domestic and foreign subsidiary corporations of the ultimate parent corporation with operations in Pennsylvania. Please include all corporate divisions or units, (whether incorporated or unincorporated) and privately held corporations. (A diagram of corporate relationships may be provided to illustrate corporate relationships.) Attach additional sheets as necessary.

Unit Name	Principal Places of Business	State of Incorporation	Taxpayer ID	Relationship to Applicant
Energy Transfer, L.P.	TX	DE	30-0108820	Limited Partner of Heritage ETC, L.P. and Ultimate Parent of Applicant
Heritage ETC GP, LLC	TX	DE	26-2124572	General partner of Heritage ETC, L.P.
Heritage ETC, L.P.	TX	DE	20-0660756	Sole Member of LA GP, LLC and Limited Partner of La Grange Acquisition, L.P.
LA GP, LLC	TX	TX	05-0532446	General partner of LaGrange Acquisition, L.P.
LaGrange Acquisition, L.P.	TX	TX	27-0030184	Parent of Applicant
*** ETC Northeast Pipeline, LLC***	PA	DE	26-2863396	***Applicant***
Subsidiaries of Ultimate Parent with Operations in PA	Attachment 1	Attachment 1	Attachment 1	Attachment 1

SECTION C. SPECIFIC INFORMATION REGARDING APPLICANT AND ITS "RELATED PARTIES"

Pennsylvania Facilities. List the name and location (mailing address, municipality, county), telephone number, and relationship to applicant (parent, subsidiary or general partner) of applicant and all Related Parties' places of business, and facilities in Pennsylvania. Attach additional sheets as necessary.

Unit Name	Street Address	County and Municipality	Telephone No.	Relationship to Applicant
Regency Marcellus Gas Gathering, LLC	101 West Third Street, 3 rd Floor Williamsport, PA 17701	City of Williamsport Lycoming County	570-505-3700	Subsidiary of Applicant
ETC Northeast Pipeline, LLC	6051 Wallace Road Extension, Suite 300, Wexford, PA 15090	Allegheny County, Wexford	724-934-0100	Applicant
ETC Northeast Field Services, LLC	6051 Wallace Road Extension, Suite 300, Wexford, PA 15090	Allegheny County, Wexford	724-934-0100	Subsidiary of Applicant
See Attachment 2				

Provide the names and business addresses of all general partners of the applicant and parent and subsidiary corporations, if any.

Name	Business Address
LaGrange Acquisition, L.P.	8111 Westchester Drive Dallas, TX 75225

Heritage ETC GP, LLC		8111 Westchester Drive Dallas, TX 75225		
List the names and business address of persons with overall management responsibility for the process being permitted (i.e. plant manager).				
Name		Business Address		
Stephen D. Schuman		6051 Wallace Road Ext, Suite 300, Wexford, PA 15090		
Plan Approvals or Operating Permits. List all plan approvals or operating permits issued by the Department or an approved local air pollution control agency under the APCA to the applicant or related parties that are currently in effect or have been in effect at any time 5 years prior to the date on which this form is notarized. This list shall include the plan approval and operating permit numbers, locations, issuance and expiration dates. Attach additional sheets as necessary.				
Air Contamination Source	Plan Approval/ Operating Permit#	Location	Issuance Date	Expiration Date
See Attachment 2				

Compliance Background. (Note: Copies of specific documents, if applicable, must be made available to the Department upon its request.) List all documented conduct of violations or enforcement actions identified by the Department pursuant to the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. Attach additional sheets as necessary. See the definition of "documented conduct" for further clarification. Unless specifically directed by the Department, deviations which have been previously reported to the Department in writing, relating to monitoring and reporting, need not be reported.

Date	Location	Plan Approval/ Operating Permit#	Nature of Documented Conduct	Type of Department Action	Status: Litigation Existing/Continuing or Corrected/Date	Dollar Amount Penalty
9/20/23	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	N/A
5/4/2023	Pike CS	TV-04-00741	Dehy control device downtime	NOV	Corrected	N/A
1/4/2023	Taylor CS	AG5-08-00013A	THC reduction efficiency requirement	NOV	Corrected, entered into CACP 5/8/23	\$7,500.00
7/28/22	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
7/7/22	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
3/9/22	Lone Walnut CS	AG5-41-00012A	HAP emission exceedance	NOV	Corrected	NA
3/9/22	Quaker State Road CS	AG5-41-00004B	HAP emission exceedance	NOV	Corrected, entered into CACP 7/3/23	\$36,491.14
2/3/22	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
1/10/22	Revolution Cryo	AG5-63-01001A	Heater emission test not conducted at adequate operating load	NOV	Corrected	NA
11/12/21	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	CACP	Corrected, CACP for multiple NOV's.	\$15,550.00
10/12/21	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
3/15/21	Milesky CS	AG5-30-00012A	HCHO testing not conducted within 180 days of permit issuance	NOV/CACP	Corrected, entered into CACP 1/5/22.	\$8,640.00

3/15/21	Revolution Cryo	AG5-63-01001A	Visible emissions and opacity exceedance from flare	NOV	Corrected	NA
3/10/21	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
1/25/21	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
1/15/21	Revolution Cryo	AG5-63-01001A	Visible emissions exceedance from flare	NOV	Corrected	NA
11/17/20	Revolution Cryo	AG5-63-01001A	Failure to conduct Method 22 observation	NOV	Corrected	NA
2/4/20	Hirkey CS	66-00010	Late SOOP renewal application	NOV	Corrected	NA
3/18/19	Chapin Dehy	GP5-66-003A	Missed LDAR inspections	NOV/CACP	Corrected, entered into CACP 3/6/2020.	\$2,550.00
5/22/17	Mehoopany CS	GP5-66-004	Periodic monitoring CO exceedance	NOV	Corrected	NA
3/30/16	Galaxy CS	GP5-10-400A	Late operating permit fee	NOV/CACP	Corrected, entered into CACP 4/6/16	\$500.00

List all incidents of deviations of the APCA, regulations, terms and conditions of an operating permit or plan approval or order by applicant or any related party, using the following format grouped by source and location in reverse chronological order. This list must include items both currently known and unknown to the Department. Attach additional sheets as necessary. See the definition of "deviations" for further clarification.

Date	Location	Plan Approval/ Operating Permit#	Nature of Deviation	Incident Status: Litigation Existing/Continuing Or Corrected/Date
None	None	None	None	None

CONTINUING OBLIGATION. Applicant is under a continuing obligation to update this form using the Compliance Review Supplemental Form if any additional deviations occur between the date of submission and Department action on the application.

VERIFICATION STATEMENT	
Subject to the penalties of Title 18 Pa.C.S. Section 4904 and 35 P.S. Section 4009(b)(2), I verify under penalty of law that I am authorized to make this verification on behalf of the Applicant/Permittee. I further verify that the information contained in this Compliance Review Form is true and complete to the best of my belief formed after reasonable inquiry. I further verify that reasonable procedures are in place to ensure that “documented conduct” and “deviations” as defined in 25 Pa Code Section 121.1 are identified and included in the information set forth in this Compliance Review Form.	
Signature	Date
Stephen D. Schuman	
Name (Print or Type)	
VP Operations - East Division	
Title	

Attachment 1
APCA Compliance Review Form
Subsidiaries with Operations in Pennsylvania of
Ultimate Parent (Energy Transfer Partners, L.P.) of Applicant (ETC Northeast Pipeline, LLC)
June 2024

Entity Name	Entity Main Address	Domestic Jurisdiction	FEIN #	Relationship to Applicant
Regency Marcellus Gas Gathering LLC	101 West Third Street, 3 rd Flr Williamsport, PA 17701	DE	27-2142725	Subsidiary of applicant
ETC Northeast Field Services, LLC	6051 Wallace Road, Suite 300 Wexford, PA 15090	DE	35-2497449	Subsidiary of applicant
ET Rover Pipeline LLC	1300 Main Street Houston, TX 77002	DE	46-5655475	Indirect subsidiary of ultimate parent and Member, Rover Pipeline LLC joint venture
Rover Pipeline LLC	1300 Main Street Houston, TX 77002	DE	47-1958303	Joint Venture of ET Rover Pipeline LLC and a non-affiliated company, AE-MidCo Rover, LLC
Energy Transfer Marketing & Terminals L.P.	8111 Westchester Drive Dallas, TX 75225	TX	23-3102655	Indirect subsidiary of ultimate parent
Sunoco Pipeline L.P.	8111 Westchester Drive Dallas, TX 75225	TX	23-3102656	Indirect subsidiary of ultimate parent
ETC Production LLC	8111 Westchester Drive Dallas, TX 75225	DE	88-1911493	Indirect subsidiary of ultimate parent

Attachment #2: Names, Locations and Permit Information for all ETC Northeast Pipeline, LLC and Subsidiary Entity Facilities in PA.

Facility	Company Name	Location	Permit Number	Permit Issuance Date	Permit Expiration
AUBURN	Regency Marcellus Gas Gathering, LLC	Auburn Twp., Susquehanna Co.	AG5-58-00015A	11/12/2019	11/30/2024
BARTO	ETC Northeast Pipeline, LLC	Penn Twp., Lycoming Co.	GP5-41-02G	6/10/2022	6/10/2027
BRADFORD	Regency Marcellus Gas Gathering, LLC	West Burlington, Twp., Bradford Co.	GP5-05-04G	5/16/2023	5/16/2028
BOBST MOUNTAIN	Regency Marcellus Gas Gathering, LLC	Cogan House Twp., Lycoming Co.	GP5-41-651B	6/20/2023	6/20/2028
CANOE RUN	Regency Marcellus Gas Gathering, LLC	Mifflin Twp., Lycoming Co.	AG5-41-00001A	5/22/2023	5/22/2028
CHAPIN	Regency Marcellus Gas Gathering, LLC	Monroe Twp., Wyoming Co.	GP5-66-003A	1/31/2023	1/31/2028
HIRKEY	Regency Marcellus Gas Gathering, LLC	Washington Twp., Wyoming Co.	66-00010	7/8/2020	7/8/2025
LONE WALNUT	Regency Marcellus Gas Gathering, LLC	Cummings Twp. Lycoming Co.	AG5-41-00012A	7/23/2020	7/23/2025
MEHOOPANY	Regency Marcellus Gas Gathering, LLC	Washington Twp. Wyoming Co.	AG5-66-00003B	8/02/2023	8/02/2028
OGONTZ EAST	Regency Marcellus Gas Gathering, LLC	Cummings Twp. Lycoming Co.	AG5-41-00016A	8/16/2021	8/16/2026
OGONTZ WEST	Regency Marcellus Gas Gathering, LLC	Cummings Twp. Lycoming Co.	AG5-41-00015A	7/22/2021	7/22/2026
POORMAN	Regency Marcellus Gas Gathering, LLC	Gallagher Twp., Clinton Co.	AG5-18-00001A	9/6/2019	9/6/2024
QUAKER	Regency Marcellus Gas Gathering, LLC	Fairfield Twp., Lycoming Co.	AG5-41-00004A	8/20/2021	8/20/2026
RED BEND	Regency Marcellus Gas Gathering, LLC	Cogan House Twp., Lycoming Co.	GP5-41-700A	6/10/2022	6/10/2027
ROUPP	Regency Marcellus Gas Gathering, LLC	Mifflin Twp., Lycoming Co.	AGP-41-00018A	10/14/2021	10/14/2026
SEVERCOOL	Regency Marcellus Gas Gathering, LLC	Forkston Twp., Wyoming Co.	AG5-66-00001A	7/18/23	7/17/2028
SUSQUEHANNA EAST	Regency Marcellus Gas Gathering, LLC	Lathrop Twp., Susquehanna Co.	GP5-58-005A	3/31/2023	3/31/2028
TAYLOR	Regency Marcellus Gas Gathering, LLC	Canton Twp., Bradford Co.	GP5-08-391A	1/10/2022	1/10/2027
TEEL	Regency Marcellus Gas Gathering, LLC	Springville Twp., Susquehanna Co.	GP5-58-002A	2/28/2023	2/28/2028
GALAXY	ETC Northeast Pipeline, LLC	Parker Twp., Butler Co.	AG5-10-00005A	12/1/2021	12/1/2026
REVOLUTION CRYO	ETC Northeast Pipeline, LLC	Smith Twp., Washington Co.	GP-1-63-01001A	8/7/2018	8/7/2023
			GP5-63-01001A (AG5-	8/7/2018	8/7/2023
PIKE	ETC Northeast Field Services, LLC	New Sewickley Twp., Beaver Co.	04-00741A	11/5/2021	11/5/2026
FREEDOM	ETC Northeast Field Services, LLC	New Sewickley Twp., Beaver Co.	GP5-04-00744A	2/1/2023	2/1/2028

ATTACHMENT C – PLAN APPROVAL FORMS



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Instructions for Completing a Plan Approval Application

- See the detailed instruction package available for plan approval applications.
- Use only the pages for the air cleaning devices that pertain to this project and remove the remaining pages.
- If there is more than one air cleaning device of the same type, copy the page for air cleaning devices and provide the appropriate information for each device.
- If the proposed source is connected to more than one stack and exhauster, copy the page for the stack and exhauster and provide the appropriate information for each stack and exhauster.
- Use additional sheets of paper, if the space provided is not sufficient to provide detailed information required for review and approval.
- Information may be grouped into a single attachment for each section or air cleaning device.
- Number all pages of the application (Sections A through G) accordingly.
- Attach any and all information for source and air cleaning device(s) for a thorough evaluation of the extent and nature of emissions.
- Identify, number and list all attachments made to this application (e.g., Attachment #1-Section A).
- Submit three (3) sets of the completed application with all attachments to the appropriate Regional Office.



Submit in Triplicate

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

PROCESSES

Application for Plan Approval to Construct, Modify or Reactivate an Air Contamination Source and/or Install an Air Cleaning Device

This application must be submitted with the General Information Form (GIF).

Before completing this form, read the instructions provided for the form.

Section A - Facility Name, Checklist And Certification

Organization Name or Registered Fictitious Name/Facility Name: Revolution Cryogenic Plant

DEP Client ID# (if known): 321427

Type of Review required and Fees:

- ☐ Source which is not subject to NSPS, NESHAPs, MACT, NSR and PSD: \$ _____
- ☒ Source requiring approval under NSPS or NESHAPS or both: \$ 7,500
- ☐ Source requiring approval under NSR regulations: \$ _____
- ☐ Source requiring the establishment of a MACT limitation: \$ _____
- ☐ Source requiring approval under PSD: \$ _____

Applicant's Checklist

Check the following list to make sure that all the required documents are included.

- ☒ **General Information Form (GIF)**
- ☒ **Processes Plan Approval Application**
- ☒ **Compliance Review Form** or provide reference of most recently submitted compliance review form for facilities submitting on a periodic basis: _____
- ☒ **Copy and Proof of County and Municipal Notifications**
- ☒ **Permit Fees**
- ☐ **Addendum A:** Source Applicable Requirements (only applicable to existing Title V facility)

Certification of Truth, Accuracy and Completeness by a Responsible Official

I, Stephen D. Schuman, certify under penalty of law in 18 Pa. C. S. A. §4904, and 35 P.S. §4009(b) (2) that based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete.

(Signature): _____

Date: _____

Name (Print): Stephen D. Shuman

Title: VP Operations – East Division

OFFICIAL USE ONLY

Application No. _____ Unit ID _____ Site ID _____

DEP Client ID #: _____ APS. ID _____ AUTH. ID _____

Date Received _____ Date Assigned _____ Reviewed By _____

Date of 1st Technical Deficiency _____ Date of 2nd Technical Deficiency _____

Comments: _____

Section B - Processes Information

1. Source Information

Source Description (give type, use, raw materials, product, etc). Attach additional sheets as necessary.
Amine Sweetening Unit (AMINE-002)

Manufacturer TBD	Model No. TBD	Number of Sources 1
Source Designation P202	Maximum Capacity 68.3 MMScfd	Rated Capacity 68.3 MMScfd

Type of Material Processed

Maximum Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Operational restrictions existing or requested, if any (e.g., bottlenecks or voluntary restrictions to limit PTE)

Capacity (specify units)

Per Hour 2.85 MMscf	Per Day 68.3 MMscfd	Per Week 478 MMscf	Per Year 243,861 MMscf

Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Seasonal variations (Months) From to

If variations exist, describe them

2. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Gas (other) _____	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Coal _____	TPH	Tons	% by wt		Btu/lb
Other * _____					

*Note: Describe and furnish information separately for other fuels in Addendum B.

Section B - Processes Information (Continued)

3. Burner

Manufacturer N/A	Type and Model No.	Number of Burners
Description:		
Rated Capacity	Maximum Capacity	

4. Process Storage Vessels (NOT APPLICABLE)**A. For Liquids:**

Name of material stored		
Tank I.D. No.	Manufacturer	Date Installed
Maximum Pressure	Capacity (gallons/Meter ³)	
Type of relief device (pressure set vent/conservation vent/emergency vent/open vent)		
Relief valve/vent set pressure (psig)	Vapor press. of liquid at storage temp. (psia/kPa)	
Type of Roof: Describe:		
Total Throughput Per Year	Number of fills per day (fill/day): Filling Rate (gal./min.): Duration of fill hr./fill):	

B. For Solids

Type: ☐ Silo ☐ Storage Bin ☐ Other, Describe		Name of Material Stored
Silo/Storage Bin I.D. No.	Manufacturer	Date Installed
State whether the material will be stored in loose or bags in silos		Capacity (Tons)
Turn over per year in tons		Turn over per day in tons
Describe fugitive dust control system for loading and handling operations		
Describe material handling system		

5. Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No
 If yes, include justification for confidentiality. Place such information on separate pages marked "**confidential**".

Section B - Processes Information (Continued)

6. Miscellaneous Information

Attach flow diagram of process giving all (gaseous, liquid and solid) flow rates. Also, list all raw materials charged to process equipment, and the amounts charged (tons/hour, etc.) at rated capacity (give maximum, minimum and average charges describing fully expected variations in production rates). Indicate (on diagram) all points where contaminants are controlled (location of water sprays, collection hoods, or other pickup points, etc.). Describe collection hoods location, design, airflow and capture efficiency. Describe any restriction requested and how it will be monitored.

See Process Flow Diagram in Attachment D.

Describe fully the facilities provided to monitor and to record process operating conditions, which may affect the emission of air contaminants. Show that they are reasonable and adequate.

Thermal oxidizer (THERM-002) will be equipped with a flame detection system and auto-pilot. FLARE-002 is equipped with a continuous pilot flame detection system to ensure ignition.

Describe each proposed modification to an existing source.

N/A

Identify and describe all fugitive emission points, all relief and emergency valves and any by-pass stacks.

Fugitive emissions from component leaks are accounted for in the emission calculations using emission factors taken from 1995 Protocol for Equipment Leak Emission Estimates Table 2-4, EPA-453/R-95-017.

Describe how emissions will be minimized especially during start up, shut down, process upsets and/or disruptions.

Emissions from the Amine Still Vent will be controlled by thermal oxidizer (THERM-002). The Flash Tank emissions will first be captured by VRU and then sent to the facility flare (FLARE-002) as a backup.

Anticipated Milestones:

- i. Expected commencement date of construction/reconstruction/installation: TBD
- ii. Expected completion date of construction/reconstruction/installation: _____
- iii. Anticipated date of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions*

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM	See Attachment E				
PM ₁₀					
SO _x					
CO					
NO _x					
VOC					
Others: (e.g., HAPs)					
Benzene					
Toluene					
Ethylbenzene					
Xylene					
n-Hexane					
Methanol					
Total HAPs					
CO ₂					
CH ₄					

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Gas Cooling (NOT APPLICABLE)

Water quenching ☐ Yes ☐ No Water injection rate _____ GPM

Radiation and convection cooling

☐ Yes ☐ No

Air dilution

☐ Yes ☐ No

If yes, _____ CFM

Forced Draft ☐ Yes ☐ No

Water cooled duct work ☐ Yes ☐ No

Other

Inlet Volume _____ ACFM

@ _____ °F _____ % Moisture

Outlet Volume _____ ACFM

@ _____ °F _____ % Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Settling Chambers (NOT APPLICABLE)

Manufacturer	Volume of gas handled _____ ACFM @ _____ °F	Gas velocity (ft/sec.)	
Length of chamber (ft.)	Width of chamber (ft.)	Height of chamber (ft.)	Number of trays
Water injection ☐ Yes ☐ No		Water injection rate (GPM)	

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

4. Inertial and Cyclone Collectors (NOT APPLICABLE)

Manufacturer	Type	Model No.
Pressure drop (in. of water)	Inlet volume _____ ACFM @ _____ °F	Outlet volume _____ ACFM @ _____ °F
Number of individual cyclone(s)		Outlet straightening vanes used? ☐ Yes ☐ No
Length of Cyclone(s) Cylinder (ft.)	Diameter of Cyclone(s) Cylinder (ft.)	Length of Cyclone(s) cone (ft.)
Inlet Diameter (ft.) or duct area (ft. ²) of cyclone(s)		Outlet Diameter (ft.) or duct area (ft. ²) of cyclone(s)

If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?

Describe any exhaust gas recirculation loop to be employed.

Attach particle size efficiency curve

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Model No.		☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment	Is Baghouse Insulated?		
		☐ Yes ☐ No		
Can each compartment be isolated for repairs and/or filter replacement?				☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)				☐ Yes ☐ No
Dew point at maximum moisture _____ °F		Design inlet volume _____ SCFM		
Type of Fabric Material _____ ☐ Felted ☐ Membrane Weight _____ oz/sq.yd ☐ Woven ☐ Others: List: _____ Thickness _____ in ☐ Felted-Woven				
Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.				
Filter dimensions Length _____ Diameter/Width _____				
Effective area per filter _____			Maximum operating temperature (°F) _____	
Effective air to cloth ratio Minimum _____ Maximum _____				
Drawing of Fabric Filter A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.				
Operation and Cleaning				
Volume of gases handled _____ ACFM @ _____ °F		Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.		
Type of filter cleaning ☐ Manual Cleaning ☐ Bag Collapse ☐ Reverse Air Jets ☐ Mechanical Shakers ☐ Sonic Cleaning ☐ Other: _____ ☐ Pneumatic Shakers ☐ Reverse Air Flow				
Describe the equipment provided if dry oil free air is required for collector operation				
Cleaning Initiated By ☐ Timer Frequency if timer actuated _____ ☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____				
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.				
Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.				
Emissions Data				
Pollutant	Inlet	Outlet	Removal Efficiency (%)	

Section C - Air Cleaning Device (Continued)

6. Wet Collection Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)

Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).

Describe pH monitoring and pH adjustment systems, if applicable.

Describe mist eliminator or separator (type, configuration, backflush capability, frequency).

Attach particulate size efficiency curve.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture

Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)

Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.)

State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Electrostatic Precipitator (NOT APPLICABLE)

Equipment Specifications

Manufacturer _____	Model No. _____	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ Yes ☐ No		Design Inlet Volume (SCFM) _____ Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft.		Collector plates size length _____ ft. x width _____ ft.	
Number of fields _____		Number of collector plates/field _____	
Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft./sec.		Minimum gas treatment time: _____ sec.	
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number of collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____ Describe in detail			

Operating Parameters

Inlet gas temperature (°F) _____	State pressure drop range (inches water gauge) across collector only _____ Describe the equipment
Outlet gas temperature (°F) _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field			
Field No.	No. of Sets	Each Transformer KVA	Each Rectifier KV Ave./Peak Ma DC
Current Density _____ Micro amperes/ft ² .		Corona Power _____ Watts/1000 ACFM	Corona Power Density _____ Watts/ft ² .
Will a flue gas conditioning system be employed? If yes, describe it.			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. Adsorption Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)	Adsorbent charge per adsorber vessel and number of adsorber vessels	
Length of Mass Transfer Zone (MTZ), supplied by the manufacturer based upon laboratory data.		
Adsorber diameter (ft.) and area ft ² .)	Adsorption bed depth (ft.)	

Adsorbent information

Adsorbent type and physical properties.

Working capacity of adsorbent (%)	Heel percent or unrecoverable solvent weight % in the adsorbent after regeneration.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	
Adsorption time per adsorption bed	Breakthrough capacity: Lbs. of solvent / 100 lbs. of adsorbent = _____
Vapor pressure of solvents at the inlet temperature	Available steam in pounds to regenerate carbon adsorber (if applicable)
Percent relative saturation of each solvent at the inlet temperature	
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Absorption Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Inlet Volume (SCFM)		Tower height (ft.) and inside diameter (ft.)	
Packing type and size (if applicable)		Height of packing (ft.) (if applicable)	
Number of trays (if applicable)		Number of bubble caps (if applicable)	
Configuration ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls.			
Absorbent information			
Absorbent type and concentration.		Retention time (sec.)	
Attach equilibrium data for absorption (if applicable)			
Attach any additional information regarding auxiliary equipment, absorption solution supply system (once through or recirculating, system capacity, etc.) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating Parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in. of water) and liquid flow rate. Describe the monitoring equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. ☐ Selective Catalytic Reduction (SCR) **(NOT APPLICABLE)**
☐ Selective Non-Catalytic Reduction (SNCR) **(NOT APPLICABLE)**
☐ Non-Selective Catalytic Reduction (NSCR) **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Design operating temperature (°F)
Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.		
Attach efficiency and other pertinent information (e.g., ammonia slip)		

Operating Parameters

Volume of gases handled _____ (ACFM) @ _____ °F	
Operating temperature range for the SCR/SNCR/NSCR system (°F) From _____ °F To _____ °F	
Reducing agent used, if any	Oxidation catalyst used, if any
State expected range of usage rate and concentration.	
Service life of catalyst	Ammonia slip (ppm)
Describe fully with a sketch giving locations of equipment, controls systems, important parameters and method of operation.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

11. Oxidizer/Afterburners

Equipment Specifications – THERM-002

Manufacturer Zeeco	Type ☒ Thermal ☐ Catalytic		Model No.
Design Inlet Volume (SCFM) 1637.94	Combustion chamber dimensions (length, cross-sectional area, effective chamber volume, etc.) 5'-0" OD by 20'-0" length chamber with 20'-0" stack discharge height		
Describe design features, which will ensure mixing in combustion chamber. 0.27 MMBtu/hr (Pilot) & 6.81 MMBtu/hr (Combustor Rating)			
Describe method of preheating incoming gases (if applicable). N/A		Describe heat exchanger system used for heat recovery (if applicable). N/A	
Catalyst used N/A	Life of catalyst N/A	Expected temperature rise across catalyst (°F) N/A	Dimensions of bed (in inches). Height: _____ Diameter or Width: _____ Depth: _____
Are temperature sensing devices being provided to measure the temperature rise across the catalyst? ☐ Yes ☐ No If yes, describe. N/A			
Describe any temperature sensing and/or recording devices (including specific location of temperature probe in a drawing or sketch). TO will be equipped with a flame detection system and auto-pilot.			
Burner Information			
Burner Manufacturer Zeeco	Model No. Forced Draft, GB Burner		Fuel Used Natural Gas
Number and capacity of burners 1	Rated capacity (each) 1.56 MMBtu/hr		Maximum capacity (each) 6.81 MMBtu/hr
Describe the operation of the burner		Attach dimensioned diagram of afterburner	
Operating Parameters			
Inlet flow rate (ACFM) _____ @ _____°F		Outlet flow rate (ACFM) _____ @ _____°F	
State pressure drop range across catalytic bed (in. of water).		Describe the method adopted for regeneration or disposal of the used catalyst.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)
	See Attachment E		

ZEECO PROPOSAL



CLIENT: Energy Transfer

END USER: Energy Transfer Bulgar, PA

ZEECO QUOTE #: 2024-05309IN-01

QUOTE REV #: 2

DATE OF ISSUE: 6/21/2024

APPLICATION ENGINEER: Mack Stockard



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Broken Arrow, OK 74014 USA

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sales@zeeco.com
zeeco.com

Date: 6/21/2024

Customer: Energy Transfer

Attention: Dustin Tindall

Reference: New Incinerator Capital Inquiry/ ETC Bulgar
Zeeco Proposal No. 2024-05309IN-01

Dear Dustin:

Thank you for your inquiry. We appreciate this opportunity to provide our proposal for this package.

➤ One (1) Zeeco Standard Thermal Oxidizer Package

The attached proposal describes specific features and performance of the system. Zeeco's design incorporates a proven thermal process to effectively treat the waste streams from your process. The design and materials of construction were chosen to maximize on-line time and operational life. We are confident we have designed and estimated a system that meets your requirements.

Again, we appreciate the opportunity to quote on your combustion equipment requirements. After you have had an opportunity to review our proposal, should you have any questions or require additional information, please contact me at (918) 893-8591 or email me at Mack_Stockard@zeeco.com.

Best regards,

Mack Stockard

Mack Stockard

Applications Engineer

Cc: Gianluca Tanda- Zeeco World Headquarters Application Manager

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1.0 INTRODUCTION

Zeeco has designed and manufactured burners, flares, incinerators, air pre-heaters, and combustion systems for worldwide use since 1980.

Zeeco's Incineration Division offers over 1,000 years of experience in the development, design, and testing of combustion systems. Zeeco has the proven skills and innovative abilities to design a practical and environmentally friendly combustion system to thermally treat virtually any industrial waste. This learned "art", gained by research and design efforts which are refined by testing and field experience, has been implemented in the process plants of numerous industries throughout the world.

From project planning through design, procurement, manufacturing, installation, and even start-up, Zeeco will provide project management and support to ensure the success of the project. It is our world-class, HANDS-ON type design skills, quality products, experienced staff, and especially our responsiveness to our customers' needs that truly set Zeeco apart from our competition.

Quality: Our customers expect it. We demand it!



2.0 SCOPE OF SUPPLY

In response to your RFQ, Zeeco will provide one (1) Zeeco Standard Thermal Oxidizer Packages. A more detailed description of this equipment is included in Section 4.0 entitled: EQUIPMENT DESCRIPTION.

Item. No	Description	Unit	Qty	Zeeco		Customer	
				Design	Supply	Design	Supply
1	Forced Draft Burner Assembly	set	1	✓	✓	-	-
2	Flame Scanner-Zeeco Pro-Flame	no	2	✓	✓	-	-
3	High Energy Ignitor System (HEI)	no	1	✓	✓	-	-
4	Fuel Gas Skid	set	1	✓	✓	-	-
5	BMS Panel – Zeeco Standard SIL-2 PLC – Mounted on Fuel Rack	set	1	✓	✓	-	-
7	Horizontal Combustion Chamber w/ Rainshield and Stack	set	1	✓	✓	-	-
8	Refractory (Shop installed)	set	1	✓	✓	-	-
9	Combustion Air Blower and Ducting	set	1	✓	✓	-	-
10	Zeeco Standard Documentation and Drawing Package, Information Only	set	1	✓	✓	-	-
11	Required Inspection and Testing to Zeeco Standard	set	1	✓	✓	-	-
12	Zeeco Standard Paint System	set	1	✓	✓	-	-
13	Oxygen Analyzer	set	1	✓	✓	-	-
13	Ladder and Platforms as required (can be provided as optional price)	set	1	-	-	✓	✓
14	Process Control System (DCS)	set	1	-	-	✓	✓
15	3D Model for Customer Review and Approval (can be provided as optional price)	set	1	-	-	✓	✓
16	Interconnecting Piping, Conduit and Wiring between the Control Panel and Instruments not located on the Fuel Rack	set	1	-	-	✓	✓
17	MCC, Motor Starters - VFD	set	1	-	-	✓	✓
18	Field Installation and/or Erection; available upon request	set	1	-	-	✓	✓
19	Heat Tracing and External Insulation	set	1	-	-	✓	✓
20	Environmental Licensing and Registration and/or Associated Testing	set	1	-	-	✓	✓
21	Other Start-Up/site activities (per diem basis)	set	1	-	-	✓	✓
22	Foundations or Foundation Design	set	1	-	-	✓	✓
23	Waste Gas Piping and Isolation Valves (can be provided as optional price)	set	1	-	-	✓	✓
24	Equipment Anchor Bolts, Templates or Slide Plates	set	1	-	-	✓	✓
25	Delivery to Jobsite	set	1	-	-	✓	✓
26	Storage of Equipment after Completion	set	1	-	-	✓	✓
27	Partial Refractory Dryout in the Shop (can be provided as optional price)	set	1	-	-	✓	✓
28	Knock Out Drum	set	1	✓	✓	-	-
29	Flame Arrestor (can be provided as optional price)	set	1	-	-	✓	✓

3.0 DESIGN BASIS

3.1 Site Conditions

Barometric Pressure, psia	14.7
Temperature, °F	-20 / 110
Design Relative Humidity, %	80
Wind Design	ASCE/SEI 7-16
Seismic Design	ASCE/SEI 7-16

3.2 Waste Stream Summary

The following waste gas streams have been considered for this application as noted in the RFQ.

Acid Gas to TO (5,383.40 lb/h)

Name	mol%
Water (g)	7.39265
Hydrogen sulfide	0
Carbon dioxide	90.9553
Nitrogen	0
Methane	0.034846
Ethane	1.47901
Propane (g)	0.123304
Butane-iso	0.002694
Butane-n (g)	0.010291
Isopentane (g)	0.000306
Pentane (gas)	0.000462
n-Hexane (g)	3.92E-05
n-Heptane (g)	4.5E-07
Octane (g)	4.82E-08
Nonane	0
Decane	0
Benzene	0.000769
Toluene	0.000205
Ethylbenzene	2.34E-05
p-Xylene	6.84E-05
MDEA	1.2E-13
Piperazine	1.07E-13

Amine Flash Gas to TO (104.349lb/h)

Name	mol%
Water (g)	0.714896
Hydrogen sulfide	0
Carbon dioxide	0.612735
Nitrogen	0
Methane	2.56457
Ethane	85.3683
Propane (g)	9.46714
Butane-iso	0.325745
Butane-n (g)	0.836041
Isopentane (g)	0.04524
Pentane (gas)	0.056625
n-Hexane (g)	0.007632
n-Heptane (g)	0.000159
Octane (g)	2.08E-05
Nonane	4.14E-07
Decane	8.2E-07
Benzene	0.000615
Toluene	0.000192
Ethylbenzene	2.62E-05
p-Xylene	4.96E-05
MDEA	1.77E-05
Piperazine	3.78E-06

3.3 Fuel Stream Summary

Name	mass%
CO2	0.041
Nitrogen	0.803
Methane	99.006
Ethane	0.151

3.4 Operating Conditions

Thermal Oxidizer Temperature	1,650 °F
Thermal Oxidizer Residence Time	1.0 s minimum
Excess Air, O2 % Vol Wet	3.0 minimum

3.5 Design Summary

Waste Stream Flow	lb/hr	5,492.18
Flue Gas Composition	wet vol %	
Argon		0.00
Carbon Dioxide		33.54
Water Vapor		16.21
Nitrogen		47.24
Hydrogen Chloride		0.00
Sulfur Dioxide		0.00
Oxygen		3.00
Total	%	100.00
Flue Gas Temperature	°F	1,650
Flue Gas Flow	lb/hr	13,118.83
Flue Gas MW	lb/lb-mol	31.878
Flue Gas Flow	ACFS	176.1
Fuel Gas Flow	lb/hr	153.9
Fuel Gas Heat Release	MM Btu/hr	3.28
Waste Stream Heat Release	MM Btu/hr	3.53
Total Heat Release	MM Btu/hr	6.81
Combustion Air Flow	lb/hr	7,472.71

3.6 Preliminary Utilities

Electrical Power	460V / 3 Phase / 60 Hz
Connected CAB Power Blower, HP	~ 5
Instrument Air, SCFH	2000 – 4000
Fuel Gas Required, MMBtu/hr	*see above design summary

3.7 System Performance

Stack Emission	Expected Performance	Units
Destruction Efficiency, H2S / VOC	>99	%

These values are understood to apply only when the system is operated in accordance with the operating conditions stipulated in the design summary and for the waste stipulated in the design basis sections of this proposal. VOC is defined as non-methane non-ethane hydrocarbons. Every mol of H2S is expected to convert into SO2 in the flue gas.

4.0 EQUIPMENT DESCRIPTION

4.1 Thermal Oxidizer

One (1) standard skid mounted horizontal thermal oxidizer is offered. Zeeco standard units are designed and constructed using Zeeco standard materials and manufacturers. It is designed to operate at 1650°F with excess air to ensure complete combustion of the waste gas combustible components. The thermal oxidizer has the following features:

- Nominal 5'-0" OD by 20'- 0" length chamber with 20'-0" stack discharge height
- Shell Material: SA-36
- Zeeco Standard Paint System
- Rainshield (ship loose for field installation)

4.2 Burner

One (1) Forced Draft Zeeco, GB Burner is offered with the following features:

- 5 MMBtu/hr maximum release rating
- High Energy Ignitor
- A-36 Carbon Steel Construction
- 10:1 Fuel Gas Turndown
- Zeeco Standard Paint System

4.3 Combustion Air Blowers

One (1) Combustion Air Fan is offered and has the following features:

- Preliminary Design Rate: 1688.32 SCFM
- TEFC Motor HP: 5
- Manufacturer's standard design
- Zeeco Standard Paint System
- VFD by others

4.4 Refractory

The thermal oxidizer chamber and stack are lined with hard castable material. Refractory will be shop installed by Zeeco. Partial Shop Dryout has not been included but can be offered as optional price.

4.5 Instrumentation and Controls

Zeeco's Standard Burner Management System and Instrumentation scope is offered by Zeeco Standard Suppliers. **Zeeco Standard AVL** has been quoted in the proposal for all instrumentation and controls.

- Pre-assembled fuel gas and instrument air control rack, field mounting by others
- Fuel rack mounted local control panel with BMS PLC
- The BMS complies with NFPA 86; the proposal offers a Zeeco Standard SIL-2 PLC
- Factory Functionality Acceptance Test included
- Oxygen Analyzer included
- Instrument/piping connections from rack to field instruments and other field equipment by others

Zeeco has not offered process control, waste gas piping or isolation valves. These items can be offered as an optional price.

5.0 PERFORMANCE WARRANTY

Zeeco warrants the system performance stated in this proposal. These values are understood to apply only when the system is operated in accordance with the operating conditions stipulated in the DESIGN SUMMARY for the waste (s) stipulated in the DESIGN BASIS sections of this proposal.

The purchaser, at his option and cost, may conduct a performance test to determine if the performance warranties are being met. The purchaser shall provide sufficient written notice to Zeeco so that a representative of Zeeco can witness the test. Additionally, Zeeco will be given access to all operating data and laboratory analysis that would bear on the final determination of performance. All analysis of operating data will be done in accordance with generally accepted engineering practice and only published physical data will be used.

Attachments:

A Clarifications, Comments and Exceptions

B Preliminary GA Drawing

C Preliminary P&IDs

ATTACHMENT A CLARIFICATIONS, COMMENTS AND EXCEPTIONS

Our quotation is in accordance with the specifications, drawings, terms and conditions and other requirements of this request for quotation with no exceptions or comments other than those listed below.

ZEECO STANDARD COMMENTS AND EXCEPTIONS:

1. Our proposal is made with the understanding that mutually agreeable terms and conditions can be negotiated before a purchase order is issued. Zeeco's Standard Terms and Conditions of Sale are the commercial basis of this proposal and are attached for your reference.
2. Three (3) copies of the operation manual are included in our pricing basis. Additional copies can be provided at an extra cost, if required.
3. All documentation and correspondence shall be supplied in the English language only.
4. Unless otherwise stated within this proposal, field installation of all equipment shall be by others.
5. Unless otherwise stated within this proposal, all field assistance associated with erection, start-up, commissioning, and performance testing shall be supplied extra as per the per diem rates noted in Attachment C of this proposal.
6. Buyer's employees and/or representatives of Buyer shall be allowed to inspect/observe the equipment fabrication from this inquiry and to review agreed to documents and qualifications as outlined in this quotation at Zeeco Inc. premises.
7. The mechanical warranty on materials and workmanship is valid for 12 months from the start-up of the equipment or 18 months from delivery of the equipment; whichever is earlier.
8. Unless otherwise stated within this proposal, all steel plate and piping materials shall originate from Zeeco standard steel suppliers.
9. All proprietary burner components shall be from Zeeco standard material suppliers.
10. Refractory material brand names that may be listed within this proposal are indicative of general properties and performance only. All refractory materials shall be sourced by Zeeco from our standard refractory manufacturers, and actual brand names may vary from those stated in this proposal.
11. Unless specifically stated within this proposal, Zeeco's pricing is exclusive of all taxes, duties, and associated fees.
12. Export crating, when included or offered as an option, provides for break bulk packing of smaller materials in wooden crates or pallets, and skid mounting and bundling of larger components for deck shipment. Packaging for large items is not designed for stacking. Containerization of any material is not included. If materials are quoted as FOB Port of Export basis, or if optional pricing is provided to move goods to the port of export, this is understood to mean the port nearest to the point of manufacture of the goods, unless an alternate port of export is clearly defined in the inquiry documents.
13. In any instance where the name of a particular manufacturer appears herein, such shall be interpreted to mean the product of that manufacturer or its equivalent (unless purchase of a particular manufacturer's product shown is mandatory).
14. Please note that we have received only process data in RFQ. Any additional specification and requirement will have cost and delivery implication.
15. Welding of proprietary components shall be per ASME Section IX and/or AWS standards unless otherwise mentioned within this proposal. Structural design shall be as per ASCE 7-98 standards.
16. If included in our proposal, ladders & platforms are to Zeeco's standards and shall meet or exceed OSHA standards.
17. If required, heat tracing, external insulation, and instrument insulation boxes are most economically supplied and installed by the field contractor. Unless otherwise stated within this proposal, Zeeco's offered price does not include materials or labor associated with these items.
18. If included in this proposal, Zeeco's fuel metering rack shall be shipped as a pre-piped and pre-wired assembly, complete with all conduit, cable trays, and junction boxes associated with the "on-rack" instruments. All interconnecting piping, wiring, conduit, and cable trays between this rack and other equipment items are most economically supplied and installed by the field contractor. Unless otherwise stated within this proposal, Zeeco's offered price does not include materials or labor associated with these items.
19. Unless otherwise stated within this proposal, hydrotest, postweld heat treatment, and charpy impact testing of materials are not included. Unless otherwise stated within this proposal, our pricing includes

- spot radiography only. Unless otherwise stated in the project specifications, system manufacturing, inspection and testing shall be as per Zeeco Inc. QA/QC manual.
20. Radiographic examination shall be performed by gamma radiation, utilizing only fine grain film. The radiographic sensitivity and quality shall be equal to or exceed that specified in the ASME Boiler & Pressure Vessel Code, Section VIII-1 and B31.3.
 21. Allowable nozzle loads shall be as stated within or extrapolated from API 560 Third Edition.
 22. Instrumentation not specifically included within this proposal shall be furnished and installed by others.
 23. Unless stated otherwise within this proposal, Zeeco's scope of supply does not include: Equipment Anchor Bolts; Foundations and Detailed Foundation Design; Slide Plates; Interconnecting Piping, Conduit, Wire, Cables, and Cable Trays; Motor Starters or MCC; Vibration Monitoring Systems; Heat Tracing, External Insulation, and Instrument Insulation Boxes.
 24. Unless otherwise stated within this proposal, combustion air ducting shall not be subject to piping material specifications.
 25. Particulate emissions guarantees are valid for *combustion-generated* particulate emissions only.
 26. Nozzles are quoted assuming loads, per table 25.1, are to be applied. If we are supplied with the loads that will be applied to the nozzles, Zeeco will be happy to requote based on the provided loads.

Table 25.1

Nozzle SIZE (inches)	FX lb	FY lb	FZ lb	MX lb-ft	MY lb-ft	MZ lb-ft
2	100	200	200	350	250	250
3	150	300	300	450	350	350
4	200	400	400	600	450	450
5	225	450	450	660	500	500
6	250	500	500	730	550	550
8	300	600	600	860	650	650
10	350	650	650	930	700	700
12	400	700	700	1000	750	750
14	403	747	747	1055	797	797
16	425	784	784	1105	834	834
18	444	818	818	1149	868	868
20	461	848	848	1189	898	898
24	491	899	899	1257	949	949
30	527	962	962	1340	1012	1012
36	557	1014	1014	1408	1064	1064
42	582	1058	1058	1466	1108	1108

PROJECT CLARIFICATIONS AND EXCEPTIONS:

ATTACHMENT B
PRELIMINARY GA DRAWING

**ATTACHMENT C
PRELIMINARY P&IDs**





The Zeeco Difference

Our only business is the combustion business. By concentrating on what we do best, Zeeco has grown into a worldwide leader in combustion solutions. We are a privately held company whose ownership stays highly involved in daily operations, with upper management comprised of the world's leading combustion experts.

When you call Zeeco, we answer. When you make a request, you get a quick, efficient response. We are lean and efficient, able to make decisions quickly, without bureaucracy and red tape. Our sales, engineering, and purchasing groups work hand-in-hand to deliver highly competitive quotes and heroic turnaround times. We stand ready and willing to travel anywhere in the world to discuss upcoming projects firsthand, and to ensure that every existing project runs seamlessly.



Visit zeeco.com/contact for additional Global Location contact information



Choose to work with our dedicated, flexible, and innovative team, and you won't be disappointed. Call or email us today to request a quote or to learn more about our proprietary combustion systems.

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REGISTERED
ISO 9001:2015

Certification applies to
Zeeco Headquarters.

Section C - Air Cleaning Device (Continued)

12. Flares (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type ☐ Elevated flare ☐ Ground flare ☐ Other _____ Describe	Model No.
Design Volume (SCFM)	Dimensions of stack (ft.) Diameter _____ Height _____	
Residence time (sec.) and outlet temperature (°F)	Turn down ratio	Burner details

Describe the flare design (air/steam-assisted or nonassisted), essential auxiliaries including pilot flame monitor of proposed flare with a sketch.

Describe the operation of the flare's ignition system.

Describe the provisions to introduce auxiliary fuel to the flare.

Operation Parameters

Detailed composition of the waste gas	Heat content	Exit velocity
Maximum and average gas flow burned (ACFM)		Operating temperature (°F)

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

13. Other Control Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Volume (SCFM)		Capacity	
Describe pH monitoring and pH adjustment, if any.			
Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.			
Attach efficiency curve and/or other efficiency information.			
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.			
Operation Parameters			
Volume of gas handled _____ ACFM @ _____ °F _____ % Moisture			
Describe fully giving important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

14. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Annual Operating Cost
Thermal Oxidizer (THERM-002)	TBD	TBD	TBD	TBD

15. Miscellaneous

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

Routine maintenance and cleaning as prescribed by device manufacturer.

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

THERM-002 manufacturer's specs attached.

Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase air contaminant emissions.

TBD, at a minimum as often as prescribed by device manufacturer.

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

No, the sources in this application are to be constructed as part of Cryo Train II, all emissions are included in the PTE calculated in this application. Cryo I was permitted at max throughputs and is permitted for Cryo I PTE.

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards.

a. Prevention of Significant Deterioration permit (PSD), 40 CFR 52?	☐ YES	☒ NO
b. New Source Review (NSR), 25 Pa. Code Chapter 127, Subchapter E?	☐ YES	☒ NO
c. New Source Performance Standards (NSPS), 40 CFR Part 60? (If Yes, which subpart) NSPS OOOOb_____	☒ YES	☐ NO
d. National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61? (If Yes, which subpart) _____	☐ YES	☒ NO
e. Maximum Achievable Control Technology (MACT) 40 CFR Part 63? (If Yes, which part) _____	☐ YES	☒ NO

Attach a demonstration showing that the emissions from any new sources will be the minimum attainable through the use of best available technology (BAT).

BAT Analysis in Attachment H.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last five (5) years for applicable PSD pollutant(s) if the facility is an existing major facility (PSD purposes).

N/A

Section F - Flue and Air Contaminant Emission

1. Estimated Atmospheric Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number

Z204 Thermal Oxidizer

List Source(s) or source ID exhausted to this stack:

Amine-002: Still Vent & Flash Tank

% of flow exhausted to stack: 100%

Stack height above grade (ft.)

Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

f. Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
Z204	40	24	36.40	80	20	49.92

Stack exhaust Volume _____ ACFM Temperature _____ °F Moisture _____ %
Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.
Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.
** If the data and collection method codes differ from those provided on the General Information Form-Authorization Application, provide the additional detail required by that form on a separate form.

Section B - Processes Information

1. Source Information

Source Description (give type, use, raw materials, product, etc). Attach additional sheets as necessary.
Compressor & Misc. Blowdowns, Residue Compressor Rod Packing, and Centrifugal Dry Compressor Seal Venting

Manufacturer N/A	Model No. N/A	Number of Sources 1
Source Designation P802	Maximum Capacity 21,286 lb/hr (total)	Rated Capacity 21,286 lb/hr (total)

Type of Material Processed
Purge Gas, Residue Gas, NGL, Closed Drain Vapors

Maximum Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8760

Operational restrictions existing or requested, if any (e.g., bottlenecks or voluntary restrictions to limit PTE)

Capacity (specify units)

Per Hour 21,286 lb/hr	Per Day 510,863.7 lb/day	Per Week 3,576,046 lb/week	Per Year 1.86x10 ⁸ lb/year

Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8760

Seasonal variations (Months) From to

If variations exist, describe them

2. Fuel (NOT APPLICABLE)

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Gas (other) _____	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Coal _____	TPH	Tons	% by wt		Btu/lb
Other *					

*Note: Describe and furnish information separately for other fuels in Addendum B.

Section B - Processes Information (Continued)

3. Burner (NOT APPLICABLE)

Manufacturer	Type and Model No.	Number of Burners
Description:		
Rated Capacity	Maximum Capacity	

4. Process Storage Vessels (NOT APPLICABLE)

A. For Liquids:

Name of material stored		
Tank I.D. No.	Manufacturer	Date Installed
Maximum Pressure	Capacity (gallons/Meter ³)	
Type of relief device (pressure set vent/conservation vent/emergency vent/open vent)		
Relief valve/vent set pressure (psig)	Vapor press. of liquid at storage temp. (psia/kPa)	
Type of Roof: Describe:		
Total Throughput Per Year	Number of fills per day (fill/day): Filling Rate (gal./min.): Duration of fill hr./fill):	

B. For Solids

Type: ☐ Silo ☐ Storage Bin ☐ Other, Describe		Name of Material Stored
Silo/Storage Bin I.D. No.	Manufacturer	Date Installed
State whether the material will be stored in loose or bags in silos		Capacity (Tons)
Turn over per year in tons		Turn over per day in tons
Describe fugitive dust control system for loading and handling operations		
Describe material handling system		

5. Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No
 If yes, include justification for confidentiality. Place such information on separate pages marked "confidential".

Section B - Processes Information (Continued)

6. Miscellaneous Information

Attach flow diagram of process giving all (gaseous, liquid and solid) flow rates. Also, list all raw materials charged to process equipment, and the amounts charged (tons/hour, etc.) at rated capacity (give maximum, minimum and average charges describing fully expected variations in production rates). Indicate (on diagram) all points where contaminants are controlled (location of water sprays, collection hoods, or other pickup points, etc.). Describe collection hoods location, design, airflow and capture efficiency. Describe any restriction requested and how it will be monitored.

See Process Flow Diagram in Attachment D.

Describe fully the facilities provided to monitor and to record process operating conditions, which may affect the emission of air contaminants. Show that they are reasonable and adequate.

FLARE-002 is equipped with a continuous pilot flame detection system to ensure ignition.

Describe each proposed modification to an existing source.

N/A

Identify and describe all fugitive emission points, all relief and emergency valves and any by-pass stacks.

N/A

Describe how emissions will be minimized especially during start up, shut down, process upsets and/or disruptions.

Compressor blowdowns and rod packing, centrifugal dry compressor seal venting, purge gas, closed drain vapors, and misc. blowdowns will be controlled by a VRU and will utilize FLARE-002 as a back up.

Anticipated Milestones:

- i. Expected commencement date of construction/reconstruction/installation: TBD
- ii. Expected completion date of construction/reconstruction/installation: _____
- iii. Anticipated date of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions*

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM	Varies – See Emission Calcs in Attachment E	----	----	----	----
PM ₁₀	----	----	----	----	----
SO _x	----	----	----	----	----
CO	----	----	----	----	----
NO _x	----	----	----	----	----
VOC	----	----	----	----	----
Others: (e.g., HAPs)	----	----	----	----	----
Benzene	----	----	----	----	----
Toluene	----	----	----	----	----
Ethylbenzene	----	----	----	----	----
Xylene	----	----	----	----	----
n-Hexane	----	----	----	----	----
Methanol	----	----	----	----	----
Total HAPs	----	----	----	----	----
CO ₂	----	----	----	----	----
CH ₄	----	----	----	----	----

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Gas Cooling (NOT APPLICABLE)

Water quenching ☐ Yes ☐ No		Water injection rate _____ GPM
Radiation and convection cooling ☐ Yes ☐ No		Air dilution ☐ Yes ☐ No If yes, _____ CFM
Forced Draft ☐ Yes ☐ No		Water cooled duct work ☐ Yes ☐ No
Other		
Inlet Volume _____ ACFM @ _____ °F _____ % Moisture		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture

Describe the system in detail.

Blowdown Sources include residue compressor (electric), moisture analyzer, facility maintenance, and misc. blowdowns. Compressor blowdowns and misc. blowdowns controlled by FLARE-002.

Section C - Air Cleaning Device (Continued)

3. Settling Chambers (NOT APPLICABLE)

Manufacturer	Volume of gas handled _____ACFM @ _____°F	Gas velocity (ft/sec.)	
Length of chamber (ft.)	Width of chamber (ft.)	Height of chamber (ft.)	Number of trays
Water injection ☐ Yes ☐ No		Water injection rate (GPM)	

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

4. Inertial and Cyclone Collectors (NOT APPLICABLE)

Manufacturer	Type	Model No.
Pressure drop (in. of water)	Inlet volume _____ACFM @ _____°F	Outlet volume _____ACFM @ _____°F
Number of individual cyclone(s)		Outlet straightening vanes used? ☐ Yes ☐ No
Length of Cyclone(s) Cylinder (ft.)	Diameter of Cyclone(s) Cylinder (ft.)	Length of Cyclone(s) cone (ft.)
Inlet Diameter (ft.) or duct area (ft. ²) of cyclone(s)		Outlet Diameter (ft.) or duct area (ft. ²) of cyclone(s)

If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?

Describe any exhaust gas recirculation loop to be employed.

Attach particle size efficiency curve

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Model No.	☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment	Is Baghouse Insulated? ☐ Yes ☐ No
Can each compartment be isolated for repairs and/or filter replacement?		☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)		☐ Yes ☐ No

Dew point at maximum moisture _____ °F	Design inlet volume _____ SCFM

Type of Fabric

Material _____	☐ Felted	☐ Membrane
Weight _____ oz/sq.yd	☐ Woven	☐ Others: List: _____
Thickness _____ in	☐ Felted-Woven	

Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.

Filter dimensions Length _____ Diameter/Width _____

Effective area per filter _____	Maximum operating temperature (°F) _____

Effective air to cloth ratio Minimum _____ Maximum _____

Drawing of Fabric Filter

A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.

Operation and Cleaning

Volume of gases handled _____ ACFM @ _____ °F	Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.

Type of filter cleaning

☐ Manual Cleaning	☐ Bag Collapse	☐ Reverse Air Jets
☐ Mechanical Shakers	☐ Sonic Cleaning	☐ Other: _____
☐ Pneumatic Shakers	☐ Reverse Air Flow	

Describe the equipment provided if dry oil free air is required for collector operation

Cleaning Initiated By

☐ Timer	Frequency if timer actuated _____	
☐ Expected pressure drop range _____ in. of water	☐ Other Specify _____	

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

6. Wet Collection Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)

Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).

Describe pH monitoring and pH adjustment systems, if applicable.

Describe mist eliminator or separator (type, configuration, backflush capability, frequency).

Attach particulate size efficiency curve.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture

Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)

Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.)

State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Electrostatic Precipitator (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Model No.	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ Yes ☐ No		Design Inlet Volume (SCFM) _____ Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft.		Collector plates size length _____ ft. x width _____ ft.	
Number of fields _____		Number of collector plates/field _____	
Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft./sec.		Minimum gas treatment time: _____ sec.	
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number of collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____ Describe in detail			

Operating Parameters

Inlet gas temperature (°F) _____	State pressure drop range (inches water gauge) across collector only _____ Describe the equipment
Outlet gas temperature (°F) _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field			
Field No.	No. of Sets	Each Transformer KVA	Each Rectifier KV Ave./Peak Ma DC
Current Density _____ Micro amperes/ft ² .		Corona Power _____ Watts/1000 ACFM	Corona Power Density _____ Watts/ft ² .
Will a flue gas conditioning system be employed? If yes, describe it.			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. Adsorption Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)	Adsorbent charge per adsorber vessel and number of adsorber vessels	
Length of Mass Transfer Zone (MTZ), supplied by the manufacturer based upon laboratory data.		
Adsorber diameter (ft.) and area ft ² .)	Adsorption bed depth (ft.)	

Adsorbent information

Adsorbent type and physical properties.

Working capacity of adsorbent (%)	Heel percent or unrecoverable solvent weight % in the adsorbent after regeneration.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	
Adsorption time per adsorption bed	Breakthrough capacity: Lbs. of solvent / 100 lbs. of adsorbent = _____
Vapor pressure of solvents at the inlet temperature	Available steam in pounds to regenerate carbon adsorber (if applicable)
Percent relative saturation of each solvent at the inlet temperature	
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Absorption Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Inlet Volume (SCFM)		Tower height (ft.) and inside diameter (ft.)	
Packing type and size (if applicable)		Height of packing (ft.) (if applicable)	
Number of trays (if applicable)		Number of bubble caps (if applicable)	
Configuration ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls.			
Absorbent information			
Absorbent type and concentration.		Retention time (sec.)	
Attach equilibrium data for absorption (if applicable)			
Attach any additional information regarding auxiliary equipment, absorption solution supply system (once through or recirculating, system capacity, etc.) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating Parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in. of water) and liquid flow rate. Describe the monitoring equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. ☐ Selective Catalytic Reduction (SCR) **(NOT APPLICABLE)**
☐ Selective Non-Catalytic Reduction (SNCR) **(NOT APPLICABLE)**
☐ Non-Selective Catalytic Reduction (NSCR) **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Design operating temperature (°F)

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.

Attach efficiency and other pertinent information (e.g., ammonia slip)

Operating Parameters

Volume of gases handled _____ (ACFM) @ _____ °F	
Operating temperature range for the SCR/SNCR/NSCR system (°F) From _____ °F To _____ °F	
Reducing agent used, if any	Oxidation catalyst used, if any
State expected range of usage rate and concentration.	
Service life of catalyst	Ammonia slip (ppm)
Describe fully with a sketch giving locations of equipment, controls systems, important parameters and method of operation.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

11. Oxidizer/Afterburners (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type ☐ Thermal ☐ Catalytic	Model No.	
Design Inlet Volume (SCFM)	Combustion chamber dimensions (length, cross-sectional area, effective chamber volume, etc.)		
Describe design features, which will ensure mixing in combustion chamber.			
Describe method of preheating incoming gases (if applicable).		Describe heat exchanger system used for heat recovery (if applicable).	
Catalyst used	Life of catalyst	Expected temperature rise across catalyst (°F) Dimensions of bed (in inches). Height: _____ Diameter or Width: _____ Depth: _____	
Are temperature sensing devices being provided to measure the temperature rise across the catalyst? ☐ Yes ☐ No If yes, describe.			
Describe any temperature sensing and/or recording devices (including specific location of temperature probe in a drawing or sketch).			
Burner Information			
Burner Manufacturer	Model No.	Fuel Used	
Number and capacity of burners	Rated capacity (each)	Maximum capacity (each)	
Describe the operation of the burner		Attach dimensioned diagram of afterburner	
Operating Parameters			
Inlet flow rate (ACFM) _____ @ _____ °F		Outlet flow rate (ACFM) _____ @ _____ °F	
State pressure drop range across catalytic bed (in. of water).		Describe the method adopted for regeneration or disposal of the used catalyst.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)
VOC			
Total HAPs			

Section C - Air Cleaning Device (Continued)

12. Flares

Equipment Specifications

Manufacturer Zeeco	Type ☒ Elevated flare ☐ Ground flare ☐ Other _____ Describe	Model No. TBD
Design Volume (SCFM) 50,000 (lb/hr)	Dimensions of stack (ft.) Diameter <u>TBD</u> Height <u>TBD</u>	
Residence time (sec.) and outlet temperature (°F)	Turn down ratio	Burner details

Describe the flare design (air/steam-assisted or nonassisted), essential auxiliaries including pilot flame monitor of proposed flare with a sketch.

FLARE-002 max design capacity is estimated at 1,359 MMBtu/hr.

Describe the operation of the flare's ignition system.

FLARE-002 is equipped with a continuous pilot, flame detection system to ensure ignition.

Describe the provisions to introduce auxiliary fuel to the flare.

Operation Parameters

Detailed composition of the waste gas Flare streams may include purge gas, pilot, residue compressor blowdowns and rod packing, centrifugal dry compressor seal venting, closed drain vapors, and misc. eqt blowdowns. See calculations for additional details.	Heat content 23,127 btu/lb	Exit velocity TBD
Maximum and average gas flow burned (ACFM) 8,282 scf/min	Operating temperature (°F) TBD	

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)
VOC	See Attachment E		
HAP			
CH ₄			



- Burners
- Flares
- Incinerators
- Aftermarket Products & Services

Customer name _____
Customer ref # _____
User name _____
Jobsite location _____
Zeeco Inc. ref # _____
Date: _____ Revision #: _____

FLARE SYSTEM DATA SHEET

FLARE TYPE: ☒ Elevated Flare ☐ Enclosed Ground Flare ☐ Pit Flare ☐ Tripod Supported
☐ Guy Wire Supported ☒ Self-supported ☐ Derrick Supported ☐ Multipoint Ground Flare ☐ Enclosure Fence

FLARE TIP: ☐ Non-assisted ☐ Steam assisted ☐ Gas assisted ☒ Air-assisted ☐ Sonic MJ

DRUM TYPE: ☐ Vertical Knockout ☐ Liquid Seal ☒ Horizontal Knockout ☐ None

PURGE SEAL TYPE: ☐ Gas Purge Seal ☒ Velocity Purge Seal ☐ None

UNITS FOR DATA SHEET:

Flow: ☐ KG/HR ☒ LB/HR ☐ SCFD ☐ NM³/HR ☐ LBMOLES/HR
Temperature: ☐ °C ☒ °F ☐ °R Heating Value: ☒ BTU/SCF ☐ BTU/LB ☐ KJ/NM³
Pressure: ☒ PSIG ☐ BARG ☐ KPAG ☐ KG/CM²
Radiation: ☒ BTU/HR-FT² ☐ KW/M² Velocity: ☒ FT/SEC ☐ MPH ☐ M/SEC

PROCESS DATA:

PROCESS RELIEF CASE	FLOWRATE	TEMPERATURE	ALLOWABLE SYSTEM PRESSURE DROP	LOWER HEATING VALUE	RELIEF DURATION SHORT/LONG/CONTINUOUS	MOLECULAR WEIGHT
Maximum	600,000	90	5	1,800	Short	25-44
Smokeless	50,000	-20		2,100	Short	25-44
Normal	Purge					
Minimum	Purge					

UTILITY DATA:

UTILITY	PRESSURE	TEMPERATURE	MOLECULAR WEIGHT	LOWER HEATING VALUE
Fuel Gas	130	60		1,000
Natural Gas				
Purge Gas				
Instrument Air			NA	NA
Plant Air	100	60	NA	NA
Plant Water			18	NA
LP Steam			18	NA
MP Steam			18	NA
HP Steam			18	NA



- Burners
- Flares
- Incinerators
- Aftermarket Products & Services

Customer name _____
Customer ref # _____
User name _____
Jobsite location _____
Zeeco Inc. ref # _____
Date: _____ Revision #: _____

POWER TYPE	VOLTAGE	PHASE	HERTZ	AC or DC
General Instruments	24			DC
General Lighting	120	Single	60	AC
Aviation Lighting	120	Single	60	AC
Ignition Control Panel	120	Single	60	AC
Motors Under 100 HP	480	Three	60	AC
Motors 101-500 HP	480	Three	60	AC
Motors 501-1000 HP				

ENVIRONMENTAL DATA:

Average wind speed (process design) 11 mph
Maximum wind speed (mechanical design) 150 mph
Site elevation above sea level 1,100'
Site relative humidity 50%
Minimum ambient temperature -20F
Average ambient temperature 45F
Maximum ambient temperature 105F
Seismic zone for site 4-8
Maximum allowable radiation: ☐ at grade _____ ☐ with ☐ without solar
☐ at distance _____ ☐ with ☐ without solar
of: _____
Solar radiation level at site _____
Maximum noise level (dBA): ☐ at grade _____ ☐ smokeless ☐ max. flow
☐ at distance _____ ☐ smokeless ☐ max. flow
of: _____
Electrical area classification at / near flare Class 1 Div 2 near gas pipe and vessels

CUSTOMER AND JOBSITE INFORMATION:

Customer name	<u>ET NE Pipeline</u>	End users name	<u>_____</u>
Street address	<u>6051 Wallace Rd Ext</u>	Street address	<u>_____</u>
Post office box	<u>_____</u>	Post office box	<u>_____</u>
City/State/Country/Zip	<u>Wexford, PA, 15090</u>	City/State/Country/Zip	<u>_____</u>
Contact name	<u>Dustin Tindall</u>	Contact name	<u>_____</u>
Phone number	<u>806-282-7263</u>	Phone number	<u>_____</u>
Facsimile number	<u>_____</u>	Facsimile number	<u>_____</u>



- Burners
- Flares
- Incinerators
- Aftermarket Products & Services

Customer name _____
 Customer ref # _____
 User name _____
 Jobsite location _____
 Zeeco Inc. ref # _____
 Date: _____ Revision #: _____

GENERAL DESIGN CRITERIA:

Rank the following factors in order of importance (1-8)(1=high) relative to the flare equipment for this project:

Equipment cost 8 Utility usage 6 Experience 4 Noise 2
 Installed cost 3 Smokeless capacity 1 Weight 7 Field service 5

Applicable specifications: ☒ NEC ☐ IEC ☐ NEMA ☐ AISC
☐ AWS ☒ ASME ☒ ANSI B31.3 ☐ ASCE 7-93

DETAILED SCOPE OF SUPPLY:

☐ Ladders/platforms: ☐ Per OSHA ☐ Caged ☐ Saf-T-Climb ☐ Galvanized ☐ Painted

☐ Ignition system: ☐ Manual ☐ Automatic relight ☐ Pilot status monitors ☐ Regulators
☐ Sun/rain shield ☐ Free standing ☐ Self-inspiring type ☐ FFG type
☐ Direct high energy spark ignition ☐ Optical pilot monitoring device

☐ Aviation marking: ☐ Per ICAO ☐ Per FAA ☐ Fixed ☐ Retractable
☐ L+P access ☐ Strobe type ☐ Incandescent type ☐ Banded paint

☐ Utility piping/wiring: ☐ Pilot gas ☐ Ignition lines ☐ Steam lines ☐ Conduit ☐ Assist gas
☐ Thermocouple wire ☐ High energy ignitor wire ☐ Power wire

☐ Corrosion protection: ☐ SP-2 cleaning ☐ SP-6 sandblast ☐ SP-10 sandblast ☐ Other _____
☐ Red oxide primer ☐ Inorganic zinc primer ☐ Epoxy primer
☐ Epoxy finish paint ☐ Silicone finish paint ☐ Other _____

DETAILED MECHANICAL DESIGN CRITERIA:

SYSTEM COMPONENT	INTERNAL DESIGN PRESSURE	MECHANICAL DESIGN TEMPERATURE	MATERIAL OF CONSTRUCTION	PROCESS SIDE CORROSION ALLOWANCE
Liquid Seal drum				
Knockout drum	150	150	CS	Min - Sec. VIII
Flare gas riser				
Gas Purge seal device				
Support structure	NA	NA		NA
Steam piping				
Pilot gas piping				
Ignition piping				

NOTE: Attach sketch if this is for modification to an existing flare system or existing vent system.



- Burners
- Flares
- Incinerators
- Aftermarket Products & Services

Customer name _____
Customer ref # _____
User name _____
Jobsite location _____
Zeeco Inc. ref # _____
Date: _____ Revision #: _____

GAS COMPOSITION:

☒ Mole % ☐ Weight %

COMPONENT	MAXIMUM FLOW CASE	SMOKELESS FLOW CASE	NORMAL FLOW CASE	MINIMUM FLOW CASE	PILOT FUEL GAS
Methane	1				
Ethane	72	27			
Propane	20	73			
Butane	6				
Pentane +	1				
Hexane					
Heptane					
Octane					
C9+ Saturates					
Ethylene					
Propylene					
Butylene					
Butene					
Butadiene					
Acetylene					
Benzene					
Toluene					
Xylene					
Styrene					
C9+ Unsaturates					
Ammonia					
Hydrogen					
Hydrogen Sulfide					
Carbon Monoxide					
Carbon Dioxide					
Water					
Nitrogen					
Oxygen					

COMMENTS:

Section C - Air Cleaning Device (Continued)

13. Other Control Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Volume (SCFM)		Capacity	
Describe pH monitoring and pH adjustment, if any.			
Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.			
Attach efficiency curve and/or other efficiency information.			
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.			
Operation Parameters			
Volume of gas handled _____ ACFM @ _____ °F _____ % Moisture			
Describe fully giving important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

14. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Annual Operating Cost
Flare	TBD	TBD	TBD	TBD

15. Miscellaneous

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

Routine maintenance and cleaning as prescribed by device manufacturer

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase air contaminant emissions.

TBD, at a minimum as often as prescribed by device manufacturer.

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

No, the sources in this application are to be constructed as part of Cryo Train II, all emissions are included in the PTE calculated in this application. Cryo I was permitted at max throughputs and is permitted for Cryo I PTE.

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards.

a. Prevention of Significant Deterioration permit (PSD), 40 CFR 52?	☐ YES	☐ NO
b. New Source Review (NSR), 25 Pa. Code Chapter 127, Subchapter E?	☐ YES	☐ NO
c. New Source Performance Standards (NSPS), 40 CFR Part 60? (If Yes, which subpart) _____	☐ YES	☐ NO
d. National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61? (If Yes, which subpart) _____	☐ YES	☐ NO
e. Maximum Achievable Control Technology (MACT) 40 CFR Part 63? (If Yes, which part) _____	☐ YES	☐ NO

Attach a demonstration showing that the emissions from any new sources will be the minimum attainable through the use of best available technology (BAT).

BAT Analysis in Attachment H.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last five (5) years for applicable PSD pollutant(s) if the facility is an existing major facility (PSD purposes).

N/A

Section F - Flue and Air Contaminant Emission

1. Estimated Atmospheric Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number

Z802 Compressor & Misc. Blowdowns

List Source(s) or source ID exhausted to this stack:

P802

% of flow exhausted to stack: 100%

Stack height above grade (ft.)

Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

f. Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack exhaust Volume _____ ACFM Temperature _____ °F Moisture _____ %
Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.
Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.
** If the data and collection method codes differ from those provided on the General Information Form-Authorization Application, provide the additional detail required by that form on a separate form.

Section B - Processes Information

1. Source Information

Source Description (give type, use, raw materials, product, etc). Attach additional sheets as necessary.
Fugitives

Manufacturer N/A	Model No. N/A	Number of Sources 1
Source Designation P703	Maximum Capacity 2,811,679 scf/yr	Rated Capacity 2,811,679 scf/yr

Type of Material Processed
Natural Gas

Maximum Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8760

Operational restrictions existing or requested, if any (e.g., bottlenecks or voluntary restrictions to limit PTE)

Capacity (specify units)

Per Hour	Per Day	Per Week	Per Year

Operating Schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8760

Seasonal variations (Months) From to

If variations exist, describe them

2. Fuel (NOT APPLICABLE)

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number _____	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Gas (other) _____	SCFH	X 10 ⁶ SCF	grain/100 SCF		Btu/SCF
Coal _____	TPH	Tons	% by wt		Btu/lb
Other * _____					

*Note: Describe and furnish information separately for other fuels in Addendum B.

Section B - Processes Information (Continued)

3. Burner (NOT APPLICABLE)

Manufacturer	Type and Model No.	Number of Burners
Description:		
Rated Capacity	Maximum Capacity	

4. Process Storage Vessels (NOT APPLICABLE)

A. For Liquids:

Name of material stored		
Tank I.D. No.	Manufacturer	Date Installed
Maximum Pressure	Capacity (gallons/Meter ³)	
Type of relief device (pressure set vent/conservation vent/emergency vent/open vent)		
Relief valve/vent set pressure (psig)	Vapor press. of liquid at storage temp. (psia/kPa)	
Type of Roof: Describe:		
Total Throughput Per Year	Number of fills per day (fill/day): Filling Rate (gal./min.): Duration of fill hr./fill):	

B. For Solids

Type: ☐ Silo ☐ Storage Bin ☐ Other, Describe		Name of Material Stored
Silo/Storage Bin I.D. No.	Manufacturer	Date Installed
State whether the material will be stored in loose or bags in silos		Capacity (Tons)
Turn over per year in tons		Turn over per day in tons
Describe fugitive dust control system for loading and handling operations		
Describe material handling system		

5. Request for Confidentiality

Do you request any information on this application to be treated as "Confidential"? ☐ Yes ☒ No
 If yes, include justification for confidentiality. Place such information on separate pages marked "confidential".

Section B - Processes Information (Continued)

6. Miscellaneous Information

Attach flow diagram of process giving all (gaseous, liquid and solid) flow rates. Also, list all raw materials charged to process equipment, and the amounts charged (tons/hour, etc.) at rated capacity (give maximum, minimum and average charges describing fully expected variations in production rates). Indicate (on diagram) all points where contaminants are controlled (location of water sprays, collection hoods, or other pickup points, etc.). Describe collection hoods location, design, airflow and capture efficiency. Describe any restriction requested and how it will be monitored.

See Process Flow Diagram in Attachment D.

Describe fully the facilities provided to monitor and to record process operating conditions, which may affect the emission of air contaminants. Show that they are reasonable and adequate.

Describe each proposed modification to an existing source.

N/A

Identify and describe all fugitive emission points, all relief and emergency valves and any by-pass stacks.

Fugitive emissions from component leaks are accounted for in the emission calculations using emission factors taken from 1995 Protocol for Equipment Leak Emission Estimates Table 2-4, EPA-453/R-95-017.

Describe how emissions will be minimized especially during start up, shut down, process upsets and/or disruptions.

Anticipated Milestones:

- i. Expected commencement date of construction/reconstruction/installation: TBD
- ii. Expected completion date of construction/reconstruction/installation: _____
- iii. Anticipated date of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions*

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM	See Attachment E				
PM ₁₀					
SO _x					
CO					
NO _x					
VOC					
Others: (e.g., HAPs)					
Benzene					
Toluene					
Ethylbenzene					
Xylene					
n-Hexane					
Methanol					
Total HAPs					
CO ₂					
CH ₄					

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Gas Cooling (NOT APPLICABLE)

Water quenching ☐ Yes ☐ No		Water injection rate _____ GPM
Radiation and convection cooling ☐ Yes ☐ No		Air dilution ☐ Yes ☐ No If yes, _____ CFM
Forced Draft ☐ Yes ☐ No		Water cooled duct work ☐ Yes ☐ No
Other		
Inlet Volume _____ ACFM @ _____ °F _____ % Moisture		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Settling Chambers (NOT APPLICABLE)

Manufacturer	Volume of gas handled _____ ACFM @ _____ °F	Gas velocity (ft/sec.)	
Length of chamber (ft.)	Width of chamber (ft.)	Height of chamber (ft.)	Number of trays
Water injection ☐ Yes ☐ No		Water injection rate (GPM)	

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

4. Inertial and Cyclone Collectors (NOT APPLICABLE)

Manufacturer	Type	Model No.
Pressure drop (in. of water)	Inlet volume _____ ACFM @ _____ °F	Outlet volume _____ ACFM @ _____ °F
Number of individual cyclone(s)		Outlet straightening vanes used? ☐ Yes ☐ No
Length of Cyclone(s) Cylinder (ft.)	Diameter of Cyclone(s) Cylinder (ft.)	Length of Cyclone(s) cone (ft.)
Inlet Diameter (ft.) or duct area (ft. ²) of cyclone(s)		Outlet Diameter (ft.) or duct area (ft. ²) of cyclone(s)

If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?

Describe any exhaust gas recirculation loop to be employed.

Attach particle size efficiency curve

Emissions Data

Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Model No.		☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment	Is Baghouse Insulated?		
		☐ Yes ☐ No		
Can each compartment be isolated for repairs and/or filter replacement?				☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)				☐ Yes ☐ No
Dew point at maximum moisture _____ °F		Design inlet volume _____ SCFM		
Type of Fabric Material _____ ☐ Felted ☐ Membrane Weight _____ oz/sq.yd ☐ Woven ☐ Others: List: _____ Thickness _____ in ☐ Felted-Woven				
Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.				
Filter dimensions Length _____ Diameter/Width _____				
Effective area per filter _____			Maximum operating temperature (°F) _____	
Effective air to cloth ratio Minimum _____ Maximum _____				
Drawing of Fabric Filter A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.				
Operation and Cleaning				
Volume of gases handled _____ ACFM @ _____ °F		Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.		
Type of filter cleaning ☐ Manual Cleaning ☐ Bag Collapse ☐ Reverse Air Jets ☐ Mechanical Shakers ☐ Sonic Cleaning ☐ Other: _____ ☐ Pneumatic Shakers ☐ Reverse Air Flow				
Describe the equipment provided if dry oil free air is required for collector operation				
Cleaning Initiated By ☐ Timer Frequency if timer actuated _____ ☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____				
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.				
Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.				
Emissions Data				
Pollutant	Inlet	Outlet	Removal Efficiency (%)	

Section C - Air Cleaning Device (Continued)

6. Wet Collection Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)	
Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).			
Describe pH monitoring and pH adjustment systems, if applicable.			
Describe mist eliminator or separator (type, configuration, backflush capability, frequency).			
Attach particulate size efficiency curve.			
Operating Parameters			
Inlet volume of gases handled _____ (ACFM) @ _____ °F		Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture	
Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)			
Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.)			
State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Electrostatic Precipitator (NOT APPLICABLE)

Equipment Specifications

Manufacturer _____	Model No. _____	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ Yes ☐ No		Design Inlet Volume (SCFM) _____	
		Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft.		Collector plates size length _____ ft. x width _____ ft.	
Number of fields _____		Number of collector plates/field _____	
Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft./sec.		Minimum gas treatment time: _____ sec.	
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number of collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____ Describe in detail			

Operating Parameters

Inlet gas temperature (°F) _____	State pressure drop range (inches water gauge) across collector only _____
Outlet gas temperature (°F) _____	
Describe the equipment _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary? _____

Power requirements

Number and size of Transformer Rectifier sets by electrical field			
Field No.	No. of Sets	Each Transformer KVA	Each Rectifier KV Ave./Peak Ma DC
Current Density _____ Micro amperes/ft ² .		Corona Power _____ Watts/1000 ACFM	Corona Power Density _____ Watts/ft ² .
Will a flue gas conditioning system be employed? If yes, describe it. _____			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe. _____			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements. _____			

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. Adsorption Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)	Adsorbent charge per adsorber vessel and number of adsorber vessels	
Length of Mass Transfer Zone (MTZ), supplied by the manufacturer based upon laboratory data.		
Adsorber diameter (ft.) and area ft ² .)	Adsorption bed depth (ft.)	

Adsorbent information

Adsorbent type and physical properties.

Working capacity of adsorbent (%)	Heel percent or unrecoverable solvent weight % in the adsorbent after regeneration.

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	
Adsorption time per adsorption bed	Breakthrough capacity: Lbs. of solvent / 100 lbs. of adsorbent = _____
Vapor pressure of solvents at the inlet temperature	Available steam in pounds to regenerate carbon adsorber (if applicable)
Percent relative saturation of each solvent at the inlet temperature	
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Absorption Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Inlet Volume (SCFM)		Tower height (ft.) and inside diameter (ft.)	
Packing type and size (if applicable)		Height of packing (ft.) (if applicable)	
Number of trays (if applicable)		Number of bubble caps (if applicable)	
Configuration ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls.			
Absorbent information			
Absorbent type and concentration.		Retention time (sec.)	
Attach equilibrium data for absorption (if applicable)			
Attach any additional information regarding auxiliary equipment, absorption solution supply system (once through or recirculating, system capacity, etc.) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating Parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in. of water) and liquid flow rate. Describe the monitoring equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. ☐ Selective Catalytic Reduction (SCR) **(NOT APPLICABLE)**
☐ Selective Non-Catalytic Reduction (SNCR) **(NOT APPLICABLE)**
☐ Non-Selective Catalytic Reduction (NSCR) **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Design operating temperature (°F)
Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.		
Attach efficiency and other pertinent information (e.g., ammonia slip)		

Operating Parameters

Volume of gases handled _____ (ACFM) @ _____ °F	
Operating temperature range for the SCR/SNCR/NSCR system (°F) From _____ °F To _____ °F	
Reducing agent used, if any	Oxidation catalyst used, if any
State expected range of usage rate and concentration.	
Service life of catalyst	Ammonia slip (ppm)
Describe fully with a sketch giving locations of equipment, controls systems, important parameters and method of operation.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

11. Oxidizer/Afterburners (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Type ☐ Thermal ☐ Catalytic		Model No.
Design Inlet Volume (SCFM)		Combustion chamber dimensions (length, cross-sectional area, effective chamber volume, etc.)		
Describe design features, which will ensure mixing in combustion chamber.				
Describe method of preheating incoming gases (if applicable).			Describe heat exchanger system used for heat recovery (if applicable).	
Catalyst used	Life of catalyst	Expected temperature rise across catalyst (°F)	Dimensions of bed (in inches). Height: _____ Diameter or Width: _____ Depth: _____	
Are temperature sensing devices being provided to measure the temperature rise across the catalyst? ☐ Yes ☐ No If yes, describe.				
Describe any temperature sensing and/or recording devices (including specific location of temperature probe in a drawing or sketch).				
Burner Information				
Burner Manufacturer		Model No.		Fuel Used
Number and capacity of burners		Rated capacity (each)		Maximum capacity (each)
Describe the operation of the burner			Attach dimensioned diagram of afterburner	
Operating Parameters				
Inlet flow rate (ACFM) _____ @ _____ °F			Outlet flow rate (ACFM) _____ @ _____ °F	
State pressure drop range across catalytic bed (in. of water).			Describe the method adopted for regeneration or disposal of the used catalyst.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.				
Emissions Data				
Pollutant	Inlet	Outlet	Removal Efficiency (%)	
VOC				
Total HAPs				

Section C - Air Cleaning Device (Continued)

12. Flares

Equipment Specifications

Manufacturer Zeeco	Type ☒ Elevated flare ☐ Ground flare ☐ Other _____ Describe	Model No. TBD
Design Volume (SCFM) 50,000 (lb/hr)	Dimensions of stack (ft.) Diameter <u>TBD</u> Height <u>TBD</u>	
Residence time (sec.) and outlet temperature (°F)	Turn down ratio	Burner details

Describe the flare design (air/steam-assisted or nonassisted), essential auxiliaries including pilot flame monitor of proposed flare with a sketch.

FLARE-002 max design capacity is estimated at 1,359 MMBtu/hr.

Describe the operation of the flare's ignition system.

FLARE-002 is equipped with a continuous pilot, flame detection system to ensure ignition.

Describe the provisions to introduce auxiliary fuel to the flare.

Operation Parameters

Detailed composition of the waste gas Flare streams may include purge gas, pilot, residue compressor blowdowns, closed drain vapors, misc. eqt blowdowns. See calculations for additional details.	Heat content 23,127 btu/lb	Exit velocity TBD
Maximum and average gas flow burned (ACFM) 8,282 scf/min	Operating temperature (°F) TBD	

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)
VOC	See Attachment E		
HAP			
CH ₄			

Section C - Air Cleaning Device (Continued)

13. Other Control Equipment (NOT APPLICABLE)

Equipment Specifications

Manufacturer	Type	Model No.	
Design Volume (SCFM)		Capacity	
Describe pH monitoring and pH adjustment, if any.			
Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.			
Attach efficiency curve and/or other efficiency information.			
Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.			
Operation Parameters			
Volume of gas handled _____ ACFM @ _____ °F _____ % Moisture			
Describe fully giving important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

14. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Annual Operating Cost
Flare	TBD	TBD	TBD	TBD

15. Miscellaneous

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

Routine maintenance and cleaning as prescribed by device manufacturer

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase air contaminant emissions.

TBD, at a minimum as often as prescribed by device manufacturer.

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

No, the sources in this application are to be constructed as part of Cryo Train II, all emissions are included in the PTE calculated in this application. Cryo I was permitted at max throughputs and is permitted for Cryo I PTE.

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards.

a. Prevention of Significant Deterioration permit (PSD), 40 CFR 52?	☐ YES	☐ NO
b. New Source Review (NSR), 25 Pa. Code Chapter 127, Subchapter E?	☐ YES	☐ NO
c. New Source Performance Standards (NSPS), 40 CFR Part 60? (If Yes, which subpart) <u>NSPS OOOOb - 40 CFR §60.5400b and 40 CFR §60.5401b</u>	☒ YES	☐ NO
d. National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61? (If Yes, which subpart) _____	☐ YES	☐ NO
e. Maximum Achievable Control Technology (MACT) 40 CFR Part 63? (If Yes, which part) _____	☐ YES	☐ NO

Attach a demonstration showing that the emissions from any new sources will be the minimum attainable through the use of best available technology (BAT).

BAT Analysis in Attachment H.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last five (5) years for applicable PSD pollutant(s) if the facility is an existing major facility (PSD purposes).

N/A

Section E - Compliance Demonstration

Note: Complete this section if source is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below

☐ Monitoring	☐ Testing	☐ Reporting
☐ Recordkeeping	☐ Work Practice Standard	

Monitoring:

- a. Monitoring device type (Parameter, CEM, etc): OGI or Method 21
- b. Monitoring device location:

- c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

Testing:

- a. Reference Test Method: Citation
- b. Reference Test Method: Description

Recordkeeping:

Describe what parameters will be recorded and the recording frequency:

Reporting:

- a. Describe what is to be reported and frequency of reporting:

- b. Reporting start date: _____

Work Practice Standard:

Describe each:

Section F - Flue and Air Contaminant Emission

1. Estimated Atmospheric Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number

Z703 Fugitives

List 3 source(s) or source ID exhausted to this stack:

P703

% of flow exhausted to stack: 100%

Stack height above grade (ft.)

Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

f. Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack exhaust Volume _____ ACFM Temperature _____ °F Moisture _____ %
Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.
Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.
** If the data and collection method codes differ from those provided on the General Information Form-Authorization Application, provide the additional detail required by that form on a separate form.

Section G - Attachments

Number and list all attachments submitted with this application below:

Attachment A – GIF
Attachment B – CRF
Attachment C – Plan Approval Forms
Attachment D – Process Flow Diagram
Attachment E – Emission Calculations
Attachment F – County and Municipal Notifications
Attachment G – Fee Schedule
Attachment H – BAT Analysis
Attachment I – Area Map



Submit in Triplicate

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

COMBUSTION UNIT

Application for Plan Approval to Construct, Modify or Reactivate an Air Contamination Source and/or Install an Air Cleaning Device

This application and the General Information Form (GIF) must be included in the submittal

Before completing this form, read the instructions provided with this form.

Section A - Facility Name, Checklist And Certification

Organization Name or Registered Fictitious Name/Facility Name: Revolution Cryogenic Plant

DEP Client ID# (If Known): 321427

Type of Review required and Fees:

Source which is not subject to NSPS, NESHAPS, MACT, NSR and PSD:	\$ _____
Source requiring approval under NSPS or NESHAPS or both:	\$7,500 _____
Source requiring approval under NSR:	\$ _____
Source requiring the establishment of a MACT limitation:	\$ _____
Source requiring approval under PSD:	\$ _____

Applicant's Checklist

Check the following list to make sure that all the required documents are included.

General Information Form (GIF)

Combustion Unit Plan Approval Application

Compliance Review Form or provide reference of most recently submitted compliance review form for facilities submitting on a periodic basis: _____

Proof of County and Municipal Notifications

Permit Fees

Addendum A: Source Applicable Requirements (only applicable to existing Title V facility)

Certification of Truth, Accuracy and Completeness by a Responsible Official

I, Stephen D. Schuman, certify under penalty of law in 18 Pa. C. S. A. §4904, and 35 P.S. §4009(b) (2) that based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete.

(Signature): _____

Date: _____

Name (Print): Stephen D. Shuman

Title: VP Operations – East Division

OFFICIAL USE ONLY

Application No. _____	Unit ID _____	Site ID _____
DEP Client ID #: _____	APS. ID _____	AUTH. ID _____
Date Received _____	Date Assigned _____	Reviewed By _____
Date of 1 st Technical Deficiency _____	Date of 2 nd Technical Deficiency _____	
Comments: _____		

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☐ Oil ☒ Natural Gas Other: _____

Description: fifteen (15) Catalytic Heaters (EXEMPT)

Manufacturer TBD	Model No. TBD	Number of units 15	
Maximum heat input (Btu/hr)	Rated heat input (Btu/hr) 0.006 MMbtu/hr (each)	Typical heat input (Btu/hr)	Furnace Volume
Grate Area (if applicable)		Method of firing	

Indicate how combustion air is supplied to boiler

Indicate the Steam Usage:

Mark and describe soot Cleaning Method:

i. Air Blown	iv. Other _____
ii. Steam Blown	v. Frequency of Cleaning _____
iii. Brushed and Vacuumed	

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour	Per day	Per week	Per year

Typical Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: _____ From _____ to _____
 Operating using secondary fuel: _____ Form _____ to _____
 Non-operating: From _____ to _____

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
 Natural Gas

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	MMscf/yr x 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer	Model Number	Type of Atomization (Steam, air, press, mech., rotary cup)	
Number of Burners	Maximum fuel firing rate (all burners)		Normal fuel firing rate
If oil, temperature and viscosity.			
Maximum theoretical air requirement			
Percent excess air 100% rating			
Turndown ratio			
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe.			
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe.			

5. Nitrogen Oxides (NO_x) control Options

Mark and describe the NO_x control options adopted

Low excess air (LEA)	Flue gas recirculation	Other. _____
Over fire air (OFA)	Burner out of service	
Low-NO _x burner	Reburning	
Low NO _x burners with over fire air	Flue gas treatment (SCR / SNCR)	

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
NA

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

TBD, at a minimum fuel usage will be monitored.

Describe each proposed modification to an existing source.

NA

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

TBD, at a minimum will follow manufacturer recommendations for startup and shutdown.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

NA

Anticipated milestones:

Expected commencement date of construction/reconstruction: TBD

Expected completion date of construction/reconstruction: _____

Anticipated date(s) of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions* (NOT APPLICABLE)

Emission Rate (each)

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM					
PM ₁₀					
SO _x					
CO					
NO _x					
VOC					
Others: (e.g., HAPs)					
Benzene					
Toluene					
Ethylbenzene					
Xylene					
n-Hexane					
Methanol					
Total HAPs					
CO ₂					
CH ₄					
N ₂ O					

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. See Emission Calculations in Attachment E.

2. Gas Conditioning (NOT APPLICABLE)

Water quenching ☐ YES ☐ NO Water injection rate _____ GPM	
Radiation and convection cooling ☐ YES ☐ NO	Air dilution ☐ YES ☐ NO If YES, _____ CFM
Forced draft ☐ YES ☐ NO	Water cooled duct work ☐ YES ☐ NO
Other _____	
Inlet volume _____ ACFM@ _____ °F	Outlet volume _____ ACFM@ _____ °F _____ % Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Inertial and Cyclone Collectors **(NOT APPLICABLE)**

Manufacturer		Type		Model No.	
Pressure Drop (in. of water)	Inlet Volume _____ ACFM @ _____ °F		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture		
Number of Individual Cyclone(s)			Outlet Straightening Vanes Used? ☐ Yes ☐ No		
Length of Cyclone(s) Cylinder (ft)		Diameter of Cyclone(s) Cylinder		Length of cyclone(s) cone (ft)	
Inlet Diameter (ft) or Duct Area (ft ²) of Cyclone(s)			Outlet Diameter (ft) or Duct area (ft ²) of cyclone(s)		
If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?					
Describe any exhaust gas recirculation loop to be employed.					
Attach particle size efficiency curve					
Emission data					
Inlet		Outlet		Removal Efficiency (%)	

Section C - Air Cleaning Device (Continued)

4. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Model No.	☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment		Is Baghouse Insulated? ☐ Yes ☐ No
Can each compartment be isolated for repairs and/or filter replacement?			☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)			☐ Yes ☐ No
Dew point at maximum moisture _____ °F		Design inlet volume _____ SCFM	
Type of Fabric Material _____ ☐ Felted ☐ Membrane Weight _____ oz/sq.yd ☐ Woven ☐ Others: List: _____ Thickness _____ in ☐ Felted-Woven			
Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.			
Filter dimensions _____ Diameter/Width _____			
Effective area per filter _____		Maximum operating temperature (°F) _____	
Effective air to cloth ratio Minimum _____ Maximum _____			
Drawing of Fabric Filter A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.			
Operation and Cleaning			
Volume of gases handled _____ ACFM _____ °F		Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.	
Type of filter cleaning ☐ Manual Cleaning ☐ Bag Collapse ☐ Reverse Air Jets ☐ Mechanical Shakers ☐ Sonic Cleaning ☐ Other: _____ ☐ Pneumatic Shakers ☐ Reverse Air Flow			
If compressed air is required for collector operation, describe the equipment with the compressor to provide dry air free from oil.			
Cleaning Initiated By ☐ Timer Frequency if timer actuated _____ ☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.			
Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Wet Collection Equipment: **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)
Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).		
Describe pH monitoring and pH adjustment systems, if applicable.		
Describe mist eliminator or separator (type, configuration, backflush capability, frequency).		
Attach particulate size efficiency curve.		

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture
Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)	
Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.).	
State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

6. Electrostatic Precipitator (NOT APPLICABLE)

Equipment specifications

Manufacturer	Model No.	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ YES ☐ NO		Design inlet volume (SCFM) _____ Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft. Collector plates size length _____ ft. x width _____ ft.			
Number of fields _____ Number of collector plates/field _____ Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft/sec. Minimum gas treatment time: _____ sec.			
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____			
Describe in detail			

Operating parameters

Inlet gas temperature (°F) _____	State pressure drop range (water gauge) across collector only. Describe the equipment.
Outlet gas temperature (°F) _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field

Field No.	No. of Sets	Each Transformer KVA	Each Rectifier	
			KV Ave./Peak	MaDC

Current density _____ Micro amperes/ft ²	Corona power _____ Watts/1000 ACFM	Corona power density _____ Watts/ft ²

Will a flue gas conditioning system be employed? If yes, describe it.

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Absorption Equipment: **(NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No	
Design inlet volume (SCFM)	Tower height (ft) and inside diameter (ft)		
Packing type and size (if applicable)	Height of packing (ft) (if applicable)		
Number of trays (if applicable)	Number of bubble caps (if applicable)		
Configuration: ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls			
Absorbent information			
Absorbent type and concentration	Sorbent injection rate	Retention time (sec)	
Attach equilibrium data for absorption (If applicable).			
Attach any additional information regarding auxiliary equipment, reagent (slurry mix) supply system (once through or recirculating, system capacity, etc) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in of water) and liquid flow rate. Describe the equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. ☐ **SELECTIVE CATALYTIC REDUCTION (SCR) (NOT APPLICABLE)**
☐ **SELECTIVE NON-CATALYTIC REDUCTION (SNCR) (NOT APPLICABLE)**
☐ **NON-SELECTIVE CATALYTIC REDUCTION (NSCR) (NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Design operating temperature (°F)

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.

Attach efficiency and other pertinent information (e.g., Ammonia, urea slip).

Operating parameters

Volume of gases handled (ACFM) _____ @ _____ (°F)			
Operating temperature range for the SCR/SNCR/NSCR system (°F)		From	To
Reducing agent used, if any.		Oxidation catalyst used, if any.	
State expected range of usage rate and concentration.			
Service life of catalyst		Ammonia slip (ppm)	
Describe fully with a sketch giving locations of equipment, controls system, important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Other Control Equipment: _____

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)	Capacity	

Describe pH monitoring and pH adjustment, if any.

Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.

Attach efficiency curve and/ or other efficiency information.

Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.

Operating parameters

Volume of gas handled

_____ @ _____ °F _____ % Moisture

Describe, in detail, important parameters and method of operation.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

TBD

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

TBD

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

TBD

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

No, the sources in this application are to be constructed as part of Cryo Train II, all emissions are included in the PTE calculated in this application. Cryo I was permitted at max throughputs and is permitted for Cryo I PTE.

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards

a. Prevention of Significant Deterioration permit (PSD), 40 CFR Part 52?	☐ YES	☐ NO
b. New Source Review, 25 Pa. Code Chapter 127, Subchapter E?	☐ YES	☐ NO
c. New Source Performance Standards, 40 CFR Part 60? (If Yes, which subpart) <u>NSPS Subpart Dc</u>	☒ YES	☐ NO
d. National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61? If Yes, which subpart) _____	☐ YES	☐ NO
e. Maximum Achievable Control Technology (MACT), 40 CFR Part 63? (If Yes, which subpart) _____	☐ YES	☐ NO

Attach a demonstration showing that the emissions from any new source will be the minimum attainable through the use of best available technology (BAT).

BAT Analysis in Attachment H.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last 5 years for applicable PSD pollutant(s) if the facility is an existing major facility (for PSD purposes)

N/A

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (See other applicable date in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from the exempted source(s), etc. **(NOT APPLICABLE)**

[illegible]

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be implemented (if applicable).
- c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of 25 Pa. Code Article III and applicable requirements of the Clean Air Act and regulations adopted there under. The Department may request additional information to evaluate the application such as a stand by plan, a plan for air pollution emergencies, air quality modeling, etc.

Emission Calculations in Attachment E.

Section E - Compliance Demonstration

Note: Complete this section if the facility is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below.

- ☐ Monitoring

 ☐ Testing

 ☐ Reporting
☐ Recordkeeping

 ☐ Work Practice Standard

Monitoring:

- a. Monitoring device type (stack test, CEM etc.):
- b. Monitoring device location:
- c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

Testing:

- a. Reference Test Method Citation:
- b. Reference Test Method Description:

Recordkeeping:

Describe the parameters that will be recorded and the recording frequency:

Reporting:

- a. Describe the type of information to be reported and the reporting frequency:
- b. Reporting start date:

Work Practice Standard: Describe each

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				
N ₂ O				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number Z038

List Source(s) or source ID exhausted to this stack:
P038

% of flow exhausted to stack: 100%

Stack height above grade (ft.)
Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack Exhaust

Volume _____ ACFM Temperature _____ °F Moisture _____ %

Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☐ Oil ☒ Natural Gas Other: _____

Description: three (3) HMO Heaters

Manufacturer TBD	Model No. TBD	Number of units 3	
Maximum heat input (Btu/hr)	Rated heat input (Btu/hr) 34.65 MMBtu/hr (each)	Typical heat input (Btu/hr)	Furnace Volume
Grate Area (if applicable)		Method of firing	

Indicate how combustion air is supplied to boiler

Indicate the Steam Usage:

Mark and describe soot Cleaning Method:

i. Air Blown	iv. Other _____
ii. Steam Blown	v. Frequency of Cleaning _____
iii. Brushed and Vacuumed	

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour 0.034 MMscf	Per day 0.826 MMscf	Per week 5.79 MMscf	Per year 300.83 MMscf

Typical Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: _____ From _____ to _____
 Operating using secondary fuel: _____ Form _____ to _____
 Non-operating: From _____ to _____

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
 Natural Gas

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	32,706 SCFH	286.5 MMscf/yr x 10 ⁶ Gal	0 gr/100 SCF	0	1,009 Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer	Model Number	Type of Atomization (Steam, air, press, mech., rotary cup)
Number of Burners	Maximum fuel firing rate (all burners)	Normal fuel firing rate
If oil, temperature and viscosity.		
Maximum theoretical air requirement		
Percent excess air 100% rating		
Turndown ratio		
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe.		
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe.		

5. Nitrogen Oxides (NO_x) control Options

Mark and describe the NO_x control options adopted

Low excess air (LEA)	Flue gas recirculation	Other. _____
Over fire air (OFA)	Burner out of service	
x Low-NO _x burner	Reburning	
Low NO _x burners with over fire air	Flue gas treatment (SCR / SNCR)	

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
NA

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

TBD, at a minimum fuel usage will be monitored.

Describe each proposed modification to an existing source.

NA

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

TBD, at a minimum will follow manufacturer recommendations for startup and shutdown.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

NA

Anticipated milestones:

Expected commencement date of construction/reconstruction: TBD

Expected completion date of construction/reconstruction: _____

Anticipated date(s) of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions* (NOT APPLICABLE)

Emission Rate (total)

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM					
PM ₁₀					
SO _x					
CO					
NO _x					
VOC					
Others: (e.g., HAPs)					
Benzene					
Toluene					
Ethylbenzene					
Xylene					
n-Hexane					
Methanol					
Total HAPs					
CO ₂					
CH ₄					
N ₂ O					

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. See Emission Calculations in Attachment E.

2. Gas Conditioning (NOT APPLICABLE)

Water quenching ☐ YES ☐ NO Water injection rate _____ GPM	
Radiation and convection cooling ☐ YES ☐ NO	Air dilution ☐ YES ☐ NO If YES, _____ CFM
Forced draft ☐ YES ☐ NO	Water cooled duct work ☐ YES ☐ NO
Other _____	
Inlet volume _____ ACFM@ _____ °F	Outlet volume _____ ACFM@ _____ °F _____ % Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Inertial and Cyclone Collectors **(NOT APPLICABLE)**

Manufacturer		Type		Model No.	
Pressure Drop (in. of water)	Inlet Volume _____ ACFM @ _____ °F		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture		
Number of Individual Cyclone(s)			Outlet Straightening Vanes Used? ☐ Yes ☐ No		
Length of Cyclone(s) Cylinder (ft)		Diameter of Cyclone(s) Cylinder		Length of cyclone(s) cone (ft)	
Inlet Diameter (ft) or Duct Area (ft ²) of Cyclone(s)			Outlet Diameter (ft) or Duct area (ft ²) of cyclone(s)		
If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?					
Describe any exhaust gas recirculation loop to be employed.					
Attach particle size efficiency curve					
Emission data					
Inlet		Outlet		Removal Efficiency (%)	

Section C - Air Cleaning Device (Continued)

4. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Model No.	☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment		Is Baghouse Insulated? ☐ Yes ☐ No
Can each compartment be isolated for repairs and/or filter replacement?			☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)			☐ Yes ☐ No
Dew point at maximum moisture _____ °F		Design inlet volume _____ SCFM	
Type of Fabric Material _____ ☐ Felted ☐ Membrane Weight _____ oz/sq.yd ☐ Woven ☐ Others: List: _____ Thickness _____ in ☐ Felted-Woven			
Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.			
Filter dimensions _____ Diameter/Width _____			
Effective area per filter _____		Maximum operating temperature (°F) _____	
Effective air to cloth ratio Minimum _____ Maximum _____			
Drawing of Fabric Filter A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.			
Operation and Cleaning			
Volume of gases handled _____ ACFM _____ °F		Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.	
Type of filter cleaning ☐ Manual Cleaning ☐ Bag Collapse ☐ Reverse Air Jets ☐ Mechanical Shakers ☐ Sonic Cleaning ☐ Other: _____ ☐ Pneumatic Shakers ☐ Reverse Air Flow			
If compressed air is required for collector operation, describe the equipment with the compressor to provide dry air free from oil.			
Cleaning Initiated By ☐ Timer Frequency if timer actuated _____ ☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.			
Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Wet Collection Equipment: **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)
Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).		
Describe pH monitoring and pH adjustment systems, if applicable.		
Describe mist eliminator or separator (type, configuration, backflush capability, frequency).		
Attach particulate size efficiency curve.		

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture
Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)	
Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.).	
State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

6. Electrostatic Precipitator (NOT APPLICABLE)

Equipment specifications

Manufacturer	Model No.	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ YES ☐ NO		Design inlet volume (SCFM) _____ Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft. Collector plates size length _____ ft. x width _____ ft.			
Number of fields _____ Number of collector plates/field _____ Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft/sec. Minimum gas treatment time: _____ sec.			
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____			
Describe in detail			

Operating parameters

Inlet gas temperature (°F) _____	State pressure drop range (water gauge) across collector only. Describe the equipment.
Outlet gas temperature (°F) _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field

Field No.	No. of Sets	Each Transformer KVA	Each Rectifier	
			KV Ave./Peak	MaDC

Current density _____ Micro amperes/ft ²	Corona power _____ Watts/1000 ACFM	Corona power density _____ Watts/ft ²

Will a flue gas conditioning system be employed? If yes, describe it.

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Absorption Equipment: **(NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No	
Design inlet volume (SCFM)	Tower height (ft) and inside diameter (ft)		
Packing type and size (if applicable)	Height of packing (ft) (if applicable)		
Number of trays (if applicable)	Number of bubble caps (if applicable)		
Configuration: ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls			
Absorbent information			
Absorbent type and concentration	Sorbent injection rate	Retention time (sec)	
Attach equilibrium data for absorption (If applicable).			
Attach any additional information regarding auxiliary equipment, reagent (slurry mix) supply system (once through or recirculating, system capacity, etc) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in of water) and liquid flow rate. Describe the equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. ☐ **SELECTIVE CATALYTIC REDUCTION (SCR) (NOT APPLICABLE)**
☐ **SELECTIVE NON-CATALYTIC REDUCTION (SNCR) (NOT APPLICABLE)**
☐ **NON-SELECTIVE CATALYTIC REDUCTION (NSCR) (NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Design operating temperature (°F)

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.

Attach efficiency and other pertinent information (e.g., Ammonia, urea slip).

Operating parameters

Volume of gases handled (ACFM) _____ @ _____ (°F)			
Operating temperature range for the SCR/SNCR/NSCR system (°F)		From	To
Reducing agent used, if any.		Oxidation catalyst used, if any.	
State expected range of usage rate and concentration.			
Service life of catalyst		Ammonia slip (ppm)	
Describe fully with a sketch giving locations of equipment, controls system, important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Other Control Equipment: _____

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Capacity

Describe pH monitoring and pH adjustment, if any.

Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.

Attach efficiency curve and/ or other efficiency information.

Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.

Operating parameters

Volume of gas handled

_____ @ _____ °F _____ % Moisture

Describe, in detail, important parameters and method of operation.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

TBD

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

TBD

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

TBD

Section D - Additional Information

Will the construction, modification, etc. of the sources covered by this application increase emissions from other sources at the facility? If so, describe and quantify.

No, the sources in this application are to be constructed as part of Cryo Train II, all emissions are included in the PTE calculated in this application. Cryo I was permitted at max throughputs and is permitted for Cryo I PTE.

If this project is subject to any one of the following, attach a demonstration to show compliance with applicable standards

a. Prevention of Significant Deterioration permit (PSD), 40 CFR Part 52?	☐ YES	☐ NO
b. New Source Review, 25 Pa. Code Chapter 127, Subchapter E?	☐ YES	☐ NO
c. New Source Performance Standards, 40 CFR Part 60? (If Yes, which subpart) <u>Subpart Dc</u>	☒ YES	☐ NO
d. National Emissions Standards for Hazardous Air Pollutants (NESHAPS), 40 CFR Part 61? If Yes, which subpart) _____	☐ YES	☐ NO
e. Maximum Achievable Control Technology (MACT), 40 CFR Part 63? (If Yes, which subpart) _____	☐ YES	☐ NO

Attach a demonstration showing that the emissions from any new source will be the minimum attainable through the use of best available technology (BAT).

BAT Analysis in Attachment H.

Provide emission increases and decreases in allowable (or potential) and actual emissions within the last 5 years for applicable PSD pollutant(s) if the facility is an existing major facility (for PSD purposes)

N/A

Section D - Additional Information (Continued)

Indicate emission increases and decreases in tons per year (tpy), for volatile organic compounds (VOCs) and nitrogen oxides (NOx) for NSR applicability since January 1, 1991 or other applicable dates (See other applicable date in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from the exempted source(s), etc. **(NOT APPLICABLE)**

[illegible]

If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- a. Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- b. Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be implemented (if applicable).
- c. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs (if applicable).

Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of 25 Pa. Code Article III and applicable requirements of the Clean Air Act and regulations adopted there under. The Department may request additional information to evaluate the application such as a stand by plan, a plan for air pollution emergencies, air quality modeling, etc.

Emission Calculations in Attachment E.

Section E - Compliance Demonstration

Note: Complete this section if the facility is not a Title V facility. Title V facilities must complete Addendum A.

Method of Compliance Type: Check all that apply and complete all appropriate sections below.

- ☐ Monitoring

 ☐ Testing

 ☐ Reporting
☐ Recordkeeping

 ☐ Work Practice Standard

Monitoring:

- a. Monitoring device type (stack test, CEM etc.):
- b. Monitoring device location:
- c. Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

Testing:

- a. Reference Test Method Citation:
- b. Reference Test Method Description:

Recordkeeping:

Describe the parameters that will be recorded and the recording frequency:

Reporting:

- a. Describe the type of information to be reported and the reporting frequency:
- b. Reporting start date:

Work Practice Standard: Describe each

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				
N ₂ O				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number Z034, Z035, Z036

List Source(s) or source ID exhausted to this stack:
P034, P035, P036

% of flow exhausted to stack: 100%

Stack height above grade (ft.)
Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack Exhaust

Volume _____ ACFM Temperature _____ °F Moisture _____ %

Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☐ Oil ☒ Natural Gas Other: _____

Description: Inlet Gas Mole Sieve Dehydration Regen Heater (EXEMPT)

Manufacturer TBD	Model No. TBD	Number of units 1	
Maximum heat input (Btu/hr)	Rated heat input (Btu/hr) 9.04 MMBtu/hr	Typical heat input (Btu/hr)	Furnace Volume
Grate Area (if applicable)		Method of firing	

Indicate how combustion air is supplied to boiler

Indicate the Steam Usage:

Mark and describe soot Cleaning Method:

i. Air Blown	iv. Other _____
ii. Steam Blown	v. Frequency of Cleaning _____
iii. Brushed and Vacuumed	

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour .009 MMscf	Per day 0.216 MMscf	Per week 1.51 MMscf	Per year 78.48 MMscf

Typical Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: _____ From _____ to _____
 Operating using secondary fuel: _____ Form _____ to _____
 Non-operating: From _____ to _____

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
 Natural Gas

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	MMscf/yr x 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer	Model Number	Type of Atomization (Steam, air, press, mech., rotary cup)	
Number of Burners	Maximum fuel firing rate (all burners)		Normal fuel firing rate
If oil, temperature and viscosity.			
Maximum theoretical air requirement			
Percent excess air 100% rating			
Turndown ratio			
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe.			
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe.			

5. Nitrogen Oxides (NO_x) control Options

Mark and describe the NO_x control options adopted

Low excess air (LEA)	Flue gas recirculation	Other. _____
Over fire air (OFA)	Burner out of service	
Low-NO _x burner	Reburning	
Low NO _x burners with over fire air	Flue gas treatment (SCR / SNCR)	

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
NA

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

TBD, at a minimum fuel usage will be monitored.

Describe each proposed modification to an existing source.

NA

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

TBD, at a minimum will follow manufacturer recommendations for startup and shutdown.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

NA

Anticipated milestones:

Expected commencement date of construction/reconstruction: TBD

Expected completion date of construction/reconstruction: _____

Anticipated date(s) of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions*(NOT APPLICABLE)

Emission Rate (each)

[illegible]

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. See Emission Calculations in Attachment E.

2. Gas Conditioning (NOT APPLICABLE)

Water quenching ☐ YES ☐ NO Water injection rate _____ GPM

Radiation and convection cooling ☐ YES ☐ NO

Air dilution ☐ YES ☐ NO

If YES, _____ CFM

Forced draft ☐ YES ☐ NO

Water cooled duct work ☐ YES ☐ NO

Other _____

Inlet volume _____ ACFM @ _____ °F

Outlet volume
_____ ACFM@ _____ °F _____ % Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Inertial and Cyclone Collectors **(NOT APPLICABLE)**

Manufacturer		Type		Model No.	
Pressure Drop (in. of water)	Inlet Volume _____ ACFM @ _____ °F		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture		
Number of Individual Cyclone(s)			Outlet Straightening Vanes Used? ☐ Yes ☐ No		
Length of Cyclone(s) Cylinder (ft)		Diameter of Cyclone(s) Cylinder		Length of cyclone(s) cone (ft)	
Inlet Diameter (ft) or Duct Area (ft ²) of Cyclone(s)			Outlet Diameter (ft) or Duct area (ft ²) of cyclone(s)		
If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?					
Describe any exhaust gas recirculation loop to be employed.					
Attach particle size efficiency curve					
Emission data					
Inlet		Outlet		Removal Efficiency (%)	

Section C - Air Cleaning Device (Continued)

4. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Model No.	☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment		Is Baghouse Insulated? ☐ Yes ☐ No
Can each compartment be isolated for repairs and/or filter replacement?			☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)			☐ Yes ☐ No
Dew point at maximum moisture _____ °F		Design inlet volume _____ SCFM	
Type of Fabric Material _____ Weight _____ oz/sq.yd Thickness _____ in ☐ Felted ☐ Woven ☐ Felted-Woven ☐ Membrane ☐ Others: List: _____			
Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.			
Filter dimensions _____ Diameter/Width _____			
Effective area per filter _____		Maximum operating temperature (°F) _____	
Effective air to cloth ratio Minimum _____ Maximum _____			
Drawing of Fabric Filter A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.			
Operation and Cleaning			
Volume of gases handled _____ ACFM _____ °F		Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.	
Type of filter cleaning ☐ Manual Cleaning ☐ Mechanical Shakers ☐ Pneumatic Shakers ☐ Bag Collapse ☐ Sonic Cleaning ☐ Reverse Air Flow ☐ Reverse Air Jets ☐ Other: _____			
If compressed air is required for collector operation, describe the equipment with the compressor to provide dry air free from oil.			
Cleaning Initiated By ☐ Timer Frequency if timer actuated _____ ☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.			
Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Wet Collection Equipment: **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)
Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).		
Describe pH monitoring and pH adjustment systems, if applicable.		
Describe mist eliminator or separator (type, configuration, backflush capability, frequency).		
Attach particulate size efficiency curve.		

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture
Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)	
Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.).	
State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

6. Electrostatic Precipitator (NOT APPLICABLE)

Equipment specifications

Manufacturer	Model No.	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ YES ☐ NO		Design inlet volume (SCFM) _____ Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft. Collector plates size length _____ ft. x width _____ ft.			
Number of fields _____ Number of collector plates/field _____ Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft/sec. Minimum gas treatment time: _____ sec.			
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____			
Describe in detail			

Operating parameters

Inlet gas temperature (°F) _____	State pressure drop range (water gauge) across collector only. Describe the equipment.
Outlet gas temperature (°F) _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field

Field No.	No. of Sets	Each Transformer KVA	Each Rectifier	
			KV Ave./Peak	MaDC

Current density _____ Micro amperes/ft ²	Corona power _____ Watts/1000 ACFM	Corona power density _____ Watts/ft ²

Will a flue gas conditioning system be employed? If yes, describe it.

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Absorption Equipment: (NOT APPLICABLE)

Equipment specifications

Manufacturer	Type	Model No	
Design inlet volume (SCFM)	Tower height (ft) and inside diameter (ft)		
Packing type and size (if applicable)	Height of packing (ft) (if applicable)		
Number of trays (if applicable)	Number of bubble caps (if applicable)		
Configuration: ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls			
Absorbent information			
Absorbent type and concentration	Sorbent injection rate	Retention time (sec)	
Attach equilibrium data for absorption (If applicable).			
Attach any additional information regarding auxiliary equipment, reagent (slurry mix) supply system (once through or recirculating, system capacity, etc) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in of water) and liquid flow rate. Describe the equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. ☐ **SELECTIVE CATALYTIC REDUCTION (SCR) (NOT APPLICABLE)**
☐ **SELECTIVE NON-CATALYTIC REDUCTION (SNCR) (NOT APPLICABLE)**
☐ **NON-SELECTIVE CATALYTIC REDUCTION (NSCR) (NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Design operating temperature (°F)

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.

Attach efficiency and other pertinent information (e.g., Ammonia, urea slip).

Operating parameters

Volume of gases handled (ACFM) _____ @ _____ (°F)			
Operating temperature range for the SCR/SNCR/NSCR system (°F)		From	To
Reducing agent used, if any.		Oxidation catalyst used, if any.	
State expected range of usage rate and concentration.			
Service life of catalyst		Ammonia slip (ppm)	
Describe fully with a sketch giving locations of equipment, controls system, important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Other Control Equipment: _____

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Capacity

Describe pH monitoring and pH adjustment, if any.

Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.

Attach efficiency curve and/ or other efficiency information.

Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.

Operating parameters

Volume of gas handled

_____ @ _____ °F _____ % Moisture

Describe, in detail, important parameters and method of operation.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

TBD

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

TBD

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

TBD

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				
N ₂ O				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number Z402 Inlet Gas Sieve Regen Heater

List Source(s) or source ID exhausted to this stack:
P402

% of flow exhausted to stack: 100%

Stack height above grade (ft.)
Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack Exhaust

Volume _____ ACFM Temperature _____ °F Moisture _____ %

Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

Section B - Combustion Unit Information

1. Combustion Units: ☐ Coal ☐ Oil ☒ Natural Gas Other: _____

Description: NGL Regen Heater (EXEMPT)

Manufacturer TBD	Model No. TBD	Number of units 1	
Maximum heat input (Btu/hr)	Rated heat input (Btu/hr) 6.64 MMBtu/hr	Typical heat input (Btu/hr)	Furnace Volume
Grate Area (if applicable)		Method of firing	

Indicate how combustion air is supplied to boiler

Indicate the Steam Usage:

Mark and describe soot Cleaning Method:

i. Air Blown	iv. Other _____
ii. Steam Blown	v. Frequency of Cleaning _____
iii. Brushed and Vacuumed	

Maximum Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Operational restrictions taken or requested, if any (e.g., bottlenecks or voluntary restrictions to limit potential to emit)

Capacity (specify units)

Per hour 0.007 MMscf	Per day 0.16 MMscf	Per week 1.11 MMscf	Per year 57.65 MMscf

Typical Operating schedule

Hours/Day 24	Days/Week 7	Days/Year 365	Hours/Year 8,760

Seasonal variations (Months): If variations exist, describe them.

Operating using primary fuel: _____ From _____ to _____
 Operating using secondary fuel: _____ Form _____ to _____
 Non-operating: From _____ to _____

2. Specify the primary, secondary and startup fuel. Furnish the details in item 3.
 Natural Gas

Section B - Combustion Unit Information (Continued)

3. Fuel

Type	Quantity Hourly	Annually	Sulfur	% Ash (Weight)	BTU Content
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Oil Number	GPH @ 60°F	X 10 ³ Gal	% by wt		Btu/Gal. & Lbs./Gal. @ 60 °F
Natural Gas	SCFH	MMscf/yr x 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Gas (other)	SCFH	X 10 ⁶ Gal	gr/100 SCF		Btu/SCF
Coal					
Other*					

* Note: Describe and furnish information separately for other fuels in Addendum B.

4. Burner

Manufacturer	Model Number	Type of Atomization (Steam, air, press, mech., rotary cup)	
Number of Burners	Maximum fuel firing rate (all burners)		Normal fuel firing rate
If oil, temperature and viscosity.			
Maximum theoretical air requirement			
Percent excess air 100% rating			
Turndown ratio			
Combustion modulation control (on/off, low-high fire, full automatic, manual). Describe.			
Main burner flame ignition method (electric spark, auto gas pilot, hand-held torch, other). Describe.			

5. Nitrogen Oxides (NO_x) control Options

Mark and describe the NO_x control options adopted

Low excess air (LEA)	Flue gas recirculation	Other. _____
Over fire air (OFA)	Burner out of service	
Low-NO _x burner	Reburning	
Low NO _x burners with over fire air	Flue gas treatment (SCR / SNCR)	

Section B - Combustion Unit Information (Continued)

6. Miscellaneous Information

Describe fly ash reinjection operation
NA

Describe, in detail, the equipment provided to monitor and to record the source(s) operating conditions, which may affect emissions of air contaminants. Show that they are reasonable and adequate.

TBD, at a minimum fuel usage will be monitored.

Describe each proposed modification to an existing source.

NA

Describe how emissions will be minimized especially during start up, shut down, combustion upsets and/or disruptions. Provide emission estimates for start up, shut down and upset conditions. Provide duration of start up and shut down.

TBD, at a minimum will follow manufacturer recommendations for startup and shutdown.

Describe in detail with a schematic diagram of the control options adopted for SO₂ (if applicable).

NA

Anticipated milestones:

Expected commencement date of construction/reconstruction: TBD

Expected completion date of construction/reconstruction: _____

Anticipated date(s) of start-up: _____

Section C - Air Cleaning Device

1. Precontrol Emissions* * (NOT APPLICABLE)

Emission Rate (each)

Pollutant	Maximum Emission Rate				Calculation/ Estimation Method
	Specify Units	Pounds/Hour	Hours/Year	Tons/Year	
PM					
PM ₁₀					
SO _x					
CO					
NO _x					
VOC					
Others: (e.g., HAPs)					
Benzene					
Toluene					
Ethylbenzene					
Xylene					
n-Hexane					
Methanol					
Total HAPs					
CO ₂					
CH ₄					
N ₂ O					

* These emissions must be calculated based on the requested operating schedule and/or process rate, e.g., operating schedule for maximum limits or restricted hours of operation and/or restricted throughput. Describe how the emission values were determined. Attach calculations. See Emission Calculations in Attachment E.

2. Gas Conditioning * (NOT APPLICABLE)

 Water quenching ☐ YES ☐ NO Water injection rate _____ GPM

 Radiation and convection cooling ☐ YES ☐ NO

 Air dilution ☐ YES ☐ NO

If YES, _____ CFM

 Forced draft ☐ YES ☐ NO

 Water cooled duct work ☐ YES ☐ NO

Other _____

 Inlet volume
 _____ ACFM@ _____ °F

 Outlet volume
 _____ ACFM@ _____ °F _____ % Moisture

Describe the system in detail.

Section C - Air Cleaning Device (Continued)

3. Inertial and Cyclone Collectors **(NOT APPLICABLE)**

Manufacturer		Type		Model No.	
Pressure Drop (in. of water)	Inlet Volume _____ ACFM @ _____ °F		Outlet Volume _____ ACFM @ _____ °F _____ % Moisture		
Number of Individual Cyclone(s)			Outlet Straightening Vanes Used? ☐ Yes ☐ No		
Length of Cyclone(s) Cylinder (ft)		Diameter of Cyclone(s) Cylinder		Length of cyclone(s) cone (ft)	
Inlet Diameter (ft) or Duct Area (ft ²) of Cyclone(s)			Outlet Diameter (ft) or Duct area (ft ²) of cyclone(s)		
If a multi-clone or multi-tube unit is installed, will any of the individual cyclones or cyclone tubes be blanked or blocked off?					
Describe any exhaust gas recirculation loop to be employed.					
Attach particle size efficiency curve					
Emission data					
Inlet		Outlet		Removal Efficiency (%)	

Section C - Air Cleaning Device (Continued)

4. Fabric Collector (NOT APPLICABLE)

Equipment Specifications

Manufacturer		Model No.	☐ Pressurized Design ☐ Suction Design
Number of Compartments	Number of Filters Per Compartment		Is Baghouse Insulated? ☐ Yes ☐ No
Can each compartment be isolated for repairs and/or filter replacement?			☐ Yes ☐ No
Are temperature controls provided? (Describe in detail)			☐ Yes ☐ No
Dew point at maximum moisture _____ °F		Design inlet volume _____ SCFM	
Type of Fabric Material _____ ☐ Felted ☐ Membrane Weight _____ oz/sq.yd ☐ Woven ☐ Others: List: _____ Thickness _____ in ☐ Felted-Woven			
Fabric permeability (clean) @ ½" water-Δ P _____ CFM/sq.ft.			
Filter dimensions _____ Diameter/Width _____			
Effective area per filter _____		Maximum operating temperature (°F) _____	
Effective air to cloth ratio Minimum _____ Maximum _____			
Drawing of Fabric Filter A sketch of the fabric filter showing all access doors, catwalks, ladders and exhaust ductwork, location of each pressure and temperature indicator should be attached.			
Operation and Cleaning			
Volume of gases handled _____ ACFM _____ °F		Pressure drop across collector (in. of water). Describe the equipment to be used to monitor the pressure drop.	
Type of filter cleaning ☐ Manual Cleaning ☐ Bag Collapse ☐ Reverse Air Jets ☐ Mechanical Shakers ☐ Sonic Cleaning ☐ Other: _____ ☐ Pneumatic Shakers ☐ Reverse Air Flow			
If compressed air is required for collector operation, describe the equipment with the compressor to provide dry air free from oil.			
Cleaning Initiated By ☐ Timer Frequency if timer actuated _____ ☐ Expected pressure drop range _____ in. of water ☐ Other Specify _____			
Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.			
Describe the warning/alarm system that protects against operation when the unit is not meeting design requirements.			
Emissions Data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

5. Wet Collection Equipment: **(NOT APPLICABLE)**

Equipment Specifications

Manufacturer	Type	Model No.
Design Inlet Volume (SCFM)		Relative Particulate/Gas Velocity (ejector scrubbers only)
Describe the internal features (e.g., variable throat, gas/liquid diffusion plates, spray nozzles, liquid redistributors, bed limiters, etc.).		
Describe pH monitoring and pH adjustment systems, if applicable.		
Describe mist eliminator or separator (type, configuration, backflush capability, frequency).		
Attach particulate size efficiency curve.		

Operating Parameters

Inlet volume of gases handled _____ (ACFM) @ _____ °F	Outlet volume of gases handled _____ (ACFM) @ _____ °F _____ % Moisture
Liquid flow rates. Describe equipment provided to measure liquid flow rates to scrubber (e.g., quenching section, recirculating solution, makeup water, bleed flow, etc.)	
Describe scrubber liquid supply system (amount of make-up and recirculating liquid, capacity of recirculating liquid system, etc.).	
State pressure drop range (in water) across scrubber (e.g., venturi throat, packed bed, etc.) only. Describe the equipment provide to measure the pressure drop. Do not include duct or de-mister losses.	
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.	

Emissions Data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

6. Electrostatic Precipitator (NOT APPLICABLE)

Equipment specifications

Manufacturer	Model No.	☐ Wet	☐ Dry
		☐ Single-Stage	☐ Two-Stage
Gas distribution grids ☐ YES ☐ NO		Design inlet volume (SCFM) _____ Maximum operating temperature (°F) _____	
Total collecting surface area _____ sq. ft. Collector plates size length _____ ft. x width _____ ft.			
Number of fields _____ Number of collector plates/field _____ Spacing between collector plates _____ inches.			
Maximum gas velocity _____ ft/sec. Minimum gas treatment time: _____ sec.			
Total discharge electrode length _____ ft.			
Number of discharge electrodes _____		Number collecting electrode rappers _____	
Rapper control ☐ Magnetic ☐ Pneumatic ☐ Other _____			
Describe in detail			

Operating parameters

Inlet gas temperature (°F) _____	State pressure drop range (water gauge) across collector only. Describe the equipment.
Outlet gas temperature (°F) _____	
Volume of gas handled (ACFM) _____	Dust resistivity (ohm-cm). Will resistivity vary?

Power requirements

Number and size of Transformer Rectifier sets by electrical field

Field No.	No. of Sets	Each Transformer KVA	Each Rectifier	
			KV Ave./Peak	MaDC

Current density _____ Micro amperes/ft ²	Corona power _____ Watts/1000 ACFM	Corona power density _____ Watts/ft ²

Will a flue gas conditioning system be employed? If yes, describe it.

Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If yes, describe.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

7. Absorption Equipment: **(NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No	
Design inlet volume (SCFM)	Tower height (ft) and inside diameter (ft)		
Packing type and size (if applicable)	Height of packing (ft) (if applicable)		
Number of trays (if applicable)	Number of bubble caps (if applicable)		
Configuration: ☐ Counter-current ☐ Cross flow ☐ Cocurrent flow			
Describe pH and/or other monitoring and controls			
Absorbent information			
Absorbent type and concentration	Sorbent injection rate	Retention time (sec)	
Attach equilibrium data for absorption (If applicable).			
Attach any additional information regarding auxiliary equipment, reagent (slurry mix) supply system (once through or recirculating, system capacity, etc) to thoroughly evaluate the control equipment. Indicate the flow rates for makeup, bleed and recirculation.			
Operating parameters			
Volume of gas handled (ACFM)	Inlet temperature (°F)	Pressure drop (in of water) and liquid flow rate. Describe the equipment.	
State operating range for pH and/or absorbent concentration in scrubber liquid.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			
Emissions data			
Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

8. ☐ **SELECTIVE CATALYTIC REDUCTION (SCR) (NOT APPLICABLE)**
☐ **SELECTIVE NON-CATALYTIC REDUCTION (SNCR) (NOT APPLICABLE)**
☐ **NON-SELECTIVE CATALYTIC REDUCTION (NSCR) (NOT APPLICABLE)**

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Design operating temperature (°F)

Is the system equipped with process controls for proper mixing/control of the reducing agent in gas stream? If yes, give details.

Attach efficiency and other pertinent information (e.g., Ammonia, urea slip).

Operating parameters

Volume of gases handled (ACFM) _____ @ _____ (°F)			
Operating temperature range for the SCR/SNCR/NSCR system (°F)		From	To
Reducing agent used, if any.		Oxidation catalyst used, if any.	
State expected range of usage rate and concentration.			
Service life of catalyst		Ammonia slip (ppm)	
Describe fully with a sketch giving locations of equipment, controls system, important parameters and method of operation.			
Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.			

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

9. Other Control Equipment: _____

Equipment specifications

Manufacturer	Type	Model No
Design inlet volume (SCFM)		Capacity

Describe pH monitoring and pH adjustment, if any.

Indicate the liquid flow rate and describe equipment provided to measure pressure drop and flow rate, if any.

Attach efficiency curve and/ or other efficiency information.

Attach any additional data including auxiliary equipment and operation details to thoroughly evaluate the control equipment.

Operating parameters

Volume of gas handled

_____ @ _____ °F _____ % Moisture

Describe, in detail, important parameters and method of operation.

Describe the warning/alarm system that protects against operation when unit is not meeting design requirements.

Emissions data

Pollutant	Inlet	Outlet	Removal Efficiency (%)

Section C - Air Cleaning Device (Continued)

10. Costs

Indicate cost associated with air cleaning device and its operating cost (attach documentation if necessary)

Device	Direct Cost	Indirect Cost	Total Cost	Operating Cost

11 MISCELLANEOUS

Describe in detail the removal, handling and disposal of dust, effluent, etc. from the air cleaning device including proposed methods of controlling fugitive emissions.

TBD

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

TBD

Attach the maintenance schedule for the control equipment and any part of the process equipment that, if in disrepair, would increase air contaminant emissions.

TBD

Section F - Flue and Air Contaminant Emission

1. Estimated Maximum Emissions*

Pollutant	Maximum emission rate			Calculation/ Estimation Method
	specify units	lbs/hr	tons/yr.	
PM	See Attachment E			
PM ₁₀				
SO _x				
CO				
NO _x				
VOC				
Others: (e.g., HAPs)				
Benzene				
Toluene				
Ethylbenzene				
Xylene				
n-Hexane				
Methanol				
Total HAPs				
CO ₂				
CH ₄				
N ₂ O				

* These emissions must be calculated based on the requested operating schedule and/or process rate e.g., operating schedule for maximum limits or restricted hours of operation and /or restricted throughput. Describe how the emission values were determined. Attach calculations.

2. Stack and Exhauster

Stack Designation/Number Z403 NGL Regen Heater

List Source(s) or source ID exhausted to this stack:
P403

% of flow exhausted to stack: 100%

Stack height above grade (ft.)
Grade elevation (ft.)

Stack diameter (ft) or Outlet duct area (sq. ft.)

Weather Cap

☐ YES ☐ NO

Distance of discharge to nearest property line (ft.). Locate on topographic map.

Does stack height meet Good Engineering Practice (GEP)?

If modeling (estimating) of ambient air quality impacts is needed, attach a site plan with buildings and their dimensions and other obstructions.

Location of Stack** Latitude/Longitude Point of Origin	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds

Stack Exhaust

Volume _____ ACFM Temperature _____ °F Moisture _____ %

Exhauster (attach fan curves) _____ in. of water _____ HP @ _____ RPM.

** If the datum and collection method information and codes differ from those provided on the General Information Form - Authorization Application, provide the additional required by that form on a separate sheet.

Section G - Attachments

Number and list all attachments submitted with this application below:

Attachment A – GIF
Attachment B – CRF
Attachment C – Plan Approval Forms
Attachment D – Process Flow Diagram
Attachment E – Emission Calculations
Attachment F – County and Municipal Notifications
Attachment G – Fee Schedule
Attachment H – BAT Analysis
Attachment I – Area Map



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BUREAU OF AIR QUALITY

Addendum A: Source Applicable Requirements

Describe and cite all applicable requirements pertaining to this source.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

Citation Number	Citation Limitation	Limitation Used
40 CFR §60.48c	NSPS Dc - Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units	



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BUREAU OF AIR QUALITY

Addendum 1 Method Of Compliance Worksheet

SECTION 1. APPLICABLE REQUIREMENT

Federal Tax Id: 26-2863376-3 Firm Name: ETC Northeast Pipeline, LLC

Plant Code: Plant Name: Revolution Cryogenic Plant

Applicable Requirement for: (please check only one box below)

- ☐ The entire site
- ☐ A group of sources, Group ID: _____
- ☒ A single source, Unit ID: P034, 035, and 036
- ☐ Alternative Scenario, Scenario Name: _____

Citation #: 40 CFR §60.48c

Compliance Method based upon: ☒ Applicable Requirement ☐ Gap Filling Requirement

Method of Compliance Type: (Check all that applies and complete all appropriate sections below)

- ☐ Monitoring ☐ Testing ☒ Reporting
- ☒ Record Keeping ☐ Work Practice Standard

Section 2: Monitoring

1. Monitoring device type (stack test, CEM, etc.): _____

2. Monitoring device location: _____

Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

3. How will data be reported: _____

Section 3: Testing

1. Reference Test Method Description:

2. Reference Test Method Citation:

Section 4: Record Keeping

Describe what parameters will be recorded and the frequency of recording:

40 CFR §60.48c(g):

(1) Except as provided under paragraphs (g)(2) and (g)(3) of this section, the owner or operator of each affected facility shall record and maintain records of the amount of each fuel combusted during each operating day.

(2) As an alternative to meeting the requirements of paragraph (g)(1) of this section, the owner or operator of an affected facility that combusts only natural gas, wood, fuels using fuel certification in § 60.48c(f) to demonstrate compliance with the SO₂ standard, fuels not subject to an emissions standard (excluding opacity), or a mixture of these fuels may elect to record and maintain records of the amount of each fuel combusted during each calendar month.

(3) As an alternative to meeting the requirements of paragraph (g)(1) of this section, the owner or operator of an affected facility or multiple affected facilities located on a contiguous property unit where the only fuels combusted in any steam generating unit (including steam generating units not subject to this subpart) at that property are natural gas, wood, distillate oil meeting the most current requirements in § 60.42C to use fuel certification to demonstrate compliance with the SO₂ standard, and/or fuels, excluding coal and residual oil, not subject to an emissions standard (excluding opacity) may elect to record and maintain records of the total amount of each steam generating unit fuel delivered to that property during each calendar month.

Section 5: Reporting

Describe what is to be reported and the frequency of reporting:

40 CFR §60.48c(a):

The owner or operator of each affected facility shall submit notification of the date of construction or reconstruction and actual startup, as provided by § 60.7 of this part. This notification shall include:

(1) The design heat input capacity of the affected facility and identification of fuels to be combusted in the affected facility.

(2) If applicable, a copy of any federally enforceable requirement that limits the annual capacity factor for any fuel or mixture of fuels under § 60.42c, or § 60.43c.

(3) The annual capacity factor at which the owner or operator anticipates operating the affected facility based on all fuels fired and based on each individual fuel fired.

1. Reporting start date: Date of construction and date of start up

Section 6: Work Practice Standard

Describe any work practice standards:



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BUREAU OF AIR QUALITY

Addendum A: Source Applicable Requirements

Describe and cite all applicable requirements pertaining to this source.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

Citation Number	Citation Limitation	Limitation Used
40 CFR §60.5400b	NSPS OOOOb - Process Unit Equipment Alternative GHG and VOC Standards	Sames



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BUREAU OF AIR QUALITY

Addendum 1 Method Of Compliance Worksheet

SECTION 1. APPLICABLE REQUIREMENT

Federal Tax Id: 26-2863376-3 Firm Name: ETC Northeast Pipeline, LLC

Plant Code: Plant Name: Revolution Cryogenic Plant

Applicable Requirement for: (please check only one box below)

- ☐ The entire site
- ☐ A group of sources, Group ID: _____
- ☒ A single source, Unit ID: P703
- ☐ Alternative Scenario, Scenario Name: _____

Citation #: 40 CFR §60.5400b

Compliance Method based upon: ☒ Applicable Requirement ☐ Gap Filling Requirement

Method of Compliance Type: (Check all that applies and complete all appropriate sections below)

- ☒ Monitoring ☐ Testing ☒ Reporting
- ☒ Record Keeping ☒ Work Practice Standard

Section 2: Monitoring

1. Monitoring device type (stack test, CEM, etc.): OGI

2. Monitoring device location: _____

Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

§60.5400b(b)(1): VOC leaks – bimonthly

§60.5400b(c)(1): Must monitor each pump in light liquid service within 5 days after each pressure release. A leak is detected if any emissions are observed using OGI or if an instrument reading of 2,000 ppmv or greater is provided using Method 21

§60.5400f: (1) Must monitor each valve in gas/vapor and in light liquid service quarterly to detect leaks by the methods specified in § 60.5403b.(2) An instrument reading of 500 ppmv or greater is a leak.

§60.5400b(g): If evidence of a potential leak is found at any time by AVO, or any other detection method, you must comply with either paragraph (g)(1) or (2) of this section. (1) You must monitor the equipment within 5 calendar days by the method specified in § 60.5403b.

§60.5400b(h): You must initially monitor all connectors in the process unit for leaks by the later of either 12 months after the compliance date or 12 months after initial startup. If all connectors in the process unit have been monitored for leaks prior to the compliance date, no initial monitoring is required provided either no process changes have been made since the monitoring or the owner or operator can determine that the results of the monitoring, with or without adjustments, reliably demonstrate compliance despite process changes. If required to monitor because of a process change, you are required to monitor only those connectors involved in the process change. (1) You must monitor all connectors in gas/vapor service and in light liquid service annually.

3. How will data be reported:

Section 3: Testing

1. Reference Test Method Description:

2. Reference Test Method Citation:

Section 4: Record Keeping

Describe what parameters will be recorded and the frequency of recording:

40 CFR §60.5400b(l): must perform the recordkeeping requirements as specified in §60.5420b(c)(8), (10), (12), and §60.5421b.

Section 5: Reporting

Describe what is to be reported and the frequency of reporting:

§60.5400b(k): Must perform the reporting requirements as specified in §§ 60.5420b(b)(1), (b)(11), and 60.5422b.

1. Reporting start date: _____

Section 6: Work Practice Standard

Describe any work practice standards:

§60.5400b(e)(1): Each open-ended valve or line must be equipped with a cap, blind flange, plug, or a second valve. The cap, blind flange, plug, or second valve must seal the open end of the valve or line at all times except during operations requiring process fluid flow through the open-ended valve or line.

§60.5400b(i): When a leak is detected, comply with the requirements of paragraphs (i)(1) through (5) of this section, except as provided in paragraph (i)(6) of this section.



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Addendum A: Source Applicable Requirements

Describe and cite all applicable requirements pertaining to this source.

Note: A Method of Compliance Worksheet (Addendum 1) must be completed for each requirement listed.

Citation Number	Citation Limitation	Limitation Used
40 CFR §60.5401b	NSPS OOOOb - Process Unit Equipment Alternative GHG and VOC Standards	Same



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Addendum 1 Method Of Compliance Worksheet

SECTION 1. APPLICABLE REQUIREMENT

Federal Tax Id: 26-2863376-3 Firm Name: ETC Northeast Pipeline, LLC

Plant Code: Plant Name: Revolution Cryogenic Plant

Applicable Requirement for: (please check only one box below)

- ☐ The entire site
- ☐ A group of sources, Group ID: _____
- ☒ A single source, Unit ID: P703
- ☐ Alternative Scenario, Scenario Name: _____

Citation #: 40 CFR §60.5401b

Compliance Method based upon: ☒ Applicable Requirement ☐ Gap Filling Requirement

Method of Compliance Type: (Check all that applies and complete all appropriate sections below)

- ☒ Monitoring ☐ Testing ☒ Reporting
- ☒ Record Keeping ☒ Work Practice Standard

Section 2: Monitoring

1. Monitoring device type (stack test, CEM, etc.): Method 21

2. Monitoring device location: _____

Describe all parameters being monitored along with the frequency and duration of monitoring each parameter:

§§60.5401b(b): Must monitor each pump in light liquid service monthly to detect leaks by the methods specified in § 60.5403b, except as provided in paragraphs (b)(2) through (4) of this section. (1) must conduct weekly visual inspections of all pumps in light liquid service for indications of liquids dripping from the pump seal. If there are indications of liquids dripping from the pump seal, you must follow the procedure specified in either paragraph (b)(1)(i) or (ii) of this section.

§60.5401b(e): Closed vent systems used to comply with the equipment leak provisions of this section must comply with the requirements in §§ 60.5411b and 60.5416b. Control devices used to comply with the equipment leak provisions of this section must comply with the requirements in §§ 60.5412b, 60.5415b(f), and 60.5417b.

§60.5401b(f): must monitor each valve in gas/vapor and in light liquid service quarterly to detect leaks by the methods specified in § 60.5403b, except as provided in paragraphs (h)(3) through (5) of this section.

§60.5401b(g): If evidence of a potential leak is found at any time by AVO, or any other detection method, you must comply with either paragraph (g)(1) or (2) of this section. (1) must monitor the equipment within 5 calendar days by the method specified in § 60.5403b and repair any leaks detected according to paragraph (i) of this section. An instrument reading of 10,000 ppmv or greater is defined as a leak. (2) You must designate the AVO, or other indication of a leak as a leak and repair the leak according to paragraph (i) of this section.

§60.5401b(h): You must initially monitor all connectors in the process unit for leaks by the later of either 12 months after the compliance date or 12 months after initial startup. If all connectors in the process unit have been monitored for leaks prior to the compliance date, no initial monitoring is required provided either no process changes have been made since the monitoring or the owner or operator can determine that the results of the monitoring, with or without adjustments, reliably demonstrate compliance despite process changes. If required to monitor because of a process change, you are required to monitor only those connectors involved in the process change.

3. How will data be reported:

Section 3: Testing

1. Reference Test Method Description:

2. Reference Test Method Citation:

Section 4: Record Keeping

Describe what parameters will be recorded and the frequency of recording:

40 CFR §60.5401b(m): You must perform the recordkeeping requirements as specified in § 60.5420b(c)(8), (10), (12), and § 60.5421b.

Section 5: Reporting

Describe what is to be reported and the frequency of reporting:

40 CFR §60.5401b(l): You must perform the reporting requirements as specified in §§ 60.5420b(b)(1), (b)(11), and 60.5422b.

1. Reporting start date:

Section 6: Work Practice Standard

Describe any work practice standards:

§60.5401b(d): Each open-ended valve or line must be equipped with a cap, blind flange, plug, or a second valve, except as provided in paragraphs (d)(4) and (5) of this section. The cap, blind flange, plug, or second valve must seal the open end of the valve or line.

§60.5401b(i): when a leak is detected, comply with the requirements of paragraphs (i)(1) through (5) of this section, except as provided in paragraph (i)(6) of this section.

Instructions for “Applicable Requirements”

Addendum A is only applicable to an existing Title V facility. The purpose of Addendum A, Applicable Requirements, is to streamline the administrative requirements for the installation, construction, modification, or reactivation of a source or air cleaning device to an existing Title V facility. Once the facility has a Title V operating permit, the applicable requirements for the proposed project (new or modified source) can be incorporated into Title V operating permit through an administrative amendment. The Department may publish a single notice to cover a plan approval application and changes in the Title V Operating Permit.

The applicable requirements should include limitations and requirements, which would apply to a proposed project covered by the plan approval application. A definition of *applicable requirements* is given in Glossary of Technical Terms (Part C). Applicable requirements include both emission limitations and work practice standards. An example of this would be the requirement of 25 Pa. Code § 123.1 that no fugitive emissions are allowed beyond the property line. When identifying applicable requirements, applicant should consult 25 Pa. Code Chapter 121-145 and note many Federal regulations are adopted by reference in these rules.

For each applicable requirement that is listed here and listed elsewhere within this addendum, a separate worksheet, “Method of Compliance Worksheet” (Addendum 1) must be filled out. This is very important since all applicable requirements must provide a description of or reference to any compliance method to achieve compliance with the stated requirements. If the proposed project is a modification to an existing Title V facility, make correction on previously submitted applicable requirements for the source(s). Submit Method of Compliance Worksheet (Addendum 1) for the only new applicable requirements pertain to proposed project. If the proposed project makes a facility to a Title V facility, contact appropriate Regional Office when the complete Title V application is required.

Citation Number: This would either be a federal, a state citation, or an existing permit condition, if applicable. Applicants do not have to delineate which of these citations are federally enforceable. If needed, the Department will separate these requirements in the permit itself.

Notes: Regulations cited in this column must be in a separate format. For **Federal Citations**, provide the Code of Federal Regulations (CFR) and the appropriate sections and/or subsections. For example, New Source Performance Standards (NSPS), Subpart Dc, would be listed as 40 CFR 60.43c for Particulate Matter.

For **State Citation**, list the appropriate chapters and sections. For example, a surface Coating Process subjected to an allowable VOC content stated in Table 1 of Chapter 129.52, would enter 129.52(b)(1) in the column.

Citation Limitation: Indicate the standard or emission limitation associated with the citation number listed.

Limitation Used: This column is optional and is to be used only if a more stringent limitation is proposed.

Example: A steam generating unit constructed after June 8, 1989, with a maximum design heat input capacity of 85 MM BTU/hr fueled by coal. Some applicable requirements would be:

Citation Number	Citation Limitation	Limitation Used (Optional)
40 CFR 60.43c	For PM: 0.05 lb/MM BTU	
40 CFR 60.42c	For SOx: 1.2 lb/MM BTU and 90 % reduction	

For purpose of complying with the above requirement, the **Method of Compliance worksheet** (Addendum1) must be completed, indicating that the compliance method for PM would be recording and maintaining of records, and Continuous Emission Monitoring (CEM), Method 6B, will be used to show compliance for SOx.

Addendum 1: Method of Compliance Worksheet (Mandatory)

To fulfill the requirement for determining compliance with all applicable requirements listed, a method of compliance worksheet must be completed. A separate worksheet must be completed for **each** applicable requirement listed in the application. Duplicate this worksheet as needed.

There are six (6) sections in this worksheet:

- Section 1: Applicable Requirement
- Section 2: Monitoring
- Section 3: Testing
- Section 4: Record Keeping
- Section 5: Reporting
- Section 6: Work Practice Standard

All six sections do not need to be completed. The completion of part or all of these sections will be determined by the applicable compliance method checked in Section 1 of this Addendum. For example, if the compliance method for an existing requirement involves monitoring, reporting, and record keeping, the applicant does not have to complete Sections 3 and 6 relating to “**Testing**” and “**Work Practice Standard**”, respectively.

Section 1: Applicable Requirement

This section cannot be omitted since it will identify the following important information. It will link an applicable requirement to the entire site, to a group of sources, to an individual source, or to an alternative operating scenario. It will also identify the basis and the method of compliance to each applicable requirement. The following questions in this section must be completed.

- **Applicable requirement for:** Check the appropriate box. (Only one should be checked).
 - ⇒ **The entire site** means the applicable requirement listed in Section 2, “Applicable Requirements for the Entire Site” of the Title V application.
 - ⇒ **A group of sources** means for those applicable requirements identified in Section 4, “Source Groups” of the Title V application.
 - ⇒ **A single source** is for those requirements listed in this plan approval application relating to the specific type of sources.
 - ⇒ **An alternative Operating Scenario** refers to those requirements identified in Addendum 3, “Alternative Operating Scenario”.

For group of sources, a single source, or an Operating Scenario, please provide the Group, Source, or Operating Scenario ID accordingly.

- **Citation Number:** Give the citation number associated with the applicable requirements.
- **Compliance Method based upon:** Check the appropriate box that represents the compliance basis for this applicable requirement. Again, do not check more than one box.
 - ⇒ **Applicable Requirement:** This box should be checked when there exists a compliance method in terms of monitoring, testing, and/or related record keeping and reporting for an applicable requirement.
 - ⇒ **Gap Filling Requirement:** This box is to be used for cases where the applicable requirement does not contain or require a compliance method. It can also be used for future enhanced monitoring requirements, if applicable.

- **Method of Compliance Type:** Check all boxes that are appropriate to this applicable requirement and complete the corresponded sections. For example, if the "Monitoring" and "Reporting" boxes are marked, only Sections 2 and 5 need to be completed.

Section 2: *Monitoring*

In this section, provide the type of monitoring device(s) and its location. Also describe all parameters monitored, the frequency, and the duration of monitoring for each monitor in the table provided. Explain how this data will be reported to the Department.

Section 3: *Testing*

List the reference test method citation as well as a description of this method in spaces provided.

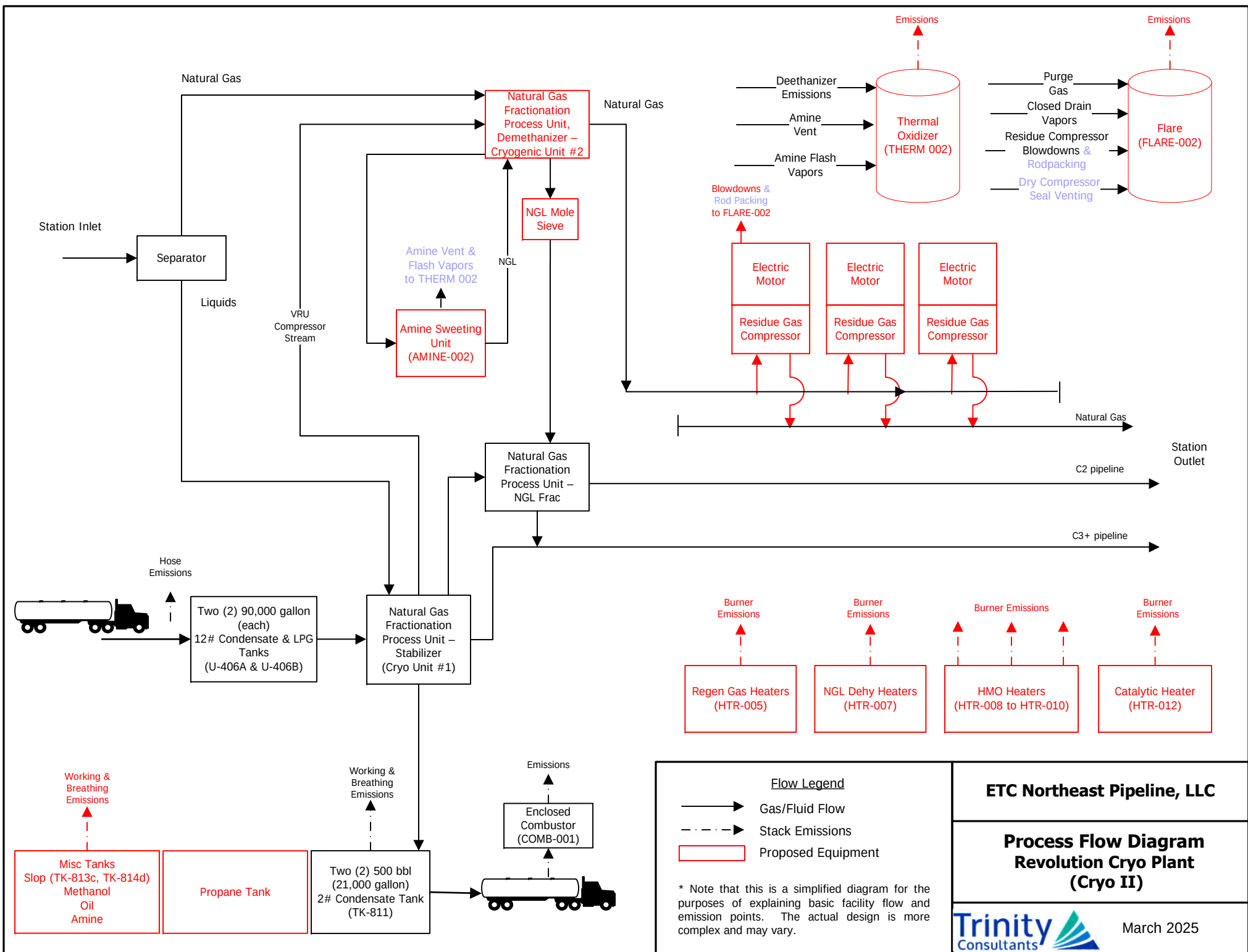
Section 4 & 5: *Record Keeping and Reporting*

If one of the compliance methods involve record keeping and reporting requirements, answer the questions as posed.

Section 6: *Work Practice Standard*

List or describe any work practice standards used for purposes of determining compliance with the applicable requirements.

ATTACHMENT D – PROCESS FLOW DIAGRAM



ATTACHMENT E – DETAILED EMISSION CALCULATIONS

[Company Name:](#) ETC Northeast Pipeline, LLC
[Facility Name:](#) Revolution Cryo II Plant
[Project Description:](#) Facility PTE

Atmospheric Emissions from Each Source at the Facility

Source	Pollutants																					
	VOC		NO _x		CO		CH ₃ OH		HCHO		Benzene		Total HAPs		PM ₁₀		PM _{2.5}		SO _x		GHG (CO ₂ e)	
	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
Amine Vent (AMINE-002)	0.15	0.64	---	---	---	---	0.04	0.19	---	---	0.00	0.00	0.04	0.19	---	---	---	---	---	---	5,444	23,844
Flare (FLARE-002)	---	---	64.06	181.52	292.04	827.51	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00	0.55	1.57	37,788	666
Thermal Oxidizer (THERM-002)	---	---	0.18	0.79	0.15	0.66	---	---	---	---	---	---	---	---	0.01	0.06	0.01	0.06	0.00	0.00	221	970
Fugitive Emissions - Component Leaks	1.32	5.79	---	---	---	---	---	---	---	---	---	---	0.03	0.13	---	---	---	---	---	---	37	164
Emissions - Blowdowns	---	3.37	---	---	---	---	---	---	---	---	---	---	---	0.11	---	---	---	---	---	---	---	322
Regen Gas Heater (HTR-006)	0.17	0.76	0.11	0.48	0.37	1.61	---	---	0.00	0.00	0.00	0.00	0.02	0.07	0.12	0.52	0.12	0.52	0.01	0.02	1,059	4,636
NGL Regen Heater (HTR-007)	0.13	0.56	0.08	0.35	0.27	1.18	---	---	0.00	0.00	0.00	0.00	0.01	0.05	0.09	0.38	0.09	0.38	0.00	0.02	778	3,406
HMO Heater (HTR-008)	0.67	2.91	0.42	1.82	1.41	6.18	---	---	0.00	0.01	0.00	0.00	0.07	0.29	0.46	2.00	0.46	2.00	0.02	0.09	4,057	17,772
HMO Heater (HTR-009)	0.67	2.91	0.42	1.82	1.41	6.18	---	---	0.00	0.01	0.00	0.00	0.07	0.29	0.46	2.00	0.46	2.00	0.02	0.09	4,057	17,772
HMO Heater (HTR-010)	0.67	2.91	0.42	1.82	1.41	6.18	---	---	0.00	0.01	0.00	0.00	0.07	0.29	0.46	2.00	0.46	2.00	0.02	0.09	4,057	17,772
Catalytic Heaters	0.00	0.02	0.08	0.37	0.07	0.31	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	31
Gas Venting	---	0.19	---	---	---	---	---	---	---	---	---	---	---	0.00	---	---	---	---	---	---	---	70
Total (Cryo II)	3.77	20.08	65.76	188.96	297.13	849.80	0.04	0.19	0.01	0.04	0.00	0.00	0.30	1.42	1.59	6.98	1.59	6.98	0.63	1.89	57,506	87,424
TOTAL (Cryo I)	3.19	29.09	68.30	30.60	287.44	35.30	0.01	0.03	0.01	0.05	0.00	0.01	0.37	2.51	1.85	8.09	1.85	8.09	0.62	0.38	94,484	80,998
TOTAL	6.96	49.16	134.06	219.56	584.57	885.11	0.05	0.21	0.02	0.08	0.00	0.02	0.67	3.93	3.44	15.06	3.44	15.06	1.24	2.27	151,990	168,422

- Notes:**
1. PM₁₀ and PM_{2.5} emissions are filterable + condensable.
 2. Emissions from loading and unloading of condensate are included in Storage Tanks totals.
 3. Short-term emissions rates from limited duration activities (ex. pigging, compressor blowdowns) are not included in the 'lb/hr' values. All potential emissions are, however, included in the 'tpy' values.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 1. Amine Sweetening Unit Vent Emissions Calculations

Amine Sweetening Unit Information:

Source ID:	AMINE-002
Max. Hours of Operation (hr/yr):	8,760
Control Device for Still Vent:	Thermal Oxidizer
Still Vent - Control Efficiency:	99%
Max Still Vent Flow Rate to Control (lb/hr):	5,517
Control Device for Flash Gas:	VRU / Flare
Flash Gas - Control Efficiency:	99.90%
Max Flash Flow Rate to Control (lb/hr):	115

Amine Unit Vent Emissions Data (each unit):

Pollutant	Uncontrolled Emissions		Controlled Emissions		Emissions Estimation Method
	lbs/hr	tpy	lbs/hr	tpy	
VOC	30.97	135.65	0.15	0.64	See Note 1 below
HAPs	4.40	19.26	0.04	0.19	See Note 1 below
CH ₃ OH	4.24	18.55	0.04	0.19	See Note 1 below
Benzene	0.08	0.37	0.00	0.00	See Note 1 below
NO _x	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
SO _x	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
CO	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
PM ₁₀	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
PM _{2.5}	N/A	N/A	N/A	N/A	See Thermal Oxidizer/MSS Flare Calculations
GHG (CO ₂ e)	5,507.15	24,121.33	5,443.86	23,844.11	See Note 2 below

Notes:

1. Controlled emissions are calculated by assuming specified control efficiencies for the combustion devices.
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265). CO₂ emissions represent the uncombusted CO₂ emissions.
3. Emissions of NO_x, SO_x, CO, PM, and GHG pollutants are the products of combustion of the vent streams in the combustion devices. Based on Promax simulation of facility and process streams.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 1. Amine Sweetening Unit Vent Emissions Calculations

Promax Emissions Data - Amine Vent (pre-control, each unit):

Pollutant	Scaled Uncontrolled Still Vent	Uncontrolled Still Vent	Scaled Uncontrolled Flash Gas	Uncontrolled Flash Gas
	lbs/hr	lbs/hr	lbs/hr	lbs/hr
CO2	5,442.6165	4,947.8332	0.9887	0.8988
Methane	0.7605	0.6913	1.5091	1.3719
Ethane	60.4593	54.9630	94.1036	85.5487
Propane	7.3953	6.7230	15.3140	13.9218
Isobutane	0.2111	0.1919	0.6883	0.6257
n-Butane	0.8220	0.7473	1.8003	1.6367
Isopentane	0.0299	0.0272	0.1193	0.1084
n-Pentane	0.0451	0.0410	0.1490	0.1355
n-Hexane	0.0051	0.0046	0.0265	0.0241
Cyclohexane	0.0000	0.0000	0.0000	0.0000
Heptanes	0.0001	0.0001	0.0006	0.0005
2,2,4-Trimethylpentane	0.0000	0.0000	0.0000	0.0000
Benzene	0.0828	0.0752	0.0018	0.0016
Toluene	0.0283	0.0258	0.0007	0.0006
Ethylbenzene	0.0037	0.0034	0.0001	0.0001
Xylenes	0.0108	0.0098	0.0002	0.0002
Methanol	4.2356	3.8505	0.0006	0.0006
C8 + Heavier Hydrocarbons	0.0000	0.0000	0.0001	0.0001
Total Emissions	5,516.7059	5,015.1872	114.7029	104.2754
Total Hydrocarbon Emissions	74.0895	67.3541	113.7142	103.3765
Total VOC Emissions	12.8697	11.6997	18.1015	16.4559
Total HAP Emissions	4.3663	3.9694	0.0299	0.0272

Notes:

1. Based on ProMax simulation of facility and process stream scaled up as an engineering factor: 1.1
2. Methanol (CH₃OH) emissions are based on a site specific sample. ProMax is used to estimate methanol emissions.
3. Amine unit flash tank gas will either be used as fuel in the HMO heaters or be routed to the thermal oxidizer during VRU downtime. These calculations assume that all flash tank gas is sent to flare.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 2. Control Device Emissions Calculations - Maintenance Startup, Shutdown (MSS) Facility Flare

Control Device Information:

Source ID:	FLARE-002
Control Efficiency:	98%
Calculated Loading to flare (MMBtu/hr):	942
Calculated Loading to flare (MMBtu/yr):	5,334,292
Pilot Gas Rate (scf/hr):	507
Pilot Gas Rate (MMBtu/hr):	0.51
Pilot Gas Rate (MMBtu/yr):	4,468
Hours of Operation (hr/yr):	8,760
Pilot Hours of Operation (hr/yr):	8,760

Emissions from Combustion of Gas in Flare:

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.068	lb/MMBtu	64.06	181.52	AP-42, Table 13.5-1 (April-2015)
CO	0.310	lb/MMBtu	292.04	827.51	AP-42, Table 13.5-2 (April-2015)
SO _x	0.001	lb/MMBtu	0.55	1.57	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.000	lb/MMBtu	0.00	0.00	Nonsmoking Flare
PM _{2.5}	0.000	lb/MMBtu	0.00	0.00	Nonsmoking Flare
GHG (CO ₂ e)	See Table Below		37,787.98	666.16	40 CFR 98, Tables C-1 & C-2

1. Emissions factors converted by lb/MMscf to lb/MMBtu based on the HHV cited in AP-42 (1020 btu/scf).

Greenhouse Gas (GHG) Emissions - Pilot Gas:

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO ₂	53.06	kg/MMBtu	60.87	266.59	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			60.93	266.87	

Notes:

- PM₁₀ and PM_{2.5} are total values (filterable + condensable).
- GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
- Emissions of NO_x, SO_x, CO, PM, and GHG pollutants are the result of combustion of the streams in the flare.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 2. Control Device Emissions Calculations - Maintenance Startup, Shutdown (MSS) Facility Flare

Greenhouse Gas (GHG) Emissions - Controlled Streams

	Purge Gas	Residue Gas Compressor Blowdowns	Amine Unit Flash Gas	Closed Drain Vapors	Residue Compressor Rod Packing	Centrifugal Dry Compressor Seal
Composition	mol%	mol%	mol%	mol%	mol%	mol%
CO2	0.0149	0.0149	0.6127	0.0441	0.0149	0.0442
Methane	99.4401	99.4401	2.5656	77.1005	99.4401	77.2557
Ethane	0.0835	0.0835	85.3556	14.9833	0.0835	15.0134
Propane	0.0000	0.0000	9.4719	5.0333	0.0000	5.0434
Isobutane	0.0000	0.0000	0.3230	0.5073	0.0000	0.5083
n-Butane	0.0000	0.0000	0.8448	1.1607	0.0000	1.1630
Isopentane	0.0000	0.0000	0.0451	0.1972	0.0000	0.1976
n-Pentane	0.0000	0.0000	0.0563	0.2528	0.0000	0.2533
n-Hexane	0.0000	0.0000	0.0084	0.1410	0.0000	0.1413
Cyclohexane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Heptanes	0.0000	0.0000	0.0002	0.0103	0.0000	0.0103
2,2,4-Trimethylpentane	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Benzene	0.0000	0.0000	0.0006	0.0011	0.0000	0.0011
Toluene	0.0000	0.0000	0.0002	0.0009	0.0000	0.0009
Ethylbenzene	0.0000	0.0000	0.0000	0.0003	0.0000	0.0003
Xylenes	0.0000	0.0000	0.0001	0.0006	0.0000	0.0006
C8 + Heavier Hydrocarbons	0.0000	0.0000	0.0000	0.1587	0.0000	0.1934
Flow Rate (scfh)	651	330,000	1,265	5.19	207	16
Flow (scf/yr)	5,702,760	198,000	554,057	2,273	90,666	7,096
Control Efficiency (%)	98.00%	98.00%	98.00%	98.00%	98.00%	98.00%
VRU Control Efficiency (%):	--	95.00%	95.00%	95.00%	95.00%	95.00%
Annual Hours of Operation	8,760	12	8,760	8,760	8,760	8,760
Density of CO ₂ (kg/ft ³ at 60F & 14.7 psia)	0.0526	0.0526	0.0526	0.0526	0.0526	0.0526
Ea,CO ₂ (combusted) - scf/hr	635	322,129	2,565	7	202	21
Ea,CO ₂ (combusted) - scf/yr	5,566,744	193,278	1,123,517	2,955	88,504	9,255
Mass, CO ₂ (combusted) - lb/hr	74	37,355	297	1	23	2
Mass, CO ₂ (combusted) - tpy	323	11	65	0	5	1

1. Purge gas (required for operation of flare) is based on ProMax run at design conditions and facility operations.
2. Closed drain vapors based on ProMax run at design conditions and facility operations.
3. Amine unit flash tank gas is sent to a VRU. For VRU downtime, flash gas will be sent to the HMO heaters and the facility flare for back up. These calculations conservatively assume that all flash tank gas is sent to flare.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 2. Control Device Emissions Calculations - Maintenance Startup, Shutdown (MSS) Facility Flare

Heating Value - Controlled Streams

	Purge Gas	Residue Gas Compressor Blowdowns	Amine Unit Flash Gas	Closed Drain Vapors	Residue Compressor Rod Packing	Centrifugal Dry Compressor Seal	Total Vented to Flare	Lower Heating Value ²	Higher Heating Value ³	Weight Percent
Composition	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	MJ/kg	btu/lb	Wt %
Water	0.00E+00	0.00E+00	1.12E+02	5.08E-04	0.00E+00	1.59E-03	1.12E+02	0.000	0	0.003
Carbon Dioxide	1.14E-02	5.77E+00	2.35E+02	2.73E-04	3.62E-03	8.30E-04	2.41E+02	0.000	0	0.006
Nitrogen	2.25E-01	1.14E+02	0.00E+00	1.41E-03	7.15E-02	4.28E-03	1.14E+02	0.000	0	0.003
Methane	2.77E+01	1.41E+04	3.58E+02	1.74E-01	8.82E+00	5.29E-01	1.45E+04	50.009	23,649	0.348
Ethane	4.36E-02	2.21E+01	2.23E+04	6.33E-02	1.39E-02	1.93E-01	2.24E+04	47.794	22,601	0.538
Propane	2.18E-07	1.11E-04	3.64E+03	3.12E-02	6.94E-08	9.49E-02	3.64E+03	46.357	21,922	0.087
Isobutane	1.14E-12	5.76E-10	1.63E+02	4.14E-03	3.61E-13	1.26E-02	1.63E+02	45.613	21,570	0.004
n-Butane	6.07E-13	3.08E-10	4.28E+02	9.48E-03	1.93E-13	2.88E-02	4.28E+02	45.752	21,636	0.010
Isopentane	0.00E+00	0.00E+00	2.83E+01	2.00E-03	0.00E+00	6.08E-03	2.83E+01	45.241	21,394	0.001
n-Pentane	0.00E+00	0.00E+00	3.54E+01	2.56E-03	0.00E+00	7.80E-03	3.54E+01	45.357	21,449	0.001
n-Hexane	0.00E+00	0.00E+00	6.29E+00	1.71E-03	0.00E+00	5.19E-03	6.30E+00	44.752	21,163	0.000
Cyclohexane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	43.450	20,547	0.000
Heptanes	0.00E+00	0.00E+00	1.39E-01	1.45E-04	0.00E+00	4.40E-04	1.40E-01	44.566	21,075	0.000
2,2,4-Trimethylpentane	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	44.310	20,954	0.000
Benzene	0.00E+00	0.00E+00	5.75E-01	1.20E-05	0.00E+00	3.66E-05	5.75E-01	40.170	18,996	0.000
Toluene	0.00E+00	0.00E+00	1.69E-01	1.16E-05	0.00E+00	3.54E-05	1.69E-01	40.589	19,194	0.000
Ethylbenzene	0.00E+00	0.00E+00	2.65E-02	4.46E-06	0.00E+00	1.36E-05	2.65E-02	40.938	19,359	0.000
Xylenes	0.00E+00	0.00E+00	4.98E-02	8.93E-06	0.00E+00	2.72E-05	4.98E-02	40.961	19,370	0.000
C8 + Heavies	0.00E+00	0.00E+00	2.20E-02	1.60E-04	0.00E+00	4.86E-04	2.27E-02	44.264	20,932	0.000
Total	28	14,204	27,352	0	9	1	41,595			1.000

Each Stream

Gas Flow Rate (lb/hr)	28.02	14,204.45	27,352.36	0.29	8.91	0.88
Higher Heating Value (Btu/lb)	23,448	23,214	22,214	22,909	23,448	22,909
Max Loading to Flare (mmBtu/hr):	0.66	329.75	607.59	0.01	0.21	0.02
Hours to Flare	8,760	12	8,760	8,760	8,760	8,760
Max Loading to Flare (mmBtu/yr):	5,756	3,957	5,322,513	58	1,830	178

Combined

Gas Flow Rate (lb/hr)	41,595
Higher Heating Value (Btu/lb)	22,636
Max Loading to Flare (mmBtu/hr):	942
Max Loading to Flare (mmBtu/yr):	5,334,292

1. Published values from https://en.wikipedia.org/wiki/Heat_of_combustion

2. 1 MJ/kg = 429.9 Btu/lb. Converts LHV to HHV with a factor of 1.1.

3. Natural gas density at standard conditions: 0.05 lb/cf at 32F and 14.7 psia

4. Natural gas density: 379 scf/lb-mol

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 3. Control Device Emissions Calculations - Thermal Oxidizer Controlling Amine Vent and Flash Gas

Control Device Information:

Source ID:	THERM-002
Control Efficiency:	99%
Calculated Loading to oxidizer (MMBtu/hr):	1.56
Calculated Loading to oxidizer (MMBtu/yr):	13,697
Pilot Gas Rate (scf/hr):	266
Pilot Gas Rate (MMBtu/hr):	0.27
Pilot Gas Rate (MMBtu/yr):	2,344
Hours of Operation (hr/yr):	8,760
Pilot Hours of Operation (hr/yr):	8,760

Emissions from Combustion of Gas in Oxidizer (each unit):

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.098	lb/MMBtu	0.18	0.79	AP-42, Table 1.4-1 (Jul-1998)
CO	0.082	lb/MMBtu	0.15	0.66	AP-42, Table 1.4-1 (Jul-1998)
SO _x	0.001	lb/MMBtu	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.007	lb/MMBtu	0.01	0.06	AP-42, Table 1.4-2 (Jul-1998)
PM _{2.5}	0.007	lb/MMBtu	0.01	0.06	AP-42, Table 1.4-2 (Jul-1998)
GHG (CO ₂ e)	See Table Below		221.43	969.87	40 CFR 98, Tables C-1 & C-2

1. Emissions factors converted by lb/MMscf to lb/MMBtu based on the HHV cited in AP-42 (1020 btu/scf).

Greenhouse Gas (GHG) Pilot Gas and HAP Emissions (each unit):

Pollutant	Emission Factor	Units	Post-Control Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
HAP:					
HAP	0.002	lb/MMBtu	0.00	0.01	AP-42, Table 1.4-1 (Jul-1998)
GHGs:					
CO ₂	53.06	kg/MMBtu	31.93	139.86	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			31.96	140.00	

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).

2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).

3. Emissions of NO_x, SO_x, CO, PM, and GHG pollutants are the result of combustion of the streams in the oxidizer.

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 3. Control Device Emissions Calculations - Thermal Oxidizer Controlling Amine Vent and Flash Gas

Greenhouse Gas (GHG) Emissions - Controlled Vent Streams

	Amine Vent Stream
Composition	mol%
CO ₂	90.8748
Methane	0.0348
Ethane	1.4775
Propane	0.1232
Isobutane	0.0027
n-Butane	0.0104
Isopentane	0.0003
n-Pentane	0.0005
n-Hexane	0.0000
Cyclohexane	0.0000
Heptanes	0.0000
2,2,4-Trimethylpentane	0.0000
Benzene	0.0008
Toluene	0.0002
Ethylbenzene	0.0000
Xylenes	0.0001
C8 + Heavier Hydrocarbons	0.0000
Methanol	0.0971
Flow Rate (scfh)	46,906
Control Efficiency (%)	99%
VRU Control Efficiency (%)	--
Hours of Operation	8,760
Density of CO ₂ (kg/ft ³ at 60F & 14.7 psia)	0.0526
Ea,CO ₂ (combusted) - scf/hr	1,634
Mass, CO ₂ (combusted) - lb/hr	189
Mass, CO ₂ (combusted) - tpy	830

1. Based on ProMax run at design conditions and facility operations. Uncombusted CO₂ shown on the Amine Vent calculations.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 3. Control Device Emissions Calculations - Thermal Oxidizer Controlling Amine Vent and Flash Gas

Heating Value - Controlled Vent Streams

	Amine Vent Stream	Total Vented to Oxidizer	Lower Heating Value ²	Higher Heating Value ³	Weight Percent	Higher Heating Value
Composition	lb/hr	lb/hr	MJ/kg	btu/lb	Wt %	Btu/lb
CO2	5.44E+03	5.44E+03	0.000	0	0.987	0.00
Methane	7.60E-01	7.60E-01	50.009	23,649	0.000	3.26
Ethane	6.05E+01	6.05E+01	47.794	22,601	0.011	247.69
Propane	7.40E+00	7.40E+00	46.357	21,922	0.001	29.39
Isobutane	2.11E-01	2.11E-01	45.613	21,570	0.000	0.83
n-Butane	8.22E-01	8.22E-01	45.752	21,636	0.000	3.22
Isopentane	2.99E-02	2.99E-02	45.241	21,394	0.000	0.12
n-Pentane	4.51E-02	4.51E-02	45.357	21,449	0.000	0.18
n-Hexane	5.08E-03	5.08E-03	44.752	21,163	0.000	0.02
Cyclohexane	0.00E+00	0.00E+00	43.450	20,547	0.000	0.00
Heptanes	6.13E-05	6.13E-05	44.566	21,075	0.000	0.00
2,2,4-Trimethylpentane	0.00E+00	0.00E+00	44.310	20,954	0.000	0.00
Benzene	8.28E-02	8.28E-02	40.170	18,996	0.000	0.29
Toluene	2.83E-02	2.83E-02	40.589	19,194	0.000	0.10
Ethylbenzene	3.72E-03	3.72E-03	40.938	19,359	0.000	0.01
Xylenes	1.08E-02	1.08E-02	40.961	19,370	0.000	0.04
Methanol	4.24E+00	4.24E+00	19.900	9,888	0.001	7.59
C8 + Heavies	7.75E-06	7.75E-06	44.264	20,932	0.000	0.00
Total	5,517	5,517			1.000	293

Gas Flow Rate (lb/hr) 5,517
Higher Heating Value (Btu/lb) 283
Max Loading to Oxidizer (mmBtu/hr): 1.56
Hours to Oxidizer 8,760
Max Loading to Oxidizer (mmBtu/yr): 13,697

1. Published values from https://en.wikipedia.org/wiki/Heat_of_combustion

2. 1 MJ/kg = 429.9 Btu/lb. Converts LHV to HHV with a factor of 1.1.

3. Natural gas density at standard conditions: 0.05 lb/cf at 32F and 14.7 psia

4. Natural gas density: 379 scf/lb-mol

http://www.engineeringtoolbox.com/gas-density-d_158.html

Company Name:
Facility Name:
Project Description:

ETC Northeast Pipeline, LLC
Revolution Cryo II Plant
Facility PTE

TABLE 4. Fugitive Emissions from Component Leaks

Total Fugitive Emissions:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	1.32	5.79	EPA Protocol, Table 2-4 & Site-Specific Gas Analysis
HAPs	0.03	0.13	EPA Protocol, Table 2-4 and Site-Specific Gas Analysis
CO ₂	0.00	0.02	40 CFR 98, Table W-1A & Site-Specific Gas Analysis
CH ₄	1.34	5.86	40 CFR 98, Table W-1A & Site-Specific Gas Analysis
GHG (CO ₂ e)	37	164	GWP: CO ₂ 1, CH ₄ 28

Fugitive Emissions from Component Leaks:

Component - Service	Stream	Estimated Component Count	Gas Leak Emission Factor (lb/hr/component)	Maximum Gas Leak Rate (lb/hr)	LDAR Control Efficiency %	Actual Gas Leak Rate (tpy)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions (tpy)	Potential CH ₄ Emissions (tpy)
Valves - Gas/Vapor	Inlet Gas	2,775	9.92E-03	27.53	97%	3.62	0.64	0.02	0.00	2.17
Valves - Gas/Vapor	Residue Gas	1,500	9.92E-03	14.88	97%	1.96	0.00	0.00	0.00	1.94
Valves - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Valves - Gas/Vapor	Refrigerant	660	9.92E-03	6.55	97%	0.86	0.86	0.00	0.00	0.00
Valves - Light Oil	Condensate	3,300	5.51E-03	18.19	97%	2.39	1.07	0.04	0.00	0.01
Valves - Water/Oil	---	---	---	---	---	---	---	---	---	---
Pump Seals - Gas	Inlet Gas	0	5.29E-03	0.00	0%	0.00	0.00	0.00	0.00	0.00
Pump Seals - Gas	Residue Gas	0	5.29E-03	0.00	0%	0.00	0.00	0.00	0.00	0.00
Pump Seals - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Pump Seals - Gas	Refrigerant	5	5.29E-03	0.03	75%	0.03	0.03	0.00	0.00	0.00
Pump Seals - Light Oil	Condensate	60	2.87E-02	1.72	75%	1.88	0.84	0.03	0.00	0.01
Pump Seals - Water/Oil	---	---	---	---	---	---	---	---	---	---
Other - Gas/Vapor	Inlet Gas	113	1.94E-02	2.19	97%	0.29	0.05	0.00	0.00	0.17
Other - Gas/Vapor	Residue Gas	60	1.94E-02	1.16	97%	0.15	0.00	0.00	0.00	0.15
Other - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Other - Gas/Vapor	Refrigerant	38	1.94E-02	0.74	75%	0.81	0.81	0.00	0.00	0.00
Other - Light Oil	Condensate	105	1.65E-02	1.74	75%	1.90	0.85	0.03	0.00	0.01
Other - Water/Oil	---	---	---	---	---	---	---	---	---	---
Connectors - Gas	Inlet Gas	1,224	4.41E-04	0.54	97%	0.07	0.01	0.00	0.00	0.04
Connectors - Gas	Residue Gas	1,224	4.41E-04	0.59	97%	0.08	0.00	0.00	0.00	0.08
Connectors - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Connectors - Light Oil	Refrigerant	---	4.63E-04	---	97%	---	---	---	---	---
Connectors - Light Oil	Condensate	---	4.63E-04	---	97%	---	---	---	---	---
Connectors - Water/Oil	---	---	---	---	---	---	---	---	---	---
Flanges - Gas/Vapor	Inlet Gas	9,881	8.60E-04	8.50	97%	1.12	0.20	0.01	0.00	0.67
Flanges - Gas/Vapor	Residue Gas	5,250	8.60E-04	4.51	97%	0.59	0.00	0.00	0.00	0.59
Flanges - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Flanges - Gas/Vapor	Refrigerant	2,190	8.60E-04	1.88	97%	0.25	0.25	0.00	0.00	0.00
Flanges - Light Oil	Condensate	12,750	2.43E-04	3.09	97%	0.41	0.18	0.01	0.00	0.00
Flanges - Water/Oil	---	---	---	---	---	---	---	---	---	---
Open-Ended Lines - Gas	Inlet Gas	0	4.41E-03	0.00	97%	0.00	0.00	0.00	0.00	0.00
Open-Ended Lines - Gas	Residue Gas	0	4.41E-03	0.00	97%	0.00	0.00	0.00	0.00	0.00
Open-Ended Lines - Heavy Oil	---	---	---	---	---	---	---	---	---	---
Open-Ended Lines - Light Oil	Refrigerant	---	3.09E-03	---	97%	---	---	---	---	---
Open-Ended Lines - Light Oil	Condensate	---	3.09E-03	---	97%	---	---	---	---	---
Open-Ended Lines - Water/Oil	---	---	---	---	---	---	---	---	---	---
Total (Cryo 2)						16.40	5.79	0.13	0.02	5.82

1. "Other" equipment types include compressor seals, relief valves, diaphragms, drains, meters, etc.
2. The component count is a preliminary estimate based on the proposed design of the facility.
3. 1995 Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017) Table 2-4.
4. Control Efficiencies from "TCEQ - Control Efficiencies for TCEQ Leak Detection and Repair Programs" (rev. 07/22). Accounts for NSPS LDAR and FLIR/AVO programs.
5. Assumes a 20% compliance margin on existing fugitive components from Cryo I.
6. VOC, HAP, CH₄, and CO₂ emissions are based on fractions of these pollutants as follows:

	Wt % VOC	Wt % HAP	Wt. % CO2	Wt % CH4
Inlet Gas	17.72	0.60	0.09	59.89
Residue Gas	0.00	0.00	0.04	99.00
Refrigerant	100.00	0.00	0.00	0.00
Condensate	44.72	1.52	0.18	0.29

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 4. Fugitive Emissions from Component Leaks

Rod Packing Emissions:

Type of Compressors	Number of Compressors	Number of Throws per Compressor	Leak Factor (scf/hr/throw)	Total Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions (tpy)	Potential CH ₄ Emissions (tpy)
Residue Compressor (Electric)	3	6	11.5	1,813	0.00	0.00	0.00	0.04
Centrifugal Dry Compressor Seal	1	1	16.2	142	0.00	0.00	0.00	0.00
Total					0.00	0.00	0.00	0.04

1. Emission factors from http://www.epa.gov/gasstar/documents/ll_rodpack.pdf

2. VRU control: 95%

3. MSS Flare Control: 98%

4. Centrifugal compressor vendor data for seal rate (scfm): 0.27

5. VOC, HAP, CH₄, and CO₂ emissions are based on fractions of these pollutants as follows:
- | | | | | | |
|-------------|----------|----------|-----------|----------|-------|
| | Wt % VOC | Wt % HAP | Wt. % CO2 | Wt % CH4 | MW |
| Inlet Gas | 17.72 | 0.60 | 0.09 | 59.89 | 20.69 |
| Residue Gas | 0.00 | 0.00 | 0.04 | 99.00 | 16.11 |

Company Name:

ETC Northeast Pipeline, LLC

Facility Name:

Revolution Cryo II Plant

Project Description:

Facility PTE

TABLE 5. Emissions from Blowdowns

Total Fugitive and Vented Emissions:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	---	3.37	Estimated Gas Volumes & Site-Specific Gas Analysis
HAPs	---	0.11	
CO ₂	---	0.02	
CH ₄	---	11.48	
GHG (CO ₂ e)	---	322	GWP: CO ₂ 1, CH ₄ 28

1. Hours/year (estimated at 10 min per event): 13.33333333 hr/yr

Vented Blowdown Emissions:

Blowdown Emissions Sources	Number of Units	Number of Annual Events	Gas Volume per Event (scf)	Controlled by Flare? (Y / N)	Total Potential Emitted Volume NG (scf/yr)	Total Actual Emitted Volume NG (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions ¹ (tpy)	Potential CH ₄ Emissions ¹ (tpy)
Residue Compressor (Electric)	3	72	55,000	Y	3,960,000	3,960	0.000	0.00	0.00	0.08
Moisture Analyzer	--	--	--	N	131,400	131,400	0.64	0.02	0.00	2.15
VRU Compressor Blowdowns	2	8	15,000	Y	120,000	120	0.00	0.00	0.00	0.00
Facility Maintenance	--	--	--	N	450,000	450,000	2.18	0.07	0.01	7.36
Miscellaneous Blowdowns	--	--	--	Y	115,740,000	115,740	0.56	0.02	0.00	1.89
Total							3.37	0.11	0.02	11.48

1. VOC, HAP, CH₄, and CO₂ emissions are based on fractions of these pollutants as follows:
- | | | | | | |
|---------------------|----------|----------|-----------|----------|-------|
| | Wt % VOC | Wt % HAP | Wt. % CO2 | Wt % CH4 | MW |
| Residue Gas | 0.00 | 0.00 | 0.04 | 99.00 | 16.11 |
| Stabilizer Overhead | 66.01 | 0.22 | 0.01 | 8.67 | 37.34 |
| Inlet Gas | 17.72 | 0.60 | 0.09 | 59.89 | 20.69 |
2. The gas volumes are estimated based on facility design and standard engineering calculations.
3. Controlled emissions include 5% VRU downtime.
4. Where applicable, emissions are calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.0.37%
5. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 25) + N₂O (GWP = 298).
6. Density as follows:
- | | | | | |
|-------------------|----------|---|------|--|
| CO ₂ : | 0.0526 | kg/ft ³ for CO ₂ at 60 °F and 14.7 psia | | |
| CH ₄ : | 0.0192 | kg/ft ³ for CH ₄ at 60 °F and 14.7 psia | | |
| VOC: | 3.31E-10 | lb VOC/ft ³ of total gas (residue gas) | HAP: | 0.00E+00 lb HAP/ft ³ of total gas (residue gas) |
| VOC: | 9.67E-03 | lb VOC/ft ³ of total gas (inlet gas) | HAP: | 3.26E-04 lb HAP/ft ³ of total gas (inlet gas) |
- Value for 'lb VOC/scf' of total gas = Sum of (vol%/100 * MW (lb/lb-mol) / 379 scf/lb-mol) for each VOC constituent

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 6. Inlet Gas Sieve Regen Heater

Heater Information:

Source ID:	HTR-006
Number of Units:	1

Heater Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006
Heat Input (MMBtu/hr)	9.04
Potential Fuel Consumption (MMBtu/yr):	79,190
Max. Fuel Consumption (MMscf/hr):	0.0090
Max. Fuel Consumption (MMscf/yr):	78.7
Max. Annual Hours of Operation (hr/yr):	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.012	lb/MMBtu	0.11	0.48	Manufacturer Guarantee
VOC	0.019	lb/MMBtu	0.17	0.76	Manufacturer Guarantee
CO	0.0407	lb/MMBtu	0.37	1.61	Manufacturer Guarantee
SO _x	0.6	lb/MMScf	0.01	0.02	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.013	lb/MMBtu	0.12	0.52	Manufacturer Guarantee
PM _{2.5}	0.013	lb/MMBtu	0.12	0.52	Manufacturer Guarantee
Formaldehyde (HCHO)	0.08	lb/MMScf	0.0007	0.0030	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		1,059	4,636	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.02	0.07	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 6. Inlet Gas Sieve Regen Heater

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO ₂	53.06	kg/MMBtu	1057.47	4,632	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.02	0.09	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			1,059	4,636	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.02	0.07	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.017	0.074	

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 7. NGL Dehy Regenerator Gas Heater Emissions Calculations

Heater Information:

Source ID:	HTR-007
Number of Units:	1

Heater Fuel Information:

Fuel Type:	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006
Heat Input (MMBtu/hr)	6.64
Potential Fuel Consumption (MMBtu/yr):	58,166
Max. Fuel Consumption (MMscf/hr):	0.0066
Max. Fuel Consumption (MMscf/yr):	57.8
Max. Annual Hours of Operation (hr/yr):	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
NO _x	0.012	lb/MMBtu	0.08	0.35	Manufacturer Guarantee
VOC	0.019	lb/MMBtu	0.13	0.56	Manufacturer Guarantee
CO	0.041	lb/MMBtu	0.27	1.18	Manufacturer Guarantee
SO _x	0.6	lb/MMScf	0.00	0.02	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.0132	lb/MMBtu	0.09	0.38	Manufacturer Guarantee
PM _{2.5}	0.0132	lb/MMBtu	0.09	0.38	Manufacturer Guarantee
Formaldehyde (HCHO)	0.08	lb/MMScf	0.0005	0.0022	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		778	3,406	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.01	0.05	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
 Facility Name: Revolution Cryo II Plant
 Project Description: Facility PTE

TABLE 7. NGL Dehy Regenerator Gas Heater Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	
GHGs:					
CO ₂	53.06	kg/MMBtu	776.73	3,402	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.01	0.06	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.01	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			778	3,406	
Organic HAPs:					
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.01	0.05	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:					
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.012	0.055	

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 8. HMO Heaters Emissions Calculations

Heater Information:

Source ID:	HTR-008 to HTR-010
Number of Units:	3

Heater Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006	1,006
Heat Input (MMBtu/hr)	34.65	103.95
Potential Fuel Consumption (MMBtu/yr):	303,534	910,602
Max. Fuel Consumption (MMscf/hr):	0.0344	0.1033
Max. Fuel Consumption (MMscf/yr):	301.8	905.3
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO _x	0.012	lb/MMBtu	0.42	1.82	1.25	5.46	Manufacturer Guarantee
VOC	0.0192	lb/MMBtu	0.67	2.91	2.00	8.74	Manufacturer Guarantee
CO	0.0407	lb/MMBtu	1.41	6.18	4.23	18.53	Manufacturer Guarantee
SO _x	0.6	lb/MMScf	0.02	0.09	0.06	0.27	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	0.013	lb/MMBtu	0.46	2.00	1.37	6.01	Manufacturer Guarantee
PM _{2.5}	0.013	lb/MMBtu	0.46	2.00	1.37	6.01	Manufacturer Guarantee
Formaldehyde (HCHO)	0.08	lb/MMScf	0.0026	0.0113	0.0078	0.0339	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		4,057	17,772	12,172	53,315	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.07	0.29	0.20	0.86	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 8. HMO Heaters Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO ₂	53.06	kg/MMBtu	4053.26	17,753	12159.79	53,260	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.08	0.33	0.23	1.00	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.01	0.03	0.02	0.10	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			4,057	17,772	12,172	53,315	
Organic HAPs:							
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.06	0.27	0.19	0.81	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:							
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.065	0.285	0.195	0.856	

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 9. Catalytic Heaters Emissions Calculations

Heater Information:

Source ID:	Catalytic Heaters
Number of Units:	15

Heater Fuel Information:

	Per Unit	As Combined
Fuel Type:	Natural Gas	Natural Gas
Higher Heating Value (HHV) (Btu/scf):	1,006	1,006
Heat Input (MMBtu/hr)	0.06	0.85
Potential Fuel Consumption (MMBtu/yr):	526	7,411
Max. Fuel Consumption (MMscf/hr):	0.0001	0.0008
Max. Fuel Consumption (MMscf/yr):	0.5	7.4
Max. Annual Hours of Operation (hr/yr):	8,760	8,760

Heater Emissions Data:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
NO _x	100	lb/MMScf	0.01	0.03	0.08	0.37	AP-42, Table 1.4-2 (Jul-1998)
VOC	5.5	lb/MMScf	0.00	0.00	0.00	0.02	AP-42, Table 1.4-2 (Jul-1998)
CO	84	lb/MMBtu	5.04	22.08	0.07	0.31	AP-42, Table 1.4-2 (Jul-1998)
SO _x	0.6	lb/MMScf	0.0000	0.00	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
PM ₁₀	7.6	lb/MMScf	0.0005	0.00	0.01	0.03	AP-42, Table 1.4-2 (Jul-1998)
PM _{2.5}	7.6	lb/MMScf	0.0005	0.00	0.01	0.03	AP-42, Table 1.4-2 (Jul-1998)
Formaldehyde (HCHO)	0.075	lb/MMScf	0.0000	0.0000	0.0001	0.0003	AP-42, Table 1.4-3 (Jul-1998)
GHG (CO ₂ e)	See Table Below		7	31	99	434	40 CFR 98, Tables C-1 & C-2
Other (Total HAP)	See Table Below		0.00	0.00	0.00	0.01	AP-42, Tables 1.4-3 & 1.4-4 (Jul-1998)

Notes:

1. PM₁₀ and PM_{2.5} are total values (filterable + condensable).
2. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
3. Total HAP is the summation of all hazardous air pollutants for which there is a published emission factor for this source type.

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

TABLE 9. Catalytic Heaters Emissions Calculations

Greenhouse Gas (GHG) & Hazardous Air Pollutant (HAP) Emissions Calculations:

Pollutant	Emission Factor	Units	Maximum Potential Emissions Per Unit		Maximum Potential Emissions All Units Combined		Estimation Basis / Emission Factor Source
			lbs/hr	tpy	lbs/hr	tpy	
GHGs:							
CO ₂	53.06	kg/MMBtu	7.02	31	98.98	434	40 CFR 98, Tables C-1 & C-2
CH ₄	0.001	kg/MMBtu	0.00	0.00	0.00	0.01	40 CFR 98, Tables C-1 & C-2
N ₂ O	0.0001	kg/MMBtu	0.00	0.00	0.00	0.00	40 CFR 98, Tables C-1 & C-2
GHG (CO ₂ e)			7	31	99	434	
Organic HAPs:							
2-Methylnaphthalene	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
3-Methylchloranthrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
7,12-Dimethylbenz(a)anthracene	1.60E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzene	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(a)pyrene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(b)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(g,h,i)perylene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Benzo(k)fluoranthene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Chrysene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Dibenzo(a,h)anthracene	1.20E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluoranthene	3.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Fluorene	2.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
n-Hexane	1.80E+00	lb/MMscf	0.00	0.00	0.00	0.01	AP-42, Table 1.4-3 (Jul-1998)
Indeno(1,2,3-c,d)pyrene	1.80E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Naphthalene	6.10E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Phenanthrene	1.70E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Pyrene	5.00E-06	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Toluene	3.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-3 (Jul-1998)
Metal HAPs:							
Arsenic	2.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Beryllium	4.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cadmium	1.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Chromium	1.40E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Cobalt	8.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Lead	5.00E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-2 (Jul-1998)
Manganese	3.80E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Mercury	2.60E-04	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Nickel	2.10E-03	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Selenium	2.40E-05	lb/MMscf	0.00	0.00	0.00	0.00	AP-42, Table 1.4-4 (Jul-1998)
Total HAP	1.892		0.000	0.000	0.002	0.007	

Company Name:ETC Northeast Pipeline, LLC

Facility Name:Revolution Cryo II Plant

Project Description:Facility PTE

TABLE 10. Gas Venting Emissions Calculations

Total Ventd Emissions:

Pollutant	Atmospheric Emissions		Emissions Estimation Method
	lbs/hr	tpy	
VOC	---	0.19	Estimated Gas Volumes & Site-Specific Gas Analysis
HAPs	---	0.00	
CO ₂	---	0.00	
CH ₄	---	2.51	
GHG (CO ₂ e)	---	70	GWP: CO ₂ 1, CH ₄ 28

Vented Emissions:

Blowdown Emissions Sources	Number of Annual Events	Gas Volume per Event (scf)	Total Mass per Event (lbs)	Controlled by Flare? (Y / N)	Total Volume NG (scf/yr)	Total Mass (lbs/yr)	Actual Volume NG Emitted (scf/yr)	Potential VOC Emissions (tpy)	Potential HAP Emissions (tpy)	Potential CO ₂ Emissions ⁷ (tpy)	Potential CH ₄ Emissions ⁷ (tpy)
Flare Purge Gas	---	---	---	Y	5,702,760	---	114,055	0.00	0.00	0.00	2.40
Closed Drain Vapors	---	---	---	Y	45,464	---	45	0.00	0.00	0.00	0.00
GC Venting (AE-101)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.04
GC Venting (AE-102)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.05
GC Venting (AE-103)	---	---	---	N	928	---	928	0.02	0.00	0.00	0.00
GC Venting (AE-104)	---	---	---	N	464	---	464	0.01	0.00	0.00	0.00
GC Venting (AE-105)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.00
GC Venting (AE-106)	---	---	---	N	464	---	464	0.03	0.00	0.00	0.00
GC Venting (AE-107)	---	---	---	N	928	---	928	0.06	0.00	0.00	0.00
GC Venting (AE-108)	---	---	---	N	928	---	928	0.00	0.00	0.00	0.00
GC Venting (AE-109)	---	---	---	N	---	---	---	---	---	---	---
GC Venting (AE-110)	---	---	---	N	928	---	928	0.06	0.00	0.00	0.00
GC Venting (AE-111)	---	---	---	N	928	---	928	0.01	0.00	0.00	0.02
Total								0.19	0.00	0.00	2.51

1. Uncombusted CH₄ and CO₂ emissions are based on fractions of these pollutants as follows:
- Residue Gas

Inlet Gas

C3+ Liquids

C2 Liquids

Vol % CO2

0.015

0.044

0.000

0.010

Vol % CH4

99.440

77.256

0.000

1.220
2. The gas volumes are estimated based on facility design and standard engineering calculations (utilizing Equation W-14B from 40 CR 98 Subpart W where appropriate).
3. Total purge gas to flare: 651 scfh
4. Where applicable, emissions are calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.
5. GHG (CO₂e) is carbon dioxide equivalent, which is the summation of CO₂ (GWP = 1) + CH₄ (GWP = 28) + N₂O (GWP = 265).
6. Density as follows: C3+ and C2 liquid lines conservatively assume gas (vapor) composition is identical to liquid composition
Value for 'lb VOC/scf' of total gas = Sum of (vol%/100 * MW (lb/lb-mol) / 379 scf/lb-mol) for each VOC constituent

CO₂:

0.0526

kg/ft³ for CO₂ at 60 °F and 14.7 psia

CH₄:

0.0192

kg/ft³ for CH₄ at 60 °F and 14.7 psia

VOC:

3.31E-10

lb VOC/ft³ of total gas (residue gas)

HAP:

0.00E+00

lb HAP/ft³ of total gas (residue gas)

VOC:

9.67E-03

lb VOC/ft³ of total gas (inlet gas)

HAP:

3.26E-04

lb HAP/ft³ of total gas (inlet gas)

VOC:

1.43E-01

lb VOC/ft³ of total gas (C3+ liquid vapors)

HAP:

1.21E-02

lb HAP/ft3 of total gas (C3+ liquid vapors)
7. Mol sieve instrumentation vent data: 3 Number of Units 5 SCF/hr, per unit

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC
Revolution Cryo II Plant
Facility PTE

TABLE 11. Site-Specific Gas Analysis

Location:

HHV (Btu/scf):

Cryo Plant Residue/Fuel Gas
1,006

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.4615	0.8024	28.0100
METHANE	99.4401	99.0011	16.0400
CO2	0.0149	0.0406	44.0100
ETHANE	0.0835	0.1558	30.0700
PROPANE	0.0000	0.0000	44.1000
I-BUTANE	0.0000	0.0000	58.1200
N-BUTANE	0.0000	0.0000	58.1200
I-PENTANE	0.00E+00	0.0000	72.1500
N-PENTANE	0.00E+00	0.0000	72.1500
I-HEXANES	0.00E+00	0.0000	86.1800
N-HEXANE	0.00E+00	0.0000	86.1800
BENZENE	0.00E+00	0.0000	78.1100
CYCLOHEXANE	0.00E+00	0.0000	84.1600
HEPTANES	0.00E+00	0.0000	100.2100
TOLUENE	0.00E+00	0.0000	92.1400
2,2,4 Trimethylpentane	0.00E+00	0.0000	114.2300
N-OCTANE	0.00E+00	0.0000	114.2400
*E-BENZENE	0.00E+00	0.0000	106.1700
*m,o,&p-XYLENE	0.00E+00	0.0000	106.1600
I-NONANES	0.00E+00	0.0000	128.2000
N-NONANE	0.00E+00	0.0000	128.2000
I-DECANES	0.00E+00	0.0000	142.2900
N-DECANE	0.00E+00	0.0000	142.2900
I-UNDECANES +	0.00E+00	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.524	99.157	
VOC (Total)	0.000	0.000	
HAP (Total)	0.000	0.000	

C8+

0.000

0.000

Molecular Weight

16.111

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

TABLE 12. Site-Specific Gas Analysis

Location:

HHV (Btu/scf):

Cryo Plant Inlet Gas

1,253

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.3579	0.4845	28.01
METHANE	77.2557	59.8889	16.04
CO2	0.0442	0.0940	44.01
ETHANE	15.0134	21.8145	30.07
PROPANE	5.0434	10.7464	44.1
I-BUTANE	0.5083	1.4275	58.12
N-BUTANE	1.1630	3.2665	58.12
I-PENTANE	0.1976	0.6888	72.15
N-PENTANE	0.2533	0.8830	72.15
I-HEXANES			86.18
N-HEXANE	0.1413	0.5882	86.18
BENZENE	0.0011	0.0042	78.11
CYCLOHEXANE	0.0000	0.0000	84.16
HEPTANES	0.0103	0.0498	100.21
TOLUENE	0.0009	0.0040	92.14
2,2,4 Trimethylpentane	0.0000	0.0000	114.23
N-OCTANE	0.0037	0.0204	114.24
*E-BENZENE	0.0003	0.0015	106.17
*m,o,&p-XYLENE			106.16
I-NONANES	0.0005	0.0031	128.2
N-NONANE			128.2
I-DECANES	0.0046	0.0316	142.29
N-DECANE			142.29
I-UNDECANES +			142.29
Totals	99.999	99.997	

	Vol %	Wt%	
TOC (Total)	99.597	99.418	
VOC (Total)	7.328	17.715	
HAP (Total)	0.144	0.598	

C8+

0.009

0.055

Molecular Weight

20.692

Company Name: ETC Northeast Pipeline, LLC
 Facility Name: Revolution Cryo II Plant
 Project Description: Facility PTE

CG Composition

Location: AE-101 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.3414	0.4653	28.0100
METHANE	77.5766	60.5506	16.0400
CO2	0.0459	0.0983	44.0100
ETHANE	14.9612	21.8919	30.0700
PROPANE	5.0127	10.7571	44.1000
I-BUTANE	0.4739	1.3402	58.1200
N-BUTANE	1.0990	3.1082	58.1200
I-PENTANE	0.1665	0.5847	72.1500
N-PENTANE	0.2100	0.7373	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.1112	0.4664	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.998	100.000	

TOC (Total)	99.611	99.436	
VOC (Total)	7.073	16.994	
HAP (Total)	0.111	0.466	

Molecular Weight 20.550

Company Name: ETC Northeast Pipeline, LLC
Facility Name: Revolution Cryo II Plant
Project Description: Facility PTE

CG Composition

Location: AE-102 Sample
HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.4403	0.7508	28.0100
METHANE	97.2527	94.9659	16.0400
CO2	0.0429	0.1150	44.0100
ETHANE	2.2374	4.0957	30.0700
PROPANE	0.0247	0.0664	44.1000
I-BUTANE	0.0006	0.0021	58.1200
N-BUTANE	0.0006	0.0021	58.1200
I-PENTANE	0.0002	0.0008	72.1500
N-PENTANE	0.0002	0.0008	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0001	0.0003	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.516	99.134	
VOC (Total)	0.026	0.073	
HAP (Total)	0.000	0.000	

Molecular Weight 16.426

Company Name: ETC Northeast Pipeline, LLC
 Facility Name: Revolution Cryo II Plant
 Project Description: Facility PTE

CG Composition

Location: AE-103 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0002	0.0002	28.0100
METHANE	0.0394	0.0178	16.0400
CO2	0.1481	0.1840	44.0100
ETHANE	71.6983	60.8644	30.0700
PROPANE	20.3954	25.3917	44.1000
I-BUTANE	1.8431	3.0241	58.1200
N-BUTANE	4.0853	6.7031	58.1200
I-PENTANE	0.6149	1.2525	72.1500
N-PENTANE	0.7741	1.5767	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.4050	0.9854	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.004	100.000	

TOC (Total)	99.856	99.816	
VOC (Total)	28.118	38.934	
HAP (Total)	0.405	0.985	

Molecular Weight 35.422

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-104 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0588	0.0255	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	66.0788	53.8272	30.0700
PROPANE	22.4394	26.8075	44.1000
I-BUTANE	2.2738	3.5800	58.1200
N-BUTANE	6.2559	9.8496	58.1200
I-PENTANE	0.6758	1.3209	72.1500
N-PENTANE	1.5307	2.9918	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.6843	1.5976	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.997	100.000	

TOC (Total)	99.997	100.000	
VOC (Total)	33.860	46.147	
HAP (Total)	0.684	1.598	

Molecular Weight

36.914

Company Name: ETC Northeast Pipeline, LLC
 Facility Name: Revolution Cryo II Plant
 Project Description: Facility PTE

CG Composition

Location: AE-105 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0834	0.0445	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	99.9112	99.9472	30.0700
PROPANE	0.0053	0.0078	44.1000
I-BUTANE	0.0000	0.0000	58.1200
N-BUTANE	0.0000	0.0000	58.1200
I-PENTANE	0.0002	0.0005	72.1500
N-PENTANE	0.0000	0.0000	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0000	0.0000	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	100.000	100.000	
VOC (Total)	0.006	0.008	
HAP (Total)	0.000	0.000	

Molecular Weight 30.059

[Company Name:](#) ETC Northeast Pipeline, LLC
[Facility Name:](#) Revolution Cryo II Plant
[Project Description:](#) Facility PTE

CG Composition

Location: AE-106 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0000	0.0000	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	0.0511	0.0310	30.0700
PROPANE	69.2467	61.4573	44.1000
I-BUTANE	7.0174	8.2080	58.1200
N-BUTANE	16.1359	18.8736	58.1200
I-PENTANE	2.6105	3.7904	72.1500
N-PENTANE	3.2673	4.7442	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	1.6695	2.8955	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.998	100.000	

TOC (Total)	99.998	100.000	
VOC (Total)	99.947	99.969	
HAP (Total)	1.670	2.896	

Molecular Weight 49.689

[Company Name:](#) ETC Northeast Pipeline, LLC
[Facility Name:](#) Revolution Cryo II Plant
[Project Description:](#) Facility PTE

CG Composition

Location: AE-107 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0000	0.0000	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	0.1443	0.0871	30.0700
PROPANE	68.1228	60.3134	44.1000
I-BUTANE	7.3167	8.5373	58.1200
N-BUTANE	16.8752	19.6905	58.1200
I-PENTANE	2.6573	3.8491	72.1500
N-PENTANE	3.2840	4.7568	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	1.5986	2.7659	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.999	100.000	

TOC (Total)	99.999	100.000	
VOC (Total)	99.855	99.913	
HAP (Total)	1.599	2.766	

Molecular Weight 49.810

[Company Name:](#) ETC Northeast Pipeline, LLC
[Facility Name:](#) Revolution Cryo II Plant
[Project Description:](#) Facility PTE

CG Composition

Location: AE-108 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.0752	0.0401	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	99.9141	99.9513	30.0700
PROPANE	0.0059	0.0086	44.1000
I-BUTANE	0.0000	0.0000	58.1200
N-BUTANE	0.0000	0.0000	58.1200
I-PENTANE	0.0000	0.0000	72.1500
N-PENTANE	0.0000	0.0000	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0000	0.0000	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.995	100.000	

TOC (Total)	99.995	100.000	
VOC (Total)	0.006	0.009	
HAP (Total)	0.000	0.000	

Molecular Weight 30.059

Company Name: ETC Northeast Pipeline, LLC
 Facility Name: Revolution Cryo II Plant
 Project Description: Facility PTE

CG Composition

Location: AE-109 Sample
 HHV (Btu/scf): 1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	1.0000	0.2052	16.0400
CO2	0.0000	0.0000	44.0100
ETHANE	1.0000	0.3847	30.0700
PROPANE	1.0000	0.5641	44.1000
I-BUTANE	1.0000	0.7435	58.1200
N-BUTANE	5.9900	4.4534	58.1200
I-PENTANE	10.9800	10.1340	72.1500
N-PENTANE	20.0500	18.5052	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	58.9700	65.0100	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	99.990	100.000	

TOC (Total)	99.990	100.000	
VOC (Total)	97.990	99.410	
HAP (Total)	58.970	65.010	

Molecular Weight 78.173

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-110 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.0000	0.0000	28.0100
METHANE	0.6000	0.1842	16.0400
CO2	0.0200	0.0168	44.0100
ETHANE	14.2000	8.1706	30.0700
PROPANE	28.5800	24.1176	44.1000
I-BUTANE	10.4000	11.5662	58.1200
N-BUTANE	32.5000	36.1444	58.1200
I-PENTANE	4.6000	6.3508	72.1500
N-PENTANE	5.8000	8.0075	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	3.3000	5.4419	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.980	99.983	
VOC (Total)	85.180	91.628	
HAP (Total)	3.300	5.442	

Molecular Weight

52.260

Company Name:

Facility Name:

Project Description:

ETC Northeast Pipeline, LLC

Revolution Cryo II Plant

Facility PTE

CG Composition

Location:

HHV (Btu/scf):

AE-111 Sample

1,020

Constituent	Natural Gas Stream Speciation (Vol. %)	Natural Gas Stream Speciation (Wt. %)	MW g/mol
N2	0.1000	0.0993	28.0100
METHANE	35.5000	20.1870	16.0400
CO2	0.1000	0.1560	44.0100
ETHANE	45.1000	48.0784	30.0700
PROPANE	16.5000	25.7966	44.1000
I-BUTANE	1.0000	2.0605	58.1200
N-BUTANE	1.5000	3.0907	58.1200
I-PENTANE	0.0800	0.2046	72.1500
N-PENTANE	0.0800	0.2046	72.1500
I-HEXANES	0.0000	0.0000	86.1800
N-HEXANE	0.0400	0.1222	86.1800
BENZENE	0.0000	0.0000	78.1100
CYCLOHEXANE	0.0000	0.0000	84.1600
HEPTANES	0.0000	0.0000	100.2100
TOLUENE	0.0000	0.0000	92.1400
2,2,4 Trimethylpentane	0.0000	0.0000	114.2300
N-OCTANE	0.0000	0.0000	114.2400
*E-BENZENE	0.0000	0.0000	106.1700
*m,o,&p-XYLENE	0.0000	0.0000	106.1600
I-NONANES	0.0000	0.0000	128.2000
N-NONANE	0.0000	0.0000	128.2000
I-DECANES	0.0000	0.0000	142.2900
N-DECANE	0.0000	0.0000	142.2900
I-UNDECANES +	0.0000	0.0000	142.2900
Totals	100.000	100.000	

TOC (Total)	99.800	99.745	
VOC (Total)	19.200	31.479	
HAP (Total)	0.040	0.122	

Molecular Weight

28.207

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Closed Drain	

Connections

	1	2	3	4	5
From Block	Gas Mol Sieve Drain	VLVE-100	NGL Amine Coalescer	VLVE-101	NGL Mol Sieve Drain
To Block	VLVE-100	MIX-100	VLVE-101	MIX-100	VLVE-102

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	99.8903	99.8903	96.9689	96.9689	99.9352
H2S	0	0	0	0	0
CO2	0.000737495	0.000737495	0.148127	0.148127	2.47948E-06
N2	0.000253661	0.000253661	4.24958E-11	4.24958E-11	3.38772E-11
C1	0.0902773	0.0902773	0.00197322	0.00197322	0.00159764
C2	0.0151518	0.0151518	0.0652493	0.0652493	0.05731
C3	0.00261812	0.00261812	0.00622727	0.00622727	0.00524522
iC4	0.000113292	0.000113292	0.000172575	0.000172575	0.000136029
nC4	0.000418311	0.000418311	0.000487367	0.000487367	0.000449999
iC5	3.05858E-05	3.05858E-05	2.2159E-05	2.2159E-05	2.19571E-05
nC5	2.26237E-05	2.26237E-05	2.8228E-05	2.8228E-05	1.34722E-05
C6	5.84114E-06	5.84114E-06	3.67835E-06	3.67835E-06	1.76394E-06
C7	2.00819E-07	2.00819E-07	6.19524E-08	6.19524E-08	3.51324E-08
C8	2.64288E-08	2.64288E-08	6.9557E-09	6.9557E-09	2.63107E-09
C9	1.52607E-09	1.52607E-09	1.28616E-10	1.28616E-10	6.71031E-11
C10	3.48457E-09	3.48457E-09	2.82553E-10	2.82553E-10	9.48008E-11
Benzene	2.59896E-05	2.59896E-05	1.16556E-05	1.16556E-05	1.01935E-05
Toluene	1.2372E-05	1.2372E-05	3.2299E-06	3.2299E-06	2.61747E-06
Ethylbenzene	2.4308E-06	2.4308E-06	3.41582E-07	3.41582E-07	2.72476E-07
para-Xylene	3.66612E-06	3.66612E-06	1.01587E-06	1.01587E-06	4.0871E-07
MDEA	0	0	2.14801	2.14801	0
Piperazine	0	0	0.660809	0.660809	0

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	120.559	123.167	95.4758	97.0827	120.12
Pressure	psig	1042	30 *	683	30 *	725.475
Molecular Weight	lb/lbmol	18.0165	18.0165	20.6863	20.6863	18.0238
Std Vapor Volumetric Flow	MMSCFD	0.0632515	0.0632515	0.0232348	0.0232348	0.0369034
Std Liquid Volumetric Flow	sgpm	0.250734	0.250734	0.10636	0.10636	0.146272
Compressibility		0.0495323	0.00309547	0.0385107	0.00365853	0.0346972
Specific Gravity				1.00646		0.988789
Mole Fraction Vapor	%	0.000281919	0.108589	0	0.129902	0
Molar Flow	lbmol/h	6.9449	6.9449	2.55114	2.55114	4.05193
Mass Flow	lb/h	125.123	125.123	52.7738	52.7738	73.0311
Mass Cp	Btu/(lb*°F)	0.97608	0.977013	0.920943	0.921175	0.976265

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Closed Drain	

Connections

	6	7	8	9	10
From Block	VLVE-102	MIX-100	V-494 Closed Drain Tank	VLVE-103	V-494 Closed Drain Tank
To Block	MIX-100	V-494 Closed Drain Tank	VLVE-103	--	VLVE-104

Stream Composition

Mole Fraction	6 %	7 %	8 %	9 %	10 %
H2O	99.9352	99.3536	3.69355	3.69355	99.4503
H2S	0	0	0	0	0
CO2	2.47948E-06	0.0282718	13.6289	13.6289	0.0145299
N2	3.38772E-11	0.00013003	0.125016	0.125016	3.84746E-06
C1	0.00159764	0.0471269	44.0252	44.0252	0.00269211
C2	0.05731	0.0371941	34.1128	34.1128	0.00276454
C3	0.00524522	0.00408345	3.82006	3.82006	0.000227848
iC4	0.000136029	0.000131255	0.125394	0.125394	4.6918E-06
nC4	0.000449999	0.000440792	0.411921	0.411921	2.50384E-05
iC5	2.19571E-05	2.64183E-05	0.0252243	0.0252243	9.58762E-07
nC5	1.34722E-05	2.0942E-05	0.0201932	0.0201932	5.60185E-07
C6	1.76394E-06	4.21447E-06	0.00410276	0.00410276	7.33616E-08
C7	3.51324E-08	1.25116E-07	0.000122379	0.000122379	1.59273E-09
C8	2.63107E-09	1.56445E-08	1.5386E-05	1.5386E-05	1.14568E-10
C9	6.71031E-11	8.26578E-10	8.14898E-07	8.14898E-07	4.05107E-12
C10	9.48008E-11	1.86781E-09	1.84598E-06	1.84598E-06	4.54358E-12
Benzene	1.01935E-05	1.85662E-05	0.00257805	0.00257805	1.59801E-05
Toluene	2.61747E-06	7.73313E-06	0.00117112	0.00117112	6.55765E-06
Ethylbenzene	2.72476E-07	1.39188E-06	0.000215949	0.000215949	1.17509E-06
para-Xylene	4.0871E-07	2.19284E-06	0.00038803	0.00038803	1.803E-06
MDEA	0	0.40448	0.00313962	0.00313962	0.404886
Piperazine	0	0.124433	1.69672E-05	1.69672E-05	0.124559

Stream Properties

Property	Units	6	7	8	9	10
Temperature	°F	121.88	117.507	117.507	114.88	117.507
Pressure	psig	30	30 *	30	0 *	30
Molecular Weight	lb/lbmol	18.0238	18.5214	26.0593	26.0593	18.5138
Std Vapor Volumetric Flow	MMSCFD	0.0369034	0.12339	0.000124545	0.000124545	0.123265
Std Liquid Volumetric Flow	sgpm	0.146272	0.503365	0.00175827	0.00175827	0.501607
Compressibility		0.00261923	0.0030853	0.988826	0.996537	0.00208932
Specific Gravity				0.899759	0.899759	0.990911
Mole Fraction Vapor	%	0.0609759	0.100937	100	100	0
Molar Flow	lbmol/h	4.05193	13.548	0.0136749	0.0136749	13.5343
Mass Flow	lb/h	73.0311	250.928	0.356357	0.356357	250.571
Mass Cp	Btu/(lb*°F)	0.97693	0.965945	0.417364	0.41341	0.966725

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Closed Drain	

Connections

	11	12	13		
From Block	VLVE-104	TK-813 Slop Tank	TK-813 Slop Tank		
To Block	TK-813 Slop Tank	--	--		

Stream Composition

Mole Fraction	11 %	12 %	13 %		
H2O	99.4503	12.0312	99.4578		
H2S	0	0	0		
CO2	0.0145299	35.0303	0.0115057		
N2	3.84746E-06	0.040186	3.77084E-07		
C1	0.00269211	25.6105	0.000480463		
C2	0.00276454	24.7944	0.000623377		
C3	0.000227848	2.16936	4.05086E-05		
iC4	4.6918E-06	0.0477976	5.64107E-07		
nC4	2.50384E-05	0.237208	4.55382E-06		
iC5	9.58762E-07	0.00973658	1.17933E-07		
nC5	5.60185E-07	0.00588464	5.20001E-08		
C6	7.33616E-08	0.000796479	4.57906E-09		
C7	1.59273E-09	1.7584E-05	7.42093E-11		
C8	1.14568E-10	1.29027E-06	3.14204E-12		
C9	4.05107E-12	4.60345E-08	7.5593E-14		
C10	4.54358E-12	5.21184E-08	4.27095E-14		
Benzene	1.59801E-05	0.00774042	1.5313E-05		
Toluene	6.55765E-06	0.00347139	6.25841E-06		
Ethylbenzene	1.17509E-06	0.000634344	1.12041E-06		
para-Xylene	1.803E-06	0.00112891	1.70565E-06		
MDEA	0.404886	0.00964371	0.40492		
Piperazine	0.124559	5.33855E-05	0.12457		

Stream Properties

Property	Units	11	12	13		
Temperature	°F	117.563	117.563	117.563		
Pressure	psig	0 *	0	0		
Molecular Weight	lb/lbmol	18.5138	30.3162	18.5128		
Std Vapor Volumetric Flow	MMSCFD	0.123265	1.0645E-05	0.123255		
Std Liquid Volumetric Flow	sgpm	0.501607	0.000135258	0.501472		
Compressibility		0.000724313	0.996304	0.000638328		
Specific Gravity			1.04674	0.990878		
Mole Fraction Vapor	%	0.00863587	100	0		
Molar Flow	lbmol/h	13.5343	0.0011688	13.5331		
Mass Flow	lb/h	250.571	0.0354337	250.536		
Mass Cp	Btu/(lb*°F)	0.966695	0.336516	0.966784		

Remarks

Blocks
Gas Mol Sieve Drain
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:31 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
17 [Gas Sieve]	Inlet	V-447 Regen Gas Scrubber [Gas Sieve]	1 [Closed Drain]	Outlet	VLVE-100 [Closed Drain]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-6770.15 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0.558768 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	120 °F	Fraction Vapor Difference	0.000281919 %
Inlet Pressure	1042 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-6770.15 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	120.559 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	1042 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0.000281919 %		

Warnings

ProMax:ProMax!Project!Flowsheets!Closed Drain!Blocks!Gas Mol Sieve Drain

Warning: The environment Closed Drain Enviro used by flowsheet Closed Drain does not contain the following component(s) present in stream 17 in flowsheet Gas Sieve:
Methanol.

Warning: Cross Flowsheet Connector Gas Mol Sieve Drain is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

Blocks
MIX-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:41 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
2	Inlet	VLVE-100	4	Inlet	VLVE-101
6	Inlet	VLVE-102	7	Outlet	V-494 Closed Drain Tank

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 7	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
NGL Amine Coalescer
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:40 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
30 [NGL Amine]	Inlet	F-427 NGL Coalescer [NGL Amine]	3 [Closed Drain]	Outlet	VLVE-101 [Closed Drain]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-5963.14 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
* Transfer Property 2	Mole Fraction Vapor	Pressure Difference	0 psi
Inlet Temperature	95.4758 °F	Fraction Vapor Difference	0 %
Inlet Pressure	683 psig	Mass Enthalpy Difference	-2.18804 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-5960.96 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	95.4758 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	683 psig	* Mass Enthalpy Tolerance	50 Btu/lb
Outlet Fraction Vapor	0 %		

Warnings

ProMax:ProMax!Project!Flowsheets!Closed Drain!Blocks!NGL Amine Coalescer

Warning: Holding the mole fraction vapor constant across XFSCconnector NGL Amine Coalescer is not valid since the entering PStream is not saturated. Transfer variables are defaulted to Temperature and Pressure.

Warning: The environment Closed Drain Enviro used by flowsheet Closed Drain does not contain the following component(s) present in stream 30 in flowsheet NGL Amine:

Methanol.

Warning: Cross Flowsheet Connector NGL Amine Coalescer is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

Blocks
NGL Mol Sieve Drain
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:40 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16 [NGL Sieve]	Inlet	F-542 NGL Dehy Regen Coalescer [NGL Sieve]	5 [Closed Drain]	Outlet	VLVE-102 [Closed Drain]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-6771.01 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0.190058 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	119.93 °F	Fraction Vapor Difference	0 %
Inlet Pressure	725.475 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-6771.01 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	120.12 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	725.475 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Warnings

ProMax:ProMax!Project!Flowsheets!Closed Drain!Blocks!NGL Mol Sieve Drain

Warning: The environment Closed Drain Enviro used by flowsheet Closed Drain does not contain the following component(s) present in stream 16 in flowsheet NGL Sieve:

Methanol.

Warning: Cross Flowsheet Connector NGL Mol Sieve Drain is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

		Blocks TK-813 Slop Tank Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:48 PM, 2/14/2023	
Flowsheet:	Closed Drain			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	VLVE-104	12	Vapor Outlet	
13	Light Liquid Outlet				
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0.00863587	%	Heat Duty	0	Btu/h
Mole Fraction Light Liquid	99.4876	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0.503777	%	Heat Release Curve Increments	10	
Remarks					

Blocks
V-494 Closed Drain Tank
Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:43 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	MIX-100	8	Vapor Outlet	VLVE-103
10	Light Liquid Outlet	VLVE-104			

Block Parameters

* Pressure Drop	0 psi	Main Liquid Phase	Light Liquid
Mole Fraction Vapor	0.100937 %	Heat Duty	0 Btu/h
Mole Fraction Light Liquid	99.3953 %	Heat Release Curve Type	Plug Flow
Mole Fraction Heavy Liquid	0.503806 %	Heat Release Curve Increments	10

Remarks

Blocks
VLVE-100
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:41 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	Gas Mol Sieve Drain	2	Outlet	MIX-100

Block Parameters

Pressure Drop	1012 psi	? Simple Compressible Cv	0.0585762
Joule-Thomson Coefficient	-0.00257683 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	0.0079089		

Remarks

Blocks
VLVE-101
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:41 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	NGL Amine Coalescer	4	Outlet	MIX-100

Block Parameters

Pressure Drop	653 psi	? Simple Compressible Cv	0.0344636
Joule-Thomson Coefficient	-0.00246078 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	0.00411506		

Remarks

Blocks
VLVE-102
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:41 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	NGL Mol Sieve Drain	6	Outlet	MIX-100

Block Parameters

Pressure Drop	695.475 psi	? Simple Compressible Cv	0.0488121
Joule-Thomson Coefficient	-0.00253049 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	0.0055671		

Remarks

		Blocks VLVE-103 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:45 PM, 2/14/2023	
Flowsheet:	Closed Drain			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	V-494 Closed Drain Tank	9	Outlet	
Block Parameters					
Pressure Drop		30 psi	? Simple Compressible Cv		0.00342926
Joule-Thomson Coefficient		0.0875634 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
? Simple Incompressible Cv		0.00239577			
Remarks					

Blocks
VLVE-104
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:47 PM, 2/14/2023
Flowsheet:	Closed Drain	Status: Solved 12:37 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	V-494 Closed Drain Tank	11	Outlet	TK-813 Slop Tank

Block Parameters

Pressure Drop	30 psi	? Simple Compressible Cv	2.82437
Joule-Thomson Coefficient	-0.001865 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	0.0918685		

Remarks

**Flowsheet Environment
Closed Drain Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Closed Drain	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
Piperazine	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Closed Drain Enviro				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	Closed Drain					
Henry's Law Component						
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C7	False	False				
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
MDEA	False	False				
Piperazine	False	False				
Phases						
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %	
Total	Total	True				
Vapor	Vapor	True	-441.67	17540.3		
Light Liquid	Light Liquid	True				
Heavy Liquid	Heavy Liquid	True				
Mixed Liquid	Mixed Liquid	True				
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3		
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70	
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75	
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75	
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75	
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75	
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model	
Total				True		
Vapor			Peng-Robinson	True		
Light Liquid				False		
Heavy Liquid				False		
Mixed Liquid				False		
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)	
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)	
Sulfur Liquid	10	Sulfur		False		
Mercury Liquid	10	Mercury		False		
Custom Liquid 1	10			False		
Custom Liquid 2	10			False		
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model			
Total						
Vapor	Chapman-Enskog	Lindsay-Bromley				
Light Liquid						
Heavy Liquid						
Mixed Liquid						
Nonspecific Liquid	Teja-Thurner	Li	Parachor			
Aqueous Liquid	Teja-Thurner	Li	Parachor			
Sulfur Liquid						
Mercury Liquid						

* User Specified Values

? Extrapolated or Approximate Values

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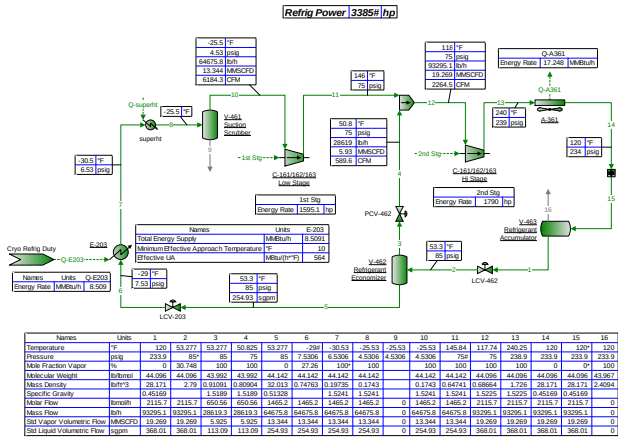
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		Flowsheet Environment			
		Closed Drain Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	Closed Drain				
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Custom Liquid 1					
Custom Liquid 2					
Physical Property Method Sets					
Liquid Molar Volume		COSTALD	Overall Package	Peng-Robinson	
Vapor Package		Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson	Sulfur Liquid Package		
Mercury Liquid Package			Custom Liquid 1 Package		
Custom Liquid 2 Package			Solid Package		
Remarks					

Cryo Refrig
Plant Schematic

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Cryo Refrig	

Cryo Refrigeration Unit



Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Cryo Refrig	

Connections

	1	2	3	4	5
From Block	V-463 Refrigerant Accumulator	LCV-462	V-462 Refrigerant Economizer	PCV-462	V-462 Refrigerant Economizer
To Block	LCV-462	V-462 Refrigerant Economizer	PCV-462	MIX-100	LCV-203

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0	0	0	0	0
N2	0	0	0	0	0
C1	0	0	0	0	0
C2	0.5	0.5	0.989798	0.989798	0.282524
C3	99	99	98.7603	98.7603	99.1064
iC4	0.5	0.5	0.249931	0.249931	0.611034
nC4	0	0	0	0	0
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	120	53.2767	53.2767	50.8253	53.2767
Pressure	psig	233.899	85 *	85	75	85
Molecular Weight	lb/lbmol	44.0956	44.0956	43.9918	43.9918	44.1417
Std Vapor Volumetric Flow	MMSCFD	19.2694	19.2694	5.92505	5.92505	13.3444
Std Liquid Volumetric Flow	sgpm	368.015	368.015	113.09	113.09	254.925
Compressibility		0.0621746	0.281943	0.861534	0.875415	0.0245982
Specific Gravity		0.451692		1.51892	1.51892	0.51328
Mole Fraction Vapor	%	0	30.7485	100	100	0
Molar Flow	lbmol/h	2115.75	2115.75	650.559	650.559	1465.19
Mass Flow	lb/h	93295.1	93295.1	28619.3	28619.3	64675.8
Mass Cp	Btu/(lb*°F)	0.812831	0.58023	0.417836	0.412038	0.65209

Remarks

Process Streams Report						
All Streams						
Tabulated by Total Phase						
Client Name:	Energy Transfer	Job: Plan Approval Application				
Location:	Cryo II					
Flowsheet:	Cryo Refrig					
Connections						
	6	7	8	9	10	
From Block	LCV-203	E-203	superht	V-461 Suction Scrubber	V-461 Suction Scrubber	
To Block	E-203	superht	V-461 Suction Scrubber	--	C-161/162/163 Low Stage	
Stream Composition						
Mole Fraction	6 %	7 %	8 %	9 %	10 %	
H2O	0	0	0		0	
H2S	0	0	0		0	
CO2	0	0	0		0	
N2	0	0	0		0	
C1	0	0	0		0	
C2	0.282524	0.282524	0.282524		0.282524	
C3	99.1064	99.1064	99.1064		99.1064	
iC4	0.611034	0.611034	0.611034		0.611034	
nC4	0	0	0		0	
iC5	0	0	0		0	
nC5	0	0	0		0	
C6	0	0	0		0	
C7	0	0	0		0	
C8	0	0	0		0	
C9	0	0	0		0	
C10	0	0	0		0	
Benzene	0	0	0		0	
Toluene	0	0	0		0	
Ethylbenzene	0	0	0		0	
para-Xylene	0	0	0		0	
Methanol	0	0	0		0	
Stream Properties						
Property	Units	6	7	8	9	10
Temperature	°F	-29 *	-30.5298	-25.5298	-25.5298	-25.5298
Pressure	psig	7.53064	6.53064	4.53064	4.53064	4.53064
Molecular Weight	lb/lbmol	44.1417	44.1417	44.1417		44.1417
Std Vapor Volumetric Flow	MMSCFD	13.3444	13.3444	13.3444	0	13.3444
Std Liquid Volumetric Flow	sgpm	254.925	254.925	254.925	0	254.925
Compressibility		0.264831	0.95828	0.96379		0.96379
Specific Gravity			1.5241	1.5241		1.5241
Mole Fraction Vapor	%	27.26	100 *	100		100
Molar Flow	lbmol/h	1465.19	1465.19	1465.19	0	1465.19
Mass Flow	lb/h	64675.8	64675.8	64675.8	0	64675.8
Mass Cp	Btu/(lb*°F)	0.497023	0.344702	0.346396		0.346396
Remarks						

Process Streams Report All Streams Tabulated by Total Phase						
Client Name:	Energy Transfer	Job: Plan Approval Application				
Location:	Cryo II					
Flowsheet:	Cryo Refrig					
Connections						
	11	12	13	14	15	
From Block	C-161/162/163 Low Stage	MIX-100	C-161/162/163 Hi Stage	A-361	TRM-1	
To Block	MIX-100	C-161/162/163 Hi Stage	A-361	TRM-1	V-463 Refrigerant Accumulator	
Stream Composition						
Mole Fraction	11 %	12 %	13 %	14 %	15 %	
H2O	0	0	0	0	0 *	
H2S	0	0	0	0	0 *	
CO2	0	0	0	0	0 *	
N2	0	0	0	0	0 *	
C1	0	0	0	0	0 *	
C2	0.282524	0.5	0.5	0.5	0.5 *	
C3	99.1064	99	99	99	99 *	
iC4	0.611034	0.5	0.5	0.5	0.5 *	
nC4	0	0	0	0	0 *	
iC5	0	0	0	0	0 *	
nC5	0	0	0	0	0 *	
C6	0	0	0	0	0 *	
C7	0	0	0	0	0 *	
C8	0	0	0	0	0 *	
C9	0	0	0	0	0 *	
C10	0	0	0	0	0 *	
Benzene	0	0	0	0	0 *	
Toluene	0	0	0	0	0 *	
Ethylbenzene	0	0	0	0	0 *	
para-Xylene	0	0	0	0	0 *	
Methanol	0	0	0	0	0 *	
Stream Properties						
Property	Units	11	12	13	14	15
Temperature	°F	145.837	117.742	240.25	120	120 *
Pressure	psig	75 *	75	238.899	233.899	233.899
Molecular Weight	lb/lbmol	44.1417	44.0956	44.0956	44.0956	44.0956
Std Vapor Volumetric Flow	MMSCFD	13.3444	19.2694	19.2694	19.2694	19.2694
Std Liquid Volumetric Flow	sgpm	254.925	368.015	368.015	368.015	368.015
Compressibility		0.925463	0.914082	0.857485	0.0621746	0.0621746
Specific Gravity		1.5241	1.52251	1.52251	0.451692	0.451692
Mole Fraction Vapor	%	100	100	100	0	0 *
Molar Flow	lbmol/h	1465.19	2115.75	2115.75	2115.75	2115.75
Mass Flow	lb/h	64675.8	93295.1	93295.1	93295.1	93295.1
Mass Cp	Btu/(lb*°F)	0.456942	0.442502	0.535751	0.812831	0.812831
Remarks						

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Cryo Refrig	

Connections

	16				
From Block	V-463 Refrigerant Accumulator				
To Block	--				

Stream Composition

Mole Fraction	16 %				
H2O	0				
H2S	0				
CO2	0				
N2	0				
C1	0				
C2	1.18531				
C3	98.5464				
iC4	0.268308				
nC4	0				
iC5	0				
nC5	0				
C6	0				
C7	0				
C8	0				
C9	0				
C10	0				
Benzene	0				
Toluene	0				
Ethylbenzene	0				
para-Xylene	0				
Methanol	0				

Stream Properties

Property	Units	16				
Temperature	°F	120				
Pressure	psig	233.899				
Molecular Weight	lb/lbmol	43.967				
Std Vapor Volumetric Flow	MMSCFD	0				
Std Liquid Volumetric Flow	sgpm	0				
Compressibility						
Specific Gravity						
Mole Fraction Vapor	%	100				
Molar Flow	lbmol/h	0				
Mass Flow	lb/h	0				
Mass Cp	Btu/(lb*°F)					

Remarks

		Energy Stream Report				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	Cryo Refrig					
Energy Streams						
Energy Stream	Energy Rate		Power		From Block	To Block
Q-A361	1.72481E+07	Btu/h	6778.77	hp	A-361	--
Q-E203	8.50908E+06	Btu/h	3344.19	hp	Cryo Refrig Duty	E-203
Q-superht	125820	Btu/h	49.449	hp	--	superht
1st Stg	4.05875E+06	Btu/h	1595.15	hp	--	C-161/162/163 Low Stage
2nd Stg	4.55447E+06	Btu/h	1789.97	hp	--	C-161/162/163 Hi Stage
Remarks						

		Blocks A-361 Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:24 PM, 3/22/2014	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	C-161/162/163 Hi Stage	14	Outlet	TRM-1
Q-A361	Energy				
Block Parameters					
* Pressure Drop	5	psi	Mass Duty	-184.877	Btu/lb
Temperature Change	-120.25	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-1.72481E+07	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks C-161/162/163 Hi Stage Compressor Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 7:30 PM, 7/4/2014	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	MIX-100	13	Outlet	A-361
2nd Stg	Energy				
Block Parameters					
Polytropic Efficiency		54.9417 %	Polytropic Head Correction Factor		1.00687
Polytropic Head		20871.5 ft	Pressure Change		163.899 psi
Polytropic n		1.13941	Compression Ratio		2.85827
* Isentropic (Adiabatic) Efficiency		52 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		19754 ft	Power		1789.97 hp
Isentropic k		1.0192	Ideal Work Method		Entropy Based
Remarks					

Blocks					
C-161/162/163 Low Stage					
Compressor Report					
Client Name:	Energy Transfer				
Location:	Cryo II				
Flowsheet:	Cryo Refrig				
Job: Plan Approval Application					
Modified: 7:30 PM, 7/4/2014					
Status: Solved 12:26 PM, 3/7/2025					
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	V-461 Suction Scrubber	11	Outlet	MIX-100
1st Stg	Energy				
Block Parameters					
Polytropic Efficiency		56.3803 %	Polytropic Head Correction Factor		1.00878
Polytropic Head		27532.9 ft	Pressure Change		70.4694 psi
Polytropic n		1.22262	Compression Ratio		4.97444
* Isentropic (Adiabatic) Efficiency		52 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		25393.8 ft	Power		1595.15 hp
Isentropic k		1.09257	Ideal Work Method		Entropy Based
Remarks					

Blocks
Cryo Refrig Duty
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:39 PM, 8/30/2022
Flowsheet:	Cryo Refrig	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E203 [Cryo Refrig]	Energy Inlet	E-203 [Cryo Refrig]	Q-E203 [RSV]	Energy Inlet	E-203 [RSV]

Block Parameters

Inlet Temperature	°F	Outlet Fraction Vapor	%
Inlet Pressure	psig	Outlet Mass Enthalpy	Btu/lb
Inlet Fraction Vapor	%	Temperature Difference	°F
Inlet Mass Enthalpy	Btu/lb	Pressure Difference	psi
Outlet Temperature	°F	Fraction Vapor Difference	%
Outlet Pressure	psig	Mass Enthalpy Difference	Btu/lb

Remarks

Blocks
E-203
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 6:48 PM, 3/16/2014
Flowsheet:	Cryo Refrig	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	LCV-203	7	Outlet	superht
Q-E203	Energy	Cryo Refrig Duty			

Block Parameters

* Pressure Drop	1 psi	Mass Duty	131.565 Btu/lb
Temperature Change	-1.52984 °F	Heat Release Curve Type	Plug Flow
Heat Duty	8.50908E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	10 °F	Highest Supply Temperature	-8.84255 °F
Minimum Effective Approach Temperature	10 °F	Lowest Supply Temperature	-19 °F
Maximum Effective Approach Temperature	21.6873 °F	Highest Demand Temperature	-29 °F
Log Mean Temperature Difference	15.0971 °F	Lowest Demand Temperature	-30.5298 °F
Effective Mean Temperature Difference	15.0861 °F	Total Energy Supply	8.50908E+06 Btu/h
End Point UA	563623 Btu/(h*°F)	Total Energy Demand	8.50908E+06 Btu/h
Effective UA	564034 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-203	-29	-30.5298	8.50908E+06	15.0861
E-203	-29	-30.5298	8.50908E+06	15.0861

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-203	564034	0.101333	0.103261
E-203	564034	0.101333	0.103261

Remarks

		Blocks LCV-203 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:51 PM, 9/19/2013	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	V-462 Refrigerant Economizer	6	Outlet	E-203
Block Parameters					
Pressure Drop	77.4694	psi	? Simple Compressible Cv	201.433	
Joule-Thomson Coefficient	1.06205	°F/psi	Valve Diameter	in	
Pressure Drop Method	User Set		Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase	True		Valve F_D, Style Modifier		
Calculate Flow	False		Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv	20.5028				
Remarks					

		Blocks LCV-462 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:52 PM, 8/30/2022	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	V-463 Refrigerant Accumulator	2	Outlet	V-462 Refrigerant Economizer
Block Parameters					
Pressure Drop	148.899	psi	? Simple Compressible Cv	123.123	
Joule-Thomson Coefficient	0.448111	°F/psi	Valve Diameter		in
Pressure Drop Method	User Set		Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase	True		Valve F_D, Style Modifier		
Calculate Flow	False		Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv	22.7408				
Remarks					

Blocks
MIX-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:50 PM, 8/30/2022
Flowsheet:	Cryo Refrig	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
4	Inlet	PCV-462	11	Inlet	C-161/162/163 Low Stage
12	Outlet	C-161/162/163 Hi Stage			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 12	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

		Blocks PCV-462 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:12 PM, 2/13/2023	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	V-462 Refrigerant Economizer	4	Outlet	MIX-100
Block Parameters					
* Pressure Drop		10 psi	Simple Compressible Cv		165.729
Joule-Thomson Coefficient		0.245138 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
? Simple Incompressible Cv		149.699			
Remarks					

		Blocks superht Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:40 PM, 2/9/2023	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	E-203	8	Outlet	V-461 Suction Scrubber
Q-superht	Energy				
Block Parameters					
* Pressure Drop	2	psi	Mass Duty	1.94539	Btu/lb
* Temperature Change	5	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	125820	Btu/h	Heat Release Curve Increments	10	
Remarks					

Blocks
TRM-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:47 PM, 8/30/2022
Flowsheet:	Cryo Refrig	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	A-361	15	Outlet	V-463 Refrigerant Accumulator

Block Parameters

Error	0	Recycle State	Active
* Calculate	False		
* Propagated Variables	Vapor Fraction, Temperature		

Remarks

		Blocks V-461 Suction Scrubber Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:20 PM, 3/22/2014	
Flowsheet:	Cryo Refrig			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	superht	10	Vapor Outlet	C-161/162/163 Low Stage
9	Light Liquid Outlet				
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	100	%	Heat Duty	0	Btu/h
Mole Fraction Light Liquid	0	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	
Remarks					

Blocks
V-462 Refrigerant Economizer
Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:51 PM, 8/30/2022
Flowsheet:	Cryo Refrig	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
2	Inlet	LCV-462	3	Vapor Outlet	PCV-462
5	Light Liquid Outlet	LCV-203			

Block Parameters

* Pressure Drop	0 psi	Main Liquid Phase	Light Liquid
Mole Fraction Vapor	30.7485 %	Heat Duty	0 Btu/h
Mole Fraction Light Liquid	69.2515 %	Heat Release Curve Type	Plug Flow
Mole Fraction Heavy Liquid	0 %	Heat Release Curve Increments	10

Remarks

Blocks
V-463 Refrigerant Accumulator
Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:49 PM, 8/30/2022
Flowsheet:	Cryo Refrig	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15	Inlet	TRM-1	16	Vapor Outlet	
1	Light Liquid Outlet	LCV-462			

Block Parameters

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

Remarks

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Cryo Refrig	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro					
Client Name:	Energy Transfer				Job: Plan Approval Application		
Location:	Cryo II						
Flowsheet:	Cryo Refrig						
Henry's Law Component							
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2	
C8	False	False					
C9	False	False					
C10	False	False					
Benzene	False	False					
Toluene	False	False					
Ethylbenzene	False	False					
para-Xylene	False	False					
Methanol	False	False					
Phases							
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %		
Total	Total	True					
Vapor	Vapor	True	-441.67	17540.3			
Light Liquid	Light Liquid	True					
Heavy Liquid	Heavy Liquid	True					
Mixed Liquid	Mixed Liquid	True					
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3			
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70		
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75		
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75		
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75		
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75		
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model		
Total				True			
Vapor			Peng-Robinson	True			
Light Liquid				False			
Heavy Liquid				False			
Mixed Liquid				False			
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)		
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)		
Sulfur Liquid	10	Sulfur		False			
Mercury Liquid	10	Mercury		False			
Custom Liquid 1	10			False			
Custom Liquid 2	10			False			
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model				
Total							
Vapor	Chapman-Enskog	Lindsay-Bromley					
Light Liquid							
Heavy Liquid							
Mixed Liquid							
Nonspecific Liquid	Teja-Thurner	Li	Parachor				
Aqueous Liquid	Teja-Thurner	Li	Parachor				
Sulfur Liquid							
Mercury Liquid							
Custom Liquid 1							
Custom Liquid 2							

* User Specified Values

? Extrapolated or Approximate Values

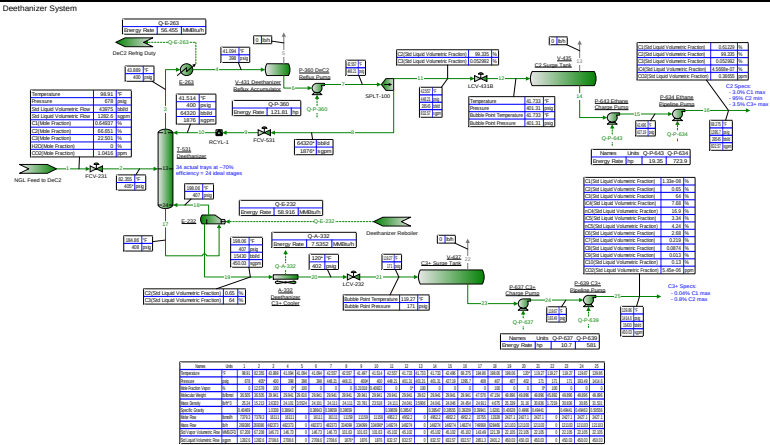
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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	Cryo Refrig				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package			
Custom Liquid 2 Package		Solid Package			
Remarks					

DeC2 Plant Schematic		
Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	



Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Connections

	1	2	3	4	5
From Block	NGL Feed to DeC2	FCV-231	T-531 Deethanizer	E-263	V-431 Deethanizer Reflux Accumulator
To Block	FCV-231	T-531 Deethanizer	E-263	V-431 Deethanizer Reflux Accumulator	--

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.000104156	0.000104156	5.72392E-05	5.72392E-05	0.000109069
N2	1.27687E-08	1.27687E-08	1.80554E-08	1.80554E-08	1.3485E-07
C1	0.649367	0.649367	0.962508	0.962508	3.25187
C2	66.6507	66.6507	98.9862	98.9862	96.7275
C3	22.5012	22.5012	0.0512601	0.0512601	0.0205184
iC4	2.26808	2.26808	3.71925E-07	3.71925E-07	7.03065E-08
nC4	5.18957	5.18957	1.8159E-07	1.8159E-07	3.09225E-08
iC5	0.881634	0.881634	5.6146E-12	5.6146E-12	4.79973E-13
nC5	1.1301	1.1301	6.58391E-13	6.58391E-13	4.60575E-14
C6	0.630191	0.630191	0	0	0
C7	0.0459166	0.0459166	0	0	0
C8	0.0164832	0.0164832	0	0	0
C9	0.00222562	0.00222562	0	0	0
C10	0.0204672	0.0204672	0	0	0
Benzene	0.00489304	0.00489304	0	0	0
Toluene	0.00400826	0.00400826	0	0	0
Ethylbenzene	0.00133598	0.00133598	0	0	0
para-Xylene	0.00267146	0.00267146	0	0	0
Methanol	0.000990997	0.000990997	0	0	0

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	98.9103	82.3554	43.8889	41.0936	41.0936
Pressure	psig	678	405 *	400	398	398
Molecular Weight	lb/lbmol	36.5055	36.5055	29.9412	29.9412	29.6158
Std Vapor Volumetric Flow	MMSCFD	67.2081	67.2081	146.73	146.73	0
Std Liquid Volumetric Flow	sgpm	1282.61	1282.61	2708.57	2708.57	0
Compressibility		0.166772 ?	0.17252	0.630284	0.0950584	
Specific Gravity		0.40469 ?		1.03379	0.386429	
Mole Fraction Vapor	%	0	12.578	100	0 *	100
Molar Flow	lbmol/h	7379.33	7379.33	16110.7	16110.7	0
Mass Flow	lb/h	269386	269386	482373	482373	0
Mass Cp	Btu/(lb*°F)	0.886367	0.844606	0.696488	1.10421	

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Connections

	6	7	8	9	10
From Block	V-431 Deethanizer Reflux Accumulator	P-360 DeC2 Reflux Pump	SPLT-100	FCV-531	RCYL-1
To Block	P-360 DeC2 Reflux Pump	SPLT-100	FCV-531	RCYL-1	T-531 Deethanizer

Stream Composition

Mole Fraction	6 %	7 %	8 %	9 %	10 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	5.72392E-05	5.72392E-05	5.72392E-05	5.72392E-05	1.37617E-05
N2	1.80554E-08	1.80554E-08	1.80554E-08	1.80554E-08	1.76243E-08
C1	0.962508	0.962508	0.962508	0.962508	0.960239
C2	98.9862	98.9862	98.9862	98.9862	98.9951
C3	0.0512601	0.0512601	0.0512601	0.0512601	0.0446073
iC4	3.71925E-07	3.71925E-07	3.71925E-07	3.71925E-07	2.86207E-07
nC4	1.8159E-07	1.8159E-07	1.8159E-07	1.8159E-07	1.31376E-07
iC5	5.6146E-12	5.6146E-12	5.6146E-12	5.6146E-12	3.8312E-12
nC5	6.58391E-13	6.58391E-13	6.58391E-13	6.58391E-13	4.46116E-13
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	6	7	8	9	10
Temperature	°F	41.0936	42.5573	42.5573	41.4965	41.5145
Pressure	psig	398	448.211	448.211	400 *	400
Molecular Weight	lb/lbmol	29.9412	29.9412	29.9412	29.9412	29.9406
Std Vapor Volumetric Flow	MMSCFD	146.73	146.73	101.627	101.627	101.627
Std Liquid Volumetric Flow	sgpm	2708.57	2708.57	1876 *	1876	1876
Compressibility		0.0950584	0.106309	0.106309	0.0967287	0.0978066
Specific Gravity		0.386429	0.386595	0.386595		
Mole Fraction Vapor	%	0	0	0	0.210183	0.409224
Molar Flow	lbmol/h	16110.7	16110.7	11158.5	11158.5	11158.4
Mass Flow	lb/h	482373	482373	334099	334099	334090 *
Mass Cp	Btu/(lb*°F)	1.10421	1.0799	1.0799	1.10832	1.10774

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Connections

	11	12	13	14	15
From Block	SPLT-100	LCV-431B	V-435 C2 Surge Tank	V-435 C2 Surge Tank	P-643 Ethane Charge Pump
To Block	LCV-431B	V-435 C2 Surge Tank	--	P-643 Ethane Charge Pump	P-634 Ethane Pipeline Pump

Stream Composition

Mole Fraction	11 %	12 %	13 %	14 %	15 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	5.72392E-05	5.72392E-05	0.000108596	5.72392E-05	5.72392E-05
N2	1.80554E-08	1.80554E-08	1.329E-07	1.80554E-08	1.80554E-08
C1	0.962508	0.962508	3.22316	0.962508	0.962508
C2	98.9862	98.9862	96.7561	98.9862	98.9862
C3	0.0512601	0.0512601	0.0206623	0.0512601	0.0512601
iC4	3.71925E-07	3.71925E-07	7.12003E-08	3.71925E-07	3.71925E-07
nC4	1.8159E-07	1.8159E-07	3.13383E-08	1.8159E-07	1.8159E-07
iC5	5.6146E-12	5.6146E-12	4.88917E-13	5.6146E-12	5.6146E-12
nC5	6.58391E-13	6.58391E-13	4.69908E-14	6.58391E-13	6.58391E-13
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	11	12	13	14	15
Temperature	°F	42.5573	41.7327	41.7327	41.7327	42.4959
Pressure	psig	448.211	401.313	401.313	401.313	427.19
Molecular Weight	lb/lbmol	29.9412	29.9412	29.6199	29.9412	29.9412
Std Vapor Volumetric Flow	MMSCFD	45.1024	45.1024	0	45.1024	45.1024
Std Liquid Volumetric Flow	sgpm	832.571	832.571	0	832.571	832.571
Compressibility		0.106309	0.0959398		0.0959398	0.101753
Specific Gravity		0.386595	0.385471		0.385471	0.385551
Mole Fraction Vapor	%	0	0 *	100	0	0
Molar Flow	lbmol/h	4952.16	4952.16	0	4952.16	4952.16
Mass Flow	lb/h	148274	148274	0	148274	148274
Mass Cp	Btu/(lb*°F)	1.0799	1.11229		1.11229	1.09905

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Connections

	16	17	18	19	20
From Block	P-634 Ethane Pipeline Pump	T-531 Deethanizer	E-232	E-232	A-332 Deethanizer C3+ Cooler
To Block	--	E-232	T-531 Deethanizer	A-332 Deethanizer C3+ Cooler	LCV-232

Stream Composition

Mole Fraction	16 %	17 %	18 %	19 %	20 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	5.72392E-05	2.56411E-09	2.86016E-09	9.38414E-10	9.38414E-10
N2	1.80554E-08	0	0	0	0
C1	0.962508	8.65898E-08	9.81575E-08	2.30672E-08	2.30672E-08
C2	98.9862	1.30343	1.4107	0.714363	0.714363
C3	0.0512601	77.4933	79.1715	68.2778	68.2778
iC4	3.71925E-07	5.61242	5.3787	6.89589	6.89589
nC4	1.8159E-07	11.5715	10.8054	15.7784	15.7784
iC5	5.6146E-12	1.4619	1.23999	2.68053	2.68053
nC5	6.58391E-13	1.77017	1.46682	3.43596	3.43596
C6	0	0.707103	0.48695	1.91604	1.91604
C7	0	0.0407991	0.0228061	0.139605	0.139605
C8	0	0.0118708	0.00490626	0.0501157	0.0501157
C9	0	0.00134485	0.000357496	0.00676679	0.00676679
C10	0	0.011468	0.00222429	0.0622287	0.0622287
Benzene	0	0.0058907	0.00425428	0.0148769	0.0148769
Toluene	0	0.00368906	0.00214159	0.0121868	0.0121868
Ethylbenzene	0	0.00100564	0.000449073	0.00406192	0.00406192
para-Xylene	0	0.00196779	0.000847021	0.00812234	0.00812234
Methanol	0	0.00213093	0.0019703	0.00301304	0.00301304

Stream Properties

Property	Units	16	17	18	19	20
Temperature	°F	68.2753	184.86	198.06	198.06	120 *
Pressure	psig	1395.72	408	407	407	402
Molecular Weight	lb/lbmol	29.9412	47.5763	47.1538	49.8964	49.8964
Std Vapor Volumetric Flow	MMSCFD	45.1024	143.491	121.386	22.1049	22.1049
Std Liquid Volumetric Flow	sgpm	832.571	2851.26	2401.22	450.032	450.032
Compressibility		0.304475 ?	0.116303 ?	0.600452	0.117226 ?	0.106878
Specific Gravity		0.39209 ?	0.399408 ?	1.6281	0.406278 ?	0.499605
Mole Fraction Vapor	%	0	0	100	0	0
Molar Flow	lbmol/h	4952.16	15755.1	13328	2427.08	2427.08
Mass Flow	lb/h	148274	749568	628466	121103	121103
Mass Cp	Btu/(lb*°F)	0.85072	1.04726	0.732244	1.00802	0.688021

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Connections

	21	22	23	24	25
From Block	LCV-232	V-437 C3+ Surge Tank	V-437 C3+ Surge Tank	P-637 C3+ Charge Pump	P-639 C3+ Pipeline Pump
To Block	V-437 C3+ Surge Tank	--	P-637 C3+ Charge Pump	P-639 C3+ Pipeline Pump	--

Stream Composition

Mole Fraction	21 %	22 %	23 %	24 %	25 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	9.38414E-10	6.11909E-09	9.38414E-10	9.38414E-10	9.38414E-10
N2	0	0	0	0	0
C1	2.30672E-08	2.79792E-07	2.30672E-08	2.30672E-08	2.30672E-08
C2	0.714363	2.26361	0.714363	0.714363	0.714363
C3	68.2778	84.3575	68.2778	68.2778	68.2778
iC4	6.89589	4.22969	6.89589	6.89589	6.89589
nC4	15.7784	7.62339	15.7784	15.7784	15.7784
iC5	2.68053	0.647475	2.68053	2.68053	2.68053
nC5	3.43596	0.713371	3.43596	3.43596	3.43596
C6	1.91604	0.155682	1.91604	1.91604	1.91604
C7	0.139605	0.00518997	0.139605	0.139605	0.139605
C8	0.0501157	0.00074465	0.0501157	0.0501157	0.0501157
C9	0.00676679	3.2455E-05	0.00676679	0.00676679	0.00676679
C10	0.0622287	0.00015127	0.0622287	0.0622287	0.0622287
Benzene	0.0148769	0.00151838	0.0148769	0.0148769	0.0148769
Toluene	0.0121868	0.000526083	0.0121868	0.0121868	0.0121868
Ethylbenzene	0.00406192	7.6279E-05	0.00406192	0.00406192	0.00406192
para-Xylene	0.00812234	0.000139139	0.00812234	0.00812234	0.00812234
Methanol	0.00301304	0.000932296	0.00301304	0.00301304	0.00301304

Stream Properties

Property	Units	21	22	23	24	25
Temperature	°F	119.272	119.272	119.272	119.674	139.864
Pressure	psig	171.001	171.001	171.001	193.485	1414.61
Molecular Weight	lb/lbmol	49.8964	45.8924	49.8964	49.8964	49.8964
Std Vapor Volumetric Flow	MMSCFD	22.1049	0	22.1049	22.1049	22.1049
Std Liquid Volumetric Flow	sgpm	450.032	0	450.032	450.032	450.032
Compressibility		0.0479739		0.0479739	0.0537687	0.351174
Specific Gravity		0.494413		0.494413	0.494631	0.50556
Mole Fraction Vapor	%	0 *	100	0	0	0
Molar Flow	lbmol/h	2427.08	0	2427.08	2427.08	2427.08
Mass Flow	lb/h	121103	0	121103	121103	121103
Mass Cp	Btu/(lb*°F)	0.70732		0.70732	0.705882	0.659201

Remarks

Energy Stream Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Energy Streams

Energy Stream	Energy Rate	Power	From Block	To Block
Q-A-332	7.53519E+06 Btu/h	2961.44 hp	A-332 Deethanizer C3+ Cooler	--
Q-E-232	5.89157E+07 Btu/h	23154.7 hp	Deethanizer Reboiler	E-232
Q-E-263	5.64551E+07 Btu/h	22187.7 hp	E-263	DeC2 Refrig Duty
Q-P-360	309941 Btu/h	121.811 hp	--	P-360 DeC2 Reflux Pump
Q-P-634	1.8419E+06 Btu/h	723.895 hp	--	P-634 Ethane Pipeline Pump
Q-P-637	27234.4 Btu/h	10.7035 hp	--	P-637 C3+ Charge Pump
Q-P-639	1.47844E+06 Btu/h	581.048 hp	--	P-639 C3+ Pipeline Pump
Q-P-643	49223.3 Btu/h	19.3455 hp	--	P-643 Ethane Charge Pump

Remarks

		Blocks A-332 Deethanizer C3+ Cooler Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:23 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
19	Inlet	E-232	20	Outlet	LCV-232
Q-A-332	Energy				
Block Parameters					
* Pressure Drop	5	psi	Mass Duty	-62.2215	Btu/lb
Temperature Change	-78.0599	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-7.53519E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks DeC2 Refrig Duty Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:42 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-263 [DeC2]	Energy Inlet	E-263 [DeC2]	Q-E263 [DeC2 Refrig]	Energy Inlet	E-263 [DeC2 Refrig]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

		Blocks Deethanizer Reboiler Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:24 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-232 [DeC2]	Energy Inlet	E-232 [DeC2]	Q-E-232 [HMO]	Energy Inlet	E-232 [HMO]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
E-232
Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:18 PM, 2/10/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
17	Inlet	T-531 Deethanizer	18	Vapor Outlet	T-531 Deethanizer
19	Light Liquid Outlet	A-332 Deethanizer C3+ Cooler	Q-E-232	Energy	Deethanizer Reboiler

Block Parameters

* Pressure Drop	1 psi	Main Liquid Phase	Light Liquid
Mole Fraction Vapor	84.5949 %	Heat Duty	5.89157E+07 Btu/h
Mole Fraction Light Liquid	15.4051 %	Heat Release Curve Type	Plug Flow
Mole Fraction Heavy Liquid	0 %	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	32.4405 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	32.4405 °F	Lowest Supply Temperature	217.3 °F
Maximum Effective Approach Temperature	151.94 °F	Highest Demand Temperature	198.06 °F
Log Mean Temperature Difference	77.3922 °F	Lowest Demand Temperature	184.86 °F
Effective Mean Temperature Difference	78.5543 °F	Total Energy Supply	5.89157E+07 Btu/h
End Point UA	761262 Btu/(h*°F)	Total Energy Demand	5.89157E+07 Btu/h
Effective UA	749999 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-232	184.86	198.06	5.89157E+07	78.5543
E-232	184.86	198.06	5.89157E+07	78.5543

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-232	749999	0.170563	0.162763	
E-232	749999	0.170563	0.162763	

Remarks

Blocks
E-263
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:15 PM, 2/10/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	T-531 Deethanizer	4	Outlet	V-431 Deethanizer Reflux Accumulator
Q-E-263	Energy	DeC2 Refrig Duty			

Block Parameters

* Pressure Drop	2 psi	Mass Duty	-117.036 Btu/lb
Temperature Change	-2.79537 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-5.64551E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	9.77318 °F	Highest Supply Temperature	43.8889 °F
Minimum Effective Approach Temperature	9.77318 °F	Lowest Supply Temperature	41.0936 °F
Maximum Effective Approach Temperature	12.7954 °F	Highest Demand Temperature	31.3204 °F
Log Mean Temperature Difference	11.2165 °F	Lowest Demand Temperature	31.0936 °F
Effective Mean Temperature Difference	11.6653 °F	Total Energy Supply	5.64551E+07 Btu/h
End Point UA	5.03322E+06 Btu/(h*°F)	Total Energy Demand	5.64551E+07 Btu/h
Effective UA	4.83957E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-263	31.3204	31.0936	5.64551E+07	11.6653
E-263	31.3204	31.0936	5.64551E+07	11.6653

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-263	4.83957E+06	0.0202222	0.0194215
E-263	4.83957E+06	0.0202222	0.0194215

Remarks

		Blocks FCV-231 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:05 PM, 2/10/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	NGL Feed to DeC2	2	Outlet	T-531 Deethanizer
Block Parameters					
Pressure Drop		273 psi	? Simple Compressible Cv		140.193
Joule-Thomson Coefficient		0.0606404 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		51.2326			
Remarks					

		Blocks FCV-531 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:30 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	SPLT-100	9	Outlet	RCYL-1
Block Parameters					
Pressure Drop		48.2105 psi	? Simple Compressible Cv 487.893		
Joule-Thomson Coefficient		0.022004 °F/psi	Valve Diameter in		
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		154.7			
Remarks					

		Blocks LCV-232 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:23 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
20	Inlet	A-332 Deethanizer C3+ Cooler	21	Outlet	V-437 C3+ Surge Tank
Block Parameters					
Pressure Drop		230.999 psi	? Simple Compressible Cv		89.6675
Joule-Thomson Coefficient		0.00315294 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		22.5345			
Remarks					

Blocks
LCV-431B
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:35 PM, 2/13/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	SPLT-100	12	Outlet	V-435 C2 Surge Tank

Block Parameters

Pressure Drop	46.898	psi	? Simple Compressible Cv	219.372
Joule-Thomson Coefficient	0.0175842	°F/psi	Valve Diameter	in
Pressure Drop Method	User Set		Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True		Valve F_D, Style Modifier	
Calculate Flow	False		Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	69.6101			

Remarks

Blocks
NGL Feed to DeC2
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:05 PM, 2/10/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6 [NGL Sieve]	Inlet	SPLT-100 [NGL Sieve]	1 [DeC2]	Outlet	FCV-231 [DeC2]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1237.6 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	98.9103 °F	Fraction Vapor Difference	0 %
Inlet Pressure	678 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1237.6 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	98.9103 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	678 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Remarks

		Blocks P-360 DeC2 Reflux Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:29 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	V-431 Deethanizer Reflux Accumulator	7	Outlet	SPLT-100
Q-P-360	Energy				
Block Parameters					
* Overall Efficiency	60	%	Power	121.811	hp
Pressure Change	50.2105	psi	Power Estimate	0	hp
* Dynamic Head	300	ft			
Remarks					

		Blocks P-634 Ethane Pipeline Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:55 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15	Inlet	P-643 Ethane Charge Pump	16	Outlet	
Q-P-634	Energy				
Block Parameters					
* Overall Efficiency	60	%	Power	723.895	hp
Pressure Change	968.532	psi	Power Estimate	0	hp
* Dynamic Head	5800	ft			
Remarks					

		Blocks P-637 C3+ Charge Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:20 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
23	Inlet	V-437 C3+ Surge Tank	24	Outlet	P-639 C3+ Pipeline Pump
Q-P-637	Energy				
Block Parameters					
* Overall Efficiency	60	%	Power	10.7035	hp
Pressure Change	22.4845	psi	Power Estimate	0	hp
* Dynamic Head	105	ft			
Remarks					

		Blocks P-639 C3+ Pipeline Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:20 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
24	Inlet	P-637 C3+ Charge Pump	25	Outlet	
Q-P-639	Energy				
Block Parameters					
* Overall Efficiency	60 %		Power	581.048 hp	
Pressure Change	1221.13 psi		Power Estimate	0 hp	
* Dynamic Head	5700 ft				
Remarks					

		Blocks P-643 Ethane Charge Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:54 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	V-435 C2 Surge Tank	15	Outlet	P-634 Ethane Pipeline Pump
Q-P-643	Energy				
Block Parameters					
* Overall Efficiency	60 %		Power	19.3455 hp	
Pressure Change	25.8778 psi		Power Estimate	0 hp	
* Dynamic Head	155 ft				
Remarks					

Blocks
RCYL-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:30 PM, 2/13/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
9	Inlet	FCV-531	10	Outlet	T-531 Deethanizer

Block Parameters

Error	0.000896508	Recycle Dependencies	1
Iterations	1	Solver Dependencies	0
Priority	1	Recycle State	Active
* Calculate	True	* Flash Variables	Pressure, Enthalpy
Block Dependencies	6		
* Recycle Variables	Pressure, Enthalpy, Component Flow, Mass Flow		

Tabulated Block Data

Index	Function values	Weights		
Pressure	0	1 *		
Enthalpy	0.000173682	1 *		
Mass Flow	2.8913E-05	1 *		
H2O	0	1 *		
H2S	0	1 *		
CO2	4.34775E-06	1 *		
N2	4.31044E-11	1 *		
C1	0.000226868	1 *		
C2	-0.000896508	1 *		
C3	0.000665278	1 *		
iC4	8.57185E-09	1 *		
nC4	5.02135E-09	1 *		
iC5	1.7834E-13	1 *		
nC5	2.12274E-14	1 *		
C6	0	1 *		
C7	0	1 *		
C8	0	1 *		
C9	0	1 *		
C10	0	1 *		
Benzene	0	1 *		
Toluene	0	1 *		
Ethylbenzene	0	1 *		
para-Xylene	0	1 *		
Methanol	0	1 *		

Remarks

Blocks
SPLT-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:29 PM, 2/13/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	P-360 DeC2 Reflux Pump	11	Outlet	LCV-431B
8	Outlet	FCV-531			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 11	30.7384 %
Flow Multiplier	100 %	Fraction to Stream 8	69.2616 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
T-531 Deethanizer
Column Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:32 AM, 5/19/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

Stage Connections

Stage	Type	Connected Stream	Direction	Block
1	Inlet	10	From	RCYL-1
1	Vapor Outlet	3	To	E-263
13	Inlet	2	From	FCV-231
24	Inlet	18	From	E-232
24	Light Liquid Outlet	17	To	E-232

Column Attachments

Type	Block Name	Type	Block Name	Type	Block Name
Reboiler	E-232				

Block Parameters

* Number of Stages	24	Copy Lock	
Degrees of Freedom	0	Murphree Efficiencies Active	False
Model Type	Ideal Stage	Efficiency Phase	Light Liquid
Ideal Stage Column Type	General Ideal Stage	Outer Loop Iterations	5
Flash Type	VLE	Enthalpy Model	Boston-Britt
* Column Add-ons	Reboiler	Inner Loop Model	Boston-Sullivan
Solve after Execute	True	K Damping	0
* First Liquid Phase	Nonspecific Liquid	Boston-Sullivan Kb	False
Phase Threshold	0.1 %	MESH Method	Boston-Sullivan Inside-Out
VLE Liquid	Default	Maximum Initial Iterations	50
Allow Overspecification	False	Use Last Solution	True
Number Column Top Down	True	Approach To Equilibrium Numerator Phase	Light Liquid
* Pressure Change	5 psi	Approach To Equilibrium Denominator Phase	Vapor
* Bottoms Head	3 psi		

Column Specifications**Boilup Ratio 1****Properties**

Target	5.49226	Lower	0.001
Value	5.49136	* Usage	Calculation During Execute
* Type	Molar Flow	Calculation Type	Specified Stage
Upper	100		
Source Information	Reboiler --- Bottoms		

Source Information

* Source	Reboiler	* Phase	Vapor

Source Information

* Source	Bottoms		

C2 in C3+**Properties**

* Target	0.65 %	* Usage	Specification
Value	0.65 %	Calculation Type	Specified Stage
Weight	1	Source Information	Bottoms Liquid
* Type	Std Liquid Volumetric Fraction		

Source Information

* Source	Bottoms Liquid	* Component	C2

Blocks
T-531 Deethanizer
Column Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:32 AM, 5/19/2023
Flowsheet:	DeC2	Status: Solved 12:36 PM, 3/7/2025

C2/C3**Properties**

* Target	0.005	* Usage	Calculation During Execute
Value	0.0101563	Calculation Type	Specified Stage
* Type	Std Liquid Volumetric Fraction		
Source Information	Reboiler --- Reboiler		

Source Information

* Source	Reboiler	* Component	C2
* Phase	Light Liquid		

Source Information

* Source	Reboiler	* Component	C3
* Phase	Light Liquid		

Reboiler Duty**Properties**

* Target	2.8E+07 Btu/h	* Usage	Calculation During Execute
Value	5.89157E+07 Btu/h	Calculation Type	Specified Stage
Upper	Btu/h	Source Information	QStream: Q-E-232
Lower	Btu/h		

Source Information

* Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2!QStreams!Q-E-232

Remarks

		Blocks T-531 Deethanizer Column Stage Report			
Client Name:		Energy Transfer			Job: Plan Approval Application
Location:		Cryo II			Modified: 11:32 AM, 5/19/2023
Flowsheet:		DeC2			Status: Solved 12:36 PM, 3/7/2025
Stage Properties					
Stages	Stage Pressure psig	Stage Head ft	Temperature °F	Vapor Molar Flow lbmol/h	Light Liquid Molar Flow lbmol/h
1	400 *	0	43.8889	16110.7	11232.4
2	400.217	0	44.523	16184.6	11249.5
3	400.435	0	44.8477	16201.8	11235.3
4	400.652	0	45.2118	16187.6	11201
5	400.87	0	45.7519	16153.2	11141.3
6	401.087	0	46.5954	16093.6	11044.5
7	401.304	0	47.9144	15996.7	10894.9
8	401.522	0	49.943	15847.1	10676.3
9	401.739	0	52.9661	15628.5	10377.7
10	401.957	0	57.2714	15330	9998.18
11	402.174	0	63.0889	14950.4	9534.09
12	402.391	0	70.692	14486.3	8909
13	402.609	0	81.2946	13861.3	15068.7
14	402.826	0	90.0689	12641.6	14818.7
15	403.043	0	102.005	12391.6	14642.6
16	403.261	0	116.267	12215.5	14671.2
17	403.478	0	130.816	12244.1	14938.8
18	403.696	0	143.677	12511.7	15360.6
19	403.913	0	153.915	12933.5	15811.6
20	404.13	0	161.633	13384.6	16194.1
21	404.348	0	167.504	13767.1	16450.5
22	404.565	0	172.446	14023.4	16537.3
23	404.783	0	177.609	14110.2	16375.2
24	405	17.3446	184.781	13948.1	15755.1
E-232	407		198.06	13328	2427.08
Remarks					

		Blocks V-431 Deethanizer Reflux Accumulator Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:12 PM, 2/10/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
4	Inlet	E-263	5	Vapor Outlet	
6	Light Liquid Outlet	P-360 DeC2 Reflux Pump			
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty		0 Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments		10
Remarks					

		Blocks V-435 C2 Surge Tank Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:37 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	LCV-431B	13	Vapor Outlet	
14	Light Liquid Outlet	P-643 Ethane Charge Pump			
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty		0 Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments		10
Remarks					

		Blocks V-437 C3+ Surge Tank Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:20 PM, 2/13/2023	
Flowsheet:	DeC2			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
21	Inlet	LCV-232	22	Vapor Outlet	
23	Light Liquid Outlet	P-637 C3+ Charge Pump			
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty		0 Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments		10
Remarks					

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro					
Client Name:	Energy Transfer				Job: Plan Approval Application		
Location:	Cryo II						
Flowsheet:	DeC2						
Henry's Law Component							
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2	
C8	False	False					
C9	False	False					
C10	False	False					
Benzene	False	False					
Toluene	False	False					
Ethylbenzene	False	False					
para-Xylene	False	False					
Methanol	False	False					
Phases							
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %		
Total	Total	True					
Vapor	Vapor	True	-441.67	17540.3			
Light Liquid	Light Liquid	True					
Heavy Liquid	Heavy Liquid	True					
Mixed Liquid	Mixed Liquid	True					
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3			
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70		
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75		
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75		
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75		
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75		
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model		
Total				True			
Vapor			Peng-Robinson	True			
Light Liquid				False			
Heavy Liquid				False			
Mixed Liquid				False			
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)		
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)		
Sulfur Liquid	10	Sulfur		False			
Mercury Liquid	10	Mercury		False			
Custom Liquid 1	10			False			
Custom Liquid 2	10			False			
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model				
Total							
Vapor	Chapman-Enskog	Lindsay-Bromley					
Light Liquid							
Heavy Liquid							
Mixed Liquid							
Nonspecific Liquid	Teja-Thurner	Li	Parachor				
Aqueous Liquid	Teja-Thurner	Li	Parachor				
Sulfur Liquid							
Mercury Liquid							
Custom Liquid 1							
Custom Liquid 2							

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	DeC2				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package			
Custom Liquid 2 Package		Solid Package			
Remarks					

DeC2 Refrig Plant Schematic

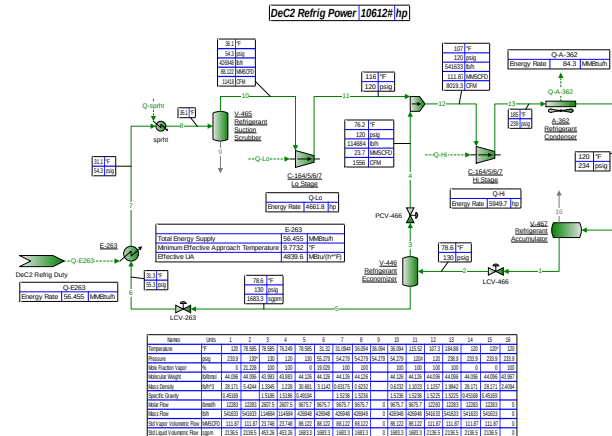
Client Name:	Energy Transfer

Location:	Cryo II

Flowsheet:	DeC2 Refrig

Job: Plan Approval Application

DeC2 Refrigeration Unit



Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2 Refrig	

Connections

	1	2	3	4	5
From Block	V-467 Refrigerant Accumulator	LCV-466	V-446 Refrigerant Economizer	PCV-466	V-446 Refrigerant Economizer
To Block	LCV-466	V-446 Refrigerant Economizer	PCV-466	MIX-100	LCV-263

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0	0	0	0	0
N2	0	0	0	0	0
C1	0	0	0	0	0
C2	0.5	0.5	1.05721	1.05721	0.349841
C3	99	99	98.6865	98.6865	99.0845
iC4	0.5	0.5	0.256311	0.256311	0.565671
nC4	0	0	0	0	0
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	120	78.5855	78.5855	76.2491	78.5855
Pressure	psig	233.899	130 *	130	120	130
Molecular Weight	lb/lbmol	44.0956	44.0956	43.9833	43.9833	44.1259
Std Vapor Volumetric Flow	MMSCFD	111.87	111.87	23.7477	23.7477	88.1225
Std Liquid Volumetric Flow	sgpm	2136.54	2136.54	453.262	453.262	1683.28
Compressibility		0.0621746	0.201527	0.817043	0.829514	0.0356541
Specific Gravity		0.451692		1.51863	1.51863	0.491936
Mole Fraction Vapor	%	0	21.2279	100	100	0
Molar Flow	lbmol/h	12283.1	12283.1	2607.45	2607.45	9675.69
Mass Flow	lb/h	541633	541633	114684	114684	426948
Mass Cp	Btu/(lb*°F)	0.812831	0.645385	0.450027	0.443552	0.697861

Remarks

		Process Streams Report All Streams Tabulated by Total Phase					
Client Name:	Energy Transfer				Job: Plan Approval Application		
Location:	Cryo II						
Flowsheet:	DeC2 Refrig						
Connections							
	6	7	8	9	10		
From Block	LCV-263	E-263	sprht	V-465 Refrigerant Suction Scrubber	V-465 Refrigerant Suction Scrubber		
To Block	E-263	sprht	V-465 Refrigerant Suction Scrubber	--	C-164/5/6/7 Lo Stage		
Stream Composition							
Mole Fraction	6 %	7 %	8 %	9 %	10 %		
H2O	0	0	0		0		
H2S	0	0	0		0		
CO2	0	0	0		0		
N2	0	0	0		0		
C1	0	0	0		0		
C2	0.349841	0.349841	0.349841		0.349841		
C3	99.0845	99.0845	99.0845		99.0845		
iC4	0.565671	0.565671	0.565671		0.565671		
nC4	0	0	0		0		
iC5	0	0	0		0		
nC5	0	0	0		0		
C6	0	0	0		0		
C7	0	0	0		0		
C8	0	0	0		0		
C9	0	0	0		0		
C10	0	0	0		0		
Benzene	0	0	0		0		
Toluene	0	0	0		0		
Ethylbenzene	0	0	0		0		
para-Xylene	0	0	0		0		
Methanol	0	0	0		0		
Stream Properties							
Property	Units	6	7	8	9	10	
Temperature	°F	31.3204	31.0936 *	36.0936	36.0936	36.0936	
Pressure	psig	55.2793	54.2793	54.2793	54.2793	54.2793	
Molecular Weight	lb/lbmol	44.1259	44.1259	44.1259		44.1259	
Std Vapor Volumetric Flow	MMSCFD	88.1225	88.1225	88.1225	0	88.1225	
Std Liquid Volumetric Flow	sgpm	1683.28	1683.28	1683.28	0	1683.28	
Compressibility		0.184149	0.894918	0.898049		0.898049	
Specific Gravity			1.52355	1.52355		1.52355	
Mole Fraction Vapor	%	19.0293	100	100		100	
Molar Flow	lbmol/h	9675.69	9675.69	9675.69	0	9675.69	
Mass Flow	lb/h	426948	426948	426948	0	426948	
Mass Cp	Btu/(lb*°F)	0.577354	0.394382	0.396557		0.396557	
Remarks							

Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2 Refrig	

Connections

	11	12	13	14	15
From Block	C-164/5/6/7 Lo Stage	MIX-100	C-164/5/6/7 Hi Stage	A-362 Refrigerant Condenser	TRM-1
To Block	MIX-100	C-164/5/6/7 Hi Stage	A-362 Refrigerant Condenser	TRM-1	V-467 Refrigerant Accumulator

Stream Composition

Mole Fraction	11 %	12 %	13 %	14 %	15 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0	0	0	0	0
N2	0	0	0	0	0
C1	0	0	0	0	0
C2	0.349841	0.5	0.5	0.5	0.5
C3	99.0845	99	99	99	99
iC4	0.565671	0.5	0.5	0.5	0.5
nC4	0	0	0	0	0
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	11	12	13	14	15
Temperature	°F	115.518	107.299	184.882	120	120 *
Pressure	psig	120 *	120	238.899	233.899	233.899
Molecular Weight	lb/lbmol	44.1259	44.0956	44.0956	44.0956	44.0956
Std Vapor Volumetric Flow	MMSCFD	88.1225	111.87	111.87	111.87	111.87
Std Liquid Volumetric Flow	sgpm	1683.28	2136.54	2136.54	2136.54	2136.54
Compressibility		0.863832	0.857545	0.809941	0.0621746	0.0621746
Specific Gravity		1.52355	1.52251	1.52251	0.451692	0.451692
Mole Fraction Vapor	%	100	100	100	0	0
Molar Flow	lbmol/h	9675.69	12283.1	12283.1	12283.1	12283.1
Mass Flow	lb/h	426948	541633	541633	541633	541633
Mass Cp	Btu/(lb*°F)	0.456072	0.453005	0.52273	0.812831	0.812831

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2 Refrig	

Connections

	16				
From Block	V-467 Refrigerant Accumulator				
To Block	--				

Stream Composition

Mole Fraction	16 %				
H2O	0				
H2S	0				
CO2	0				
N2	0				
C1	0				
C2	1.18531				
C3	98.5464				
iC4	0.268308				
nC4	0				
iC5	0				
nC5	0				
C6	0				
C7	0				
C8	0				
C9	0				
C10	0				
Benzene	0				
Toluene	0				
Ethylbenzene	0				
para-Xylene	0				
Methanol	0				

Stream Properties

Property	Units	16				
Temperature	°F	120				
Pressure	psig	233.899				
Molecular Weight	lb/lbmol	43.967				
Std Vapor Volumetric Flow	MMSCFD	0				
Std Liquid Volumetric Flow	sgpm	0				
Compressibility						
Specific Gravity						
Mole Fraction Vapor	%	100				
Molar Flow	lbmol/h	0				
Mass Flow	lb/h	0				
Mass Cp	Btu/(lb*°F)					

Remarks

		Energy Stream Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	DeC2 Refrig				
Energy Streams					
Energy Stream	Energy Rate		Power	From Block	To Block
Q-A-362	8.42996E+07	Btu/h	33131 hp	A-362 Refrigerant Condenser	--
Q-E263	5.64551E+07	Btu/h	22187.7 hp	DeC2 Refrig Duty	E-263
Q-Hi	1.51387E+07	Btu/h	5949.72 hp	--	C-164/5/6/7 Hi Stage
Q-Lo	1.18616E+07	Btu/h	4661.79 hp	--	C-164/5/6/7 Lo Stage
Q-sprht	844217	Btu/h	331.79 hp	--	sprht
Remarks					

		Blocks A-362 Refrigerant Condenser Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:49 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	C-164/5/6/7 Hi Stage	14	Outlet	TRM-1
Q-A-362	Energy				
Block Parameters					
* Pressure Drop	5 psi		Mass Duty	-155.64 Btu/lb	
Temperature Change	-64.8818 °F		Heat Release Curve Type	Plug Flow	
Heat Duty	-8.42996E+07 Btu/h		Heat Release Curve Increments	10	
Remarks					

Blocks
C-164/5/6/7 Hi Stage
Compressor Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:48 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:37 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	MIX-100	13	Outlet	A-362 Refrigerant Condenser
Q-Hi	Energy				

Block Parameters

* Polytropic Efficiency	52 %	Polytropic Head Correction Factor	1.00386
Polytropic Head	11309.9 ft	Pressure Change	118.899 psi
Polytropic n	1.1255	Compression Ratio	1.89264
Isentropic (Adiabatic) Efficiency	49.8816 %	Compressor Rotation Speed	rpm
Isentropic (Adiabatic) Head	10849.2 ft	Power	5949.72 hp
Isentropic k	0.982091	Ideal Work Method	Entropy Based

Remarks

		Blocks C-164/5/6/7 Lo Stage Compressor Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:48 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	V-465 Refrigerant Suction Scrubber	11	Outlet	MIX-100
Q-Lo	Energy				
Block Parameters					
* Polytropic Efficiency		52 %	Polytropic Head Correction Factor		1.00314
Polytropic Head		11242.1 ft	Pressure Change		65.7207 psi
Polytropic n		1.19245	Compression Ratio		1.97394
Isentropic (Adiabatic) Efficiency		49.7621 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		10758.2 ft	Power		4661.79 hp
Isentropic k		1.03458	Ideal Work Method		Entropy Based
Remarks					

		Blocks DeC2 Refrig Duty Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:43 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E263 [DeC2 Refrig]	Energy Inlet	E-263 [DeC2 Refrig]	Q-E-263 [DeC2]	Energy Inlet	E-263 [DeC2]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
E-263
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:51 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	LCV-263	7	Outlet	sprht
Q-E263	Energy	DeC2 Refrig Duty			

Block Parameters

* Pressure Drop	1 psi	Mass Duty	132.229 Btu/lb
Temperature Change	-0.226822 °F	Heat Release Curve Type	Plug Flow
Heat Duty	5.64551E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	9.77318 °F	Highest Supply Temperature	43.8889 °F
Minimum Effective Approach Temperature	9.77318 °F	Lowest Supply Temperature	41.0936 °F
Maximum Effective Approach Temperature	12.7954 °F	Highest Demand Temperature	31.3204 °F
Log Mean Temperature Difference	11.2165 °F	Lowest Demand Temperature	31.0936 °F
Effective Mean Temperature Difference	11.6653 °F	Total Energy Supply	5.64551E+07 Btu/h
End Point UA	5.03322E+06 Btu/(h*°F)	Total Energy Demand	5.64551E+07 Btu/h
Effective UA	4.83957E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-263	31.3204	31.0936	5.64551E+07	11.6653
E-263	31.3204	31.0936	5.64551E+07	11.6653

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-263	4.83957E+06	0.0202222	0.0194215
E-263	4.83957E+06	0.0202222	0.0194215

Remarks

Blocks
LCV-263
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:40 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	V-446 Refrigerant Economizer	6	Outlet	E-263

Block Parameters

Pressure Drop	74.7207 psi	? Simple Compressible Cv	935.184
Joule-Thomson Coefficient	0.632557 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	140.771		

Remarks

		Blocks LCV-466 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:40 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	V-467 Refrigerant Accumulator	2	Outlet	V-446 Refrigerant Economizer
Block Parameters					
Pressure Drop		103.899 psi	? Simple Compressible Cv		714.803
Joule-Thomson Coefficient		0.398603 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		158.049			
Remarks					

Blocks
MIX-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:40 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	C-164/5/6/7 Lo Stage	4	Inlet	PCV-466
12	Outlet	C-164/5/6/7 Hi Stage			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 12	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
PCV-466
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:06 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	V-446 Refrigerant Economizer	4	Outlet	MIX-100

Block Parameters

* Pressure Drop	10 psi	Simple Compressible Cv	558.725
Joule-Thomson Coefficient	0.233638 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	495.603		

Remarks

		Blocks sprht Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:56 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	E-263	8	Outlet	V-465 Refrigerant Suction Scrubber
Q-sprht	Energy				
Block Parameters					
* Pressure Drop		0 psi	Mass Duty		1.97733 Btu/lb
* Temperature Change		5 °F	Heat Release Curve Type		Plug Flow
Heat Duty		844217 Btu/h	Heat Release Curve Increments		10
Remarks					

Blocks
TRM-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:40 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	A-362 Refrigerant Condenser	15	Outlet	V-467 Refrigerant Accumulator

Block Parameters

Error	2.08234E-16	Recycle State	Active
* Calculate	False		
* Propagated Variables	Vapor Fraction, Temperature		

Remarks

		Blocks V-446 Refrigerant Economizer Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:48 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
2	Inlet	LCV-466	3	Vapor Outlet	PCV-466
5	Light Liquid Outlet	LCV-263			
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	21.2279	%	Heat Duty	0 Btu/h	
Mole Fraction Light Liquid	78.7721	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	
Remarks					

	Blocks V-465 Refrigerant Suction Scrubber Separator Report	

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:48 PM, 2/13/2023
Flowsheet:	DeC2 Refrig	Status: Solved 12:36 PM, 3/7/2025

Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	sprht	10	Vapor Outlet	C-164/5/6/7 Lo Stage
9	Light Liquid Outlet				

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

Remarks

		Blocks V-467 Refrigerant Accumulator Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 1:48 PM, 2/13/2023	
Flowsheet:	DeC2 Refrig			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15	Inlet	TRM-1	16	Vapor Outlet	
1	Light Liquid Outlet	LCV-466			
Block Parameters					
* Pressure Drop	0 psi	Main Liquid Phase	Light Liquid		
Mole Fraction Vapor	0 %	Heat Duty	0 Btu/h		
Mole Fraction Light Liquid	100 %	Heat Release Curve Type	Plug Flow		
Mole Fraction Heavy Liquid	0 %	Heat Release Curve Increments	10		
Remarks					

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	DeC2 Refrig	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

ProMax 6.0.24240.0

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		Flowsheet Environment Hydrocarbon Enviro				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	DeC2 Refrig					
Henry's Law Component						
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
Methanol	False	False				
Phases						
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %	
Total	Total	True				
Vapor	Vapor	True	-441.67	17540.3		
Light Liquid	Light Liquid	True				
Heavy Liquid	Heavy Liquid	True				
Mixed Liquid	Mixed Liquid	True				
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3		
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70	
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75	
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75	
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75	
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75	
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model	
Total				True		
Vapor			Peng-Robinson	True		
Light Liquid				False		
Heavy Liquid				False		
Mixed Liquid				False		
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)	
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)	
Sulfur Liquid	10	Sulfur		False		
Mercury Liquid	10	Mercury		False		
Custom Liquid 1	10			False		
Custom Liquid 2	10			False		
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model			
Total						
Vapor	Chapman-Enskog	Lindsay-Bromley				
Light Liquid						
Heavy Liquid						
Mixed Liquid						
Nonspecific Liquid	Teja-Thurner	Li	Parachor			
Aqueous Liquid	Teja-Thurner	Li	Parachor			
Sulfur Liquid						
Mercury Liquid						
Custom Liquid 1						
Custom Liquid 2						

* User Specified Values

? Extrapolated or Approximate Values

ProMax 6.0.24240.0

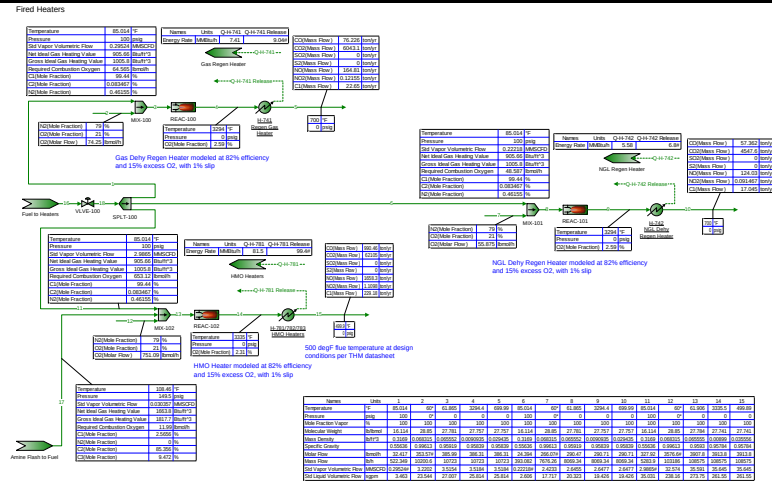
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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	DeC2 Refrig				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package				Custom Liquid 1 Package	
Custom Liquid 2 Package				Solid Package	
Remarks					

Fired Heaters Plant Schematic

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Fired Heaters	



Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Fired Heaters	

Connections

	1	2	3	4	5
From Block	SPLT-100	--	MIX-100	REAC-100	H-741 Regen Gas Heater
To Block	MIX-100	MIX-100	REAC-100	H-741 Regen Gas Heater	--

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0	0 *	0	16.5426	16.5426
H2S	0	0 *	0	0	0
CO2	0.0148783	0 *	0.00124954	8.1152	8.1152
N2	0.461548	79 *	72.404	72.181	72.181
C1	99.4401	0 *	8.35136	0.0834436	0.0834436
C2	0.0834666	0 *	0.00700984	7.00397E-05	7.00397E-05
C3	2.84571E-07	0 *	2.38994E-08	2.38793E-10	2.38793E-10
iC4	1.12323E-12	0 *	9.4333E-14	0	0
nC4	6.00632E-13	0 *	5.04434E-14	0	0
iC5	0	0 *	0	0	0
nC5	0	0 *	0	0	0
C6	0	0 *	0	0	0
C7	0	0 *	0	0	0
C8	0	0 *	0	0	0
C9	0	0 *	0	0	0
C10	0	0 *	0	0	0
Benzene	0	0 *	0	0	0
Toluene	0	0 *	0	0	0
Ethylbenzene	0	0 *	0	0	0
para-Xylene	0	0 *	0	0	0
MDEA	0	0 *	0	0	0
O2	0	21 *	19.2363	2.59207	2.59207
CO	0	0 *	0	0.160833	0.160833
NO	0	0 *	0	0.324619	0.324619
NO2	0	0 *	0	0.000156143	0.000156143
SO2	0	0 *	0	0	0
S2	0	0 *	0	0	0

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	85.0139	60 *	61.8649	3294.45	699.987
Pressure	psig	100	0 *	0	0	0
Molecular Weight	lb/lbmol	16.1136	28.8503	27.7807	27.7574	27.7574
Std Vapor Volumetric Flow	MMSCFD	0.295239 *	3.22018	3.51542	3.51837	3.51837
Std Liquid Volumetric Flow	sgpm	3.46301	23.5439	27.0069	25.814	25.814
Compressibility		0.984709	0.999587	0.999495	1.00012	1.00022
Specific Gravity		0.55636	0.996127	0.959194	0.95839	0.95839
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	32.4167	353.57 *	385.987	386.311	386.311
Mass Flow	lb/h	522.349	10200.6	10723	10723	10723
Mass Cp	Btu/(lb*°F)	0.542327	0.241675	0.255479	0.351066 ?	0.283944

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Fired Heaters	

Connections

	6	7	8	9	10
From Block	SPLT-100	--	MIX-101	REAC-101	H-742 NGL Dehy Regen Heater
To Block	MIX-101	MIX-101	REAC-101	H-742 NGL Dehy Regen Heater	--

Stream Composition

Mole Fraction	6 %	7 %	8 %	9 %	10 %
H2O	0	0 *	0	16.5426	16.5426
H2S	0	0 *	0	0	0
CO2	0.0148783	0 *	0.00124954	8.1152	8.1152
N2	0.461548	79 *	72.404	72.181	72.181
C1	99.4401	0 *	8.35136	0.0834436	0.0834436
C2	0.0834666	0 *	0.00700984	7.00397E-05	7.00397E-05
C3	2.84571E-07	0 *	2.38994E-08	2.38793E-10	2.38793E-10
iC4	1.12323E-12	0 *	9.4333E-14	0	0
nC4	6.00632E-13	0 *	5.04434E-14	0	0
iC5	0	0 *	0	0	0
nC5	0	0 *	0	0	0
C6	0	0 *	0	0	0
C7	0	0 *	0	0	0
C8	0	0 *	0	0	0
C9	0	0 *	0	0	0
C10	0	0 *	0	0	0
Benzene	0	0 *	0	0	0
Toluene	0	0 *	0	0	0
Ethylbenzene	0	0 *	0	0	0
para-Xylene	0	0 *	0	0	0
MDEA	0	0 *	0	0	0
O2	0	21 *	19.2363	2.59207	2.59207
CO	0	0 *	0	0.160833	0.160833
NO	0	0 *	0	0.324619	0.324619
NO2	0	0 *	0	0.000156143	0.000156143
SO2	0	0 *	0	0	0
S2	0	0 *	0	0	0

Stream Properties

Property	Units	6	7	8	9	10
Temperature	°F	85.0139	60 *	61.8649	3294.45	699.987
Pressure	psig	100	0 *	0	0	0
Molecular Weight	lb/lbmol	16.1136	28.8503	27.7807	27.7574	27.7574
Std Vapor Volumetric Flow	MMSCFD	0.222175 *	2.42328	2.64546	2.64768	2.64768
Std Liquid Volumetric Flow	sgpm	2.60601	17.7175	20.3235	19.4258	19.4258
Compressibility		0.984709	0.999587	0.999495	1.00012	1.00022
Specific Gravity		0.55636	0.996127	0.959194	0.95839	0.95839
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	24.3945	266.072 *	290.466	290.71	290.71
Mass Flow	lb/h	393.082	7676.26	8069.34	8069.34	8069.34
Mass Cp	Btu/(lb*°F)	0.542327	0.241675	0.255479	0.351066 ?	0.283944

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Fired Heaters	

Connections

	11	12	13	14	15
From Block	SPLT-100	--	MIX-102	REAC-102	H-781/782/783 HMO Heaters
To Block	MIX-102	MIX-102	REAC-102	H-781/782/783 HMO Heaters	--

Stream Composition

Mole Fraction	11 %	12 %	13 %	14 %	15 %
H2O	0	0 *	0.000609777	16.7755	16.7755
H2S	0	0 *	0	0	0
CO2	0.0148783	0 *	0.00177111	8.23203	8.23203
N2	0.461548	79 *	72.3423	72.0709	72.0709
C1	99.4401	0 *	8.34642	0.0833372	0.0833372
C2	0.0834666	0 *	0.079808	0.000796866	0.000796866
C3	2.84571E-07	0 *	0.00807911	8.06681E-05	8.06681E-05
iC4	1.12323E-12	0 *	0.00027548	2.75061E-06	2.75061E-06
nC4	6.00632E-13	0 *	0.000720571	7.19475E-06	7.19475E-06
iC5	0	0 *	3.84619E-05	3.84033E-07	3.84033E-07
nC5	0	0 *	4.80463E-05	4.79732E-07	4.79732E-07
C6	0	0 *	7.15482E-06	7.14393E-08	7.14393E-08
C7	0	0 *	1.35801E-07	1.35594E-09	1.35594E-09
C8	0	0 *	1.78248E-08	1.77977E-10	1.77977E-10
C9	0	0 *	3.53708E-10	3.5317E-12	3.5317E-12
C10	0	0 *	7.01179E-10	7.00112E-12	7.00112E-12
Benzene	0	0 *	5.30838E-07	5.3003E-09	5.3003E-09
Toluene	0	0 *	1.7964E-07	1.79367E-09	1.79367E-09
Ethylbenzene	0	0 *	2.44499E-08	2.44127E-10	2.44127E-10
para-Xylene	0	0 *	4.59644E-08	4.58944E-10	4.58944E-10
MDEA	0	0 *	1.50647E-08	1.50418E-10	1.50418E-10
O2	0	21 *	19.2199	2.30852	2.30852
CO	0	0 *	0	0.206277	0.206277
NO	0	0 *	0	0.322385	0.322385
NO2	0	0 *	0	0.000140726	0.000140726
SO2	0	0 *	0	0	0
S2	0	0 *	0	0	0

Stream Properties

Property	Units	11	12	13	14	15
Temperature	°F	85.0139	60 *	61.9057	3335.47	499.889
Pressure	psig	100	0 *	0	0	0
Molecular Weight	lb/lbmol	16.1136	28.8503	27.7838	27.7415	27.7415
Std Vapor Volumetric Flow	MMSCFD	2.98653 *	32.5743	35.5912	35.6454	35.6454
Std Liquid Volumetric Flow	sgpm	35.0306	238.162	273.749	261.548	261.548
Compressibility		0.984709	0.999587	0.999492	1.00012	1.00013
Specific Gravity		0.55636	0.996127	0.959301	0.957841	0.957841
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	327.916	3576.6 *	3907.85	3913.8	3913.8
Mass Flow	lb/h	5283.9	103186	108575	108575	108575
Mass Cp	Btu/(lb*°F)	0.542327	0.241675	0.255627 ?	0.352286 ?	0.276386

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Fired Heaters	

Connections

	16	17	18		
From Block	Fuel to Heaters	Amine Flash to Fuel	VLVE-100		
To Block	VLVE-100	MIX-102	SPLT-100		

Stream Composition

Mole Fraction	16 %	17 %	18 %		
H2O	0	0.714906	0		
H2S	0	0	0		
CO2	0.0148783	0.612743	0.0148783		
N2	0.461548	0	0.461548		
C1	99.4401	2.5656	99.4401		
C2	0.0834666	85.3561	0.0834666		
C3	2.84571E-07	9.47197	2.84571E-07		
iC4	1.12323E-12	0.322975	1.12323E-12		
nC4	6.00632E-13	0.844803	6.00632E-13		
iC5	0	0.0450929	0		
nC5	0	0.0563298	0		
C6	0	0.00838836	0		
C7	0	0.000159214	0		
C8	0	2.08979E-05	0		
C9	0	4.1469E-07	0		
C10	0	8.22067E-07	0		
Benzene	0	0.000622358	0		
Toluene	0	0.000210611	0		
Ethylbenzene	0	2.86653E-05	0		
para-Xylene	0	5.38889E-05	0		
MDEA	0	1.7662E-05	0		
O2	0	0	0		
CO	0	0	0		
NO	0	0	0		
NO2	0	0	0		
SO2	0	0	0		
S2	0	0	0		

Stream Properties

Property	Units	16	17	18		
Temperature	°F	91.5324	108.455	85.0139		
Pressure	psig	207	149.5	100 *		
Molecular Weight	lb/lbmol	16.1136	31.4126	16.1136		
Std Vapor Volumetric Flow	MMSCFD	3.50395	0.0303574	3.50395		
Std Liquid Volumetric Flow	sgpm	41.0997	0.555762	41.0997		
Compressibility		0.972001	0.91205	0.984709		
Specific Gravity		0.55636	1.0846	0.55636		
Mole Fraction Vapor	%	100	100	100		
Molar Flow	lbmol/h	384.727	3.33319	384.727		
Mass Flow	lb/h	6199.33	104.704	6199.33		
Mass Cp	Btu/(lb*°F)	0.555282	0.458605	0.542327		

Remarks

		Energy Stream Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	Fired Heaters				
Energy Streams					
Energy Stream	Energy Rate		Power	From Block	To Block
Q-H-741	7.41443E+06	Btu/h	2913.98 hp	--	Gas Regen Heater
Q-H-741 Release	9.04199E+06	* Btu/h	3553.64 * hp	H-741 Regen Gas Heater	--
Q-H-742	5.57957E+06	Btu/h	2192.85 hp	--	NGL Regen Heater
Q-H-742 Release	6.80435E+06	* Btu/h	2674.21 * hp	H-742 NGL Dehy Regen Heater	--
Q-H-781	8.14921E+07	Btu/h	32027.6 hp	--	HMO Heaters
Q-H-781 Release	9.93806E+07	* Btu/h	39058 * hp	H-781/782/783 HMO Heaters	--
Remarks					

Blocks
Amine Flash to Fuel
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:54 PM, 4/11/2023
Flowsheet:	Fired Heaters	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15 [NGL Amine]	Inlet	V-422 Amine Flash Tank [NGL Amine]	17 [Fired Heaters]	Outlet	MIX-102 [Fired Heaters]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1218.54 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	-0.0175702 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	108.473 °F	Fraction Vapor Difference	0 %
Inlet Pressure	149.5 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1218.54 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	108.455 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	149.5 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Warnings

ProMax:ProMax!Project!Flowsheets!Fired Heaters!Blocks!Amine Flash to Fuel

Warning: The environment Combustion Enviro used by flowsheet Fired Heaters does not contain the following component(s) present in stream 15 in flowsheet NGL Amine:
Piperazine, Methanol.

Warning: Cross Flowsheet Connector Amine Flash to Fuel is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

		Blocks Fuel to Heaters Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:49 PM, 4/11/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
53 [RSV]	Inlet	SPLT-103 [RSV]	16 [Fired Heaters]	Outlet	VLVE-100 [Fired Heaters]
Block Parameters					
Mole Fraction Transfer Threshold		0 %	Outlet Mass Enthalpy -1982.25 Btu/lb		
Transfer Property 1		Pressure	Temperature Difference 0 °F		
Transfer Property 2		Mass Enthalpy	Pressure Difference 0 psi		
Inlet Temperature		91.5324 °F	Fraction Vapor Difference 0 %		
Inlet Pressure		207 psig	Mass Enthalpy Difference 0 Btu/lb		
Inlet Fraction Vapor		100 %	Temperature Tolerance 1 °F		
Inlet Mass Enthalpy		-1982.25 Btu/lb	Pressure Tolerance 1 psi		
Outlet Temperature		91.5324 °F	Fraction Vapor Tolerance 1 %		
Outlet Pressure		207 psig	Mass Enthalpy Tolerance 1 Btu/lb		
Outlet Fraction Vapor		100 %			
Remarks					

		Blocks Gas Regen Heater Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:02 PM, 2/13/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-H-741 [Fired Heaters]	Energy Inlet	[Fired Heaters]	Q-H-741 [Gas Sieve]	Energy Inlet	H-741 Regen Gas Heater [Gas Sieve]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

		Blocks H-741 Regen Gas Heater Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:53 PM, 2/13/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
4	Inlet	REAC-100	5	Outlet	
Q-H-741 Release	Energy				
Block Parameters					
* Pressure Drop	0	psi	Mass Duty	-843.235	Btu/lb
Temperature Change	-2594.46	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-9.04199E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks H-742 NGL Dehy Regen Heater Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:36 PM, 2/13/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
9	Inlet	REAC-101	10	Outlet	
Q-H-742 Release	Energy				
Block Parameters					
* Pressure Drop	0 psi		Mass Duty	-843.235 Btu/lb	
Temperature Change	-2594.46 °F		Heat Release Curve Type	Plug Flow	
Heat Duty	-6.80435E+06 Btu/h		Heat Release Curve Increments	10	
Remarks					

		Blocks H-781/782/783 HMO Heaters Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:26 PM, 1/19/2022	
Flowsheet:	Fired Heaters			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	REAC-102	15	Outlet	
Q-H-781 Release	Energy				
Block Parameters					
* Pressure Drop		0 psi	Mass Duty		-915.32 Btu/lb
Temperature Change		-2835.58 °F	Heat Release Curve Type		Plug Flow
Heat Duty		-9.93806E+07 Btu/h	Heat Release Curve Increments		10
Remarks					

		Blocks HMO Heaters Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:04 PM, 2/13/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-H-781 [Fired Heaters]	Energy Inlet	[Fired Heaters]	Q-H-781 [HMO]	Energy Inlet	H-781/782/783 HMO Heaters [HMO]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
MIX-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:06 PM, 2/13/2023
Flowsheet:	Fired Heaters	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
2	Inlet		1	Inlet	SPLT-100
3	Outlet	REAC-100			

Block Parameters

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

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:06 PM, 2/13/2023
Flowsheet:	Fired Heaters	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet		6	Inlet	SPLT-100
8	Outlet	REAC-101			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 8	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-102
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:54 PM, 4/11/2023
Flowsheet:	Fired Heaters	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet		11	Inlet	SPLT-100
17	Inlet	Amine Flash to Fuel	13	Outlet	REAC-102

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 13	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

		Blocks NGL Regen Heater Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:05 PM, 2/13/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-H-742 [Fired Heaters]	Energy Inlet	[Fired Heaters]	Q-H-742 [NGL Sieve]	Energy Inlet	H-742 NGL Dehy Regen Heater [NGL Sieve]
Block Parameters					
Inlet Temperature	°F		Outlet Fraction Vapor	%	
Inlet Pressure	psig		Outlet Mass Enthalpy	Btu/lb	
Inlet Fraction Vapor	%		Temperature Difference	°F	
Inlet Mass Enthalpy	Btu/lb		Pressure Difference	psi	
Outlet Temperature	°F		Fraction Vapor Difference	%	
Outlet Pressure	psig		Mass Enthalpy Difference	Btu/lb	
Remarks					

Blocks
REAC-100
Reactor Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:49 PM, 2/13/2023
Flowsheet:	Fired Heaters	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	MIX-100	4	Outlet	H-741 Regen Gas Heater

Block Parameters

* Type	Gibbs Minimization	Mole Fraction Heavy Liquid	0 %
* Gibbs Set	Burner	* Bypass Fraction	1 %
* Pressure Drop	0 psi	Maximum Phases	1
Holdup	0 %	First Phase	Vapor
Heat Duty	0 Btu/h	Heat Release Curve Increments	10
Maximum Temperature	3294.45 °F	Reactor Increment Type	by Bypass
Temperature Change	3232.58 °F	Maximum Available Constraints	22
Mole Fraction Vapor	100 %	Yield Component	
Mole Fraction Light Liquid	0 %		

Tabulated Block Data

Index	Conversion %	Yield	Gibbs Reactive	
H2O			True	
H2S			True	
CO2	-649901		True	
N2	0.224468		True	
C1	99		True	
C2	99		True	
C3	99		True	
iC4	100		True	
nC4	100		True	
iC5			True	
nC5			True	
C6			True	
C7			True	
C8			True	
C9			True	
C10			True	
Benzene			True	
Toluene			True	
Ethylbenzene			True	
para-Xylene			True	
MDEA			True	
O2	86.5138		True	
CO			True	
NO			True	
NO2			True	
SO2			True	
S2			True	

Remarks

Blocks REAC-101 Reactor Report		
Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:44 PM, 2/13/2023
Flowsheet:	Fired Heaters	Status: Solved 12:26 PM, 3/7/2025

Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	MIX-101	9	Outlet	H-742 NGL Dehy Regen Heater

Block Parameters					
* Type	Gibbs Minimization		Mole Fraction Heavy Liquid	0 %	
* Gibbs Set	Burner		* Bypass Fraction	1 %	
* Pressure Drop	0 psi		Maximum Phases	1	
Holdup	0 %		First Phase	Vapor	
Heat Duty	0 Btu/h		Heat Release Curve Increments	10	
Maximum Temperature	3294.45 °F		Reactor Increment Type	by Bypass	
Temperature Change	3232.58 °F		Maximum Available Constraints	22	
Mole Fraction Vapor	100 %		Yield Component		
Mole Fraction Light Liquid	0 %				

Tabulated Block Data				
Index	Conversion %	Yield	Gibbs Reactive	
H2O			True	
H2S			True	
CO2	-649901		True	
N2	0.224468		True	
C1	99		True	
C2	99		True	
C3	99		True	
iC4	100		True	
nC4	100		True	
iC5			True	
nC5			True	
C6			True	
C7			True	
C8			True	
C9			True	
C10			True	
Benzene			True	
Toluene			True	
Ethylbenzene			True	
para-Xylene			True	
MDEA			True	
O2	86.5138		True	
CO			True	
NO			True	
NO2			True	
SO2			True	
S2			True	

Remarks

		Blocks			
		REAC-102			
		Reactor Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:28 PM, 2/13/2023	
Flowsheet:	Fired Heaters			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	MIX-102	14	Outlet	H-781/782/783 HMO Heaters
Block Parameters					
* Type		Gibbs Minimization	Mole Fraction Heavy Liquid		0 %
* Gibbs Set		Burner	* Bypass Fraction		1 %
* Pressure Drop		0 psi	Maximum Phases		1
Holdup		0 %	First Phase		Vapor
Heat Duty		0 Btu/h	Heat Release Curve Increments		10
Maximum Temperature		3335.47 °F	Reactor Increment Type		by Bypass
Temperature Change		3273.57 °F	Maximum Available Constraints		22
Mole Fraction Vapor		100 %	Yield Component		
Mole Fraction Light Liquid		0 %			
Tabulated Block Data					
Index	Conversion %	Yield	Gibbs Reactive		
H2O	-2.75518E+06		True		
H2S			True		
CO2	-465404		True		
N2	0.223256		True		
C1	99		True		
C2	99		True		
C3	99		True		
iC4	99		True		
nC4	99		True		
iC5	99		True		
nC5	99		True		
C6	99		True		
C7	99		True		
C8	99		True		
C9	99		True		
C10	99		True		
Benzene	99		True		
Toluene	99		True		
Ethylbenzene	99		True		
para-Xylene	99		True		
MDEA	99		True		
O2	87.9706		True		
CO			True		
NO			True		
NO2			True		
SO2			True		
S2			True		
Remarks					

Blocks
SPLT-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:54 PM, 4/11/2023
Flowsheet:	Fired Heaters	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
18	Inlet	VLVE-100	1	Outlet	MIX-100
6	Outlet	MIX-101	11	Outlet	MIX-102

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 6	6.34072 %
Flow Multiplier	100 %	Fraction to Stream 11	85.2334 %
Fraction to Stream 1	8.42588 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
VLVE-100
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:50 PM, 4/11/2023
Flowsheet:	Fired Heaters	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16	Inlet	Fuel to Heaters	18	Outlet	SPLT-100

Block Parameters

Pressure Drop	107 psi	? Simple Compressible Cv	14.3857
Joule-Thomson Coefficient	0.0609207 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	12.0439		

Remarks

**Flowsheet Environment
Combustion Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Fired Heaters	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
O2	True	False				
CO	True	False				
NO	True	False				
NO2	True	False				
SO2	True	False				
S2	False	False				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				

* User Specified Values

? Extrapolated or Approximate Values

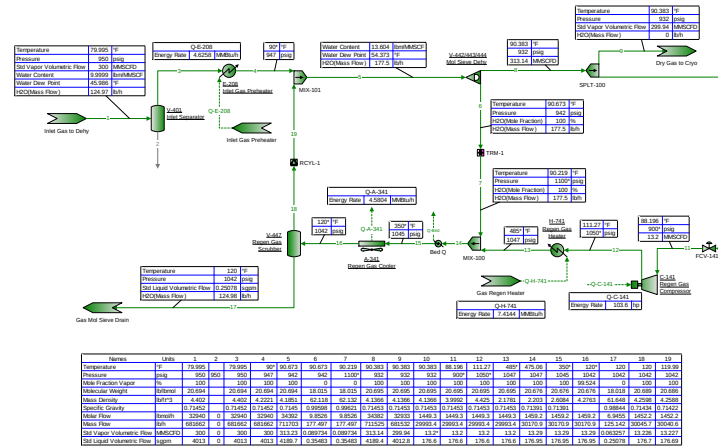
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		Flowsheet Environment Combustion Enviro					
Client Name:	Energy Transfer				Job: Plan Approval Application		
Location:	Cryo II						
Flowsheet:	Fired Heaters						
Henry's Law Component							
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2	
iC4	False	False					
nC4	False	False					
iC5	False	False					
nC5	False	False					
C6	False	False					
C7	False	False					
C8	False	False					
C9	False	False					
C10	False	False					
Benzene	False	False					
Toluene	False	False					
Ethylbenzene	False	False					
para-Xylene	False	False					
MDEA	False	False					
O2	False	False					
CO	False	False					
NO	False	False					
NO2	False	False					
SO2	False	False					
S2	False	False					
Phases							
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %		
Total	Total	True					
Vapor	Vapor	True	-441.67	17540.3			
Light Liquid	Light Liquid	True					
Heavy Liquid	Heavy Liquid	True					
Mixed Liquid	Mixed Liquid	True					
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3			
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70		
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75		
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75		
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75		
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75		
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model		
Total				True			
Vapor			Peng-Robinson	True			
Light Liquid				False			
Heavy Liquid				False			
Mixed Liquid				False			
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)		
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)		
Sulfur Liquid	10	Sulfur		False			
Mercury Liquid	10	Mercury		False			
Custom Liquid 1	10			False			
Custom Liquid 2	10			False			

		Flowsheet Environment Combustion Enviro			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Flowsheet:		Fired Heaters			
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					
Physical Property Method Sets					
Liquid Molar Volume		COSTALD	Overall Package	Peng-Robinson	
Vapor Package		Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson	Sulfur Liquid Package		
Mercury Liquid Package			Custom Liquid 1 Package		
Custom Liquid 2 Package			Solid Package		
Remarks					

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	



Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	

Connections

	1	2	3	4	5
From Block	Inlet Gas to Dehy	V-401 Inlet Separator	V-401 Inlet Separator	E-208 Inlet Gas Preheater	MIX-101
To Block	V-401 Inlet Separator	--	E-208 Inlet Gas Preheater	MIX-101	V-442/443/444 Mol Sieve Dehy

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0.02106		0.02106	0.02106	0.0286479
H2S	0		0	0	0
CO2	0.0441904		0.0441904	0.0441904	0.044187
N2	0.357822		0.357822	0.357822	0.357798
C1	77.2385		77.2385	77.2385	77.2331
C2	15.0102		15.0102	15.0102	15.009
C3	5.04241		5.04241	5.04241	5.04192
iC4	0.50819		0.50819	0.50819	0.508129
nC4	1.16285		1.16285	1.16285	1.16269
iC5	0.197557		0.197557	0.197557	0.19752
nC5	0.253245		0.253245	0.253245	0.253192
C6	0.141269		0.141269	0.141269	0.141215
C7	0.0102978		0.0102978	0.0102978	0.0102915
C8	0.0036992		0.0036992	0.0036992	0.00369574
C9	0.000499891		0.000499891	0.000499891	0.000499224
C10	0.004599		0.004599	0.004599	0.00459193
Benzene	0.00109976		0.00109976	0.00109976	0.00109937
Toluene	0.000899805		0.000899805	0.000899805	0.000899251
Ethylbenzene	0.000299935		0.000299935	0.000299935	0.000299648
para-Xylene	0.00059987		0.00059987	0.00059987	0.000599284
Methanol	0.000645848		0.000645848	0.000645848	0.000618576

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	79.9948		79.9948	90 *	90.6731
Pressure	psig	950	950	950	947	942
Molecular Weight	lb/lbmol	20.6942		20.6942	20.6942	20.6938
Std Vapor Volumetric Flow	MMSCFD	300.003	0	300.003	300.003	313.23
Std Liquid Volumetric Flow	sgpm	4013.04	0	4013.04	4013.04	4189.73
Compressibility		0.781862		0.781862	0.797843	0.799714
Specific Gravity		0.714516		0.714516	0.714516	0.714503
Mole Fraction Vapor	%	100		100	100	100
Molar Flow	lbmol/h	32939.8	0	32939.8	32939.8	34392.1
Mass Flow	lb/h	681662	0	681662	681662	711703
Mass Cp	Btu/(lb*°F)	0.671142		0.671142	0.658479	0.656366

Warnings

ProMax:ProMax!Project!Flowsheets!Gas Sieve!PStreams!1!Analyses!Freeze 1!Properties!Water Dew Point

Warning: Water dew point temperature is thermodynamically unstable as other phases will form instead of a free aqueous liquid phase.

ProMax:ProMax!Project!Flowsheets!Gas Sieve!PStreams!5!Analyses!Freeze 1!Properties!Water Dew Point

Warning: Water dew point temperature is thermodynamically unstable as other phases will form instead of a free aqueous liquid phase.

Remarks

Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	

Connections

	6	7	8	9	10
From Block	V-442/443/444 Mol Sieve Dehy	TRM-1	V-442/443/444 Mol Sieve Dehy	SPLT-100	SPLT-100
To Block	TRM-1	MIX-100	SPLT-100	Dry Gas to Cryo	FCV-141A

Stream Composition

Mole Fraction	6 %	7 %	8 %	9 %	10 %
H2O	100	100	0	0	0
H2S	0	0	0	0	0
CO2	0	0	0.0441997	0.0441997	0.0441997
N2	0	0	0.3579	0.3579	0.3579
C1	0	0	77.2552	77.2552	77.2552
C2	0	0	15.0133	15.0133	15.0133
C3	0	0	5.04337	5.04337	5.04337
iC4	0	0	0.508274	0.508274	0.508274
nC4	0	0	1.16302	1.16302	1.16302
iC5	0	0	0.197577	0.197577	0.197577
nC5	0	0	0.253264	0.253264	0.253264
C6	0	0	0.141255	0.141255	0.141255
C7	0	0	0.0102944	0.0102944	0.0102944
C8	0	0	0.0036968	0.0036968	0.0036968
C9	0	0	0.000499367	0.000499367	0.000499367
C10	0	0	0.00459324	0.00459324	0.00459324
Benzene	0	0	0.00109969	0.00109969	0.00109969
Toluene	0	0	0.000899509	0.000899509	0.000899509
Ethylbenzene	0	0	0.000299734	0.000299734	0.000299734
para-Xylene	0	0	0.000599455	0.000599455	0.000599455
Methanol	0	0	0.000618753	0.000618753	0.000618753

Stream Properties

Property	Units	6	7	8	9	10
Temperature	°F	90.6731	90.2193	90.3831	90.3831	90.3831
Pressure	psig	942	1100 *	932	932	932
Molecular Weight	lb/lbmol	18.0153	18.0153	20.6946	20.6946	20.6946
Std Vapor Volumetric Flow	MMSCFD	0.0897336	0.0897336	313.14	299.94	13.2 *
Std Liquid Volumetric Flow	sgpm	0.35483	0.35483	4189.38	4012.78	176.598
Compressibility		0.0469051	0.0546963	0.801059	0.801059	0.801059
Specific Gravity		0.995981	0.996209	0.71453	0.71453	0.71453
Mole Fraction Vapor	%	0	0	100	100	100
Molar Flow	lbmol/h	9.85259	9.85259	34382.2	32932.9	1449.34
Mass Flow	lb/h	177.497	177.497	711525	681532	29993.4
Mass Cp	Btu/(lb*°F)	0.975507	0.97523	0.654308	0.654308	0.654308

Remarks

Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	

Connections

	11	12	13	14	15
From Block	FCV-141A	C-141 Regen Gas Compressor	H-741 Regen Gas Heater	MIX-100	Bed Q
To Block	C-141 Regen Gas Compressor	H-741 Regen Gas Heater	MIX-100	Bed Q	A-341 Regen Gas Cooler

Stream Composition

Mole Fraction	11 %	12 %	13 %	14 %	15 %
H2O	0	0	0	0.67521	0.67521
H2S	0	0	0	0	0
CO2	0.0441997	0.0441997	0.0441997	0.0439012	0.0439012
N2	0.3579	0.3579	0.3579	0.355484	0.355484
C1	77.2552	77.2552	77.2552	76.7336	76.7336
C2	15.0133	15.0133	15.0133	14.912	14.912
C3	5.04337	5.04337	5.04337	5.00931	5.00931
iC4	0.508274	0.508274	0.508274	0.504842	0.504842
nC4	1.16302	1.16302	1.16302	1.15517	1.15517
iC5	0.197577	0.197577	0.197577	0.196243	0.196243
nC5	0.253264	0.253264	0.253264	0.251554	0.251554
C6	0.141255	0.141255	0.141255	0.140301	0.140301
C7	0.0102944	0.0102944	0.0102944	0.0102249	0.0102249
C8	0.0036968	0.0036968	0.0036968	0.00367184	0.00367184
C9	0.000499367	0.000499367	0.000499367	0.000495995	0.000495995
C10	0.00459324	0.00459324	0.00459324	0.00456223	0.00456223
Benzene	0.00109969	0.00109969	0.00109969	0.00109226	0.00109226
Toluene	0.000899509	0.000899509	0.000899509	0.000893435	0.000893435
Ethylbenzene	0.000299734	0.000299734	0.000299734	0.00029771	0.00029771
para-Xylene	0.000599455	0.000599455	0.000599455	0.000595408	0.000595408
Methanol	0.000618753	0.000618753	0.000618753	0.000614575	0.000614575

Stream Properties

Property	Units	11	12	13	14	15
Temperature	°F	88.1957	111.265	485 *	475.062	350 *
Pressure	psig	900 *	1050 *	1047	1047	1045
Molecular Weight	lb/lbmol	20.6946	20.6946	20.6946	20.6765	20.6765
Std Vapor Volumetric Flow	MMSCFD	13.2	13.2	13.2	13.2897	13.2897
Std Liquid Volumetric Flow	sgpm	176.598	176.598	176.598	176.953	176.953
Compressibility		0.803728	0.811528	0.993648	0.991975	0.965381
Specific Gravity		0.71453	0.71453	0.71453	0.713905	0.713905
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	1449.34	1449.34	1449.34	1459.19	1459.19
Mass Flow	lb/h	29993.4	29993.4	29993.4	30170.9	30170.9
Mass Cp	Btu/(lb*°F)	0.648653	0.659735	0.717245	0.711939	0.665829

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	

Connections

	16	17	18	19	
From Block	A-341 Regen Gas Cooler	V-447 Regen Gas Scrubber	V-447 Regen Gas Scrubber	RCYL-1	
To Block	V-447 Regen Gas Scrubber	Gas Mol Sieve Drain	RCYL-1	MIX-101	

Stream Composition

Mole Fraction	16 %	17 %	18 %	19 %	
H2O	0.67521	99.8819	0.200745	0.200756	
H2S	0	0	0	0	
CO2	0.0439012	0.000737432	0.0441077	0.0441104	
N2	0.355484	0.000253639	0.357183	0.357239	
C1	76.7336	0.0902697	77.1001	77.1089	
C2	14.912	0.0151505	14.9832	14.982	
C3	5.00931	0.0026179	5.03326	5.03096	
iC4	0.504842	0.000113282	0.507256	0.506743	
nC4	1.15517	0.000418275	1.16069	1.15911	
iC5	0.196243	3.05832E-05	0.197181	0.19668	
nC5	0.251554	2.26218E-05	0.252757	0.251987	
C6	0.140301	5.84065E-06	0.140972	0.139972	
C7	0.0102249	2.00802E-07	0.0102738	0.0101491	
C8	0.00367184	2.64266E-08	0.0036894	0.00361729	
C9	0.000495995	1.52595E-09	0.000498367	0.000484079	
C10	0.00456223	3.48428E-09	0.00458405	0.00443151	
Benzene	0.00109226	2.59874E-05	0.00109736	0.00109058	
Toluene	0.000893435	1.2371E-05	0.000897649	0.000886697	
Ethylbenzene	0.00029771	2.43059E-06	0.000299122	0.000293137	
para-Xylene	0.000595408	3.66581E-06	0.000598238	0.000585987	
Methanol	0.000614575	0.0084834	0.000576942	0	

Stream Properties

Property	Units	16	17	18	19	
Temperature	°F	120 *	120	120	119.989	
Pressure	psig	1042	1042	1042	1042	
Molecular Weight	lb/lbmol	20.6765	18.0177	20.6892	20.6856	
Std Vapor Volumetric Flow	MMSCFD	13.2897	0.0632569	13.2265	13.2265	
Std Liquid Volumetric Flow	sgpm	176.953	0.250781	176.702	176.69	
Compressibility		0.820152	0.0495761	0.823837	0.8239	
Specific Gravity			0.98844	0.714344	0.714219	
Mole Fraction Vapor	%	99.524	0	100	100	
Molar Flow	lbmol/h	1459.19	6.94549	1452.24	1452.25	
Mass Flow	lb/h	30170.9	125.142	30045.7	30040.6	
Mass Cp	Btu/(lb*°F)	0.652931	0.976014	0.651585	0.651562	

Remarks

		Energy Stream Report				
Client Name:	Energy Transfer				Job: Plan Approval Application	
Location:	Cryo II					
Flowsheet:	Gas Sieve					
Energy Streams						
Energy Stream	Energy Rate		Power		From Block	To Block
Q-A-341	4.58043E+06	Btu/h	1800.18	hp	A-341 Regen Gas Cooler	--
Q-Bed	2.59569E+06	Btu/h	1020.15	hp	Bed Q	--
Q-C-141	263599	Btu/h	103.598	hp	--	C-141 Regen Gas Compressor
Q-E-208	4.62581E+06	Btu/h	1818.01	hp	Inlet Gas Preheater	E-208 Inlet Gas Preheater
Q-H-741	7.41443E+06	Btu/h	2913.98	hp	Gas Regen Heater	H-741 Regen Gas Heater
Remarks						

		Blocks A-341 Regen Gas Cooler Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:55 PM, 2/7/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15	Inlet	Bed Q	16	Outlet	V-447 Regen Gas Scrubber
Q-A-341	Energy				
Block Parameters					
* Pressure Drop	3	psi	Mass Duty	-151.816	Btu/lb
Temperature Change	-230	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-4.58043E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks Bed Q Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:21 PM, 2/7/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	MIX-100	15	Outlet	A-341 Regen Gas Cooler
Q-Bed	Energy				
Block Parameters					
* Pressure Drop	2	psi	Mass Duty	-86.033	Btu/lb
Temperature Change	-125.062	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-2.59569E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

Blocks
C-141 Regen Gas Compressor
Compressor Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:08 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	FCV-141A	12	Outlet	H-741 Regen Gas Heater
Q-C-141	Energy				

Block Parameters

* Polytropic Efficiency	75 %	Polytropic Head Correction Factor	0.999811
Polytropic Head	5129.24 ft	Pressure Change	150 psi
Polytropic n	1.50311	Compression Ratio	1.16426
Isentropic (Adiabatic) Efficiency	74.5627 %	Compressor Rotation Speed	rpm
Isentropic (Adiabatic) Head	5099.33 ft	Power	103.598 hp
Isentropic k	1.34839	Ideal Work Method	Entropy Based

Remarks

Blocks
Dry Gas to Cryo
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:25 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
9 [Gas Sieve]	Inlet	SPLT-100 [Gas Sieve]	1 [RSV]	Outlet	SPLT-100 [RSV]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1670.65 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	90.3831 °F	Fraction Vapor Difference	0 %
Inlet Pressure	932 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1670.65 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	90.3831 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	932 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

Blocks
E-208 Inlet Gas Preheater
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:11 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	V-401 Inlet Separator	4	Outlet	MIX-101
Q-E-208	Energy	Inlet Gas Preheater			

Block Parameters

* Pressure Drop	3 psi	Mass Duty	6.78608 Btu/lb
Temperature Change	10.0052 °F	Heat Release Curve Type	Plug Flow
Heat Duty	4.62581E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	70.0052 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	70.0052 °F	Lowest Supply Temperature	150 °F
Maximum Effective Approach Temperature	260 °F	Highest Demand Temperature	90 °F
Log Mean Temperature Difference	144.801 °F	Lowest Demand Temperature	79.9948 °F
Effective Mean Temperature Difference	146.867 °F	Total Energy Supply	4.62581E+06 Btu/h
End Point UA	31946 Btu/(h*°F)	Total Energy Demand	4.62581E+06 Btu/h
Effective UA	31496.6 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-208 Inlet Gas Preheater	79.9948	90	4.62581E+06	146.867
E-208	350	150	-4.62581E+06	146.867

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-208 Inlet Gas Preheater	31496.6	0.0690964	0.0679792	
E-208	31496.6	1.38121	1.38009	

Remarks

		Blocks FCV-141A JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:32 PM, 2/7/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	SPLT-100	11	Outlet	C-141 Regen Gas Compressor
Block Parameters					
Pressure Drop		32 psi	Simple Compressible Cv		46.4267
Joule-Thomson Coefficient		0.0683558 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
? Simple Incompressible Cv		41.1551			
Remarks					

Blocks
Gas Mol Sieve Drain
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:30 PM, 2/14/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
17 [Gas Sieve]	Inlet	V-447 Regen Gas Scrubber [Gas Sieve]	1 [Closed Drain]	Outlet	VLVE-100 [Closed Drain]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-6770.15 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0.558768 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	120 °F	Fraction Vapor Difference	0.000281919 %
Inlet Pressure	1042 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-6770.15 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	120.559 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	1042 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0.000281919 %		

Warnings

ProMax!ProMax!Project!Flowsheets!Gas Sieve!Blocks!Gas Mol Sieve Drain

Warning: The environment Closed Drain Enviro used by flowsheet Closed Drain does not contain the following component(s) present in stream 17 in flowsheet Gas Sieve:
Methanol.

Warning: Cross Flowsheet Connector Gas Mol Sieve Drain is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

		Blocks Gas Regen Heater Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:50 PM, 2/13/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-H-741 [Gas Sieve]	Energy Inlet	H-741 Regen Gas Heater [Gas Sieve]	Q-H-741 [Fired Heaters]	Energy Inlet	[Fired Heaters]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

		Blocks H-741 Regen Gas Heater Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:53 PM, 2/7/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	C-141 Regen Gas Compressor	13	Outlet	MIX-100
Q-H-741	Energy	Gas Regen Heater			
Block Parameters					
* Pressure Drop	3	psi	Mass Duty	247.202	Btu/lb
Temperature Change	373.735	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	7.41443E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks Inlet Gas Preheater Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:21 PM, 2/13/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-208 [Gas Sieve]	Energy Inlet	E-208 Inlet Gas Preheater [Gas Sieve]	Q-E-208 [HMO]	Energy Inlet	E-208 [HMO]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
Inlet Gas to Dehy
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:07 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5 [Inlet]	Inlet	SPLT-100 [Inlet]	1 [Gas Sieve]	Outlet	V-401 Inlet Separator [Gas Sieve]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1679.11 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	79.9948 °F	Fraction Vapor Difference	0 %
Inlet Pressure	950 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1679.11 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	79.9948 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	950 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

Blocks
MIX-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:29 PM, 2/14/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	H-741 Regen Gas Heater	7	Inlet	TRM-1
14	Outlet	Bed Q			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 14	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False	

Remarks

Blocks
MIX-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:23 PM, 2/8/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
4	Inlet	E-208 Inlet Gas Preheater	19	Inlet	RCYL-1
5	Outlet	V-442/443/444 Mol Sieve Dehy			

Block Parameters

* Pressure Drop	5 psi	Fraction to Stream 5	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
RCYL-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:53 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
18	Inlet	V-447 Regen Gas Scrubber	19	Outlet	MIX-101

Block Parameters

Error	0.000882009	Recycle Dependencies	1
Iterations	1	Solver Dependencies	0
Priority	1	Recycle State	Active
* Calculate	True	* Flash Variables	Pressure, Enthalpy
Block Dependencies	10		
* Recycle Variables	Pressure, Enthalpy, Component Flow, Mass Flow		

Tabulated Block Data

Index	Function values	Weights		
Pressure	0	1		
Enthalpy	-0.000108554	1		
Mass Flow	0.000172664	1		
H2O	-1.05472E-06	1		
H2S	0	1		
CO2	-2.67783E-07	1		
N2	-5.68612E-06	1		
C1	-0.000882009	1		
C2	0.000124715	1		
C3	0.000230042	1		
iC4	5.13094E-05	1		
nC4	0.000158058	1		
iC5	5.01481E-05	1		
nC5	7.70574E-05	1		
C6	0.000100034	1		
C7	1.24686E-05	1		
C8	7.21116E-06	1		
C9	1.42879E-06	1		
C10	1.52537E-05	1		
Benzene	6.78033E-07	1		
Toluene	1.09519E-06	1		
Ethylbenzene	5.98552E-07	1		
para-Xylene	1.22509E-06	1		
Methanol	5.76942E-05	1		

Remarks

Blocks
SPLT-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:51 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	V-442/443/444 Mol Sieve Dehy	10	Outlet	FCV-141A
9	Outlet	Dry Gas to Cryo			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 10	4.21537 %
Flow Multiplier	100 %	Fraction to Stream 9	95.7846 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
TRM-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:27 PM, 2/14/2023
Flowsheet:	Gas Sieve	Status: Failed

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	V-442/443/444 Mol Sieve Dehy	7	Outlet	MIX-100

Block Parameters

Error	0.141933	Recycle State	Active
* Calculate	False		
* Propagated Variables	Enthalpy, Mass Flow, Component Flow		

Warnings

ProMax:ProMax!Project!Flowsheets!Gas Sieve!Blocks!TRM-1
Error: TRM-1 has the following errors: Pressure 14.1933%

Remarks

		Blocks V-401 Inlet Separator Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:08 PM, 2/7/2023	
Flowsheet:	Gas Sieve			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	Inlet Gas to Dehy	3	Vapor Outlet	E-208 Inlet Gas Preheater
2	Light Liquid Outlet				
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	100	%	Heat Duty		0 Btu/h
Mole Fraction Light Liquid	0	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments		10
Remarks					

Blocks
V-442/443/444 Mol Sieve Dehy
Divider Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:23 PM, 3/7/2025
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	MIX-101	8	Divider Bulk Stream	SPLT-100
6	Divider Extracted Stream	TRM-1			

Block Parameters

* Bulk Stream Pressure Drop	10 psi	* nC4 Fraction Extracted	0 %
Bulk Stream Temperature Change	-0.290024 °F	* iC5 Fraction Extracted	0 %
Extracted Stream Pressure Drop	0 psi	* nC5 Fraction Extracted	0 %
Extracted Stream Temperature Change	0 °F	* C6 Fraction Extracted	0 %
* Enthalpy Change	0 Btu/h	* C7 Fraction Extracted	0 %
* H2O Fraction Extracted	100 %	* C8 Fraction Extracted	0 %
* H2S Fraction Extracted	0 %	* C9 Fraction Extracted	0 %
* CO2 Fraction Extracted	0 %	* C10 Fraction Extracted	0 %
* N2 Fraction Extracted	0 %	* Benzene Fraction Extracted	0 %
* C1 Fraction Extracted	0 %	* Toluene Fraction Extracted	0 %
* C2 Fraction Extracted	0 %	* Ethylbenzene Fraction Extracted	0 %
* C3 Fraction Extracted	0 %	* para-Xylene Fraction Extracted	0 %
* iC4 Fraction Extracted	0 %	* Methanol Fraction Extracted	0 %

Remarks

Blocks
V-447 Regen Gas Scrubber
Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:56 PM, 2/7/2023
Flowsheet:	Gas Sieve	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16	Inlet	A-341 Regen Gas Cooler	18	Vapor Outlet	RCYL-1
17	Light Liquid Outlet	Gas Mol Sieve Drain			

Block Parameters

* Pressure Drop	0 psi	Main Liquid Phase	Light Liquid
Mole Fraction Vapor	99.524 %	Heat Duty	0 Btu/h
Mole Fraction Light Liquid	0.475983 %	Heat Release Curve Type	Plug Flow
Mole Fraction Heavy Liquid	0 %	Heat Release Curve Increments	10

Remarks

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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Flowsheet Environment Hydrocarbon Enviro		
Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Gas Sieve	

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
Methanol	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	Gas Sieve				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package			
Custom Liquid 2 Package		Solid Package			
Remarks					

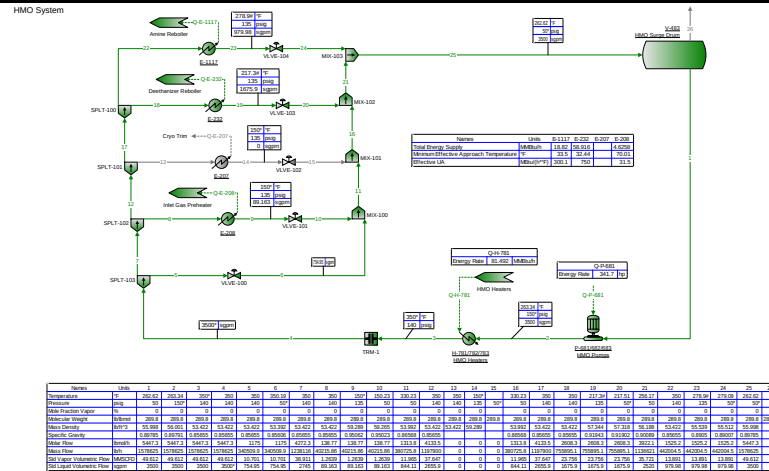
HMO Plant Schematic

Client Name:	Energy Transfer

Location:	Cryo II

Flowsheet:	HMO

Job: Plan Approval Application



Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	HMO	

Connections

	1	2	3	4	5
From Block	V-483 HMO Surge Drum	P-681/682/683 HMO Pumps	H-781/782/783 HMO Heaters	TRM-1	SPLT-103
To Block	P-681/682/683 HMO Pumps	H-781/782/783 HMO Heaters	TRM-1	SPLT-103	VLVE-100

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
CHEMTHERM 550	100	100	100	100 *	100

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	262.624	263.337	350 *	350	350
Pressure	psig	50	150 *	140	140	140
Molecular Weight	lb/lbmol	289.8	289.8	289.8	289.8	289.8
Std Vapor Volumetric Flow	MMSCFD	49.6119	49.6119	49.6119	49.6119	10.7013
Std Liquid Volumetric Flow	sgpm	3500	3500	3500	3500 *	754.951
Compressibility		0.0421955	0.108847	0.0956454	0.0956454	0.0956454
Specific Gravity		0.897852	0.897905	0.856553	0.856553	0.856553
Mole Fraction Vapor	%	0	0	0	0	0
Molar Flow	lbmol/h	5447.29	5447.29	5447.29	5447.29	1174.98
Mass Flow	lb/h	1.57863E+06	1.57863E+06	1.57863E+06	1.57863E+06	340510
Mass Cp	Btu/(lb*°F)	0.579454	0.579643	0.612236	0.612236	0.612236

Remarks

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	HMO					
Connections						
	6	7	8	9	10	
From Block	VLVE-100	SPLT-103	SPLT-102	E-208	VLVE-101	
To Block	MIX-100	SPLT-102	E-208	VLVE-101	MIX-100	
Stream Composition						
	6	7	8	9	10	
Mole Fraction	%	%	%	%	%	
CHEMTHERM 550	100	100	100	100	100	
Stream Properties						
Property	Units	6	7	8	9	10
Temperature	°F	350.19	350	350	150 *	150.226
Pressure	psig	50 *	140	140	135	50
Molecular Weight	lb/lbmol	289.8	289.8	289.8	289.8	289.8
Std Vapor Volumetric Flow	MMSCFD	10.7013	38.9106	1.26387	1.26387	1.26387
Std Liquid Volumetric Flow	sgpm	754.951	2745.05	89.1633	89.1633	89.1633
Compressibility		0.0394701	0.0956454	0.0956454	0.110717	0.0472172
Specific Gravity		0.856065	0.856553	0.856553	0.950621	0.950229
Mole Fraction Vapor	%	0	0	0	0	0
Molar Flow	lbmol/h	1174.98	4272.31	138.771	138.771	138.771
Mass Flow	lb/h	340510	1.23812E+06	40215.9	40215.9	40215.9
Mass Cp	Btu/(lb*°F)	0.612409	0.612236	0.612236	0.539249	0.539364
Remarks						

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	HMO					
Connections						
	11	12	13	14	15	
From Block	MIX-100	SPLT-102	SPLT-101	E-207	VLVE-102	
To Block	MIX-101	SPLT-101	E-207	VLVE-102	MIX-101	
Stream Composition						
Mole Fraction	11 %	12 %	13 %	14 %	15 %	
CHEMTHERM 550	100	100	100	100	100	
Stream Properties						
Property	Units	11	12	13	14	15
Temperature	°F	330.226	350	350	150 *	
Pressure	psig	50	140	140	135	50 *
Molecular Weight	lb/lbmol	289.8	289.8	289.8	289.8	289.8
Std Vapor Volumetric Flow	MMSCFD	11.9652	37.6467	0	0	0
Std Liquid Volumetric Flow	sgpm	844.114	2655.89	0	0	0
Compressibility		0.0400181	0.0956454			
Specific Gravity		0.865683	0.856553			
Mole Fraction Vapor	%	0	0	0	0	
Molar Flow	lbmol/h	1313.75	4133.54	0	0	0
Mass Flow	lb/h	380726	1.1979E+06	0	0	0
Mass Cp	Btu/(lb*°F)	0.604766	0.612236			
Remarks						

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	HMO					
Connections						
	16	17	18	19	20	
From Block	MIX-101	SPLT-101	SPLT-100	E-232	VLVE-103	
To Block	MIX-102	SPLT-100	E-232	VLVE-103	MIX-102	
Stream Composition						
Mole Fraction	16 %	17 %	18 %	19 %	20 %	
CHEMTHERM 550	100	100	100	100	100	
Stream Properties						
Property	Units	16	17	18	19	20
Temperature	°F	330.226	350	350	217.3 *	217.512
Pressure	psig	50	140	140	135	50 *
Molecular Weight	lb/lbmol	289.8	289.8	289.8	289.8	289.8
Std Vapor Volumetric Flow	MMSCFD	11.9652	37.6467	23.7557	23.7557	23.7557
Std Liquid Volumetric Flow	sgpm	844.114	2655.89	1675.91	1675.91	1675.91
Compressibility		0.0400181	0.0956454	0.0956454	0.103092	0.0439697
Specific Gravity		0.865683	0.856553	0.856553	0.919432	0.919022
Mole Fraction Vapor	%	0	0	0	0	0
Molar Flow	lbmol/h	1313.75	4133.54	2608.33	2608.33	2608.33
Mass Flow	lb/h	380726	1.1979E+06	755895	755895	755895
Mass Cp	Btu/(lb*°F)	0.604766	0.612236	0.612236	0.562926	0.563052
Remarks						

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	HMO					
Connections						
	21	22	23	24	25	
From Block	MIX-102	SPLT-100	E-1117	VLVE-104	MIX-103	
To Block	MIX-103	E-1117	VLVE-104	MIX-103	V-483 HMO Surge Drum	
Stream Composition						
	21	22	23	24	25	
Mole Fraction	%	%	%	%	%	
CHEMTHERM 550	100	100	100	100	100	
Stream Properties						
Property	Units	21	22	23	24	25
Temperature	°F	256.172	350	278.897 *	279.094	262.624
Pressure	psig	50	140	135	50 *	50 *
Molecular Weight	lb/lbmol	289.8	289.8	289.8	289.8	289.8
Std Vapor Volumetric Flow	MMSCFD	35.7209	13.891	13.891	13.891	49.6119
Std Liquid Volumetric Flow	sgpm	2520.02	979.976	979.976	979.976	3500
Compressibility		0.0424321	0.0956454	0.0975647	0.0416156	0.0421955
Specific Gravity		0.900894	0.856553	0.890499	0.890067	0.897852
Mole Fraction Vapor	%	0	0	0	0	0
Molar Flow	lbmol/h	3922.09	1525.21	1525.21	1525.21	5447.29
Mass Flow	lb/h	1.13662E+06	442005	442005	442005	1.57863E+06
Mass Cp	Btu/(lb*°F)	0.577084	0.612236	0.5854	0.585541	0.579454
Remarks						

		Process Streams Report All Streams Tabulated by Total Phase					
Client Name:		Energy Transfer				Job: Plan Approval Application	
Location:		Cryo II					
Flowsheet:		HMO					
Connections							
		26					
From Block		V-483 HMO Surge Drum					
To Block		--					
Stream Composition							
		26					
Mole Fraction		%					
CHEMTHERM 550		100					
Stream Properties							
Property	Units	26					
Temperature	°F						
Pressure	psig	50					
Molecular Weight	lb/lbmol	289.8					
Std Vapor Volumetric Flow	MMSCFD	0					
Std Liquid Volumetric Flow	sgpm	0					
Compressibility							
Specific Gravity							
Mole Fraction Vapor	%						
Molar Flow	lbmol/h	0					
Mass Flow	lb/h	0					
Mass Cp	Btu/(lb*°F)						
Remarks							

		Energy Stream Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	HMO				
Energy Streams					
Energy Stream	Energy Rate		Power	From Block	To Block
Q-E-207	0 * Btu/h		0 * hp	E-207	--
Q-E-208	4.62581E+06	Btu/h	1818.01 hp	E-208	Inlet Gas Preheater
Q-E-232	5.89157E+07	Btu/h	23154.7 hp	E-232	Deethanizer Reboiler
Q-E-1117	1.882E+07	Btu/h	7396.54 hp	E-1117	Amine Reboiler
Q-H-781	8.14921E+07	Btu/h	32027.6 hp	HMO Heaters	H-781/782/783 HMO Heaters
Q-P-681	869424	Btu/h	341.696 hp	--	P-681/682/683 HMO Pumps
Remarks					

		Blocks Amine Reboiler Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:25 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 5:03 PM, 3/4/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-1117 [HMO]	Energy Inlet	E-1117 [HMO]	Q-E-1117 [NGL Amine]	Energy Inlet	E-1117 Amine Reboiler [NGL Amine]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

		Blocks Deethanizer Reboiler Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:23 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-232 [HMO]	Energy Inlet	E-232 [HMO]	Q-E-232 [DeC2]	Energy Inlet	E-232 [DeC2]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

		Blocks E-207 Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:23 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 5:03 PM, 3/4/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	SPLT-101	14	Outlet	VLVE-102
Q-E-207	Energy				
Block Parameters					
* Pressure Drop	5	psi	Mass Duty	-115.024	Btu/lb
Temperature Change	-200	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	0	Btu/h	Heat Release Curve Increments	10	
Remarks					

Blocks
E-208
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:08 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	SPLT-102	9	Outlet	VLVE-101
Q-E-208	Energy	Inlet Gas Preheater			

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-115.024 Btu/lb
Temperature Change	-200 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-4.62581E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	70.0052 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	70.0052 °F	Lowest Supply Temperature	150 °F
Maximum Effective Approach Temperature	260 °F	Highest Demand Temperature	90 °F
Log Mean Temperature Difference	144.801 °F	Lowest Demand Temperature	79.9948 °F
Effective Mean Temperature Difference	146.867 °F	Total Energy Supply	4.62581E+06 Btu/h
End Point UA	31946 Btu/(h*°F)	Total Energy Demand	4.62581E+06 Btu/h
Effective UA	31496.6 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-208 Inlet Gas Preheater	79.9948	90	4.62581E+06	146.867
E-208	350	150	-4.62581E+06	146.867

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-208 Inlet Gas Preheater	31496.6	0.0690964	0.0679792	
E-208	31496.6	1.38121	1.38009	

Remarks

Blocks
E-232
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:23 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
18	Inlet	SPLT-100	19	Outlet	VLVE-103
Q-E-232	Energy	Deethanizer Reboiler			

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-77.9416 Btu/lb
Temperature Change	-132.7 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-5.89157E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	32.4405 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	32.4405 °F	Lowest Supply Temperature	217.3 °F
Maximum Effective Approach Temperature	151.94 °F	Highest Demand Temperature	198.06 °F
Log Mean Temperature Difference	77.3922 °F	Lowest Demand Temperature	184.86 °F
Effective Mean Temperature Difference	78.5543 °F	Total Energy Supply	5.89157E+07 Btu/h
End Point UA	761262 Btu/(h*°F)	Total Energy Demand	5.89157E+07 Btu/h
Effective UA	749999 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-232	184.86	198.06	5.89157E+07	78.5543
E-232	184.86	198.06	5.89157E+07	78.5543

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-232	749999	0.170563	0.162763
E-232	749999	0.170563	0.162763

Remarks

Blocks
E-1117
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:23 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
22	Inlet	SPLT-100	23	Outlet	VLVE-104
Q-E-1117	Energy	Amine Reboiler			

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-42.5788 Btu/lb
Temperature Change	-71.103 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-1.882E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	33.4994 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	33.4994 °F	Lowest Supply Temperature	278.897 °F
Maximum Effective Approach Temperature	104.602 °F	Highest Demand Temperature	245.398 °F
Log Mean Temperature Difference	62.4456 °F	Lowest Demand Temperature	245.398 °F
Effective Mean Temperature Difference	62.7033 °F	Total Energy Supply	1.882E+07 Btu/h
End Point UA	301382 Btu/(h*°F)	Total Energy Demand	1.882E+07 Btu/h
Effective UA	300144 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-1117 Amine Reboiler	245.398	245.398	1.882E+07	62.7033
E-1117	350	278.897	-1.882E+07	62.7033

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-1117 Amine Reboiler	300144	0	0	
E-1117	300144	1.13864	1.13864	

Remarks

		Blocks H-781/782/783 HMO Heaters Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:15 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
2	Inlet	P-681/682/683 HMO Pumps	3	Outlet	TRM-1
Q-H-781	Energy	HMO Heaters			
Block Parameters					
* Pressure Drop	10	psi	Mass Duty	51.6222	Btu/lb
Temperature Change	86.6629	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	8.14921E+07	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks HMO Heaters Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:03 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-H-781 [HMO]	Energy Inlet	H-781/782/783 HMO Heaters [HMO]	Q-H-781 [Fired Heaters]	Energy Inlet	[Fired Heaters]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

		Blocks Inlet Gas Preheater Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:21 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-208 [HMO]	Energy Inlet	E-208 [HMO]	Q-E-208 [Gas Sieve]	Energy Inlet	E-208 Inlet Gas Preheater [Gas Sieve]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
MIX-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:16 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:37 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	VLVE-100	10	Inlet	VLVE-101
11	Outlet	MIX-101			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 11	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:17 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:37 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	MIX-100	15	Inlet	VLVE-102
16	Outlet	MIX-102			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 16	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-102
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:17 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16	Inlet	MIX-101	20	Inlet	VLVE-103
21	Outlet	MIX-103			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 21	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-103
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:17 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
21	Inlet	MIX-102	24	Inlet	VLVE-104
25	Outlet	V-483 HMO Surge Drum			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 25	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False	

Remarks

		Blocks P-681/682/683 HMO Pumps Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:14 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:37 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	V-483 HMO Surge Drum	2	Outlet	H-781/782/783 HMO Heaters
Q-P-681	Energy				
Block Parameters					
* Overall Efficiency	60	%	Power	341.696	hp
Pressure Change	100	psi	Power Estimate	0	hp
Dynamic Head	257.145	ft			
Remarks					

Blocks
SPLT-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:08 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
17	Inlet	SPLT-101	18	Outlet	E-232
22	Outlet	E-1117			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 18	63.1017 %
Flow Multiplier	100 %	Fraction to Stream 22	36.8983 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
SPLT-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:06 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	SPLT-102	17	Outlet	SPLT-100
13	Outlet	E-207			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 17	100 %
Flow Multiplier	100 %	Fraction to Stream 13	0 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

		Blocks SPLT-102 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:06 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	SPLT-103	12	Outlet	SPLT-101
8	Outlet	E-208			
Block Parameters					
Pressure Drop		0 psi	Fraction to Stream 12		96.7518 %
Flow Multiplier		100 %	Fraction to Stream 8		3.24815 %
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

			Blocks SPLT-103 Mixer/Splitter Report						
Client Name:		Energy Transfer			Job: Plan Approval Application				
Location:		Cryo II			Modified: 4:10 PM, 2/13/2023				
Flowsheet:		HMO			Status: Solved 12:36 PM, 3/7/2025				
Connections									
Stream		Connection Type		Other Block	Stream		Connection Type		Other Block
4		Inlet		TRM-1	7		Outlet		SPLT-102
5		Outlet		VLVE-100					
Block Parameters									
Pressure Drop			0 psi		Fraction to Stream 7			78.43 %	
Flow Multiplier			100 %		Fraction to Stream 5			21.57 %	
Pressure Balancing Mode Properties									
Pressure Balancing Mode			False						
Remarks									

		Blocks TRM-1 Recycle Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:12 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	H-781/782/783 HMO Heaters	4	Outlet	SPLT-103
Block Parameters					
Error	0		Recycle State	Active	
* Calculate	False				
* Propagated Variables	Pressure, Enthalpy, Component Flow				
Remarks					

		Blocks V-483 HMO Surge Drum Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:13 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
25	Inlet	MIX-103	26	Vapor Outlet	
1	Light Liquid Outlet	P-681/682/683 HMO Pumps			
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty		0 Btu/h
Mole Fraction Light Liquid	100	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments		10
Remarks					

Blocks
VLVE-100
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:06 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:37 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	SPLT-103	6	Outlet	MIX-100

Block Parameters

Pressure Drop	90 psi	? Simple Compressible Cv	341.137
Joule-Thomson Coefficient	-0.00211251 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	77.5256		

Remarks

Blocks
VLVE-101
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:16 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
9	Inlet	E-208	10	Outlet	MIX-100

Block Parameters

Pressure Drop	85 psi	? Simple Compressible Cv	36.122
Joule-Thomson Coefficient	-0.00266393 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	8.9433		

Remarks

		Blocks VLVE-102 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:17 PM, 2/13/2023	
Flowsheet:	HMO			Status: Solved 5:03 PM, 3/4/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	E-207	15	Outlet	MIX-101
Block Parameters					
Pressure Drop		85 psi	? Simple Compressible Cv		0
Joule-Thomson Coefficient		°F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		0			
Remarks					

Blocks
VLVE-103
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:17 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
19	Inlet	E-232	20	Outlet	MIX-102

Block Parameters

Pressure Drop	85 psi	? Simple Compressible Cv	715.581
Joule-Thomson Coefficient	-0.00249111 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	170.925		

Remarks

Blocks
VLVE-104
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:17 PM, 2/13/2023
Flowsheet:	HMO	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
23	Inlet	E-1117	24	Outlet	MIX-103

Block Parameters

Pressure Drop	85 psi	? Simple Compressible Cv	437.124
Joule-Thomson Coefficient	-0.00232349 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	101.558		

Remarks

Client Name:		Energy Transfer		Job: Plan Approval Application		
Location:		Cryo II				
Flowsheet:		HMO				
Flowsheet Environment HMO Enviro						
Environment Settings						
Perform Freeze Out Check		True		Gibbs Excess Model Evaluation Temperature 77 °F		
Freeze Out Temperature Threshold Difference		10 °F		Enable Mixed Liquid Phase Emulsion Viscosity False		
Apply Poynting Correction Factor		True		Minimum Mole Fraction Compositional Threshold 2.22045E-14 %		
Number of Poynting Intervals		0				
Flash Settings						
Use Submitted Guess		True		* Rachford-Rice Style Algorithm True		
Reverse Guess Algorithm Order		False		* Boston-Britt Style Algorithm True		
Use First Guess Algorithm Only		False		Initial Guess Tolerance 0.001 %		
Favor First Guess Algorithm		True		Minimum Phase Threshold 0.000251189 %		
* Only Isothermal Property Flash		False		Distinct Phase Composition Threshold 0.1 %		
* Flash Polish Step		True		Validate Phases True		
Liked Phases						
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
CHEMTHERM 550	True					
Henry's Law Component						
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
CHEMTHERM 550	False					
Phases						
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %	
Total	Total	True				
Vapor	Vapor	True	-441.67	17540.3		
Light Liquid	Light Liquid	True				
Heavy Liquid	Heavy Liquid	True				
Mixed Liquid	Mixed Liquid	True				
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3		
Aqueous Liquid	Aqueous Liquid	False	-441.67	17540.3	90	
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75	
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75	
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75	
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75	
Phases						
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model	
Total				True		
Vapor			Peng-Robinson	True		
Light Liquid				False		
Heavy Liquid				False		
Mixed Liquid				False		
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)	
Aqueous Liquid	10	Water	Peng-Robinson	False	COSTALD (HBT)	
Sulfur Liquid	10	Sulfur		False		

* User Specified Values

? Extrapolated or Approximate Values

ProMax 6.0.24240.0

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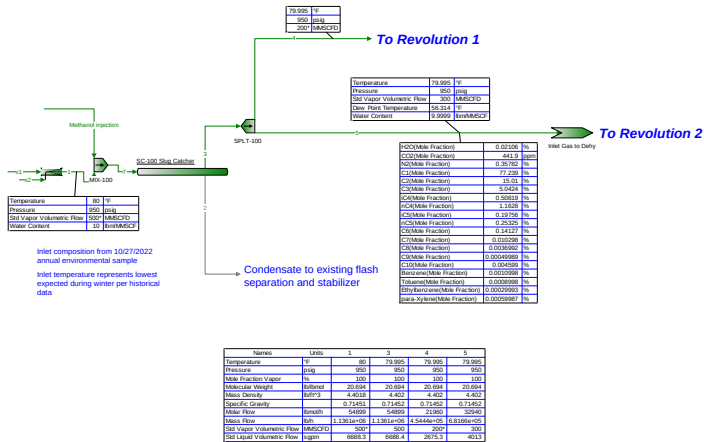
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		Flowsheet Environment HMO Enviro			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Flowsheet:		HMO			
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					
Physical Property Method Sets					
Liquid Molar Volume		COSTALD	Overall Package	Peng-Robinson	
Vapor Package		Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson	Sulfur Liquid Package		
Mercury Liquid Package			Custom Liquid 1 Package		
Custom Liquid 2 Package			Solid Package		
Warnings ProMax:ProMax!Project!Environments!HMO Enviro Warning: Calculated stream Heating Values are approximate due to the presence of component(s) with unknown chemical formula: CHEMTHERM 550. These component(s) have an assumed ideal gas heating value of 0.0 Warning: It is recommended to use a Heat Transfer Fluid property package in a dedicated flowsheet for the following components: CHEMTHERM 550.					
Remarks					

Inlet
Plant Schematic

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Inlet	

Inlet Separation



Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Inlet	

Connections

	Methanol injection	x1	x2	1	2
From Block	--	--	--	SAT-1	SC-100 Slug Catcher
To Block	MIX-100	SAT-1	SAT-1	MIX-100	--

Stream Composition

	Methanol injection	x1	x2	1	2
Mole Fraction	%	%	%	%	%
H2O	0 *	0 *	100 *	0.0210601	
H2S	0 *	0 *	0 *	0	
CO2	0 *	0.0442 *	0 *	0.0441907	
N2	0 *	0.3579 *	0 *	0.357825	
C1	0 *	77.2553 *	0 *	77.239	
C2	0 *	15.0135 *	0 *	15.0103	
C3	0 *	5.0435 *	0 *	5.04244	
iC4	0 *	0.5083 *	0 *	0.508193	
nC4	0 *	1.1631 *	0 *	1.16286	
iC5	0 *	0.1976 *	0 *	0.197558	
nC5	0 *	0.2533 *	0 *	0.253247	
C6	0 *	0.1413 *	0 *	0.14127	
C7	0 *	0.0103 *	0 *	0.0102978	
C8	0 *	0.0037 *	0 *	0.00369922	
C9	0 *	0.0005 *	0 *	0.000499895	
C10	0 *	0.0046 *	0 *	0.00459903	
Benzene	0 *	0.0011 *	0 *	0.00109977	
Toluene	0 *	0.0009 *	0 *	0.00089981	
Ethylbenzene	0 *	0.0003 *	0 *	0.000299937	
para-Xylene	0 *	0.0006 *	0 *	0.000599874	
Methanol	100 *	0 *	0 *	0	

Stream Properties

Property	Units	Methanol injection	x1	x2	1	2
Temperature	°F	80 *	80 *	539.783	80	
Pressure	psig	950 *	950 *	950	950	950
Molecular Weight	lb/lbmol	32.0419	20.6947	18.0153	20.6941	
Std Vapor Volumetric Flow	MMSCFD	0.00322926	499.895	0.105301	500 *	0
Std Liquid Volumetric Flow	sgpm	0.0285337 *	6687.93	0.416386	6688.35	0
Compressibility		0.106238	0.781872	0.598777	0.781878	
Specific Gravity		0.804256	0.714533		0.714513	
Mole Fraction Vapor	%	0	100	75.4763	100	
Molar Flow	lbmol/h	0.354567	54887.5	11.5618	54899.1	0
Mass Flow	lb/h	11.361	1.13588E+06	208.289	1.13609E+06	0
Mass Cp	Btu/(lb*°F)	0.647462	0.67115	0.868873	0.671128	

Remarks

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	Inlet					
Connections						
	3	4	5	7		
From Block	SC-100 Slug Catcher	SPLT-100	SPLT-100	MIX-100		
To Block	SPLT-100	--	Inlet Gas to Dehy	SC-100 Slug Catcher		
Stream Composition						
Mole Fraction	3 %	4 %	5 %	7 %		
H2O	0.02106	0.02106	0.02106	0.02106		
H2S	0	0	0	0		
CO2	0.0441904	0.0441904	0.0441904	0.0441904		
N2	0.357822	0.357822	0.357822	0.357822		
C1	77.2385	77.2385	77.2385	77.2385		
C2	15.0102	15.0102	15.0102	15.0102		
C3	5.04241	5.04241	5.04241	5.04241		
iC4	0.50819	0.50819	0.50819	0.50819		
nC4	1.16285	1.16285	1.16285	1.16285		
iC5	0.197557	0.197557	0.197557	0.197557		
nC5	0.253245	0.253245	0.253245	0.253245		
C6	0.141269	0.141269	0.141269	0.141269		
C7	0.0102978	0.0102978	0.0102978	0.0102978		
C8	0.0036992	0.0036992	0.0036992	0.0036992		
C9	0.000499891	0.000499891	0.000499891	0.000499891		
C10	0.004599	0.004599	0.004599	0.004599		
Benzene	0.00109976	0.00109976	0.00109976	0.00109976		
Toluene	0.000899805	0.000899805	0.000899805	0.000899805		
Ethylbenzene	0.000299935	0.000299935	0.000299935	0.000299935		
para-Xylene	0.00059987	0.00059987	0.00059987	0.00059987		
Methanol	0.000645848	0.000645848	0.000645848	0.000645848		
Stream Properties						
Property	Units	3	4	5	7	
Temperature	°F	79.9948	79.9948	79.9948	79.9948	
Pressure	psig	950	950	950	950	
Molecular Weight	lb/lbmol	20.6942	20.6942	20.6942	20.6942	
Std Vapor Volumetric Flow	MMSCFD	500.003	200 *	300.003	500.003	
Std Liquid Volumetric Flow	sgpm	6688.38	2675.33	4013.04	6688.38	
Compressibility		0.781862	0.781862	0.781862	0.781862	
Specific Gravity		0.714516	0.714516	0.714516	0.714516	
Mole Fraction Vapor	%	100	100	100	100	
Molar Flow	lbmol/h	54899.5	21959.6	32939.8	54899.5	
Mass Flow	lb/h	1.1361E+06	454436	681662	1.1361E+06	
Mass Cp	Btu/(lb*°F)	0.671142	0.671142	0.671142	0.671142	
Remarks						

Blocks
Inlet Gas to Dehy
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:06 PM, 2/7/2023
Flowsheet:	Inlet	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5 [Inlet]	Inlet	SPLT-100 [Inlet]	1 [Gas Sieve]	Outlet	V-401 Inlet Separator [Gas Sieve]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1679.11 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	79.9948 °F	Fraction Vapor Difference	0 %
Inlet Pressure	950 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1679.11 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	79.9948 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	950 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

		Blocks MIX-100 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:24 PM, 3/7/2025	
Flowsheet:	Inlet			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	SAT-1	Methanol injection	Inlet	
7	Outlet	SC-100 Slug Catcher			
Block Parameters					
Pressure Drop		0 psi	Fraction to Stream 7		100 %
Flow Multiplier		100 %			
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

		Blocks SAT-1 Saturator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:25 PM, 2/14/2023	
Flowsheet:	Inlet			Status: Solved 5:03 PM, 3/4/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
x1	Inlet		x2	Saturation Stream	
1	Outlet	MIX-100			
Block Parameters					
Calculation Mode		Saturator	Temperature Change		0 °F
Fraction of Saturation		31.444 %	Saturation Pressure		950 psig
* Outlet Saturant Concentration		10 lbm/MMSCF	Saturation Temperature		80 °F
Pressure Drop		0 psi	Fraction of Saturant Flow		0.0210646 %
Saturant Pressure Drop		0 psi			
Remarks					

		Blocks SC-100 Slug Catcher Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:24 PM, 3/7/2025	
Flowsheet:	Inlet			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	MIX-100	3	Vapor Outlet	SPLT-100
2	Light Liquid Outlet				
Block Parameters					
* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	100	%	Heat Duty	0 Btu/h	
Mole Fraction Light Liquid	0	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	
Remarks					

			Blocks SPLT-100 Mixer/Splitter Report						
Client Name:		Energy Transfer			Job: Plan Approval Application				
Location:		Cryo II			Modified: 3:39 PM, 2/7/2023				
Flowsheet:		Inlet			Status: Solved 12:26 PM, 3/7/2025				
Connections									
Stream		Connection Type		Other Block	Stream		Connection Type		Other Block
3		Inlet		SC-100 Slug Catcher	4		Outlet		
5		Outlet		Inlet Gas to Dehy					
Block Parameters									
Pressure Drop			0 psi		Fraction to Stream 4			39.9997 %	
Flow Multiplier			100 %		Fraction to Stream 5			60.0003 %	
Pressure Balancing Mode Properties									
Pressure Balancing Mode			False						
Remarks									

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	Inlet	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro					
Client Name:	Energy Transfer				Job: Plan Approval Application		
Location:	Cryo II						
Flowsheet:	Inlet						
Henry's Law Component							
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2	
C8	False	False					
C9	False	False					
C10	False	False					
Benzene	False	False					
Toluene	False	False					
Ethylbenzene	False	False					
para-Xylene	False	False					
Methanol	False	False					
Phases							
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %		
Total	Total	True					
Vapor	Vapor	True	-441.67	17540.3			
Light Liquid	Light Liquid	True					
Heavy Liquid	Heavy Liquid	True					
Mixed Liquid	Mixed Liquid	True					
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3			
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70		
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75		
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75		
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75		
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75		
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model		
Total				True			
Vapor			Peng-Robinson	True			
Light Liquid				False			
Heavy Liquid				False			
Mixed Liquid				False			
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)		
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)		
Sulfur Liquid	10	Sulfur		False			
Mercury Liquid	10	Mercury		False			
Custom Liquid 1	10			False			
Custom Liquid 2	10			False			
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model				
Total							
Vapor	Chapman-Enskog	Lindsay-Bromley					
Light Liquid							
Heavy Liquid							
Mixed Liquid							
Nonspecific Liquid	Teja-Thurner	Li	Parachor				
Aqueous Liquid	Teja-Thurner	Li	Parachor				
Sulfur Liquid							
Mercury Liquid							
Custom Liquid 1							
Custom Liquid 2							

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	Inlet				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package			
Custom Liquid 2 Package		Solid Package			
Remarks					

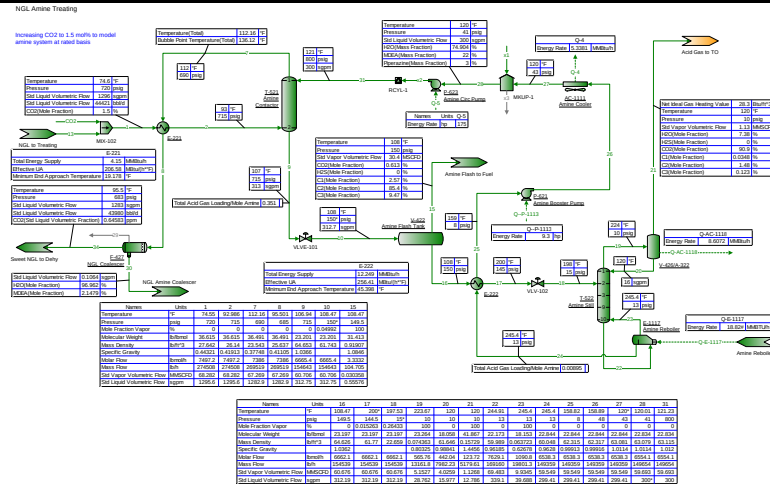
NGL Amine Plant Schematic

Client Name:	Energy Transfer

Location:	Cryo II

Flowsheet:	NGL Amine

Job: Plan Approval Application



* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Amine	

Connections

	CO2	x1	x2	x3	1
From Block	--	--	P-623 Amine Circ Pump	MKUP-1	MIX-102
To Block	MIX-102	MKUP-1	RCYL-1	--	E-221

Stream Composition

Mole Fraction	CO2 %	x1 %	x2 %	x3 %	1 %
H2O	0 *	99.25	94.9374	94.927	0
H2S	0 *	0	0	0	0
CO2	100 *	0	0.0448217	0.0449299	1.5
N2	0 *	0	0	0	1.28327E-08
C1	0 *	0	0	0	0.640875
C2	0 *	0	0	0	65.6636
C3	0 *	0	0	0	22.1539
iC4	0 *	0	0	0	2.23269
nC4	0 *	0	0	0	5.10879
iC5	0 *	0	0	0	0.867891
nC5	0 *	0	0	0	1.11251
C6	0 *	0	0	0	0.620488
C7	0 *	0	0	0	0.0452202
C8	0 *	0	0	0	0.0162388
C9	0 *	0	0	0	0.00219356
C10	0 *	0	0	0	0.0201767
Benzene	0 *	0	0	0	0.00483058
Toluene	0 *	0	0	0	0.00395125
Ethylbenzene	0 *	0	0	0	0.00131663
para-Xylene	0 *	0	0	0	0.00263321
MDEA	0 *	0.531605	4.21559	4.22448	0
Piperazine	0 *	0.218414	0.795266	0.796659	0
Methanol	0 *	0	0.00688006	0.00689667	0.00271799

Stream Properties

Property	Units	CO2	x1	x2	x3	1
Temperature	°F	80 *	120 *	121.228		74.5505
Pressure	psig	720 *	50 *	800 *	43	720
Molecular Weight	lb/lbmol	44.0095	18.7018	22.8336	22.8435	36.6147
Std Vapor Volumetric Flow	MMSCFD	0.926184	0.143836	59.6926	0	68.2818
Std Liquid Volumetric Flow	sgpm	10.9485	0.591916	300	0	1295.62
Compressibility		0.665075	0.00306839	0.0471924		0.169403
Specific Gravity		1.51953	0.992837	1.01197		0.443206
Mole Fraction Vapor	%	100	0	0		0
Molar Flow	lbmol/h	101.693 *	15.7929	6554.14	0	7497.22
Mass Flow	lb/h	4475.47	295.356	149654	0	274508
Mass Cp	Btu/(lb*°F)	0.388899	0.982249	0.908978		0.782792

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Amine	

Connections

	2	7	8	9	10
From Block	E-221	T-521 Amine Contactor	E-221	T-521 Amine Contactor	VLVE-101
To Block	T-521 Amine Contactor	E-221	F-427 NGL Coalescer	VLVE-101	V-422 Amine Flash Tank

Stream Composition

Mole Fraction	2 %	7 %	8 %	9 %	10 %
H2O	0	0.0883238	0.0883238	93.2549	93.2549
H2S	0	0	0	0	0
CO2	1.5	0.000155346	0.000155346	1.7311	1.7311
N2	1.28327E-08	1.29921E-08	1.29921E-08	0	0
C1	0.640875	0.648787	0.648787	0.00192953	0.00192953
C2	65.6636	66.5894	66.5894	0.0701079	0.0701079
C3	22.1539	22.4813	22.4813	0.00702406	0.00702406
iC4	2.23269	2.26613	2.26613	0.000211044	0.000211044
nC4	5.10879	5.18519	5.18519	0.000615349	0.000615349
iC5	0.867891	0.880939	0.880939	2.82061E-05	2.82061E-05
nC5	1.11251	1.12923	1.12923	3.66895E-05	3.66895E-05
C6	0.620488	0.62983	0.62983	4.99939E-06	4.99939E-06
C7	0.0452202	0.0459012	0.0459012	8.79581E-08	8.79581E-08
C8	0.0162388	0.0164834	0.0164834	1.13758E-08	1.13758E-08
C9	0.00219356	0.0022266	0.0022266	2.15365E-10	2.15365E-10
C10	0.0201767	0.0204806	0.0204806	4.18045E-10	4.18045E-10
Benzene	0.00483058	0.00489002	0.00489002	1.47638E-05	1.47638E-05
Toluene	0.00395125	0.00400689	0.00400689	4.30142E-06	4.30142E-06
Ethylbenzene	0.00131663	0.00133602	0.00133602	4.92215E-07	4.92215E-07
para-Xylene	0.00263321	0.00267161	0.00267161	1.41175E-06	1.41175E-06
MDEA	0	0.00113546	0.00113546	4.14396	4.14396
Piperazine	0	0.000466792	0.000466792	0.781474	0.781474
Methanol	0.00271799	0.0011316	0.0011316	0.00856841	0.00856841

Stream Properties

Property	Units	2	7	8	9	10
Temperature	°F	92.9859	112.164	95.501	106.937	108.472
Pressure	psig	715	690	685	715	150 *
Molecular Weight	lb/lbmol	36.6147	36.4908	36.4908	23.2009	23.2009
Std Vapor Volumetric Flow	MMSCFD	68.2818	67.2685	67.2685	60.7059	60.7059
Std Liquid Volumetric Flow	sgpm	1295.62	1282.87	1282.87	312.75	312.75
Compressibility		0.17198 ?	0.17761 ?	0.166805 ?	0.0429755	0.0100582
Specific Gravity		0.419125 ?	0.37748 ?	0.411051 ?	1.03663	
Mole Fraction Vapor	%	0	0	0	0	0.0499195
Molar Flow	lbmol/h	7497.22	7385.96	7385.96	6665.4	6665.4
Mass Flow	lb/h	274508	269519	269519	154643	154643
Mass Cp	Btu/(lb*°F)	0.852168	0.98446	0.867064	0.845322	0.846225

Remarks

Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Amine	

Connections

	13	15	16	17	18
From Block	NGL to Treating	V-422 Amine Flash Tank	V-422 Amine Flash Tank	E-222	VLV-102
To Block	MIX-102	Amine Flash to Fuel	E-222	VLV-102	T-522 Amine Still

Stream Composition

Mole Fraction	13 %	15 %	16 %	17 %	18 %
H2O	0	0.714902	93.3012	93.3012	93.3012
H2S	0	0	0	0	0
CO2	0.14556	0.61274	1.73166	1.73166	1.73166
N2	1.30092E-08	0	0	0	0
C1	0.649687	2.56558	0.000646865	0.000646865	0.000646865
C2	66.5665	85.3556	0.0274374	0.0274374	0.0274374
C3	22.4585	9.47192	0.00228853	0.00228853	0.00228853
iC4	2.26339	0.322973	4.95581E-05	4.95581E-05	4.95581E-05
nC4	5.17904	0.844798	0.000192983	0.000192983	0.000192983
iC5	0.879825	0.0450927	5.65918E-06	5.65918E-06	5.65918E-06
nC5	1.12781	0.0563295	8.52469E-06	8.52469E-06	8.52469E-06
C6	0.62902	0.00838831	8.04998E-07	8.04998E-07	8.04998E-07
C7	0.045842	0.000159213	8.34359E-09	8.34359E-09	8.34359E-09
C8	0.0164621	2.08978E-05	9.25773E-10	9.25773E-10	9.25773E-10
C9	0.00222372	4.14688E-07	7.99395E-12	7.99395E-12	7.99395E-12
C10	0.0204541	8.22062E-07	6.95486E-12	6.95486E-12	6.95486E-12
Benzene	0.004897	0.000622354	1.44598E-05	1.44598E-05	1.44598E-05
Toluene	0.00400559	0.00021061	4.1982E-06	4.1982E-06	4.1982E-06
Ethylbenzene	0.00133474	2.86651E-05	4.78119E-07	4.78119E-07	4.78119E-07
para-Xylene	0.00266942	5.38886E-05	1.3855E-06	1.3855E-06	1.3855E-06
MDEA	0	1.76619E-05	4.14603	4.14603	4.14603
Piperazine	0	3.78053E-06	0.781865	0.781865	0.781865
Methanol	0.00275536	0.000533988	0.00857243	0.00857243	0.00857243

Stream Properties

Property	Units	13	15	16	17	18
Temperature	°F	73.7691	108.473	108.473	200 *	197.529
Pressure	psig	720	149.5	149.5	144.5	15 *
Molecular Weight	lb/lbmol	36.513	31.4126	23.1968	23.1968	23.1968
Std Vapor Volumetric Flow	MMSCFD	67.3556	0.0303575	60.6755	60.6755	60.6755
Std Liquid Volumetric Flow	sgpm	1284.67	0.555763	312.194	312.194	312.194
Compressibility		0.170141	0.912058	0.00957834	0.00836544	0.00409335
Specific Gravity		0.440703	1.0846	1.03619		
Mole Fraction Vapor	%	0	100	0	0.0152634	0.264333
Molar Flow	lbmol/h	7395.52	3.3332	6662.06	6662.06	6662.06
Mass Flow	lb/h	270033	104.705	154539	154539	154539
Mass Cp	Btu/(lb*°F)	0.779433	0.458612	0.846488	0.889506	0.889471

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Amine	

Connections

	19	20	21	22	23
From Block	T-522 Amine Still	V-426/A-322	V-426/A-322	T-522 Amine Still	E-1117 Amine Reboiler
To Block	V-426/A-322	T-522 Amine Still	Acid Gas to TO	E-1117 Amine Reboiler	T-522 Amine Still

Stream Composition

Mole Fraction	19 %	20 %	21 %	22 %	23 %
H2O	79.5441	99.7416	7.37749	95.5944	99.5949
H2S	0	0	0	0	0
CO2	19.9119	0.0512388	90.8748	0.0816555	0.301793
N2	0	0	0	0	0
C1	0.00761793	9.9406E-07	0.0348335	0	0
C2	0.323125	4.70366E-05	1.47749	0	0
C3	0.0269509	3.01299E-06	0.123237	0	0
iC4	0.000583603	4.11411E-08	0.00266869	0	0
nC4	0.00227266	2.41397E-07	0.0103921	0	0
iC5	6.66425E-05	3.57033E-09	0.000304746	0	0
nC5	0.000100388	6.63976E-09	0.000459052	0	0
C6	9.47953E-06	3.54825E-10	4.33489E-05	0	0
C7	9.82516E-08	2.12373E-12	4.493E-07	0	0
C8	1.09016E-08	2.02465E-13	4.98526E-08	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0.00017161	1.71302E-06	0.000778657	0	0
Toluene	4.97282E-05	3.74024E-07	0.000226072	0	0
Ethylbenzene	5.6572E-06	3.4691E-08	2.57466E-05	0	0
para-Xylene	1.64326E-05	1.50603E-07	7.46086E-05	0	0
MDEA	1.64785E-05	2.10904E-05	1.19632E-13	3.6235	0.0211031
Piperazine	3.75031E-05	4.79993E-05	1.07406E-13	0.689772	0.0490748
Methanol	0.182974	0.206998	0.0971355	0.0106455	0.0331165

Stream Properties

Property	Units	19	20	21	22	23
Temperature	°F	223.666	120	120	244.908	245.398
Pressure	psig	10	10	10	13	13
Molecular Weight	lb/lbmol	23.2642	18.0577	41.8671	22.1729	18.1531
Std Vapor Volumetric Flow	MMSCFD	5.15269	4.02593	1.12676	69.4833	9.93452
Std Liquid Volumetric Flow	sgpm	28.7623	15.9766	12.7857	339.097	39.6885
Compressibility		0.989741	0.00109245	0.992665	0.00128073	0.986417
Specific Gravity		0.803251	0.988413	1.44556	0.961851	0.626781
Mole Fraction Vapor	%	100	0	100	0	100
Molar Flow	lbmol/h	565.756	442.04	123.716	7629.14	1090.79
Mass Flow	lb/h	13161.8	7982.23	5179.61	169160	19801.3
Mass Cp	Btu/(lb*°F)	0.368401	0.996835	0.21961	0.972101	0.458435

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Amine	

Connections

	24	25	26	27	28
From Block	E-1117 Amine Reboiler	E-222	P-621 Amine Booster Pump	AC-1111 Amine Cooler	MKUP-1
To Block	E-222	P-621 Amine Booster Pump	AC-1111 Amine Cooler	MKUP-1	P-623 Amine Circ Pump

Stream Composition

Mole Fraction	24 %	25 %	26 %	27 %	28 %
H2O	94.927	94.927	94.927	94.927	94.9374
H2S	0	0	0	0	0
CO2	0.0449299	0.0449299	0.0449299	0.0449299	0.0448217
N2	0	0	0	0	0
C1	0	0	0	0	0
C2	0	0	0	0	0
C3	0	0	0	0	0
iC4	0	0	0	0	0
nC4	0	0	0	0	0
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
MDEA	4.22448	4.22448	4.22448	4.22448	4.21559
Piperazine	0.796659	0.796659	0.796659	0.796659	0.795266
Methanol	0.00689667	0.00689667	0.00689667	0.00689667	0.00688006

Stream Properties

Property	Units	24	25	26	27	28
Temperature	°F	245.398	158.822	158.893	120 *	120.006
Pressure	psig	13	8	48	43	41
Molecular Weight	lb/lbmol	22.8435	22.8435	22.8435	22.8435	22.8336
Std Vapor Volumetric Flow	MMSCFD	59.5488	59.5488	59.5488	59.5488	59.6926
Std Liquid Volumetric Flow	sgpm	299.408	299.408	299.408	299.408	300 *
Compressibility		0.00131725	0.00117088	0.00337959	0.00327155	0.00315384
Specific Gravity		0.962795	0.999134	0.999163	1.01143	1.01139
Mole Fraction Vapor	%	0	0	0	0	0
Molar Flow	lbmol/h	6538.35	6538.35	6538.35	6538.35	6554.14
Mass Flow	lb/h	149359	149359	149359	149359	149654
Mass Cp	Btu/(lb*°F)	0.968546	0.926901	0.926784	0.9109	0.91105

Remarks

Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Amine	

Connections

	29	30	31	34	
From Block	F-427 NGL Coalescer	F-427 NGL Coalescer	RCYL-1	F-427 NGL Coalescer	
To Block	--	NGL Amine Coalescer	T-521 Amine Contactor	Sweet NGL to Dehy	

Stream Composition

Mole Fraction	29 %	30 %	31 %	34 %	
H2O		96.9617	94.9374	0.0548493	
H2S		0	0	0	
CO2		0.148116	0.0448233	0.000104218	
N2		4.24927E-11	0	1.29966E-08	
C1		0.00197307	0	0.649011	
C2		0.0652445	0	66.6124	
C3		0.00622682	0	22.489	
iC4		0.000172562	0	2.26691	
nC4		0.000487331	0	5.18698	
iC5		2.21574E-05	0	0.881243	
nC5		2.8226E-05	0	1.12962	
C6		3.67808E-06	0	0.630048	
C7		6.19479E-08	0	0.0459171	
C8		6.95519E-09	0	0.0164891	
C9		1.28606E-10	0	0.00222737	
C10		2.82532E-10	0	0.0204877	
Benzene		1.16548E-05	0	0.00489171	
Toluene		3.22966E-06	0	0.00400827	
Ethylbenzene		3.41556E-07	0	0.00133648	
para-Xylene		1.0158E-06	0	0.00267253	
MDEA		2.14785	4.21558	0.00039366	
Piperazine		0.660761	0.795266	0.000238629	
Methanol		0.00734886	0.00688	0.00112945	

Stream Properties

Property	Units	29	30	31	34	
Temperature	°F		95.4758	121.228	95.4758	
Pressure	psig	683	683	800	683	
Molecular Weight	lb/lbmol		20.6872	22.8336	36.4962	
Std Vapor Volumetric Flow	MMSCFD	0	0.0232365	59.6926	67.2453	
Std Liquid Volumetric Flow	sgpm	0	0.106375	300	1282.76	
Compressibility			0.0383896	0.0471924	0.166404	?
Specific Gravity			1.00968	1.01197	0.410941	?
Mole Fraction Vapor	%		0	0	0	
Molar Flow	lbmol/h	0	2.55133	6554.14	7383.41	
Mass Flow	lb/h	0	52.7798	149654	269467	
Mass Cp	Btu/(lb*°F)		0.93459	0.908978	0.867674	

Remarks

		Energy Stream Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	NGL Amine				
Energy Streams					
Energy Stream	Energy Rate		Power	From Block	To Block
Q--P-1113	23655.1	Btu/h	9.2968 hp	--	P-621 Amine Booster Pump
Q-AC-1118	8.60716E+06	Btu/h	3382.74 hp	V-426/A-322	--
Q-E-1117	1.882E+07 *	Btu/h	7396.54 * hp	Amine Reboiler	E-1117 Amine Reboiler
Q-4	5.3381E+06	Btu/h	2097.95 hp	AC-1111 Amine Cooler	--
Q-5	444169	Btu/h	174.565 hp	--	P-623 Amine Circ Pump
Remarks					

		Blocks AC-1111 Amine Cooler Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 10:48 AM, 2/10/2023	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
26	Inlet	P-621 Amine Booster Pump	27	Outlet	MKUP-1
Q-4	Energy				
Block Parameters					
* Pressure Drop		5 psi	Mass Duty		-35.74 Btu/lb
Temperature Change		-38.8931 °F	Heat Release Curve Type		Plug Flow
Heat Duty		-5.3381E+06 Btu/h	Heat Release Curve Increments		10
Remarks					

Blocks
Acid Gas to TO
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:13 PM, 10/7/2015
Flowsheet:	NGL Amine	Status: Approximate 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
21 [NGL Amine]	Inlet	V-426/A-322 [NGL Amine]	1 [ThermOx]	Outlet	VLVE-100 [ThermOx]

Block Parameters

* Mole Fraction Transfer Threshold	0.001 %	Outlet Mass Enthalpy	-3863.23 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	4.56171 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	120 °F	Fraction Vapor Difference	0 %
Inlet Pressure	10 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-3863.23 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	124.562 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	10 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!Acid Gas to TO

Warning: The environment Combustion Enviro used by flowsheet ThermOx does not contain the following component(s) present in stream 21 in flowsheet NGL Amine:

Piperazine, Methanol.

Warning: The following components were zeroed out in stream 1 on flowsheet ThermOx because they were less than the mole fraction transfer threshold in stream 21 on flowsheet NGL Amine:

iC5, nC5, C6, C7, C8, Benzene, Toluene, Ethylbenzene, para-Xylene, MDEA.

Warning: Cross Flowsheet Connector Acid Gas to TO is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Warning: The Temperature Difference of 4.56171 °F exceeds specified tolerance of 1 °F.
Consider changing transfer variables for a closer match.

Remarks

Blocks
Amine Flash to Fuel
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:53 PM, 4/11/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15 [NGL Amine]	Inlet	V-422 Amine Flash Tank [NGL Amine]	17 [Fired Heaters]	Outlet	MIX-102 [Fired Heaters]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1218.54 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	-0.0175702 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	108.473 °F	Fraction Vapor Difference	0 %
Inlet Pressure	149.5 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1218.54 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	108.455 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	149.5 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!Amine Flash to Fuel

Warning: The environment Combustion Enviro used by flowsheet Fired Heaters does not contain the following component(s) present in stream 15 in flowsheet NGL Amine:
Piperazine, Methanol.

Warning: Cross Flowsheet Connector Amine Flash to Fuel is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

		Blocks Amine Reboiler Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:26 PM, 2/13/2023	
Flowsheet:	NGL Amine			Status: Solved 5:03 PM, 3/4/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E-1117 [NGL Amine]	Energy Inlet	E-1117 Amine Reboiler [NGL Amine]	Q-E-1117 [HMO]	Energy Inlet	E-1117 [HMO]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
E-221
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:08 PM, 6/5/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	MIX-102	7	Inlet	T-521 Amine Contactor
2	Outlet	T-521 Amine Contactor	8	Outlet	F-427 NGL Coalescer

Energy Specifications

Minimum End Approach Temperature	19.1777 °F	Highest Supply Temperature	112.164 °F
Minimum Effective Approach Temperature	19.1777 °F	Lowest Supply Temperature	95.501 °F
Maximum Effective Approach Temperature	20.9505 °F	Highest Demand Temperature	92.9859 °F
Log Mean Temperature Difference	20.051 °F	Lowest Demand Temperature	74.5505 °F
Effective Mean Temperature Difference	20.0892 °F	Total Energy Supply	4.15E+06 Btu/h
End Point UA	206972 Btu/(h*°F)	Total Energy Demand	4.15E+06 Btu/h
Effective UA	206579 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-221 - A	74.5505	92.9859	4.15E+06	20.0892
E-221 - B	112.164	95.501	-4.15E+06	20.0892

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-221 - A	206579	0.919428	0.917081	
E-221 - B	206579	0.83101	0.828663	

Remarks

Blocks
E-221 - A
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:08 PM, 6/5/2023
Flowsheet:	NGL Amine	Status: Solved

Block Parameters

* Pressure Drop	5 psi	Mass Duty	15.1179 Btu/lb
Temperature Change	18.4355 °F	Heat Release Curve Type	Plug Flow
* Heat Duty	4.15E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	19.1777 °F	Highest Supply Temperature	112.164 °F
Minimum Effective Approach Temperature	19.1777 °F	Lowest Supply Temperature	95.501 °F
Maximum Effective Approach Temperature	20.9505 °F	Highest Demand Temperature	92.9859 °F
Log Mean Temperature Difference	20.051 °F	Lowest Demand Temperature	74.5505 °F
Effective Mean Temperature Difference	20.0892 °F	Total Energy Supply	4.15E+06 Btu/h
End Point UA	206972 Btu/(h*°F)	Total Energy Demand	4.15E+06 Btu/h
Effective UA	206579 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-221 - A	74.5505	92.9859	4.15E+06	20.0892
E-221 - B	112.164	95.501	-4.15E+06	20.0892

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-221 - A	206579	0.919428	0.917081	
E-221 - B	206579	0.83101	0.828663	

Remarks

Blocks
E-221 - B
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:56 PM, 7/4/2015
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-15.3978 Btu/lb
Temperature Change	-16.6626 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-4.15E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	19.1777 °F	Highest Supply Temperature	112.164 °F
Minimum Effective Approach Temperature	19.1777 °F	Lowest Supply Temperature	95.501 °F
Maximum Effective Approach Temperature	20.9505 °F	Highest Demand Temperature	92.9859 °F
Log Mean Temperature Difference	20.051 °F	Lowest Demand Temperature	74.5505 °F
Effective Mean Temperature Difference	20.0892 °F	Total Energy Supply	4.15E+06 Btu/h
End Point UA	206972 Btu/(h*°F)	Total Energy Demand	4.15E+06 Btu/h
Effective UA	206579 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-221 - A	74.5505	92.9859	4.15E+06	20.0892
E-221 - B	112.164	95.501	-4.15E+06	20.0892

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-221 - A	206579	0.919428	0.917081	
E-221 - B	206579	0.83101	0.828663	

Remarks

Blocks
E-222
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:04 PM, 5/23/2022
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16	Inlet	V-422 Amine Flash Tank	24	Inlet	E-1117 Amine Reboiler
17	Outlet	VLV-102	25	Outlet	P-621 Amine Booster Pump

Energy Specifications

Minimum End Approach Temperature	45.3976 °F	Highest Supply Temperature	245.398 °F
Minimum Effective Approach Temperature	45.3976 °F	Lowest Supply Temperature	158.822 °F
Maximum Effective Approach Temperature	50.349 °F	Highest Demand Temperature	200 °F
Log Mean Temperature Difference	47.8306 °F	Lowest Demand Temperature	108.473 °F
Effective Mean Temperature Difference	47.7712 °F	Total Energy Supply	1.22491E+07 Btu/h
End Point UA	256093 Btu/(h*°F)	Total Energy Demand	1.22491E+07 Btu/h
Effective UA	256412 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-222 - A	108.473	200	1.22491E+07	47.7712
E-222 - B	245.398	158.822	-1.22491E+07	47.7712

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-222 - A	256412	1.91357	1.91513
E-222 - B	256412	1.81005	1.81161

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!E-222!QManager!HEXRating
Warning: Heat exchanger is under designed.

Remarks

		Blocks E-222 - A Heat Exchanger Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II		Modified: 11:48 PM, 11/25/2009	
Flowsheet:		NGL Amine		Status: Solved	
Block Parameters					
* Pressure Drop		5 psi		Mass Duty 79.2624 Btu/lb	
Temperature Change		91.5272 °F		Heat Release Curve Type Plug Flow	
Heat Duty		1.22491E+07 Btu/h		* Heat Release Curve Increments 10	
Energy Specifications					
Minimum End Approach Temperature		45.3976 °F		Highest Supply Temperature 245.398 °F	
Minimum Effective Approach Temperature		45.3976 °F		Lowest Supply Temperature 158.822 °F	
Maximum Effective Approach Temperature		50.349 °F		Highest Demand Temperature 200 °F	
Log Mean Temperature Difference		47.8306 °F		Lowest Demand Temperature 108.473 °F	
Effective Mean Temperature Difference		47.7712 °F		Total Energy Supply 1.22491E+07 Btu/h	
End Point UA		256093 Btu/(h*°F)		Total Energy Demand 1.22491E+07 Btu/h	
Effective UA		256412 Btu/(h*°F)		Allow Temperature Cross False	
Energy Specifications (Tabular Data)					
Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F	
E-222 - A	108.473	200	1.22491E+07	47.7712	
E-222 - B	245.398	158.822	-1.22491E+07	47.7712	
Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU		
E-222 - A	256412	1.91357	1.91513		
E-222 - B	256412	1.81005	1.81161		
Warnings ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!E-222!QManager!HEXRating Warning: Heat exchanger is under designed.					
Remarks					

Blocks
E-222 - B
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:09 AM, 11/26/2009
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-82.0112 Btu/lb
Temperature Change	-86.5757 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-1.22491E+07 Btu/h	* Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	45.3976 °F	Highest Supply Temperature	245.398 °F
Minimum Effective Approach Temperature	45.3976 °F	Lowest Supply Temperature	158.822 °F
Maximum Effective Approach Temperature	50.349 °F	Highest Demand Temperature	200 °F
Log Mean Temperature Difference	47.8306 °F	Lowest Demand Temperature	108.473 °F
Effective Mean Temperature Difference	47.7712 °F	Total Energy Supply	1.22491E+07 Btu/h
End Point UA	256093 Btu/(h*°F)	Total Energy Demand	1.22491E+07 Btu/h
Effective UA	256412 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-222 - A	108.473	200	1.22491E+07	47.7712
E-222 - B	245.398	158.822	-1.22491E+07	47.7712

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-222 - A	256412	1.91357	1.91513	
E-222 - B	256412	1.81005	1.81161	

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!E-222!QManager!HEXRating
Warning: Heat exchanger is under designed.

Remarks

Blocks

E-1117 Amine Reboiler

Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:42 PM, 1/19/2022
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
22	Inlet	T-522 Amine Still	23	Vapor Outlet	T-522 Amine Still
24	Light Liquid Outlet	E-222	Q-E-1117	Energy	Amine Reboiler

Block Parameters

* Pressure Drop	0	psi	Main Liquid Phase	Light Liquid
Mole Fraction Vapor	14.2977	%	Heat Duty	1.882E+07 Btu/h
Mole Fraction Light Liquid	85.7023	%	* Heat Release Curve Type	Pool Boiling
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	33.4994 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	33.4994 °F	Lowest Supply Temperature	278.897 °F
Maximum Effective Approach Temperature	104.602 °F	Highest Demand Temperature	245.398 °F
Log Mean Temperature Difference	62.4456 °F	Lowest Demand Temperature	245.398 °F
Effective Mean Temperature Difference	62.7033 °F	Total Energy Supply	1.882E+07 Btu/h
End Point UA	301382 Btu/(h*°F)	Total Energy Demand	1.882E+07 Btu/h
Effective UA	300144 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-1117 Amine Reboiler	245.398	245.398	1.882E+07	62.7033
E-1117	350	278.897	-1.882E+07	62.7033

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-1117 Amine Reboiler	300144	0	0	
E-1117	300144	1.13864	1.13864	

Remarks

			Blocks F-427 NGL Coalescer Separator Report								
Client Name:		Energy Transfer			Job: Plan Approval Application						
Location:		Cryo II			Modified: 2:55 PM, 2/10/2023						
Flowsheet:		NGL Amine			Status: Solved 12:36 PM, 3/7/2025						
Connections											
Stream		Connection Type		Other Block		Stream		Connection Type		Other Block	
8		Inlet		E-221		29		Vapor Outlet			
34		Light Liquid Outlet		Sweet NGL to Dehy		30		Heavy Liquid Outlet		NGL Amine Coalescer	
Block Parameters											
* Pressure Drop				2 psi		Main Liquid Phase				Light Liquid	
Mole Fraction Vapor				0 %		Heat Duty				0 Btu/h	
Mole Fraction Light Liquid				99.9655 %		Heat Release Curve Type				Plug Flow	
Mole Fraction Heavy Liquid				0.034543 %		Heat Release Curve Increments				10	
Remarks											

Blocks
MIX-102
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:35 PM, 2/10/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	NGL to Treating	CO2	Inlet	
1	Outlet	E-221			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 1	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MKUP-1
Makeup Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:27 PM, 2/13/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
27	Inlet	AC-1111 Amine Cooler	x1	Makeup	
28	Outlet	P-623 Amine Circ Pump	x3	Blowdown	

Block Parameters

* Pressure Drop	2 psi	* Target Outlet Composition Basis	Mass Fraction
* Bulk Composition Basis	Mass Fraction		

Tabulated Block Data

Index	Makeup Bulk Composition %	Target Outlet Composition %		
H2O	100 *	*		
H2S	0 *	*		
CO2	0 *	*		
N2	0 *	*		
C1	0 *	*		
C2	0 *	*		
C3	0 *	*		
iC4	0 *	*		
nC4	0 *	*		
iC5	0 *	*		
nC5	0 *	*		
C6	0 *	*		
C7	0 *	*		
C8	0 *	*		
C9	0 *	*		
C10	0 *	*		
Benzene	0 *	*		
Toluene	0 *	*		
Ethylbenzene	0 *	*		
para-Xylene	0 *	*		
MDEA	*	22 *		
Piperazine	*	3 *		
Methanol	0 *	*		

Remarks

Blocks
NGL Amine Coalescer
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:35 PM, 2/14/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
30 [NGL Amine]	Inlet	F-427 NGL Coalescer [NGL Amine]	3 [Closed Drain]	Outlet	VLVE-101 [Closed Drain]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-5963.14 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
* Transfer Property 2	Mole Fraction Vapor	Pressure Difference	0 psi
Inlet Temperature	95.4758 °F	Fraction Vapor Difference	0 %
Inlet Pressure	683 psig	Mass Enthalpy Difference	-2.18804 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-5960.96 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	95.4758 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	683 psig	* Mass Enthalpy Tolerance	50 Btu/lb
Outlet Fraction Vapor	0 %		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!NGL Amine Coalescer

Warning: Holding the mole fraction vapor constant across XFSCconnector NGL Amine Coalescer is not valid since the entering PStream is not saturated. Transfer variables are defaulted to Temperature and Pressure.

Warning: The environment Closed Drain Enviro used by flowsheet Closed Drain does not contain the following component(s) present in stream 30 in flowsheet NGL Amine:

Methanol.

Warning: Cross Flowsheet Connector NGL Amine Coalescer is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

Blocks
NGL to Treating
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:35 PM, 2/10/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
35 [RSV]	Inlet	MIX-103 [RSV]	13 [NGL Amine]	Outlet	MIX-102 [NGL Amine]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1263.52 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	73.7691 °F	Fraction Vapor Difference	0 %
Inlet Pressure	720 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1263.52 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	73.7691 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	720 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Remarks

		Blocks P-621 Amine Booster Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:19 PM, 3/18/2014	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
25	Inlet	E-222	26	Outlet	AC-1111 Amine Cooler
Q--P-1113	Energy				
Block Parameters					
* Overall Efficiency	75 %	Power	9.2968 hp		
* Pressure Change	40 psi	Speed	rpm		
Dynamic Head	92.4327 ft	Power Estimate	0 hp		
Remarks					

		Blocks P-623 Amine Circ Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 10:47 AM, 2/10/2023	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
28	Inlet	MKUP-1	x2	Outlet	RCYL-1
Q-5	Energy				
Block Parameters					
* Overall Efficiency	75	%	Power	174.565	hp
Pressure Change	759	psi	Speed		rpm
Dynamic Head	1732.18	ft	Power Estimate	0	hp
Remarks					

Blocks
RCYL-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 10:47 AM, 2/10/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
x2	Inlet	P-623 Amine Circ Pump	31	Outlet	T-521 Amine Contactor

Block Parameters

Error	2.15114E-05	Recycle Dependencies	1
Iterations	5	Solver Dependencies	0
Priority	1	Recycle State	Active
* Calculate	True	* Flash Variables	Pressure, Enthalpy
Block Dependencies	11		
* Recycle Variables	Pressure, Enthalpy, Component Flow, Mass Flow		

Tabulated Block Data

Index	Function values	Weights		
Pressure	0	1		
Enthalpy	-1.57435E-07	1		
Mass Flow	-8.75535E-08	1		
H2O	-1.00583E-05	1000		
H2S	0	1000		
CO2	-1.61084E-05	1000		
N2	0	1		
C1	0	1		
C2	0	1		
C3	0	1		
iC4	0	1		
nC4	0	1		
iC5	0	1		
nC5	0	1		
C6	0	1		
C7	0	1		
C8	0	1		
C9	0	1		
C10	0	1		
Benzene	0	1		
Toluene	0	1		
Ethylbenzene	0	1		
para-Xylene	0	1		
MDEA	2.15114E-05	1000		
Piperazine	4.05811E-06	1000		
Methanol	5.97204E-09	1		

Remarks

Blocks
Sweet NGL to Dehy
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:13 PM, 2/10/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
34 [NGL Amine]	Inlet	F-427 NGL Coalescer [NGL Amine]	1 [NGL Sieve]	Outlet	MIX-101 [NGL Sieve]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1241.89 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0.00445698 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	95.4758 °F	Fraction Vapor Difference	0 %
Inlet Pressure	683 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1241.89 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	95.4802 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	683 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!Sweet NGL to Dehy

Warning: The environment Hydrocarbon Enviro used by flowsheet NGL Sieve does not contain the following component(s) present in stream 34 in flowsheet NGL Amine:

MDEA, Piperazine.

Warning: Cross Flowsheet Connector Sweet NGL to Dehy is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

Blocks
T-521 Amine Contactor
Column Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:06 PM, 5/12/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Stage Connections

Stage	Type	Connected Stream	Direction	Block
1	Inlet	31	From	RCYL-1
1	Light Liquid Outlet	7	To	E-221
2	Inlet	2	From	E-221
2	Heavy Liquid Outlet	9	To	VLVE-101

Block Parameters

* Number of Stages	2	Copy Lock	
Degrees of Freedom	0	Murphree Efficiencies Active	False
Model Type	Ideal Stage	Efficiency Phase	Light Liquid
Ideal Stage Column Type	General Ideal Stage	Outer Loop Iterations	1
* Flash Type	LLE	Enthalpy Model	Boston-Britt
* Column Add-ons	None	Inner Loop Model	Boston-Sullivan
Solve after Execute	True	K Damping	0
* First Liquid Phase	Aqueous Liquid	Boston-Sullivan Kb	True
* Second Liquid Phase	Nonspecific Liquid	MESH Method	Boston-Sullivan Inside-Out
Phase Threshold	0.1 %	Maximum Initial Iterations	50
Number Column Top Down	True	Use Last Solution	True
* Pressure Change	25 psi	Approach To Equilibrium Numerator Phase	Light Liquid
Bottoms Head	0 psi	Approach To Equilibrium Denominator Phase	Heavy Liquid

Column Specifications

Rich Approach

Properties

Value	%	Calculation Type	Specified Stage
* Type	Maximum Loading	Source Information	Stage: 2 ---
* Usage	Calculation During Execute		

Source Information

* Phase	Total	* Component	CO2
* Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!T-521 Amine Contactor!Stages!2		

Source Information

* Component	CO2

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!T-521 Amine Contactor!Specifications!Rich Approach
Warning: Staged column specification Rich Approach cannot be activated since it is invalid or incomplete.

Remarks

		Blocks T-521 Amine Contactor Column Stage Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:06 PM, 5/12/2023	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Stage Properties					
Stages	Stage Pressure psig	Stage Head ft	Temperature °F	Light Liquid Molar Flow lbmol/h	Heavy Liquid Molar Flow lbmol/h
1	690	0	112.164	7385.96	6565.44
2	715		106.937	7397.26	6665.4
Remarks					

Blocks
T-522 Amine Still
Column Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:05 PM, 6/5/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Stage Connections

Stage	Type	Connected Stream	Direction	Block
1	Inlet	20	From	V-426/A-322
1	Vapor Outlet	19	To	V-426/A-322
2	Inlet	18	From	VLV-102
10	Inlet	23	From	E-1117 Amine Reboiler
10	Light Liquid Outlet	22	To	E-1117 Amine Reboiler

Column Attachments

Type	Block Name	Type	Block Name	Type	Block Name
Condenser	V-426/A-322	Reboiler	E-1117 Amine Reboiler		

Block Parameters

* Number of Stages	10	Copy Lock	
Degrees of Freedom	0	Murphree Efficiencies Active	False
Model Type	Ideal Stage	Efficiency Phase	Light Liquid
* Ideal Stage Column Type	TSWEET Stripper	Outer Loop Iterations	5
* Flash Type	VLE	* Enthalpy Model	Composition-Dependent
* Column Add-ons	Partial Condenser with Reboiler	* Inner Loop Model	Boston-Sullivan Nonideal
Solve after Execute	True	K Damping	0
* First Liquid Phase	Aqueous Liquid	* Boston-Sullivan Kb	True
Phase Threshold	0.1 %	MESH Method	Boston-Sullivan Inside-Out
Allow Overspecification	False	Maximum Initial Iterations	50
* Number Column Top Down	True	Use Last Solution	True
* Pressure Change	3 psi	Approach To Equilibrium Numerator Phase	Vapor
Bottoms Head	0 psi	Approach To Equilibrium Denominator Phase	Light Liquid

Column Specifications**Boilup Ratio 1****Properties**

Target	0.166821	Lower	0.001
Value	0.16683	Usage	Calculation During Execute
Type	Molar Flow	Calculation Type	Specified Stage
Upper	100		
Source Information	Reboiler --- Bottoms		

Source Information

* Source	Reboiler	* Phase	Vapor

Source Information

* Source	Bottoms		

CO2 Loading**Properties**

* Target	0.005	* Usage	Calculation During Execute
Value	0.0106356	Calculation Type	Specified Stage
* Type	Molar Flow		
Source Information	Reboiler --- Reboiler		

Source Information

* Source	Reboiler	* Component	CO2

* User Specified Values

? Extrapolated or Approximate Values

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Blocks
T-522 Amine Still
Column Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:05 PM, 6/5/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Source Information

* Phase	Light Liquid

Source Information

* Source	Reboiler	* Component	MDEA
* Phase	Light Liquid		

Reboiler Duty

Properties

* Target	1.882E+07 Btu/h	Lower	Btu/h
Value	1.882E+07 Btu/h	* Usage	Specification
Weight	1	Calculation Type	Specified Stage
Upper	Btu/h	Source Information	QStream: Q-E-1117

Source Information

* Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Amine!QStreams!Q-E-1117

Reboiler Temp

Properties

* Target	245 °F	* Usage	Calculation During Execute
Value	245.398 °F	Calculation Type	Specified Stage
* Type	Temperature	Source Information	Reboiler

Source Information

* Source	Reboiler	* Phase	Total

Reflux Ratio 1

Properties

Target	3.57521	Lower	0.01
Value	3.57303	* Usage	Calculation During Execute
Type	Molar Flow	Calculation Type	Specified Stage
Upper	100		
Source Information	Condenser --- Distillate		

Source Information

* Source	Condenser	* Phase	Light Liquid

Source Information

* Source	Distillate

Still Condenser Temp

Properties

* Target	120 °F	* Usage	Specification
Value	120 °F	Calculation Type	Specified Stage
Weight	1	Source Information	Condenser
* Type	Temperature		

Source Information

* Source	Condenser	* Phase	Total

Still OVHD Temp Spec

Properties

* Target	195 °F	* Usage	Calculation During

* User Specified Values

? Extrapolated or Approximate Values

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		Blocks T-522 Amine Still Column Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:05 PM, 6/5/2023	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Still OVHD Temp Spec					
Properties					
Value			Execute		
223.666 °F			Calculation Type Specified Stage		
* Type	Temperature		Source Information		Stage: 1
Source Information					
* Phase	Vapor				
* Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!T-522 Amine Still!Stages!1				
Remarks					

Blocks
T-522 Amine Still
Column Stage Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:05 PM, 6/5/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Stage Properties

Stages	Pressure psig	Stage Head ft	Temperature °F	Vapor Molar Flow lbmol/h	Light Liquid Molar Flow lbmol/h
V-426/A-3 22	10		120	123.716	442.04
1	10 *	0	223.666	565.756	488.139
2	10.3333	0	228.141	611.854	7402.81
3	10.6667	0	235.113	864.467	7486.07
4	11	0	237.645	947.726	7526.3
5	11.3333	0	239.497	987.953	7555.86
6	11.6667	0	240.95	1017.51	7577.85
7	12	0	242.133	1039.51	7594.58
8	12.3333	0	243.147	1056.23	7607.93
9	12.6667	0	244.059	1069.58	7619.16
10	13		244.908	1080.81	7629.14
E-1117 Amine Reboiler	13		245.398	1090.79	6538.35

Remarks

		Blocks V-422 Amine Flash Tank Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:07 PM, 5/12/2023	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	VLVE-101	15	Vapor Outlet	Amine Flash to Fuel
16	Light Liquid Outlet	E-222			
Block Parameters					
* Pressure Drop	0.5	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0.0500076	%	Heat Duty	0 Btu/h	
Mole Fraction Light Liquid	99.95	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	
Remarks					

		Blocks V-426/A-322 Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 9:19 PM, 8/20/2013	
Flowsheet:	NGL Amine			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
19	Inlet	T-522 Amine Still	21	Vapor Outlet	Acid Gas to TO
20	Light Liquid Outlet	T-522 Amine Still	Q-AC-1118	Energy	
Block Parameters					
Pressure Drop	0	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	21.8673	%	Heat Duty	-8.60716E+06	Btu/h
Mole Fraction Light Liquid	78.1327	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	
Remarks					

Blocks
VLV-102
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 10:55 AM, 2/10/2023
Flowsheet:	NGL Amine	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
17	Inlet	E-222	18	Outlet	T-522 Amine Still

Block Parameters

Pressure Drop	129.5 psi	? Simple Compressible Cv	462.574
Joule-Thomson Coefficient	0.0190822 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	27.2778		

Remarks

			Blocks VLVE-101 JT-Valve Report								
Client Name:		Energy Transfer			Job: Plan Approval Application						
Location:		Cryo II			Modified: 2:07 PM, 5/12/2023						
Flowsheet:		NGL Amine			Status: Solved 12:36 PM, 3/7/2025						
Connections											
Stream		Connection Type		Other Block		Stream		Connection Type		Other Block	
9		Inlet		T-521 Amine Contactor		10		Outlet		V-422 Amine Flash Tank	
Block Parameters											
Pressure Drop				565 psi		? Simple Compressible Cv				92.5979	
Joule-Thomson Coefficient				-0.00271538 °F/psi		Valve Diameter				in	
Pressure Drop Method				User Set		Valve F_L, Liquid Pressure Recovery Factor					
Allow Pressure Increase				True		Valve F_D, Style Modifier					
Calculate Flow				False		Valve X_T, Rated Pressure Drop Ratio Factor					
Simple Incompressible Cv				12.7735							
Remarks											

Client Name:		Energy Transfer		Job: Plan Approval Application		
Location:		Cryo II				
Flowsheet:		NGL Amine				
Flowsheet Environment Amine Enviro						
Environment Settings						
Perform Freeze Out Check		False	Gibbs Excess Model		77 °F	
Apply Poynting Correction Factor		True	Evaluation Temperature			
Number of Poynting Intervals		0	Enable Mixed Liquid Phase Emulsion Viscosity		False	
			Minimum Mole Fraction Compositional Threshold		1E-10 %	
Flash Settings						
Use Submitted Guess		True	* Rachford-Rice Style Algorithm		True	
Reverse Guess Algorithm Order		False	* Boston-Britt Style Algorithm		True	
Use First Guess Algorithm Only		False	Initial Guess Tolerance		0.001 %	
Favor First Guess Algorithm		True	Minimum Phase Threshold		0.000251189 %	
* Only Isothermal Property Flash		False	Distinct Phase Composition Threshold		0.1 %	
* Flash Polish Step		True	Validate Phases		True	
Liked Phases						
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
Piperazine	False	True				
Methanol	False	True				
Henry's Law Component						
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	True				
CO2	False	True				
N2	False	True				
C1	False	True				
C2	False	True				
C3	False	True				
iC4	False	True				
nC4	False	True				
iC5	False	True				
nC5	False	True				
C6	False	True				

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment			
		Amine Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	NGL Amine				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C7	False	True				
C8	False	True				
C9	False	True				
C10	False	True				
Benzene	False	True				
Toluene	False	True				
Ethylbenzene	False	True				
para-Xylene	False	True				
MDEA	False	True				
Piperazine	False	True				
Methanol	False	True				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-9.67	704.93	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Electrolytic ELR	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					

* User Specified Values

? Extrapolated or Approximate Values

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Flowsheet Environment		Amine Enviro	
Client Name:	Energy Transfer	Job: Plan Approval Application	
Location:	Cryo II		
Flowsheet:	NGL Amine		
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model
Mercury Liquid			
Custom Liquid 1			
Custom Liquid 2			
Electrolytic Reactions			
Dissociation of Water	$H_2O = H^+ + HO^-$		
First Dissociation of CO ₂	$CO_2 + H_2O = (CHO_3)^- + H^+$		
First Dissociation of H ₂ S	$H_2S = H^+ + HS^-$		
MDEAH ⁺ Proton Transfer	$(C_5H_{14}NO_2)^+ = C_5H_{13}NO_2 + H^+$		
Piperazine Dicarbamate Hydrolysis	$(C_5H_9N_2O_2)^- + (CHO_3)^- = (C_6H_8N_2O_4)^{2-} + H_2O$		
Piperazine Monocarbamate Hydrolysis	$(CHO_3)^- + C_4H_{10}N_2 = (C_5H_9N_2O_2)^- + H_2O$		
Piperazine Monocarbamate Protonation	$(C_5H_9N_2O_2)^- + H^+ = C_5H_{10}N_2O_2$		
Second Dissociation of CO ₂	$(CHO_3)^- = H^+ + (CO_3)^{2-}$		
Second Dissociation of H ₂ S	$HS^- = H^+ + (S)^{2-}$		
1st Protonation of Piperazine	$(C_4H_{11}N_2)^+ = C_4H_{10}N_2 + H^+$		
2nd Protonation of Piperazine	$(C_4H_{12}N_2)^{2+} = (C_4H_{11}N_2)^+ + H^+$		
Physical Property Method Sets			
Liquid Molar Volume	COSTALD	Overall Package	Amine Sweetening - PR
Vapor Package	Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson
Aqueous Liquid Package	Electrolytic ELR	Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package	
Custom Liquid 2 Package		Solid Package	
Remarks			

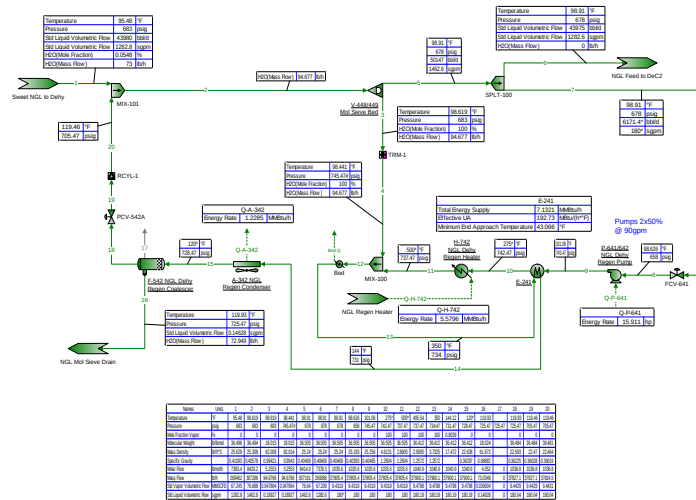
NGL Sieve Plant Schematic

Client Name:	Energy Transfer

Location:	Cryo II

Flowsheet:	NGL Sieve

Job: Plan Approval Application

[illegible]

Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Sieve	

Connections

	1	2	3	4	5
From Block	Sweet NGL to Dehy	MIX-101	V-448/449 Mol Sieve Bed	TRM-1	V-448/449 Mol Sieve Bed
To Block	MIX-101	V-448/449 Mol Sieve Bed	TRM-1	MIX-100	SPLT-100

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0.0548497	0.0624136	100	100	0
H2S	0	0	0	0	0
CO2	0.000104219	0.000104091	0	0	0.000104156
N2	1.29967E-08	1.27607E-08	0	0	1.27687E-08
C1	0.649015	0.648962	0	0	0.649367
C2	66.6128	66.6091	0	0	66.6507
C3	22.4892	22.4872	0	0	22.5012
iC4	2.26692	2.26666	0	0	2.26808
nC4	5.18701	5.18633	0	0	5.18957
iC5	0.881249	0.881084	0	0	0.881634
nC5	1.12963	1.12939	0	0	1.1301
C6	0.630052	0.629798	0	0	0.630191
C7	0.0459174	0.0458879	0	0	0.0459166
C8	0.0164892	0.0164729	0	0	0.0164832
C9	0.00222738	0.00222423	0	0	0.00222562
C10	0.0204878	0.0204544	0	0	0.0204672
Benzene	0.00489174	0.00488999	0	0	0.00489304
Toluene	0.0040083	0.00400576	0	0	0.00400826
Ethylbenzene	0.00133649	0.00133514	0	0	0.00133598
para-Xylene	0.00267254	0.00266979	0	0	0.00267146
Methanol	0.00112946	0.000990379	0	0	0.000990997

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	95.4802	98.6193	98.6193	98.441	98.9103
Pressure	psig	683	683	683	745.475 *	678
Molecular Weight	lb/lbmol	36.4958	36.4939	18.0153	18.0153	36.5055
Std Vapor Volumetric Flow	MMSCFD	67.2449	76.6879	0.0478637	0.0478637	76.6401
Std Liquid Volumetric Flow	sgpm	1282.75	1462.8	0.189265	0.189265	1462.61
Compressibility		0.166407 ?	0.167562 ?	0.0337603	0.0367982	0.166772 ?
Specific Gravity		0.410925 ?	0.405778 ?	0.994211	0.994304	0.40469 ?
Mole Fraction Vapor	%	0	0	0	0	0
Molar Flow	lbmol/h	7383.36	8420.2	5.25535	5.25535	8414.94
Mass Flow	lb/h	269462	307286	94.6766	94.6766	307191
Mass Cp	Btu/(lb*°F)	0.867714	0.883271	0.97573	0.975609	0.886367

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Sieve	

Connections

	6	7	8	9	10
From Block	SPLT-100	SPLT-100	FCV-641	P-641/642 NGL Dehy Regen Pump	E-241
To Block	NGL Feed to DeC2	FCV-641	P-641/642 NGL Dehy Regen Pump	E-241	H-742 NGL Dehy Regen Heater

Stream Composition

Mole Fraction	6 %	7 %	8 %	9 %	10 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.000104156	0.000104156	0.000104156	0.000104156	0.000104156
N2	1.27687E-08	1.27687E-08	1.27687E-08	1.27687E-08	1.27687E-08
C1	0.649367	0.649367	0.649367	0.649367	0.649367
C2	66.6507	66.6507	66.6507	66.6507	66.6507
C3	22.5012	22.5012	22.5012	22.5012	22.5012
iC4	2.26808	2.26808	2.26808	2.26808	2.26808
nC4	5.18957	5.18957	5.18957	5.18957	5.18957
iC5	0.881634	0.881634	0.881634	0.881634	0.881634
nC5	1.1301	1.1301	1.1301	1.1301	1.1301
C6	0.630191	0.630191	0.630191	0.630191	0.630191
C7	0.0459166	0.0459166	0.0459166	0.0459166	0.0459166
C8	0.0164832	0.0164832	0.0164832	0.0164832	0.0164832
C9	0.00222562	0.00222562	0.00222562	0.00222562	0.00222562
C10	0.0204672	0.0204672	0.0204672	0.0204672	0.0204672
Benzene	0.00489304	0.00489304	0.00489304	0.00489304	0.00489304
Toluene	0.00400826	0.00400826	0.00400826	0.00400826	0.00400826
Ethylbenzene	0.00133598	0.00133598	0.00133598	0.00133598	0.00133598
para-Xylene	0.00267146	0.00267146	0.00267146	0.00267146	0.00267146
Methanol	0.000990997	0.000990997	0.000990997	0.000990997	0.000990997

Stream Properties

Property	Units	6	7	8	9	10
Temperature	°F	98.9103	98.9103	98.6264	101.056	275 *
Pressure	psig	678	678	658	745.475	742.475
Molecular Weight	lb/lbmol	36.5055	36.5055	36.5055	36.5055	36.5055
Std Vapor Volumetric Flow	MMSCFD	67.2081	9.43194	9.43194	9.43194	9.43194
Std Liquid Volumetric Flow	sgpm	1282.61	180 *	180	180	180
Compressibility		0.166772 ?	0.166772 ?	0.162333 ?	0.182235 ?	0.758474
Specific Gravity		0.40469 ?	0.40469 ?	0.403932 ?	0.40495 ?	1.26044
Mole Fraction Vapor	%	0	0	0	0	100
Molar Flow	lbmol/h	7379.33	1035.61	1035.61	1035.61	1035.61
Mass Flow	lb/h	269386	37805.4	37805.4	37805.4	37805.4
Mass Cp	Btu/(lb*°F)	0.886367	0.886367	0.89346	0.870773	0.647476

Remarks

Process Streams Report All Streams Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Sieve	

Connections

	11	12	13	14	15
From Block	H-742 NGL Dehy Regen Heater	MIX-100	Bed	E-241	A-342 NGL Regen Condenser
To Block	MIX-100	Bed	E-241	A-342 NGL Regen Condenser	F-542 NGL Dehy Regen Coalescer

Stream Composition

Mole Fraction	11 %	12 %	13 %	14 %	15 %
H2O	0	0.504902	0.504902	0.504902	0.504902
H2S	0	0	0	0	0
CO2	0.000104156	0.00010363	0.00010363	0.00010363	0.00010363
N2	1.27687E-08	1.27042E-08	1.27042E-08	1.27042E-08	1.27042E-08
C1	0.649367	0.646088	0.646088	0.646088	0.646088
C2	66.6507	66.3142	66.3142	66.3142	66.3142
C3	22.5012	22.3876	22.3876	22.3876	22.3876
iC4	2.26808	2.25663	2.25663	2.25663	2.25663
nC4	5.18957	5.16337	5.16337	5.16337	5.16337
iC5	0.881634	0.877182	0.877182	0.877182	0.877182
nC5	1.1301	1.12439	1.12439	1.12439	1.12439
C6	0.630191	0.627009	0.627009	0.627009	0.627009
C7	0.0459166	0.0456848	0.0456848	0.0456848	0.0456848
C8	0.0164832	0.0164	0.0164	0.0164	0.0164
C9	0.00222562	0.00221438	0.00221438	0.00221438	0.00221438
C10	0.0204672	0.0203638	0.0203638	0.0203638	0.0203638
Benzene	0.00489304	0.00486834	0.00486834	0.00486834	0.00486834
Toluene	0.00400826	0.00398802	0.00398802	0.00398802	0.00398802
Ethylbenzene	0.00133598	0.00132923	0.00132923	0.00132923	0.00132923
para-Xylene	0.00267146	0.00265797	0.00265797	0.00265797	0.00265797
Methanol	0.000990997	0.000985994	0.000985994	0.000985994	0.000985994

Stream Properties

Property	Units	11	12	13	14	15
Temperature	°F	500 *	495.54	350	144.122	120 *
Pressure	psig	737.475	737.475	734.475	731.475	728.475
Molecular Weight	lb/lbmol	36.5055	36.4121	36.4121	36.4121	36.4121
Std Vapor Volumetric Flow	MMSCFD	9.43194	9.4798	9.4798	9.4798	9.4798
Std Liquid Volumetric Flow	sgpm	180	180.189	180.189	180.189	180.189
Compressibility		0.920571	0.919298	0.839432	0.239501 ?	0.19177 ?
Specific Gravity		1.26044	1.25722	1.25722		0.362967 ?
Mole Fraction Vapor	%	100	100	100	0.903895	0
Molar Flow	lbmol/h	1035.61	1040.86	1040.86	1040.86	1040.86
Mass Flow	lb/h	37805.4	37900.1	37900.1	37900.1	37900.1
Mass Cp	Btu/(lb*°F)	0.687081	0.684809	0.64056	1.83117	1.04002

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Sieve	

Connections

	16	17	18	19	20
From Block	F-542 NGL Dehy Regen Coalescer	F-542 NGL Dehy Regen Coalescer	F-542 NGL Dehy Regen Coalescer	PCV-542A	RCYL-1
To Block	NGL Mol Sieve Drain	--	PCV-542A	RCYL-1	MIX-101

Stream Composition

Mole Fraction	16 %	17 %	18 %	19 %	20 %
H2O	99.9323		0.116323	0.116323	0.116277
H2S	0		0	0	0
CO2	2.47941E-06		0.000104026	0.000104026	0.000103182
N2	3.38762E-11		1.27537E-08	1.27537E-08	1.10803E-08
C1	0.0015976		0.648607	0.648607	0.648584
C2	0.0573084		66.5732	66.5732	66.5828
C3	0.00524506		22.4751	22.4751	22.473
iC4	0.000136025		2.26545	2.26545	2.26481
nC4	0.000449986		5.18354	5.18354	5.18149
iC5	2.19564E-05		0.880611	0.880611	0.879909
nC5	1.34718E-05		1.12879	1.12879	1.12769
C6	1.76389E-06		0.62946	0.62946	0.62799
C7	3.51314E-08		0.0458633	0.0458633	0.0456783
C8	2.631E-09		0.0164641	0.0164641	0.0163566
C9	6.71012E-11		0.00222303	0.00222303	0.00220176
C10	9.47981E-11		0.0204434	0.0204434	0.0202168
Benzene	1.01932E-05		0.00488733	0.00488733	0.00487755
Toluene	2.6174E-06		0.0040036	0.0040036	0.00398767
Ethylbenzene	2.72468E-07		0.00133443	0.00133443	0.00132554
para-Xylene	4.08698E-07		0.00266836	0.00266836	0.0026502
Methanol	0.00288566		0.00097857	0.00097857	0

Stream Properties

Property	Units	16	17	18	19	20
Temperature	°F	119.93		119.93	119.458	119.459
Pressure	psig	725.475	725.475	725.475	705.475	705.467
Molecular Weight	lb/lbmol	18.0242		36.484	36.484	36.4808
Std Vapor Volumetric Flow	MMSCFD	0.0369045	0	9.44289	9.44289	9.44308
Std Liquid Volumetric Flow	sgpm	0.146281	0	180.043	180.043	180.043
Compressibility		0.0347081		0.191773 ?	0.187755 ?	0.187783 ?
Specific Gravity		0.988825		0.362251 ?	0.360277 ?	0.360188 ?
Mole Fraction Vapor	%	0		0	0	0
Molar Flow	lbmol/h	4.05204	0	1036.81	1036.81	1036.83
Mass Flow	lb/h	73.0348	0	37827.1	37827.1	37824.5
Mass Cp	Btu/(lb*°F)	0.976241		1.04232	1.05739	1.05781

Remarks

		Energy Stream Report					
Client Name:	Energy Transfer					Job: Plan Approval Application	
Location:	Cryo II						
Flowsheet:	NGL Sieve						
Energy Streams							
Energy Stream	Energy Rate		Power		From Block	To Block	
Bed Q	3.63951E+06	Btu/h	1430.38	hp	Bed	--	
Q-A-342	1.22855E+06	Btu/h	482.838	hp	A-342 NGL Regen Condenser	--	
Q-H-742	5.57957E+06	Btu/h	2192.85	hp	NGL Regen Heater	H-742 NGL Dehy Regen Heater	
Q-P-641	40485.4	Btu/h	15.9114	hp	--	P-641/642 NGL Dehy Regen Pump	
Remarks							

		Blocks A-342 NGL Regen Condenser Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:56 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	E-241	15	Outlet	F-542 NGL Dehy Regen Coalescer
Q-A-342	Energy				
Block Parameters					
* Pressure Drop	3	psi	Mass Duty	-32.4155	Btu/lb
Temperature Change	-24.1219	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-1.22855E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks Bed Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:45 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	MIX-100	13	Outlet	E-241
Bed Q	Energy				
Block Parameters					
* Pressure Drop	3	psi	Mass Duty	-96.029	Btu/lb
Temperature Change	-145.54	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-3.63951E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

Blocks E-241 Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:37 PM, 5/12/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	Bed	9	Inlet	P-641/642 NGL Dehy Regen Pump
14	Outlet	A-342 NGL Regen Condenser	10	Outlet	H-742 NGL Dehy Regen Heater

Energy Specifications

Minimum End Approach Temperature	43.066 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	17.9787 °F	Lowest Supply Temperature	144.122 °F
Maximum Effective Approach Temperature	75 °F	Highest Demand Temperature	275 °F
Log Mean Temperature Difference	57.5642 °F	Lowest Demand Temperature	101.056 °F
Effective Mean Temperature Difference	37.0057 °F	Total Energy Supply	7.13212E+06 Btu/h
End Point UA	123899 Btu/(h*°F)	Total Energy Demand	7.13212E+06 Btu/h
Effective UA	192730 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-241 - A	350	144.122	-7.13212E+06	37.0057
E-241 - B	101.056	275	7.13212E+06	37.0057

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-241 - A	192730	3.5765	4.51731	
E-241 - B	192730	3.02174	3.96255	

Remarks

Blocks
E-241 - A
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:32 PM, 5/12/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Block Parameters

* Pressure Drop	3 psi	Mass Duty	-188.182 Btu/lb
Temperature Change	-205.878 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-7.13212E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	43.066 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	17.9787 °F	Lowest Supply Temperature	144.122 °F
Maximum Effective Approach Temperature	75 °F	Highest Demand Temperature	275 °F
Log Mean Temperature Difference	57.5642 °F	Lowest Demand Temperature	101.056 °F
Effective Mean Temperature Difference	37.0057 °F	Total Energy Supply	7.13212E+06 Btu/h
End Point UA	123899 Btu/(h*°F)	Total Energy Demand	7.13212E+06 Btu/h
Effective UA	192730 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-241 - A	350	144.122	-7.13212E+06	37.0057
E-241 - B	101.056	275	7.13212E+06	37.0057

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-241 - A	192730	3.5765	4.51731	
E-241 - B	192730	3.02174	3.96255	

Remarks

Blocks
E-241 - B
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:37 PM, 5/12/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Block Parameters

* Pressure Drop	3 psi	Mass Duty	188.653 Btu/lb
Temperature Change	173.944 °F	Heat Release Curve Type	Plug Flow
Heat Duty	7.13212E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	43.066 °F	Highest Supply Temperature	350 °F
Minimum Effective Approach Temperature	17.9787 °F	Lowest Supply Temperature	144.122 °F
Maximum Effective Approach Temperature	75 °F	Highest Demand Temperature	275 °F
Log Mean Temperature Difference	57.5642 °F	Lowest Demand Temperature	101.056 °F
Effective Mean Temperature Difference	37.0057 °F	Total Energy Supply	7.13212E+06 Btu/h
End Point UA	123899 Btu/(h*°F)	Total Energy Demand	7.13212E+06 Btu/h
Effective UA	192730 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-241 - A	350	144.122	-7.13212E+06	37.0057
E-241 - B	101.056	275	7.13212E+06	37.0057

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-241 - A	192730	3.5765	4.51731	
E-241 - B	192730	3.02174	3.96255	

Remarks

		Blocks F-542 NGL Dehy Regen Coalescer Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:58 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
15	Inlet	A-342 NGL Regen Condenser	17	Vapor Outlet	
18	Light Liquid Outlet	PCV-542A	16	Heavy Liquid Outlet	NGL Mol Sieve Drain
Block Parameters					
* Pressure Drop	3	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	0	%	Heat Duty	0 Btu/h	
Mole Fraction Light Liquid	99.6107	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0.389296	%	Heat Release Curve Increments	10	
Remarks					

		Blocks FCV-641 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:32 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	SPLT-100	8	Outlet	P-641/642 NGL Dehy Regen Pump
Block Parameters					
* Pressure Drop20 psi			? Simple Compressible Cv65.5938		
Joule-Thomson Coefficient0.0141917 °F/psi			Valve Diameterin		
Pressure Drop MethodUser Set			Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure IncreaseTrue			Valve F_D, Style Modifier		
Calculate FlowFalse			Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv26.5639					
Remarks					

		Blocks H-742 NGL Dehy Regen Heater Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:41 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	E-241	11	Outlet	MIX-100
Q-H-742	Energy	NGL Regen Heater			
Block Parameters					
* Pressure Drop	5	psi	Mass Duty	147.587	Btu/lb
Temperature Change	225	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	5.57957E+06	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks MIX-100 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:11 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
4	Inlet	TRM-1	11	Inlet	H-742 NGL Dehy Regen Heater
12	Outlet	Bed			
Block Parameters					
Pressure Drop	0	psi	Fraction to Stream 12	100	%
Flow Multiplier	100	%			
Pressure Balancing Mode Properties					
Pressure Balancing Mode	False				
Remarks					

Blocks
MIX-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:26 PM, 2/10/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
20	Inlet	RCYL-1	1	Inlet	Sweet NGL to Dehy
2	Outlet	V-448/449 Mol Sieve Bed			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 2	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False	

Remarks

Blocks
NGL Feed to DeC2
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:46 PM, 2/10/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6 [NGL Sieve]	Inlet	SPLT-100 [NGL Sieve]	1 [DeC2]	Outlet	FCV-231 [DeC2]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1237.6 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	98.9103 °F	Fraction Vapor Difference	0 %
Inlet Pressure	678 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1237.6 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	98.9103 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	678 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Remarks

Blocks
NGL Mol Sieve Drain
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:37 PM, 2/14/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16 [NGL Sieve]	Inlet	F-542 NGL Dehy Regen Coalescer [NGL Sieve]	5 [Closed Drain]	Outlet	VLVE-102 [Closed Drain]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-6771.01 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0.190058 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	119.93 °F	Fraction Vapor Difference	0 %
Inlet Pressure	725.475 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-6771.01 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	120.12 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	725.475 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Sieve!Blocks!NGL Mol Sieve Drain

Warning: The environment Closed Drain Enviro used by flowsheet Closed Drain does not contain the following component(s) present in stream 16 in flowsheet NGL Sieve:
Methanol.

Warning: Cross Flowsheet Connector NGL Mol Sieve Drain is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

		Blocks NGL Regen Heater Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:04 PM, 2/13/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-H-742 [NGL Sieve]	Energy Inlet	H-742 NGL Dehy Regen Heater [NGL Sieve]	Q-H-742 [Fired Heaters]	Energy Inlet	[Fired Heaters]
Block Parameters					
Inlet Temperature	°F		Outlet Fraction Vapor	%	
Inlet Pressure	psig		Outlet Mass Enthalpy	Btu/lb	
Inlet Fraction Vapor	%		Temperature Difference	°F	
Inlet Mass Enthalpy	Btu/lb		Pressure Difference	psi	
Outlet Temperature	°F		Fraction Vapor Difference	%	
Outlet Pressure	psig		Mass Enthalpy Difference	Btu/lb	
Remarks					

		Blocks P-641/642 NGL Dehy Regen Pump Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:32 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	FCV-641	9	Outlet	E-241
Q-P-641	Energy				
Block Parameters					
* Overall Efficiency	60 %	Power	15.9114 hp		
Pressure Change	87.4748 psi	Power Estimate	0 hp		
* Dynamic Head	500 ft				
Remarks					

		Blocks PCV-542A JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:36 PM, 2/10/2023	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
18	Inlet	F-542 NGL Dehy Regen Coalescer	19	Outlet	RCYL-1
Block Parameters					
* Pressure Drop		20 psi	? Simple Compressible Cv		64.6593
Joule-Thomson Coefficient		0.0236066 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		28.0929			
Remarks					

Blocks
RCYL-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:35 PM, 2/10/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
19	Inlet	PCV-542A	20	Outlet	MIX-101

Block Parameters

Error	0.000965511	Recycle Dependencies	1
Iterations	1	Solver Dependencies	0
Priority	1	Recycle State	Active
* Calculate	True	* Flash Variables	Pressure, Enthalpy
Block Dependencies	13		
* Recycle Variables	Pressure, Enthalpy, Component Flow, Mass Flow		

Tabulated Block Data

Index	Function values	Weights		
Pressure	1.05802E-05	1 *		
Enthalpy	-8.94091E-06	1 *		
Mass Flow	6.71646E-05	1 *		
H2O	4.55115E-06	1 *		
H2S	0	1 *		
CO2	8.43653E-08	1 *		
N2	1.67346E-10	1 *		
C1	2.29083E-06	1 *		
C2	-0.000965511	1 *		
C3	0.000206226	1 *		
iC4	6.33559E-05	1 *		
nC4	0.000205463	1 *		
iC5	7.01845E-05	1 *		
nC5	0.000109245	1 *		
C6	0.000146938	1 *		
C7	1.8504E-05	1 *		
C8	1.07429E-05	1 *		
C9	2.12736E-06	1 *		
C10	2.26666E-05	1 *		
Benzene	9.77442E-07	1 *		
Toluene	1.59299E-06	1 *		
Ethylbenzene	8.88314E-07	1 *		
para-Xylene	1.81549E-06	1 *		
Methanol	9.7857E-05	1 *		

Remarks

Blocks
SPLT-100
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:11 PM, 2/10/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	V-448/449 Mol Sieve Bed	7	Outlet	FCV-641
6	Outlet	NGL Feed to DeC2			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 7	12.3068 %
Flow Multiplier	100 %	Fraction to Stream 6	87.6932 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
Sweet NGL to Dehy
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:26 PM, 2/10/2023
Flowsheet:	NGL Sieve	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
34 [NGL Amine]	Inlet	F-427 NGL Coalescer [NGL Amine]	1 [NGL Sieve]	Outlet	MIX-101 [NGL Sieve]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1241.89 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0.00445698 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	95.4758 °F	Fraction Vapor Difference	0 %
Inlet Pressure	683 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1241.89 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	95.4802 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	683 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Sieve!Blocks!Sweet NGL to Dehy

Warning: The environment Hydrocarbon Enviro used by flowsheet NGL Sieve does not contain the following component(s) present in stream 34 in flowsheet NGL Amine:

MDEA, Piperazine.

Warning: Cross Flowsheet Connector Sweet NGL to Dehy is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Remarks

Blocks
TRM-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:11 PM, 2/10/2023
Flowsheet:	NGL Sieve	Status: Failed

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	V-448/449 Mol Sieve Bed	4	Outlet	MIX-100

Block Parameters

Error	0.0823473	Recycle State	Active
* Calculate	False		
* Propagated Variables	Enthalpy, Mass Flow, Component Flow		

Warnings

ProMax:ProMax!Project!Flowsheets!NGL Sieve!Blocks!TRM-1
Error: TRM-1 has the following errors: Pressure 8.23473%

Remarks

		Blocks V-448/449 Mol Sieve Bed Divider Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:23 PM, 3/7/2025	
Flowsheet:	NGL Sieve			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
2	Inlet	MIX-101	5	Divider Bulk Stream	SPLT-100
3	Divider Extracted Stream	TRM-1			
Block Parameters					
* Bulk Stream Pressure Drop	5 psi		* nC4 Fraction Extracted	0 %	
Bulk Stream Temperature Change	0.290969 °F		* iC5 Fraction Extracted	0 %	
Extracted Stream Pressure Drop	0 psi		* nC5 Fraction Extracted	0 %	
* Extracted Stream Temperature Change	0 °F		* C6 Fraction Extracted	0 %	
* Enthalpy Change	0 Btu/h		* C7 Fraction Extracted	0 %	
* H2O Fraction Extracted	100 %		* C8 Fraction Extracted	0 %	
* H2S Fraction Extracted	0 %		* C9 Fraction Extracted	0 %	
* CO2 Fraction Extracted	0 %		* C10 Fraction Extracted	0 %	
* N2 Fraction Extracted	0 %		* Benzene Fraction Extracted	0 %	
* C1 Fraction Extracted	0 %		* Toluene Fraction Extracted	0 %	
* C2 Fraction Extracted	0 %		* Ethylbenzene Fraction Extracted	0 %	
* C3 Fraction Extracted	0 %		* para-Xylene Fraction Extracted	0 %	
* iC4 Fraction Extracted	0 %		* Methanol Fraction Extracted	0 %	
Remarks					

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Sieve	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	NGL Sieve	

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
Methanol	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	NGL Sieve				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package				Custom Liquid 1 Package	
Custom Liquid 2 Package				Solid Package	
Remarks					

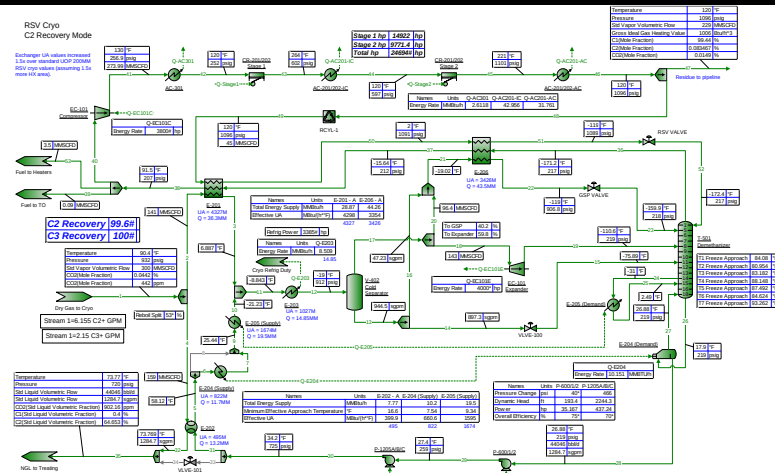
RSV Plant Schematic

Client Name:	Energy Transfer

Location:	Cryo II

Flowsheet:	RSV

Job: Plan Approval Application



* User Specified Values
? Extrapolated or Approximate Values

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	1	2	3	4	5
From Block	Dry Gas to Cryo	SPLT-100	E-201	SPLT-100	E-202
To Block	SPLT-100	E-201	MIX-100	E-202	SPLT-104

Stream Composition

Mole Fraction	1 %	2 %	3 %	4 %	5 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.0441997	0.0441997	0.0441997	0.0441997	0.0441997
N2	0.3579	0.3579	0.3579	0.3579	0.3579
C1	77.2552	77.2552	77.2552	77.2552	77.2552
C2	15.0133	15.0133	15.0133	15.0133	15.0133
C3	5.04337	5.04337	5.04337	5.04337	5.04337
iC4	0.508274	0.508274	0.508274	0.508274	0.508274
nC4	1.16302	1.16302	1.16302	1.16302	1.16302
iC5	0.197577	0.197577	0.197577	0.197577	0.197577
nC5	0.253264	0.253264	0.253264	0.253264	0.253264
C6	0.141255	0.141255	0.141255	0.141255	0.141255
C7	0.0102944	0.0102944	0.0102944	0.0102944	0.0102944
C8	0.0036968	0.0036968	0.0036968	0.0036968	0.0036968
C9	0.000499367	0.000499367	0.000499367	0.000499367	0.000499367
C10	0.00459324	0.00459324	0.00459324	0.00459324	0.00459324
Benzene	0.00109969	0.00109969	0.00109969	0.00109969	0.00109969
Toluene	0.000899509	0.000899509	0.000899509	0.000899509	0.000899509
Ethylbenzene	0.000299734	0.000299734	0.000299734	0.000299734	0.000299734
para-Xylene	0.000599455	0.000599455	0.000599455	0.000599455	0.000599455
Methanol	0.000618753	0.000618753	0.000618753	0.000618753	0.000618753

Stream Properties

Property	Units	1	2	3	4	5
Temperature	°F	90.3831	90.3831	6.88701	90.3831	58.1191
Pressure	psig	932	932	927	932	927
Molecular Weight	lb/lbmol	20.6946	20.6946	20.6946	20.6946	20.6946
Std Vapor Volumetric Flow	MMSCFD	299.94	140.972	140.972	158.968	158.968
Std Liquid Volumetric Flow	sgpm	4012.78	1886.01	1886.01	2126.77	2126.77
Compressibility		0.801059	0.801059	0.62091	0.801059	0.747639
Specific Gravity		0.71453	0.71453		0.71453	0.71453
Mole Fraction Vapor	%	100	100	91.2826	100	100
Molar Flow	lbmol/h	32932.9	15478.4	15478.4	17454.4	17454.4
Mass Flow	lb/h	681532	320320	320320	361212	361212
Mass Cp	Btu/(lb*°F)	0.654308	0.654308	0.838969	0.654308	0.70091

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	6	7	8	9	10
From Block	SPLT-104	E-204 (Supply)	SPLT-104	MIX-102	E-205 (Supply)
To Block	E-204 (Supply)	MIX-102	MIX-102	E-205 (Supply)	MIX-100

Stream Composition

Mole Fraction	6 %	7 %	8 %	9 %	10 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.0441997	0.0441997	0.0441997	0.0441997	0.0441997
N2	0.3579	0.3579	0.3579	0.3579	0.3579
C1	77.2552	77.2552	77.2552	77.2552	77.2552
C2	15.0133	15.0133	15.0133	15.0133	15.0133
C3	5.04337	5.04337	5.04337	5.04337	5.04337
iC4	0.508274	0.508274	0.508274	0.508274	0.508274
nC4	1.16302	1.16302	1.16302	1.16302	1.16302
iC5	0.197577	0.197577	0.197577	0.197577	0.197577
nC5	0.253264	0.253264	0.253264	0.253264	0.253264
C6	0.141255	0.141255	0.141255	0.141255	0.141255
C7	0.0102944	0.0102944	0.0102944	0.0102944	0.0102944
C8	0.0036968	0.0036968	0.0036968	0.0036968	0.0036968
C9	0.000499367	0.000499367	0.000499367	0.000499367	0.000499367
C10	0.00459324	0.00459324	0.00459324	0.00459324	0.00459324
Benzene	0.00109969	0.00109969	0.00109969	0.00109969	0.00109969
Toluene	0.000899509	0.000899509	0.000899509	0.000899509	0.000899509
Ethylbenzene	0.000299734	0.000299734	0.000299734	0.000299734	0.000299734
para-Xylene	0.000599455	0.000599455	0.000599455	0.000599455	0.000599455
Methanol	0.000618753	0.000618753	0.000618753	0.000618753	0.000618753

Stream Properties

Property	Units	6	7	8	9	10
Temperature	°F	58.1191	25.4413		25.4413	-21.2339
Pressure	psig	927	922	927	922	917
Molecular Weight	lb/lbmol	20.6946	20.6946	20.6946	20.6946	20.6946
Std Vapor Volumetric Flow	MMSCFD	158.968	158.968	0	158.968	158.968
Std Liquid Volumetric Flow	sgpm	2126.77	2126.77	0	2126.77	2126.77
Compressibility		0.747639	0.675306		0.675306	0.523794
Specific Gravity		0.71453				
Mole Fraction Vapor	%	100	96.5014		96.5014	78.3499
Molar Flow	lbmol/h	17454.4	17454.4	0	17454.4	17454.4
Mass Flow	lb/h	361212	361212	0	361212	361212
Mass Cp	Btu/(lb*°F)	0.70091	0.777848		0.777848	0.948226

Remarks

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer				Job: Plan Approval Application	
Location:	Cryo II					
Flowsheet:	RSV					
Connections						
	11	12	13	14	15	
From Block	MIX-100	E-203	V-402 Cold Separator	SPLT-102	VLVE-100	
To Block	E-203	V-402 Cold Separator	SPLT-102	VLVE-100	T-501 Demethanizer	
Stream Composition						
Mole Fraction	11 %	12 %	13 %	14 %	15 %	
H2O	0	0	0	0	0	
H2S	0	0	0	0	0	
CO2	0.0441997	0.0441997	0.0506085	0.0506085	0.0506085	
N2	0.3579	0.3579	0.108438	0.108438	0.108438	
C1	77.2552	77.2552	50.0644	50.0644	50.0644	
C2	15.0133	15.0133	26.2674	26.2674	26.2674	
C3	5.04337	5.04337	14.4425	14.4425	14.4425	
iC4	0.508274	0.508274	1.85825	1.85825	1.85825	
nC4	1.16302	1.16302	4.45001	4.45001	4.45001	
iC5	0.197577	0.197577	0.860923	0.860923	0.860923	
nC5	0.253264	0.253264	1.11863	1.11863	1.11863	
C6	0.141255	0.141255	0.66883	0.66883	0.66883	
C7	0.0102944	0.0102944	0.0499638	0.0499638	0.0499638	
C8	0.0036968	0.0036968	0.0181763	0.0181763	0.0181763	
C9	0.000499367	0.000499367	0.00247069	0.00247069	0.00247069	
C10	0.00459324	0.00459324	0.0227636	0.0227636	0.0227636	
Benzene	0.00109969	0.00109969	0.00513136	0.00513136	0.00513136	
Toluene	0.000899509	0.000899509	0.00434469	0.00434469	0.00434469	
Ethylbenzene	0.000299734	0.000299734	0.00147055	0.00147055	0.00147055	
para-Xylene	0.000599455	0.000599455	0.00294397	0.00294397	0.00294397	
Methanol	0.000618753	0.000618753	0.00281792	0.00281792	0.00281792	
Stream Properties						
Property	Units	11	12	13	14	15
Temperature	°F	-8.84255	-19 *	-19.0158	-19.0158	-75.8881
Pressure	psig	917	912	911.75	911.75	220 *
Molecular Weight	lb/lbmol	20.6946	20.6946	28.1421	28.1421	28.1421
Std Vapor Volumetric Flow	MMSCFD	299.94	299.94	60.4136	57.3929	57.3929
Std Liquid Volumetric Flow	sgpm	4012.78	4012.78	944.519	897.293	897.293
Compressibility		0.572006	0.535246	0.213101	0.213101	0.421588
Specific Gravity				0.414154	0.414154	
Mole Fraction Vapor	%	85.0517	79.8595	0	0	44.6255
Molar Flow	lbmol/h	32932.9	32932.9	6633.31	6301.64	6301.64
Mass Flow	lb/h	681532	681532	186675	177342	177342
Mass Cp	Btu/(lb*°F)	0.889988	0.930825	0.797949	0.797949	0.556561
Remarks						

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	16	17	18	19	20
From Block	SPLT-102	V-402 Cold Separator	SPLT-101	EC-101 Expander	SPLT-101
To Block	MIX-101	SPLT-101	EC-101 Expander	T-501 Demethanizer	MIX-101

Stream Composition

Mole Fraction	16 %	17 %	18 %	19 %	20 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.0506085	0.0425832	0.0425832	0.0425832	0.0425832
N2	0.108438	0.42082	0.42082	0.42082	0.42082
C1	50.0644	84.1133	84.1133	84.1133	84.1133
C2	26.2674	12.1748	12.1748	12.1748	12.1748
C3	14.4425	2.67272	2.67272	2.67272	2.67272
iC4	1.85825	0.167781	0.167781	0.167781	0.167781
nC4	4.45001	0.333976	0.333976	0.333976	0.333976
iC5	0.860923	0.0302667	0.0302667	0.0302667	0.0302667
nC5	1.11863	0.0350017	0.0350017	0.0350017	0.0350017
C6	0.66883	0.00818933	0.00818933	0.00818933	0.00818933
C7	0.0499638	0.000288989	0.000288989	0.000288989	0.000288989
C8	0.0181763	4.47557E-05	4.47557E-05	4.47557E-05	4.47557E-05
C9	0.00247069	2.15766E-06	2.15766E-06	2.15766E-06	2.15766E-06
C10	0.0227636	1.02995E-05	1.02995E-05	1.02995E-05	1.02995E-05
Benzene	0.00513136	8.28148E-05	8.28148E-05	8.28148E-05	8.28148E-05
Toluene	0.00434469	3.05611E-05	3.05611E-05	3.05611E-05	3.05611E-05
Ethylbenzene	0.00147055	4.42781E-06	4.42781E-06	4.42781E-06	4.42781E-06
para-Xylene	0.00294397	8.11855E-06	8.11855E-06	8.11855E-06	8.11855E-06
Methanol	0.00281792	6.40777E-05	6.40777E-05	6.40777E-05	6.40777E-05

Stream Properties

Property	Units	16	17	18	19	20
Temperature	°F	-19.0158	-19.0158	-19.0158	-110.554	-19.0158
Pressure	psig	911.75	911.75	911.75	219 *	911.75
Molecular Weight	lb/lbmol	28.1421	18.8161	18.8161	18.8161	18.8161
Std Vapor Volumetric Flow	MMSCFD	3.02068	239.526	143.159	143.159	96.3676
Std Liquid Volumetric Flow	sgpm	47.2259	3068.26	1833.82	1833.82	1234.44
Compressibility		0.213101	0.616557	0.616557	0.738298	0.616557
Specific Gravity		0.414154	0.649673	0.649673		0.649673
Mole Fraction Vapor	%	0	100	100	86.359	100
Molar Flow	lbmol/h	331.665	26299.6	15718.6	15718.6	10581
Mass Flow	lb/h	9333.77	494856	295763	295763	199093
Mass Cp	Btu/(lb*°F)	0.797949	0.980652	0.980652	0.571868 ?	0.980652

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	21	22	23	24	25
From Block	MIX-101	E-206	GSP VALVE	T-501 Demethanizer	E-205 (Demand)
To Block	E-206	GSP VALVE	T-501 Demethanizer	E-205 (Demand)	T-501 Demethanizer

Stream Composition

Mole Fraction	21 %	22 %	23 %	24 %	25 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.0428272	0.0428272	0.0428272	0.295829	0.295829
N2	0.411326	0.411326	0.411326	2.55161E-05	2.55161E-05
C1	83.0784	83.0784	83.0784	9.65037	9.65037
C2	12.6032	12.6032	12.6032	67.0599	67.0599
C3	3.03043	3.03043	3.03043	16.2691	16.2691
iC4	0.219159	0.219159	0.219159	1.51494	1.51494
nC4	0.459073	0.459073	0.459073	3.43757	3.43757
iC5	0.0555126	0.0555126	0.0555126	0.571841	0.571841
nC5	0.067936	0.067936	0.067936	0.730898	0.730898
C6	0.028268	0.028268	0.028268	0.40486	0.40486
C7	0.00179874	0.00179874	0.00179874	0.0294611	0.0294611
C8	0.000595823	0.000595823	0.000595823	0.0105744	0.0105744
C9	7.71831E-05	7.71831E-05	7.71831E-05	0.00142816	0.00142816
C10	0.000701834	0.000701834	0.000701834	0.013136	0.013136
Benzene	0.000236254	0.000236254	0.000236254	0.00315679	0.00315679
Toluene	0.000161679	0.000161679	0.000161679	0.00257517	0.00257517
Ethylbenzene	4.89874E-05	4.89874E-05	4.89874E-05	0.000857433	0.000857433
para-Xylene	9.73472E-05	9.73472E-05	9.73472E-05	0.0017148	0.0017148
Methanol	0.000147774	0.000147774	0.000147774	0.001784	0.001784

Stream Properties

Property	Units	21	22	23	24	25
Temperature	°F	-19.0158	-119 *	-159.885	-31.0287	2.49498
Pressure	psig	911.75	906.75	218 *	218.529	218.529
Molecular Weight	lb/lbmol	19.0996	19.0996	19.0996	33.2541	33.2541
Std Vapor Volumetric Flow	MMSCFD	99.3883	99.3883	99.3883	103.842	103.842
Std Liquid Volumetric Flow	sgpm	1281.67	1281.67	1281.67	1895.6	1895.6
Compressibility		0.604295	0.213546	0.251944	0.0540915	0.239496
Specific Gravity			0.360855		0.496562	
Mole Fraction Vapor	%	96.9607	0	27.0932	0	24.209
Molar Flow	lbmol/h	10912.7	10912.7	10912.7	11401.7	11401.7
Mass Flow	lb/h	208427	208427	208427	379154	379154
Mass Cp	Btu/(lb*°F)	0.97247	0.959469 ?	0.77127 ?	0.654364	0.641393

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	26	27	28	29	30
From Block	T-501 Demethanizer	E-204 (Demand)	E-204 (Demand)	P-600/1/2	P-1205A/B/C
To Block	E-204 (Demand)	T-501 Demethanizer	P-600/1/2	P-1205A/B/C	SPLT-106

Stream Composition

Mole Fraction	26 %	27 %	28 %	29 %	30 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.205014	0.448013	0.14556	0.14556	0.14556
N2	6.46206E-08	2.75564E-07	1.30092E-08	1.30092E-08	1.30092E-08
C1	1.42652	4.60157	0.649687	0.649687	0.649687
C2	70.2832	85.4738	66.5665	66.5665	66.5665
C3	19.7092	8.47249	22.4585	22.4585	22.4585
iC4	1.88188	0.322625	2.26339	2.26339	2.26339
nC4	4.27777	0.594163	5.17904	5.17904	5.17904
iC5	0.714811	0.0403713	0.879825	0.879825	0.879825
nC5	0.914034	0.0403079	1.12781	1.12781	1.12781
C6	0.506608	0.00629216	0.62902	0.62902	0.62902
C7	0.0368626	0.000162709	0.045842	0.045842	0.045842
C8	0.0132299	1.9169E-05	0.0164621	0.0164621	0.0164621
C9	0.00178671	5.77457E-07	0.00222372	0.00222372	0.00222372
C10	0.0164338	2.15081E-06	0.0204541	0.0204541	0.0204541
Benzene	0.00394965	7.76823E-05	0.004897	0.004897	0.004897
Toluene	0.00322216	2.01897E-05	0.00400559	0.00400559	0.00400559
Ethylbenzene	0.00107277	2.08638E-06	0.00133474	0.00133474	0.00133474
para-Xylene	0.00214545	3.89145E-06	0.00266942	0.00266942	0.00266942
Methanol	0.00223385	0.000102369	0.00275536	0.00275536	0.00275536

Stream Properties

Property	Units	26	27	28	29	30
Temperature	°F	17.9032	26.8832	26.8832	27.4483	34.2107
Pressure	psig	219	219	219	259	725 *
Molecular Weight	lb/lbmol	35.4233	30.9693	36.513	36.513	36.513
Std Vapor Volumetric Flow	MMSCFD	83.8354	16.4798	67.3556	67.3556	67.3556
Std Liquid Volumetric Flow	sgpm	1585.74	301.069	1284.67	1284.67	1284.67
Compressibility		0.0540909	0.790619	0.0545375	0.0638136	0.169477
Specific Gravity		0.475726	1.06929	0.477368	0.477702	0.481126
Mole Fraction Vapor	%	0	100	0	0	0
Molar Flow	lbmol/h	9204.98	1809.45	7395.52	7395.52	7395.52
Mass Flow	lb/h	326070	56037.6	270033	270033	270033
Mass Cp	Btu/(lb*°F)	0.710916	0.475891	0.710024	0.707563	0.684333

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	31	32	33	34	35
From Block	SPLT-106	E-202	SPLT-106	VLVE-101	MIX-103
To Block	E-202	MIX-103	VLVE-101	MIX-103	NGL to Treating

Stream Composition

Mole Fraction	31 %	32 %	33 %	34 %	35 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.14556	0.14556	0.14556	0.14556	0.14556
N2	1.30092E-08	1.30092E-08	1.30092E-08	1.30092E-08	1.30092E-08
C1	0.649687	0.649687	0.649687	0.649687	0.649687
C2	66.5665	66.5665	66.5665	66.5665	66.5665
C3	22.4585	22.4585	22.4585	22.4585	22.4585
iC4	2.26339	2.26339	2.26339	2.26339	2.26339
nC4	5.17904	5.17904	5.17904	5.17904	5.17904
iC5	0.879825	0.879825	0.879825	0.879825	0.879825
nC5	1.12781	1.12781	1.12781	1.12781	1.12781
C6	0.62902	0.62902	0.62902	0.62902	0.62902
C7	0.045842	0.045842	0.045842	0.045842	0.045842
C8	0.0164621	0.0164621	0.0164621	0.0164621	0.0164621
C9	0.00222372	0.00222372	0.00222372	0.00222372	0.00222372
C10	0.0204541	0.0204541	0.0204541	0.0204541	0.0204541
Benzene	0.004897	0.004897	0.004897	0.004897	0.004897
Toluene	0.00400559	0.00400559	0.00400559	0.00400559	0.00400559
Ethylbenzene	0.00133474	0.00133474	0.00133474	0.00133474	0.00133474
para-Xylene	0.00266942	0.00266942	0.00266942	0.00266942	0.00266942
Methanol	0.00275536	0.00275536	0.00275536	0.00275536	0.00275536

Stream Properties

Property	Units	31	32	33	34	35
Temperature	°F	34.2107	73.7691 *			73.7691
Pressure	psig	725	720	725	720	720
Molecular Weight	lb/lbmol	36.513	36.513	36.513	36.513	36.513
Std Vapor Volumetric Flow	MMSCFD	67.3556	67.3556	0	0	67.3556
Std Liquid Volumetric Flow	sgpm	1284.67	1284.67	0	0	1284.67
Compressibility		0.169477	0.170141			0.170141
Specific Gravity		0.481126	0.440703			0.440703
Mole Fraction Vapor	%	0	0			0
Molar Flow	lbmol/h	7395.52	7395.52	0	0	7395.52
Mass Flow	lb/h	270033	270033	0	0	270033
Mass Cp	Btu/(lb*°F)	0.684333	0.779433			0.779433

Remarks

Process Streams Report All Streams Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	36	37	38	39	40
From Block	T-501 Demethanizer	E-206	E-201	SPLT-103	SPLT-103
To Block	E-206	E-201	SPLT-103	Fuel to TO	EC-101 Compressor

Stream Composition

Mole Fraction	36 %	37 %	38 %	39 %	40 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.0148783	0.0148783	0.0148783	0.0148783	0.0148783
N2	0.461548	0.461548	0.461548	0.461548	0.461548
C1	99.4401	99.4401	99.4401	99.4401	99.4401
C2	0.0834666	0.0834666	0.0834666	0.0834666	0.0834666
C3	2.84571E-07	2.84571E-07	2.84571E-07	2.84571E-07	2.84571E-07
iC4	1.12323E-12	1.12323E-12	1.12323E-12	1.12323E-12	1.12323E-12
nC4	6.00632E-13	6.00632E-13	6.00632E-13	6.00632E-13	6.00632E-13
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	36	37	38	39	40
Temperature	°F	-171.184	-15.6398	91.5324 *	91.5324	91.5324
Pressure	psig	217	212	207	207	207
Molecular Weight	lb/lbmol	16.1136	16.1136	16.1136	16.1136	16.1136
Std Vapor Volumetric Flow	MMSCFD	277.584	277.584	277.584	0.09	273.99
Std Liquid Volumetric Flow	sgpm	3255.94	3255.94	3255.94	1.05566	3213.78
Compressibility		0.752807	0.938987	0.972001	0.972001	0.972001
Specific Gravity		0.55636	0.55636	0.55636	0.55636	0.55636
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	30478.3	30478.3	30478.3	9.88184	30083.7
Mass Flow	lb/h	491114	491114	491114	159.232	484755
Mass Cp	Btu/(lb*°F)	0.684453 ?	0.543182	0.555282	0.555282	0.555282

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Connections

	41	42	43	44	45
From Block	EC-101 Compressor	AC-301	CR-201/202 Stage 1	AC-201/202-IC	CR-201/202 Stage 2
To Block	AC-301	CR-201/202 Stage 1	AC-201/202-IC	CR-201/202 Stage 2	AC-201/202-A C

Stream Composition

Mole Fraction	41 %	42 %	43 %	44 %	45 %
H2O	0	0	0	0	0
H2S	0	0	0	0	0
CO2	0.0148783	0.0148783	0.0148783	0.0148783	0.0148783
N2	0.461548	0.461548	0.461548	0.461548	0.461548
C1	99.4401	99.4401	99.4401	99.4401	99.4401
C2	0.0834666	0.0834666	0.0834666	0.0834666	0.0834666
C3	2.84571E-07	2.84571E-07	2.84571E-07	2.84571E-07	2.84571E-07
iC4	1.12323E-12	1.12323E-12	1.12323E-12	1.12323E-12	1.12323E-12
nC4	6.00632E-13	6.00632E-13	6.00632E-13	6.00632E-13	6.00632E-13
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
Methanol	0	0	0	0	0

Stream Properties

Property	Units	41	42	43	44	45
Temperature	°F	129.733	120 *	263.652	120 *	220.619
Pressure	psig	256.894	251.894	601.8 *	596.8	1101.3 *
Molecular Weight	lb/lbmol	16.1136	16.1136	16.1136	16.1136	16.1136
Std Vapor Volumetric Flow	MMSCFD	273.99	273.99	273.99	273.99	273.99
Std Liquid Volumetric Flow	sgpm	3213.78	3213.78	3213.78	3213.78	3213.78
Compressibility		0.97395	0.972586	0.981473	0.941162	0.958684
Specific Gravity		0.55636	0.55636	0.55636	0.55636	0.55636
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	30083.7	30083.7	30083.7	30083.7	30083.7
Mass Flow	lb/h	484755	484755	484755	484755	484755
Mass Cp	Btu/(lb*°F)	0.570492	0.567252	0.639621	0.601548	0.656946

Remarks

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	RSV					
Connections						
From Block	46 AC-201/202-A C	47 SPLT-105	48 SPLT-105	49 RCYL-1	50 E-201	
To Block	SPLT-105	--	RCYL-1	E-201	E-206	
Stream Composition						
Mole Fraction	46 %	47 %	48 %	49 %	50 %	
H2O	0	0	0	0	0	
H2S	0	0	0	0	0	
CO2	0.0148783	0.0148783	0.0148783	0.0150444	0.0150444	
N2	0.461548	0.461548	0.461548	0.461556	0.461556	
C1	99.4401	99.4401	99.4401	99.4413	99.4413	
C2	0.0834666	0.0834666	0.0834666	0.0820721	0.0820721	
C3	2.84571E-07	2.84571E-07	2.84571E-07	3.31789E-07	3.31789E-07	
iC4	1.12323E-12	1.12323E-12	1.12323E-12	1.15377E-12	1.15377E-12	
nC4	6.00632E-13	6.00632E-13	6.00632E-13	6.00321E-13	6.00321E-13	
iC5	0	0	0	0	0	
nC5	0	0	0	0	0	
C6	0	0	0	0	0	
C7	0	0	0	0	0	
C8	0	0	0	0	0	
C9	0	0	0	0	0	
C10	0	0	0	0	0	
Benzene	0	0	0	0	0	
Toluene	0	0	0	0	0	
Ethylbenzene	0	0	0	0	0	
para-Xylene	0	0	0	0	0	
Methanol	0	0	0	0	0	
Stream Properties						
Property	Units	46	47	48	49	50
Temperature	°F	120 *	120	120	120	2 *
Pressure	psig	1096.3	1096.3	1096.3	1096.3	1091.3
Molecular Weight	lb/lbmol	16.1136	16.1136	16.1136	16.1134	16.1134
Std Vapor Volumetric Flow	MMSCFD	273.99	228.99	45 *	45	45
Std Liquid Volumetric Flow	sgpm	3213.78	2685.95	527.829	527.825	527.825
Compressibility		0.905423	0.905423	0.905423	0.905426	0.759753
Specific Gravity		0.55636	0.55636	0.55636	0.556355	0.556355
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	30083.7	25142.7	4940.92	4940.92	4940.92
Mass Flow	lb/h	484755	405140	79615.9	79615.2	79615.2
Mass Cp	Btu/(lb*°F)	0.6541	0.6541	0.6541	0.654099	0.774076
Remarks						

		Process Streams Report All Streams Tabulated by Total Phase				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II					
Flowsheet:	RSV					
Connections						
From Block		51 E-206	52 RSV VALVE	53 SPLT-103		
To Block		RSV VALVE	T-501 Demethanizer	Fuel to Heaters		
Stream Composition						
Mole Fraction		51 %	52 %	53 %		
H2O		0	0	0		
H2S		0	0	0		
CO2		0.0150444	0.0150444	0.0148783		
N2		0.461556	0.461556	0.461548		
C1		99.4413	99.4413	99.4401		
C2		0.0820721	0.0820721	0.0834666		
C3		3.31789E-07	3.31789E-07	2.84571E-07		
iC4		1.15377E-12	1.15377E-12	1.12323E-12		
nC4		6.00321E-13	6.00321E-13	6.00632E-13		
iC5		0	0	0		
nC5		0	0	0		
C6		0	0	0		
C7		0	0	0		
C8		0	0	0		
C9		0	0	0		
C10		0	0	0		
Benzene		0	0	0		
Toluene		0	0	0		
Ethylbenzene		0	0	0		
para-Xylene		0	0	0		
Methanol		0	0	0		
Stream Properties						
Property	Units	51	52	53		
Temperature	°F	-119 *	-172.385	91.5324		
Pressure	psig	1089.3	217 *	207		
Molecular Weight	lb/lbmol	16.1134	16.1134	16.1136		
Std Vapor Volumetric Flow	MMSCFD	45	45	3.50395		
Std Liquid Volumetric Flow	sgpm	527.825	527.825	41.0997		
Compressibility		0.274633 ?	0.310081	0.972001		
Specific Gravity		0.283694 ?		0.55636		
Mole Fraction Vapor	%	0	36.4884	100		
Molar Flow	lbmol/h	4940.92	4940.92	384.727		
Mass Flow	lb/h	79615.2	79615.2	6199.33		
Mass Cp	Btu/(lb*°F)	1.39953 ?	0.98318 ?	0.555282		
Remarks						

Energy Stream Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Energy Streams

Energy Stream	Energy Rate	Power	From Block	To Block
Q-AC201-AC	3.17606E+07 Btu/h	12482.4 hp	AC-201/202-AC	--
Q-AC201-IC	4.29557E+07 Btu/h	16882.2 hp	AC-201/202-IC	--
Q-AC301	2.61184E+06 Btu/h	1026.49 hp	AC-301	--
Q-EC101C	9.66885E+06 * Btu/h	3800 * hp	--	EC-101 Compressor
Q-EC101E	1.01777E+07 * Btu/h	4000 * hp	EC-101 Expander	--
Q-E203	8.50908E+06 Btu/h	3344.19 hp	E-203	Cryo Refrig Duty
Q-E204	1.01509E+07 Btu/h	3989.44 hp	E-204 (Supply)	E-204 (Demand)
Q-E205	1.95E+07 * Btu/h	7663.79 * hp	E-205 (Supply)	E-205 (Demand)
Q-P600	89481.1 Btu/h	35.1674 hp	--	P-600/1/2
Q-P1205	1.11254E+06 Btu/h	437.244 hp	--	P-1205A/B/C
Q-Stage1	3.7969E+07 Btu/h	14922.4 hp	--	CR-201/202 Stage 1
Q-Stage2	2.48627E+07 Btu/h	9771.41 hp	--	CR-201/202 Stage 2

Remarks

		Blocks AC-201/202-AC Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:54 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
45	Inlet	CR-201/202 Stage 2	46	Outlet	SPLT-105
Q-AC201-AC	Energy				
Block Parameters					
* Pressure Drop	5	psi	Mass Duty	-65.5188	Btu/lb
Temperature Change	-100.619	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-3.17606E+07	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks AC-201/202-IC Heat Exchanger Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:53 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
43	Inlet	CR-201/202 Stage 1	44	Outlet	CR-201/202 Stage 2
Q-AC201-IC	Energy				
Block Parameters					
* Pressure Drop	5	psi	Mass Duty	-88.6132	Btu/lb
Temperature Change	-143.652	°F	Heat Release Curve Type	Plug Flow	
Heat Duty	-4.29557E+07	Btu/h	Heat Release Curve Increments	10	
Remarks					

		Blocks AC-301 Heat Exchanger Report				
Client Name:	Energy Transfer			Job: Plan Approval Application		
Location:	Cryo II			Modified: 1:07 PM, 2/9/2023		
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025		
Connections						
Stream	Connection Type	Other Block		Stream	Connection Type	Other Block
41	Inlet	EC-101 Compressor		42	Outlet	CR-201/202 Stage 1
Q-AC301	Energy					
Block Parameters						
* Pressure Drop		5 psi		Mass Duty		-5.38795 Btu/lb
Temperature Change		-9.73272 °F		Heat Release Curve Type		Plug Flow
Heat Duty		-2.61184E+06 Btu/h		Heat Release Curve Increments		10
Remarks						

		Blocks CR-201/202 Stage 1 Compressor Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:53 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
42	Inlet	AC-301	43	Outlet	AC-201/202-IC
Q-Stage1	Energy				
Block Parameters					
Polytropic Efficiency		83.9831 %	Polytropic Head Correction Factor		1.00033
Polytropic Head		51188.5 ft	Pressure Change		349.906 psi
Polytropic n		1.37721	Compression Ratio		2.31993
* Isentropic (Adiabatic) Efficiency		82.5 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		50284.5 ft	Power		14922.4 hp
Isentropic k		1.30378	Ideal Work Method		Entropy Based
Remarks					

		Blocks CR-201/202 Stage 2 Compressor Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:54 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
44	Inlet	AC-201/202-IC	45	Outlet	AC-201/202-AC
Q-Stage2	Energy				
Block Parameters					
Polytropic Efficiency		86.4474 %	Polytropic Head Correction Factor		0.999383
Polytropic Head		34502.6 ft	Pressure Change		504.5 psi
Polytropic n		1.4208	Compression Ratio		1.82705
* Isentropic (Adiabatic) Efficiency		85.5 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		34124.5 ft	Power		9771.41 hp
Isentropic k		1.35245	Ideal Work Method		Entropy Based
Remarks					

		Blocks Cryo Refrig Duty Flowsheet Connector Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:58 PM, 9/19/2013	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Q-E203 [RSV]	Energy Inlet	E-203 [RSV]	Q-E203 [Cryo Refrig]	Energy Inlet	E-203 [Cryo Refrig]
Block Parameters					
Inlet Temperature		°F	Outlet Fraction Vapor		%
Inlet Pressure		psig	Outlet Mass Enthalpy		Btu/lb
Inlet Fraction Vapor		%	Temperature Difference		°F
Inlet Mass Enthalpy		Btu/lb	Pressure Difference		psi
Outlet Temperature		°F	Fraction Vapor Difference		%
Outlet Pressure		psig	Mass Enthalpy Difference		Btu/lb
Remarks					

Blocks
Dry Gas to Cryo
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:25 PM, 2/7/2023
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
9 [Gas Sieve]	Inlet	SPLT-100 [Gas Sieve]	1 [RSV]	Outlet	SPLT-100 [RSV]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1670.65 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	90.3831 °F	Fraction Vapor Difference	0 %
Inlet Pressure	932 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1670.65 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	90.3831 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	932 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

Blocks
E-201
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:12 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
49	Inlet	RCYL-1	37	Inlet	E-206
2	Inlet	SPLT-100	50	Outlet	E-206
38	Outlet	SPLT-103	3	Outlet	MIX-100

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	120 °F
Minimum Effective Approach Temperature	4.08184 °F	Lowest Supply Temperature	2 °F
Maximum Effective Approach Temperature	28.4675 °F	Highest Demand Temperature	91.5324 °F
Log Mean Temperature Difference	22.6234 °F	Lowest Demand Temperature	-15.6398 °F
Effective Mean Temperature Difference	6.71763 °F	Total Energy Supply	2.88726E+07 Btu/h
End Point UA	1.27623E+06 Btu/(h*°F)	Total Energy Demand	2.88726E+07 Btu/h
Effective UA	4.29804E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-201 - A	120	2	-6.48477E+06	6.71763
E-201 - B	-15.6398	91.5324	2.88726E+07	6.71763
E-201 - C	90.3831	6.88701	-2.23879E+07	6.49152

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-201 - A	965336	5.21583	16.399	
E-201 - B	4.29804E+06	4.73722	15.9204	
E-201 - C	3.44879E+06	7.67884	13.8727	

Remarks

Blocks
E-201 - A
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:08 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 5:03 PM, 3/4/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-81.4515 Btu/lb
Temperature Change	-118 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-6.48477E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	120 °F
Minimum Effective Approach Temperature	4.08184 °F	Lowest Supply Temperature	2 °F
Maximum Effective Approach Temperature	28.4675 °F	Highest Demand Temperature	91.5324 °F
Log Mean Temperature Difference	22.6234 °F	Lowest Demand Temperature	-15.6398 °F
Effective Mean Temperature Difference	6.71763 °F	Total Energy Supply	2.88726E+07 Btu/h
End Point UA	1.27623E+06 Btu/(h*°F)	Total Energy Demand	2.88726E+07 Btu/h
Effective UA	4.29804E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-201 - A	120	2	-6.48477E+06	6.71763
E-201 - B	-15.6398	91.5324	2.88726E+07	6.71763
E-201 - C	90.3831	6.88701	-2.23879E+07	6.49152

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-201 - A	965336	5.21583	16.399	
E-201 - B	4.29804E+06	4.73722	15.9204	
E-201 - C	3.44879E+06	7.67884	13.8727	

Remarks

Blocks
E-201 - B
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:09 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	58.7901 Btu/lb
Temperature Change	107.172 °F	Heat Release Curve Type	Plug Flow
Heat Duty	2.88726E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	120 °F
Minimum Effective Approach Temperature	4.08184 °F	Lowest Supply Temperature	2 °F
Maximum Effective Approach Temperature	28.4675 °F	Highest Demand Temperature	91.5324 °F
Log Mean Temperature Difference	22.6234 °F	Lowest Demand Temperature	-15.6398 °F
Effective Mean Temperature Difference	6.71763 °F	Total Energy Supply	2.88726E+07 Btu/h
End Point UA	1.27623E+06 Btu/(h*°F)	Total Energy Demand	2.88726E+07 Btu/h
Effective UA	4.29804E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-201 - A	120	2	-6.48477E+06	6.71763
E-201 - B	-15.6398	91.5324	2.88726E+07	6.71763
E-201 - C	90.3831	6.88701	-2.23879E+07	6.49152

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-201 - A	965336	5.21583	16.399	
E-201 - B	4.29804E+06	4.73722	15.9204	
E-201 - C	3.44879E+06	7.67884	13.8727	

Remarks

Blocks
E-201 - C
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:10 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-69.8923 Btu/lb
Temperature Change	-83.4961 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-2.23879E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	120 °F
Minimum Effective Approach Temperature	4.08184 °F	Lowest Supply Temperature	2 °F
Maximum Effective Approach Temperature	28.4675 °F	Highest Demand Temperature	91.5324 °F
Log Mean Temperature Difference	22.6234 °F	Lowest Demand Temperature	-15.6398 °F
Effective Mean Temperature Difference	6.71763 °F	Total Energy Supply	2.88726E+07 Btu/h
End Point UA	1.27623E+06 Btu/(h*°F)	Total Energy Demand	2.88726E+07 Btu/h
Effective UA	4.29804E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-201 - A	120	2	-6.48477E+06	6.71763
E-201 - B	-15.6398	91.5324	2.88726E+07	6.71763
E-201 - C	90.3831	6.88701	-2.23879E+07	6.49152

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-201 - A	965336	5.21583	16.399	
E-201 - B	4.29804E+06	4.73722	15.9204	
E-201 - C	3.44879E+06	7.67884	13.8727	

Remarks

Blocks
E-202
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:14 AM, 8/30/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
4	Inlet	SPLT-100	31	Inlet	SPLT-106
5	Outlet	SPLT-104	32	Outlet	MIX-103

Energy Specifications

Minimum End Approach Temperature	16.614 °F	Highest Supply Temperature	90.3831 °F
Minimum Effective Approach Temperature	16.614 °F	Lowest Supply Temperature	58.1191 °F
Maximum Effective Approach Temperature	23.9084 °F	Highest Demand Temperature	73.7691 °F
Log Mean Temperature Difference	20.0404 °F	Lowest Demand Temperature	34.2107 °F
Effective Mean Temperature Difference	19.4384 °F	Total Energy Supply	7.77428E+06 Btu/h
End Point UA	387930 Btu/(h*°F)	Total Energy Demand	7.77428E+06 Btu/h
Effective UA	399943 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-202 - A	90.3831	58.1191	-7.77428E+06	19.4384
E-202 - B	34.2107	73.7691	7.77428E+06	19.4384

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-202 - A	399943	1.60994	1.6631	
E-202 - B	399943	1.97393	2.02709	

Remarks

Blocks
E-202 - A
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 6:14 PM, 10/26/2015
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-21.5228 Btu/lb
Temperature Change	-32.264 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-7.77428E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	16.614 °F	Highest Supply Temperature	90.3831 °F
Minimum Effective Approach Temperature	16.614 °F	Lowest Supply Temperature	58.1191 °F
Maximum Effective Approach Temperature	23.9084 °F	Highest Demand Temperature	73.7691 °F
Log Mean Temperature Difference	20.0404 °F	Lowest Demand Temperature	34.2107 °F
Effective Mean Temperature Difference	19.4384 °F	Total Energy Supply	7.77428E+06 Btu/h
End Point UA	387930 Btu/(h*°F)	Total Energy Demand	7.77428E+06 Btu/h
Effective UA	399943 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-202 - A	90.3831	58.1191	-7.77428E+06	19.4384
E-202 - B	34.2107	73.7691	7.77428E+06	19.4384

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-202 - A	399943	1.60994	1.6631	
E-202 - B	399943	1.97393	2.02709	

Remarks

Blocks
E-202 - B
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:40 PM, 6/26/2012
Flowsheet:	RSV	Status: Solved

Block Parameters

* Pressure Drop	5 psi	Mass Duty	28.7901 Btu/lb
Temperature Change	39.5584 °F	Heat Release Curve Type	Plug Flow
Heat Duty	7.77428E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	16.614 °F	Highest Supply Temperature	90.3831 °F
Minimum Effective Approach Temperature	16.614 °F	Lowest Supply Temperature	58.1191 °F
Maximum Effective Approach Temperature	23.9084 °F	Highest Demand Temperature	73.7691 °F
Log Mean Temperature Difference	20.0404 °F	Lowest Demand Temperature	34.2107 °F
Effective Mean Temperature Difference	19.4384 °F	Total Energy Supply	7.77428E+06 Btu/h
End Point UA	387930 Btu/(h*°F)	Total Energy Demand	7.77428E+06 Btu/h
Effective UA	399943 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-202 - A	90.3831	58.1191	-7.77428E+06	19.4384
E-202 - B	34.2107	73.7691	7.77428E+06	19.4384

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-202 - A	399943	1.60994	1.6631	
E-202 - B	399943	1.97393	2.02709	

Remarks

Blocks
E-203
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:15 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	MIX-100	12	Outlet	V-402 Cold Separator
Q-E203	Energy	Cryo Refrig Duty			

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-12.4852 Btu/lb
Temperature Change	-10.1575 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-8.50908E+06 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	10 °F	Highest Supply Temperature	-8.84255 °F
Minimum Effective Approach Temperature	10 °F	Lowest Supply Temperature	-19 °F
Maximum Effective Approach Temperature	21.6873 °F	Highest Demand Temperature	-29 °F
Log Mean Temperature Difference	15.0971 °F	Lowest Demand Temperature	-30.5298 °F
Effective Mean Temperature Difference	15.0861 °F	Total Energy Supply	8.50908E+06 Btu/h
End Point UA	563623 Btu/(h*°F)	Total Energy Demand	8.50908E+06 Btu/h
Effective UA	564034 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-203	-29	-30.5298	8.50908E+06	15.0861
E-203	-29	-30.5298	8.50908E+06	15.0861

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-203	564034	0.101333	0.103261
E-203	564034	0.101333	0.103261

Remarks

Blocks
E-204 (Demand)
Separator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:40 PM, 9/14/2011
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
26	Inlet	T-501 Demethanizer	27	Vapor Outlet	T-501 Demethanizer
28	Light Liquid Outlet	P-600/1/2	Q-E204	Energy	E-204 (Supply)

Block Parameters

Pressure Drop	0 psi	Main Liquid Phase	Light Liquid
Mole Fraction Vapor	19.6573 %	Heat Duty	1.01509E+07 Btu/h
Mole Fraction Light Liquid	80.3427 %	Heat Release Curve Type	Plug Flow
Mole Fraction Heavy Liquid	0 %	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	7.53817 °F	Highest Supply Temperature	58.1191 °F
Minimum Effective Approach Temperature	7.53817 °F	Lowest Supply Temperature	25.4413 °F
Maximum Effective Approach Temperature	31.2359 °F	Highest Demand Temperature	26.8832 °F
Log Mean Temperature Difference	16.6699 °F	Lowest Demand Temperature	17.9032 °F
Effective Mean Temperature Difference	15.3656 °F	Total Energy Supply	1.01509E+07 Btu/h
End Point UA	608934 Btu/(h*°F)	Total Energy Demand	1.01509E+07 Btu/h
Effective UA	660622 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-204 (Demand)	17.9032	26.8832	1.01509E+07	15.3656
E-204 (Supply)	58.1191	25.4413	-1.01509E+07	15.3656

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU
E-204 (Demand)	660622	0.538699	0.619547
E-204 (Supply)	660622	1.96029	2.04114

Remarks

Blocks
E-204 (Supply)
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:06 AM, 8/31/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	SPLT-104	7	Outlet	MIX-102
Q-E204	Energy	E-204 (Demand)			

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-28.1022 Btu/lb
Temperature Change	-32.6778 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-1.01509E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	7.53817 °F	Highest Supply Temperature	58.1191 °F
Minimum Effective Approach Temperature	7.53817 °F	Lowest Supply Temperature	25.4413 °F
Maximum Effective Approach Temperature	31.2359 °F	Highest Demand Temperature	26.8832 °F
Log Mean Temperature Difference	16.6699 °F	Lowest Demand Temperature	17.9032 °F
Effective Mean Temperature Difference	15.3656 °F	Total Energy Supply	1.01509E+07 Btu/h
End Point UA	608934 Btu/(h*°F)	Total Energy Demand	1.01509E+07 Btu/h
Effective UA	660622 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-204 (Demand)	17.9032	26.8832	1.01509E+07	15.3656
E-204 (Supply)	58.1191	25.4413	-1.01509E+07	15.3656

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-204 (Demand)	660622	0.538699	0.619547	
E-204 (Supply)	660622	1.96029	2.04114	

Remarks

Blocks
E-205 (Demand)
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 7:48 PM, 3/18/2014
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
24	Inlet	T-501 Demethanizer	25	Outlet	T-501 Demethanizer
Q-E205	Energy	E-205 (Supply)			

Block Parameters

* Pressure Drop	0 psi	Mass Duty	51.4303 Btu/lb
Temperature Change	33.5237 °F	Heat Release Curve Type	Plug Flow
Heat Duty	1.95E+07 Btu/h	* Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	9.79479 °F	Highest Supply Temperature	25.4413 °F
Minimum Effective Approach Temperature	9.33661 °F	Lowest Supply Temperature	-21.2339 °F
Maximum Effective Approach Temperature	22.9464 °F	Highest Demand Temperature	2.49498 °F
Log Mean Temperature Difference	15.4486 °F	Lowest Demand Temperature	-31.0287 °F
Effective Mean Temperature Difference	12.2279 °F	Total Energy Supply	1.95E+07 Btu/h
End Point UA	1.26225E+06 Btu/(h*°F)	Total Energy Demand	1.95E+07 Btu/h
Effective UA	1.59472E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-205 (Demand)	-31.0287	2.49498	1.95E+07	12.2279
E-205 (Supply)	25.4413	-21.2339	-1.95E+07	12.2279

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-205 (Demand)	1.59472E+06	2.17001	2.89146	
E-205 (Supply)	1.59472E+06	3.02132	3.74277	

Remarks

Blocks
E-205 (Supply)
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 10:46 AM, 8/30/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
9	Inlet	MIX-102	10	Outlet	MIX-100
Q-E205	Energy	E-205 (Demand)			

Block Parameters

* Pressure Drop	5 psi	Mass Duty	-53.985 Btu/lb
Temperature Change	-46.6753 °F	Heat Release Curve Type	Plug Flow
Heat Duty	-1.95E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	9.79479 °F	Highest Supply Temperature	25.4413 °F
Minimum Effective Approach Temperature	9.33661 °F	Lowest Supply Temperature	-21.2339 °F
Maximum Effective Approach Temperature	22.9464 °F	Highest Demand Temperature	2.49498 °F
Log Mean Temperature Difference	15.4486 °F	Lowest Demand Temperature	-31.0287 °F
Effective Mean Temperature Difference	12.2279 °F	Total Energy Supply	1.95E+07 Btu/h
End Point UA	1.26225E+06 Btu/(h*°F)	Total Energy Demand	1.95E+07 Btu/h
Effective UA	1.59472E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-205 (Demand)	-31.0287	2.49498	1.95E+07	12.2279
E-205 (Supply)	25.4413	-21.2339	-1.95E+07	12.2279

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-205 (Demand)	1.59472E+06	2.17001	2.89146	
E-205 (Supply)	1.59472E+06	3.02132	3.74277	

Remarks

Blocks
E-206
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 10:09 PM, 7/31/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
50	Inlet	E-201	36	Inlet	T-501 Demethanizer
21	Inlet	MIX-101	51	Outlet	RSV VALVE
37	Outlet	E-201	22	Outlet	GSP VALVE

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	2 °F
Minimum Effective Approach Temperature	1.69219 °F	Lowest Supply Temperature	-119 °F
Maximum Effective Approach Temperature	52.3375 °F	Highest Demand Temperature	-15.6398 °F
Log Mean Temperature Difference	31.8491 °F	Lowest Demand Temperature	-171.184 °F
Effective Mean Temperature Difference	13.193 °F	Total Energy Supply	4.42555E+07 Btu/h
End Point UA	1.38954E+06 Btu/(h*°F)	Total Energy Demand	4.42555E+07 Btu/h
Effective UA	3.35446E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-206 - A	2	-119	-1.27135E+07	13.193
E-206 - B	-171.184	-15.6398	4.42555E+07	13.193
E-206 - C	-19.0158	-119	-3.1542E+07	13.6127

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-206 - A	963649	3.79917	11.2035	
E-206 - B	3.35446E+06	4.88378	12.2881	
E-206 - C	2.3171E+06	6.78967	8.10083	

Remarks

Blocks
E-206 - A
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:43 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 5:03 PM, 3/4/2025

Block Parameters

* Pressure Drop	2 psi	? Mass Duty	-159.687 Btu/lb
Temperature Change	-121 °F	Heat Release Curve Type	Plug Flow
? Heat Duty	-1.27135E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	2 °F
Minimum Effective Approach Temperature	1.69219 °F	Lowest Supply Temperature	-119 °F
Maximum Effective Approach Temperature	52.3375 °F	Highest Demand Temperature	-15.6398 °F
Log Mean Temperature Difference	31.8491 °F	Lowest Demand Temperature	-171.184 °F
Effective Mean Temperature Difference	13.193 °F	Total Energy Supply	4.42555E+07 Btu/h
End Point UA	1.38954E+06 Btu/(h*°F)	Total Energy Demand	4.42555E+07 Btu/h
Effective UA	3.35446E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-206 - A	2	-119	-1.27135E+07	13.193
E-206 - B	-171.184	-15.6398	4.42555E+07	13.193
E-206 - C	-19.0158	-119	-3.1542E+07	13.6127

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-206 - A	963649	3.79917	11.2035	
E-206 - B	3.35446E+06	4.88378	12.2881	
E-206 - C	2.3171E+06	6.78967	8.10083	

Remarks

Blocks
E-206 - B
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:45 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	Mass Duty	90.1125 Btu/lb
Temperature Change	155.544 °F	Heat Release Curve Type	Plug Flow
Heat Duty	4.42555E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	2 °F
Minimum Effective Approach Temperature	1.69219 °F	Lowest Supply Temperature	-119 °F
Maximum Effective Approach Temperature	52.3375 °F	Highest Demand Temperature	-15.6398 °F
Log Mean Temperature Difference	31.8491 °F	Lowest Demand Temperature	-171.184 °F
Effective Mean Temperature Difference	13.193 °F	Total Energy Supply	4.42555E+07 Btu/h
End Point UA	1.38954E+06 Btu/(h*°F)	Total Energy Demand	4.42555E+07 Btu/h
Effective UA	3.35446E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-206 - A	2	-119	-1.27135E+07	13.193
E-206 - B	-171.184	-15.6398	4.42555E+07	13.193
E-206 - C	-19.0158	-119	-3.1542E+07	13.6127

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-206 - A	963649	3.79917	11.2035	
E-206 - B	3.35446E+06	4.88378	12.2881	
E-206 - C	2.3171E+06	6.78967	8.10083	

Remarks

Blocks
E-206 - C
Heat Exchanger Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:45 PM, 6/10/2017
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Block Parameters

* Pressure Drop	5 psi	? Mass Duty	-151.334 Btu/lb
Temperature Change	-99.9842 °F	Heat Release Curve Type	Plug Flow
? Heat Duty	-3.1542E+07 Btu/h	Heat Release Curve Increments	10

Energy Specifications

Minimum End Approach Temperature	17.6398 °F	Highest Supply Temperature	2 °F
Minimum Effective Approach Temperature	1.69219 °F	Lowest Supply Temperature	-119 °F
Maximum Effective Approach Temperature	52.3375 °F	Highest Demand Temperature	-15.6398 °F
Log Mean Temperature Difference	31.8491 °F	Lowest Demand Temperature	-171.184 °F
Effective Mean Temperature Difference	13.193 °F	Total Energy Supply	4.42555E+07 Btu/h
End Point UA	1.38954E+06 Btu/(h*°F)	Total Energy Demand	4.42555E+07 Btu/h
Effective UA	3.35446E+06 Btu/(h*°F)	Allow Temperature Cross	False

Energy Specifications (Tabular Data)

Index	Side Inlet Temperature °F	Side Outlet Temperature °F	Side Heat Duty Btu/h	Side Effective Mean Temperature Difference °F
E-206 - A	2	-119	-1.27135E+07	13.193
E-206 - B	-171.184	-15.6398	4.42555E+07	13.193
E-206 - C	-19.0158	-119	-3.1542E+07	13.6127

Index	Side Effective UA Btu/(h*°F)	Side End Point NTU	Side Effective NTU	
E-206 - A	963649	3.79917	11.2035	
E-206 - B	3.35446E+06	4.88378	12.2881	
E-206 - C	2.3171E+06	6.78967	8.10083	

Remarks

		Blocks EC-101 Compressor Compressor Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:53 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
40	Inlet	SPLT-103	41	Outlet	AC-301
Q-EC101C	Energy				
Block Parameters					
* Polytropic Efficiency		70 %	Polytropic Head Correction Factor		1.00003
Polytropic Head		10864.9 ft	Pressure Change		49.8941 psi
Polytropic n		1.51035	Compression Ratio		1.22659
Isentropic (Adiabatic) Efficiency		69.2771 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		10752.7 ft	Power		3800 hp
Isentropic k		1.31101	Ideal Work Method		Entropy Based
Remarks					

		Blocks EC-101 Expander Expander Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:33 PM, 8/12/2017	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
18	Inlet	SPLT-101	19	Outlet	T-501 Demethanizer
Q-EC101E	Energy				
Block Parameters					
Polytropic Efficiency		89.0118 %	Polytropic Head Correction Factor		1.00138
Polytropic Head		-30083.9 ft	Pressure Change		-692.75 psi
Polytropic n		1.03961	Compression Ratio		0.251041
* Isentropic (Adiabatic) Efficiency		90 %	Compressor Rotation Speed		rpm
Isentropic (Adiabatic) Head		-29753.6 ft	Power		-4000 hp
Isentropic k		1.05736	Ideal Work Method		Entropy Based
Remarks					

Blocks
Fuel to Heaters
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:47 PM, 4/11/2023
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
53 [RSV]	Inlet	SPLT-103 [RSV]	16 [Fired Heaters]	Outlet	VLVE-100 [Fired Heaters]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1982.25 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	91.5324 °F	Fraction Vapor Difference	0 %
Inlet Pressure	207 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1982.25 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	91.5324 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	207 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

Blocks
Fuel to TO
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:46 PM, 4/11/2023
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
39 [RSV]	Inlet	SPLT-103 [RSV]	11 [ThermOx]	Outlet	VLVE-101 [ThermOx]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1982.25 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	91.5324 °F	Fraction Vapor Difference	0 %
Inlet Pressure	207 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1982.25 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	91.5324 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	207 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

Blocks
GSP VALVE
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:05 PM, 8/29/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
22	Inlet	E-206	23	Outlet	T-501 Demethanizer

Block Parameters

Pressure Drop	688.75 psi	? Simple Compressible Cv	83.522
Joule-Thomson Coefficient	0.0593617 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
Simple Incompressible Cv	26.4284		

Remarks

		Blocks MIX-100 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 4:42 PM, 10/26/2016	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
10	Inlet	E-205 (Supply)	3	Inlet	E-201
11	Outlet	E-203			
Block Parameters					
Pressure Drop		0 psi	Fraction to Stream 11		100 %
Flow Multiplier		100 %			
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

Blocks
MIX-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:04 PM, 8/29/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
16	Inlet	SPLT-102	20	Inlet	SPLT-101
21	Outlet	E-206			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 21	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-102
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 10:46 AM, 8/30/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	SPLT-104	7	Inlet	E-204 (Supply)
9	Outlet	E-205 (Supply)			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 9	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
MIX-103
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:14 AM, 8/30/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
34	Inlet	VLVE-101	32	Inlet	E-202
35	Outlet	NGL to Treating			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 35	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
NGL to Treating
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 4:26 PM, 2/9/2023
Flowsheet:	RSV	Status: Solved 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
35 [RSV]	Inlet	MIX-103 [RSV]	13 [NGL Amine]	Outlet	MIX-102 [NGL Amine]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1263.52 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	73.7691 °F	Fraction Vapor Difference	0 %
Inlet Pressure	720 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	0 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1263.52 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	73.7691 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	720 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	0 %		

Remarks

		Blocks P-600/1/2 Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 5:10 PM, 10/26/2016	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
28	Inlet	E-204 (Demand)	29	Outlet	P-1205A/B/C
Q-P600	Energy				
Block Parameters					
* Overall Efficiency	75	%	Power	35.1674	hp
* Pressure Change	40	psi	Speed		rpm
Dynamic Head	193.397	ft	Power Estimate	0	hp
Remarks					

		Blocks P-1205A/B/C Pump Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:51 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
29	Inlet	P-600/1/2	30	Outlet	SPLT-106
Q-P1205	Energy				
Block Parameters					
* Overall Efficiency	70 %	Power	437.244 hp		
Pressure Change	466 psi	Speed	rpm		
Dynamic Head	2244.28 ft	Power Estimate	0 hp		
Remarks					

Blocks
RCYL-1
Recycle Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:53 PM, 8/29/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
48	Inlet	SPLT-105	49	Outlet	E-201

Block Parameters

Error	0.000139447	Recycle Dependencies	1
Iterations	1	Solver Dependencies	0
Priority	1	Recycle State	Active
* Calculate	True	* Flash Variables	Pressure, Enthalpy
Block Dependencies	14		
* Recycle Variables	Pressure, Enthalpy, Component Flow, Mass Flow		

Tabulated Block Data

Index	Function values	Weights		
Pressure	0	1		
Enthalpy	-1.41977E-05	1		
Mass Flow	9.19927E-06	1		
H2O	0	1		
H2S	0	1		
CO2	-1.66093E-05	1		
N2	-7.51232E-07	1		
C1	-0.000122082	1		
C2	0.000139447	1		
C3	-4.72182E-09	1		
iC4	-3.05448E-15	1		
nC4	3.11506E-17	1		
iC5	0	1		
nC5	0	1		
C6	0	1		
C7	0	1		
C8	0	1		
C9	0	1		
C10	0	1		
Benzene	0	1		
Toluene	0	1		
Ethylbenzene	0	1		
para-Xylene	0	1		
Methanol	0	1		

Remarks

		Blocks RSV VALVE JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:06 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 5:03 PM, 3/4/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
51	Inlet	E-206	52	Outlet	T-501 Demethanizer
Block Parameters					
Pressure Drop		872.3 psi	? Simple Compressible Cv		28.885
Joule-Thomson Coefficient		0.0611999 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		10.117			
Remarks					

		Blocks SPLT-100 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:01 PM, 6/5/2023	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	Dry Gas to Cryo	2	Outlet	E-201
4	Outlet	E-202			
Block Parameters					
Pressure Drop		0 psi	Fraction to Stream 2		47 %
Flow Multiplier		100 %	* Fraction to Stream 4		53 %
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

			Blocks SPLT-101 Mixer/Splitter Report							
Client Name:		Energy Transfer			Job: Plan Approval Application					
Location:		Cryo II			Modified: 3:57 PM, 2/20/2023					
Flowsheet:		RSV			Status: Solved 12:26 PM, 3/7/2025					
Connections										
Stream		Connection Type		Other Block	Stream		Connection Type		Other Block	
17		Inlet		V-402 Cold Separator	18		Outlet		EC-101 Expander	
20		Outlet		MIX-101						
Block Parameters										
Pressure Drop			0 psi		Fraction to Stream 18			59.7674 %		
Flow Multiplier			100 %		Fraction to Stream 20			40.2326 %		
Pressure Balancing Mode Properties										
Pressure Balancing Mode			False							
Remarks										

		Blocks SPLT-102 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:14 PM, 2/16/2023	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
13	Inlet	V-402 Cold Separator	16	Outlet	MIX-101
14	Outlet	VLVE-100			
Block Parameters					
Pressure Drop		0 psi	* Fraction to Stream 16		5 %
Flow Multiplier		100 %	Fraction to Stream 14		95 %
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

		Blocks SPLT-103 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:47 PM, 4/11/2023	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
38	Inlet	E-201	40	Outlet	EC-101 Compressor
39	Outlet	Fuel to TO	53	Outlet	Fuel to Heaters
Block Parameters					
Pressure Drop		0 psi	Fraction to Stream 39		0.0324226 %
Flow Multiplier		100 %	Fraction to Stream 53		1.2623 %
Fraction to Stream 40		98.7053 %			
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

		Blocks SPLT-104 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 11:07 AM, 8/31/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	E-202	6	Outlet	E-204 (Supply)
8	Outlet	MIX-102			
Block Parameters					
Pressure Drop	0	psi	* Fraction to Stream 6	100	%
Flow Multiplier	100	%	Fraction to Stream 8	0	%
Pressure Balancing Mode Properties					
Pressure Balancing Mode	False				
Remarks					

Blocks
SPLT-105
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:54 PM, 8/29/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
46	Inlet	AC-201/202-AC	48	Outlet	RCYL-1
47	Outlet				

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 48	16.4239 %
Flow Multiplier	100 %	Fraction to Stream 47	83.5761 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
SPLT-106
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 1:59 PM, 8/31/2022
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
30	Inlet	P-1205A/B/C	31	Outlet	E-202
33	Outlet	VLVE-101			

Block Parameters

Pressure Drop	0 psi	* Fraction to Stream 31	100 %
Flow Multiplier	100 %	Fraction to Stream 33	0 %

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

Blocks
T-501 Demethanizer
Column Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 12:33 PM, 5/12/2023
Flowsheet:	RSV	Status: Solved 12:26 PM, 3/7/2025

Stage Connections

Stage	Type	Connected Stream	Direction	Block
1	Inlet	52	From	RSV VALVE
1	Vapor Outlet	36	To	E-206
5	Inlet	23	From	GSP VALVE
8	Inlet	19	From	EC-101 Expander
11	Inlet	15	From	VLVE-100
14	Light Liquid Outlet	24	To	E-205 (Demand)
15	Inlet	25	From	E-205 (Demand)
18	Inlet	27	From	E-204 (Demand)
18	Light Liquid Outlet	26	To	E-204 (Demand)

Column Attachments

Type	Block Name	Type	Block Name	Type	Block Name
Reboiler	E-204 (Demand)				

Block Parameters

* Number of Stages	18	Copy Lock	
Degrees of Freedom	0	Murphree Efficiencies Active	False
Model Type	Ideal Stage	Efficiency Phase	Light Liquid
Ideal Stage Column Type	General Ideal Stage	Outer Loop Iterations	11
* Flash Type	VLE	Enthalpy Model	Boston-Britt
* Column Add-ons	Reboiler	Inner Loop Model	Boston-Sullivan
Solve after Execute	True	K Damping	0
* First Liquid Phase	Nonspecific Liquid	Boston-Sullivan Kb	False
Phase Threshold	0.1 %	MESH Method	Boston-Sullivan Inside-Out
VLE Liquid	Default	Maximum Initial Iterations	50
Allow Overspecification	False	Use Last Solution	True
* Number Column Top Down	True	Approach To Equilibrium Numerator Phase	Light Liquid
* Pressure Change	2 psi	Approach To Equilibrium Denominator Phase	Vapor
Bottoms Head	0 psi		

Column Specifications**Boilup Ratio 1****Properties**

Target	0.244669	Lower	0.001
Value	0.244669	Usage	Calculation During Execute
Type	Molar Flow	Calculation Type	Specified Stage
Upper	100		
Source Information	Reboiler --- Bottoms		

Source Information

* Source	Reboiler	* Phase	Vapor

Source Information

* Source	Bottoms		

CO2 LV%**Properties**

* Target	0.05 %	Usage	Calculation During Execute
Value	0.0902156 %	Calculation Type	Specified Stage
* Type	Std Liquid Volumetric Fraction	Source Information	Bottoms Liquid

		Blocks T-501 Demethanizer Column Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:33 PM, 5/12/2023	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Source Information					
* Source	Bottoms Liquid			* Component	CO2
CO2 SPEC C2 RATIO					
Properties					
* Target	0.0035		Usage	Calculation During Execute	
Value	0.00218668		Calculation Type	Specified Stage	
* Type	Mole Fraction				
Source Information	Reboiler --- Reboiler				
Source Information					
* Source	Reboiler			* Component	CO2
* Phase	Light Liquid				
Source Information					
* Source	Reboiler			* Component	C2
* Phase	Light Liquid				
C1 MAX LV %					
Properties					
* Target	0.4 %		* Usage	Specification	
Value	0.400001 %		Calculation Type	Specified Stage	
Weight	1		Source Information	Bottoms Liquid	
* Type	Std Liquid Volumetric Fraction				
Source Information					
* Source	Bottoms Liquid			* Component	C1
C1/C2 RATIO SPEC					
Properties					
* Target	0.015		* Usage	Calculation During Execute	
Value	0.00618693		Calculation Type	Specified Stage	
* Type	Std Liquid Volumetric Fraction				
Source Information	Reboiler --- Reboiler				
Source Information					
* Source	Reboiler			* Component	C1
* Phase	Light Liquid				
Source Information					
* Source	Reboiler			* Component	C2
* Phase	Light Liquid				
Flow Ratio 1					
Properties					
* Target	100		Lower	1E-05	
Value	100		* Usage	Specification	
* Type	Molar Flow		Calculation Type	Specified Stage	
Upper	100				
Source Information	PStream: 24 --- Stage: 14				

		Blocks T-501 Demethanizer Column Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:33 PM, 5/12/2023	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Source Information					
* Source Moniker		ProMax:ProMax!Project!Flowsheets!RSV!PStreams!24			
Source Information					
* Phase		Light Liquid			
* Source Moniker		ProMax:ProMax!Project!Flowsheets!RSV!Blocks!T-501 Demethanizer!Stages!14			
Limit C2 Recovery					
Properties					
* Target		60 %		* Usage	
Value		99.4859 %		Calculation During	
* Type		Molar Flow		Execute	
				Calculation Type	
				Specified Stage	
				Source Information	
				Bottoms Liquid	
Source Information					
* Source		Bottoms Liquid		* Component	
				C2	
Phase Property 1					
Properties					
* Target		75 °F		* Usage	
Value		26.8832 °F		Calculation During	
* Type		Temperature		Execute	
				Calculation Type	
				Specified Stage	
				Source Information	
				Reboiler	
Source Information					
* Source		Reboiler		* Phase	
				Light Liquid	
Phase Property 2					
Properties					
* Target		90 °F		* Usage	
Value		26.8832 °F		Calculation During	
* Type		Temperature		Execute	
				Calculation Type	
				Specified Stage	
				Source Information	
				Reboiler	
Source Information					
* Source		Reboiler		* Phase	
				Total	
Phase Property 3					
Properties					
* Target		0 °F		* Usage	
Value		26.8832 °F		Calculation During	
* Type		Temperature		Execute	
				Calculation Type	
				Specified Stage	
				Source Information	
				Reboiler	
Source Information					
* Source		Reboiler		* Phase	
				Light Liquid	
Remarks					

		Blocks T-501 Demethanizer Column Stage Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 12:33 PM, 5/12/2023	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Stage Properties					
Stages	Stage Pressure psig	Stage Head ft	Temperature °F	Vapor Molar Flow lbmol/h	Light Liquid Molar Flow lbmol/h
1	217 *	0	-171.184	30478.3	2872.47
2	217.118	0	-169.225	28409.8	2450.69
3	217.235	0	-166.18	27988	1985.55
4	217.353	0	-162.667	27522.9	1515.81
5	217.471	0	-158.627	27053.2	8957.19
6	217.588	0	-153.518	23581.9	7766.36
7	217.706	0	-141.367	22391.1	6351.84
8	217.824	0	-124.542	20976.5	7759.51
9	217.941	0	-120.527	6665.63	7636.75
10	218.059	0	-112.841	6542.86	7406.86
11	218.176	0	-96.5645	6312.97	10607.2
12	218.294	0	-88.0526	3211.63	10605.3
13	218.412	0	-66.1607	3209.83	10823.7
14	218.529	0	-31.0287	3428.21	114.017
15	218.647	0	3.51252	4120.2	8795.54
16	218.765	0	7.60192	1400.02	8916.61
17	218.882	0	12.5497	1521.09	9067.69
18	219		17.9032	1672.17	9204.98
E-204 (Demand)	219		26.8832	1809.45	7395.52
Remarks					

		Blocks V-402 Cold Separator Separator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 6:58 PM, 7/29/2013	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
12	Inlet	E-203	17	Vapor Outlet	SPLT-101
13	Light Liquid Outlet	SPLT-102			
Block Parameters					
* Pressure Drop	0.25	psi	Main Liquid Phase	Light Liquid	
Mole Fraction Vapor	79.8581	%	Heat Duty	0 Btu/h	
Mole Fraction Light Liquid	20.1419	%	Heat Release Curve Type	Plug Flow	
Mole Fraction Heavy Liquid	0	%	Heat Release Curve Increments	10	
Remarks					

		Blocks VLVE-100 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 3:05 PM, 8/29/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
14	Inlet	SPLT-102	15	Outlet	T-501 Demethanizer
Block Parameters					
Pressure Drop		691.75 psi	? Simple Compressible Cv		67.1238
Joule-Thomson Coefficient		0.082215 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv		20.9444			
Remarks					

		Blocks VLVE-101 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 11:14 AM, 8/30/2022	
Flowsheet:	RSV			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
33	Inlet	SPLT-106	34	Outlet	MIX-103
Block Parameters					
* Pressure Drop		5 psi	Simple Compressible Cv		
Joule-Thomson Coefficient		°F/psi	Valve Diameter in		
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
Simple Incompressible Cv					
Remarks					

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV	

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
Methanol	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	RSV				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package			
Custom Liquid 2 Package		Solid Package			
Remarks					

RSV_data

Plant Schematic

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV_data	

RSV Cryo
C2 Recovery Mode

Names	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Temperature	1	40.302	40.302	4.007	40.302	40.314	40.312	40.402	39.502	133.220	4.040E-4	112	110.004	4.000E-4	4.000E-4	10.002	1.000E-4	1.000E-4	1.000E-4	4.000E-4	1.000E-4	4.000E-4	1.000E-4	4.000E-4	1.000E-4
Pressure	2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Mass Fraction Vapor	3	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Molecular Weight	4	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
Mass Density	5	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	
Specific Gravity	6	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	
Mass Flow	7	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Mass Flow	8	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Std Vapor Volumetric Flow	9	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Std Liquid Volumetric Flow	10	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0

Names	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Temperature	1	40.302	40.302	4.007	40.302	40.314	40.312	40.402	39.502	133.220	4.040E-4	112	110.004	4.000E-4	4.000E-4	10.002	1.000E-4	1.000E-4	1.000E-4	4.000E-4	1.000E-4	4.000E-4	1.000E-4	4.000E-4	1.000E-4	1.000E-4
Pressure	2	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Mass Fraction Vapor	3	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Molecular Weight	4	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
Mass Density	5	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	4.100E-4	
Specific Gravity	6	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	1.000E-4	
Mass Flow	7	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Mass Flow	8	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Std Vapor Volumetric Flow	9	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
Std Liquid Volumetric Flow	10	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0

**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV_data	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				

* User Specified Values

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**Flowsheet Environment
Hydrocarbon Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	RSV_data	

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
Methanol	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

* User Specified Values

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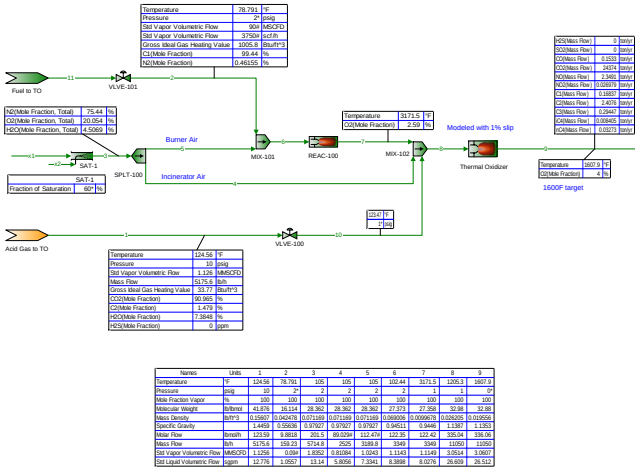
		Flowsheet Environment Hydrocarbon Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	RSV_data				
Physical Property Method Sets					
Liquid Molar Volume		COSTALD		Overall Package Peng-Robinson	
Vapor Package		Peng-Robinson		Nonspecific Liquid Package Peng-Robinson	
Aqueous Liquid Package		Peng-Robinson		Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package			
Custom Liquid 2 Package		Solid Package			
Remarks					

ThermOx

Plant Schematic

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	ThermOx	

Thermal Oxidizer



Process Streams Report

All Streams

Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	ThermOx	

Connections

	x1	x2	1	2	3
From Block	--	--	Acid Gas to TO	VLVE-101	SAT-1
To Block	SAT-1	SAT-1	VLVE-100	MIX-101	SPLT-100

Stream Composition

Mole Fraction	x1 %	x2 %	1 %	2 %	3 %
H2O	0	100 *	7.38481	0	4.50688
H2S	0	0 *	0	0	0
CO2	0	0 *	90.9649	0.0148783	0
N2	79	0 *	0	0.461548	75.4396
C1	0	0 *	0.034868	99.4401	0
C2	0	0 *	1.47896	0.0834666	0
C3	0	0 *	0.123359	2.84571E-07	0
iC4	0	0 *	0.00267134	1.12323E-12	0
nC4	0	0 *	0.0104024	6.00632E-13	0
iC5	0	0 *	0	0	0
nC5	0	0 *	0	0	0
C6	0	0 *	0	0	0
C7	0	0 *	0	0	0
C8	0	0 *	0	0	0
C9	0	0 *	0	0	0
C10	0	0 *	0	0	0
Benzene	0	0 *	0	0	0
Toluene	0	0 *	0	0	0
Ethylbenzene	0	0 *	0	0	0
para-Xylene	0	0 *	0	0	0
MDEA	0	0 *	0	0	0
O2	21	0 *	0	0	20.0536
CO	0	0 *	0	0	0
NO	0	0 *	0	0	0
NO2	0	0 *	0	0	0
SO2	0	0 *	0	0	0
S2	0	0 *	0	0	0

Stream Properties

Property	Units	x1	x2	1	2	3
Temperature	°F	105	213.717	124.562	78.7912	105
Pressure	psig	2 *	2	10	2 *	2
Molecular Weight	lb/lbmol	28.8503	18.0153	41.8759	16.1136	28.362
Std Vapor Volumetric Flow	MMSCFD	1.75244	0.0827082	1.12564	0.09 *	1.83515
Std Liquid Volumetric Flow	sgpm	12.8127	0.327049	12.7755	1.05566	13.1398
Compressibility		0.999802	0.942563	0.992853	0.997831	0.999613
Specific Gravity		0.996127		1.44587	0.55636	0.979267
Mole Fraction Vapor	%	100	95.0969	100	100	100
Molar Flow	lbmol/h	192.415	9.08121	123.593	9.88184	201.496
Mass Flow	lb/h	5551.24	163.6	5175.58	159.232	5714.84
Mass Cp	Btu/(lb*°F)	0.241822	0.481633	0.220098	0.530445	0.247725

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	ThermOx	

Connections

	4	5	6	7	8
From Block	SPLT-100	SPLT-100	MIX-101	REAC-100	MIX-102
To Block	MIX-102	MIX-101	REAC-100	MIX-102	Thermal Oxidizer

Stream Composition

Mole Fraction	4 %	5 %	6 %	7 %	8 %
H2O	4.50688	4.50688	4.14287	19.8936	11.1905
H2S	0	0	0	0	0
CO2	0	0	0.00120168	7.77921	36.3987
N2	75.4396	75.4396	69.3838	69.2135	45.3355
C1	0	0	8.03149	0.160543	0.0715217
C2	0	0	0.00674135	0.000134754	0.545628
C3	0	0	2.2984E-08	4.59431E-10	0.0455063
iC4	0	0	9.07199E-14	0	0.000985438
nC4	0	0	4.85113E-14	0	0.00383736
iC5	0	0	0	0	0
nC5	0	0	0	0	0
C6	0	0	0	0	0
C7	0	0	0	0	0
C8	0	0	0	0	0
C9	0	0	0	0	0
C10	0	0	0	0	0
Benzene	0	0	0	0	0
Toluene	0	0	0	0	0
Ethylbenzene	0	0	0	0	0
para-Xylene	0	0	0	0	0
MDEA	0	0	0	0	0
O2	20.0536	20.0536	18.4339	2.58571	6.27353
CO	0	0	0	0.101797	0.0371947
NO	0	0	0	0.265292	0.0969322
NO2	0	0	0	0.000138854	5.07346E-05
SO2	0	0	0	0	0
S2	0	0	0	0	0

Stream Properties

Property	Units	4	5	6	7	8
Temperature	°F	105	105	102.439	3171.54	1205.25
Pressure	psig	2	2	2	1	1
Molecular Weight	lb/lbmol	28.362	28.362	27.3727	27.3579	32.9803
Std Vapor Volumetric Flow	MMSCFD	0.810838	1.02431	1.11431	1.11492	3.0514
Std Liquid Volumetric Flow	sgpm	5.80564	7.33415	8.38981	8.02755	26.6087
Compressibility		0.999613	0.999613	0.999523	1.00013	1.00025
Specific Gravity		0.979267	0.979267	0.94511	0.944598	1.13873
Mole Fraction Vapor	%	100	100	100	100	100
Molar Flow	lbmol/h	89.0285 *	112.468 *	122.35	122.416	335.038
Mass Flow	lb/h	2525.03	3189.82	3349.05	3349.05	11049.7
Mass Cp	Btu/(lb*°F)	0.247725	0.247725	0.26152	0.358911 ?	0.300913

Remarks

Process Streams Report
All Streams
Tabulated by Total Phase

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	ThermOx	

Connections

	9	10	11		
From Block	Thermal Oxidizer	VLVE-100	Fuel to TO		
To Block	--	MIX-102	VLVE-101		

Stream Composition

Mole Fraction	9 %	10 %	11 %		
H2O	13.1169	7.38481	0		
H2S	0	0	0		
CO2	37.6266	90.9649	0.0148783		
N2	45.2439	0	0.461548		
C1	0.00071305	0.034868	99.4401		
C2	0.00543975	1.47896	0.0834666		
C3	0.000453684	0.123359	2.84571E-07		
iC4	9.82452E-06	0.00267134	1.12323E-12		
nC4	3.82574E-05	0.0104024	6.00632E-13		
iC5	0	0	0		
nC5	0	0	0		
C6	0	0	0		
C7	0	0	0		
C8	0	0	0		
C9	0	0	0		
C10	0	0	0		
Benzene	0	0	0		
Toluene	0	0	0		
Ethylbenzene	0	0	0		
para-Xylene	0	0	0		
MDEA	0	0	0		
O2	4.00027	0	0		
CO	0.000371833	0	0		
NO	0.00531869	0	0		
NO2	3.98412E-05	0	0		
SO2	0	0	0		
S2	0	0	0		

Stream Properties

Property	Units	9	10	11		
Temperature	°F	1607.95	123.471	91.5324		
Pressure	psig	0 *	1 *	207		
Molecular Weight	lb/lbmol	32.8804	41.8759	16.1136		
Std Vapor Volumetric Flow	MMSCFD	3.06067	1.12564	0.09		
Std Liquid Volumetric Flow	sgpm	26.5121	12.7755	1.05566		
Compressibility		1.0002	0.995605	0.972001		
Specific Gravity		1.13527	1.44587	0.55636		
Mole Fraction Vapor	%	100	100	100		
Molar Flow	lbmol/h	336.056	123.593	9.88184		
Mass Flow	lb/h	11049.7	5175.58	159.232		
Mass Cp	Btu/(lb*°F)	0.314487	0.219297	0.555282		

Remarks

Blocks
Acid Gas to TO
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 5:39 PM, 7/29/2014
Flowsheet:	ThermOx	Status: Approximate 12:36 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
21 [NGL Amine]	Inlet	V-426/A-322 [NGL Amine]	1 [ThermOx]	Outlet	VLVE-100 [ThermOx]

Block Parameters

* Mole Fraction Transfer Threshold	0.001 %	Outlet Mass Enthalpy	-3863.23 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	4.56171 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	120 °F	Fraction Vapor Difference	0 %
Inlet Pressure	10 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-3863.23 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	124.562 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	10 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Warnings

ProMax:ProMax!Project!Flowsheets!ThermOx!Blocks!Acid Gas to TO

Warning: The environment Combustion Enviro used by flowsheet ThermOx does not contain the following component(s) present in stream 21 in flowsheet NGL Amine:

Piperazine, Methanol.

Warning: The following components were zeroed out in stream 1 on flowsheet ThermOx because they were less than the mole fraction transfer threshold in stream 21 on flowsheet NGL Amine:

iC5, nC5, C6, C7, C8, Benzene, Toluene, Ethylbenzene, para-Xylene, MDEA.

Warning: Cross Flowsheet Connector Acid Gas to TO is not in mass balance. Check Untransferred Flows in the Composition table on the Streams tab.

Warning: The Temperature Difference of 4.56171 °F exceeds specified tolerance of 1 °F.
Consider changing transfer variables for a closer match.

Remarks

Blocks
Fuel to TO
Flowsheet Connector Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:48 PM, 4/11/2023
Flowsheet:	ThermOx	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
39 [RSV]	Inlet	SPLT-103 [RSV]	11 [ThermOx]	Outlet	VLVE-101 [ThermOx]

Block Parameters

Mole Fraction Transfer Threshold	0 %	Outlet Mass Enthalpy	-1982.25 Btu/lb
Transfer Property 1	Pressure	Temperature Difference	0 °F
Transfer Property 2	Mass Enthalpy	Pressure Difference	0 psi
Inlet Temperature	91.5324 °F	Fraction Vapor Difference	0 %
Inlet Pressure	207 psig	Mass Enthalpy Difference	0 Btu/lb
Inlet Fraction Vapor	100 %	Temperature Tolerance	1 °F
Inlet Mass Enthalpy	-1982.25 Btu/lb	Pressure Tolerance	1 psi
Outlet Temperature	91.5324 °F	Fraction Vapor Tolerance	1 %
Outlet Pressure	207 psig	Mass Enthalpy Tolerance	1 Btu/lb
Outlet Fraction Vapor	100 %		

Remarks

Blocks
MIX-101
Mixer/Splitter Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 2:05 PM, 5/24/2022
Flowsheet:	ThermOx	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
5	Inlet	SPLT-100	2	Inlet	VLVE-101
6	Outlet	REAC-100			

Block Parameters

Pressure Drop	0 psi	Fraction to Stream 6	100 %
Flow Multiplier	100 %		

Pressure Balancing Mode Properties

Pressure Balancing Mode	False

Remarks

		Blocks MIX-102 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 11:00 AM, 2/14/2023	
Flowsheet:	ThermOx			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
7	Inlet	REAC-100	4	Inlet	SPLT-100
10	Inlet	VLVE-100	8	Outlet	Thermal Oxidizer
Block Parameters					
Pressure Drop		0 psi	Fraction to Stream 8		100 %
Flow Multiplier		100 %			
Pressure Balancing Mode Properties					
Pressure Balancing Mode		False			
Remarks					

Blocks
REAC-100
Reactor Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:02 AM, 2/14/2023
Flowsheet:	ThermOx	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
6	Inlet	MIX-101	7	Outlet	MIX-102

Block Parameters

* Type	Gibbs Minimization	Mole Fraction Heavy Liquid	0 %
* Gibbs Set	Burner	* Bypass Fraction	2 %
* Pressure Drop	1 psi	Maximum Phases	1
Holdup	0 %	First Phase	Vapor
Heat Duty	0 Btu/h	Heat Release Curve Increments	10
Maximum Temperature	3171.54 °F	Reactor Increment Type	by Bypass
Temperature Change	3069.11 °F	Maximum Available Constraints	22
Mole Fraction Vapor	100 %	Yield Component	
Mole Fraction Light Liquid	0 %		

Tabulated Block Data

Index	Conversion %	Yield	Gibbs Reactive	
H2O	-380.449		True	
H2S			True	
CO2	-647613		True	
N2	0.191381		True	
C1	98		True	
C2	98		True	
C3	98		True	
iC4	100		True	
nC4	100		True	
iC5			True	
nC5			True	
C6			True	
C7			True	
C8			True	
C9			True	
C10			True	
Benzene			True	
Toluene			True	
Ethylbenzene			True	
para-Xylene			True	
MDEA			True	
O2	85.9655		True	
CO			True	
NO			True	
NO2			True	
SO2			True	
S2			True	

Remarks

		Blocks SAT-1 Saturator Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:04 PM, 5/24/2022	
Flowsheet:	ThermOx			Status: Solved 12:26 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
x1	Inlet		x2	Saturation Stream	
3	Outlet	SPLT-100			
Block Parameters					
Calculation Mode		Saturator	Temperature Change		0 °F
* Fraction of Saturation		60 %	Saturation Pressure		2 psig
Outlet Saturant Concentration		2240.53 lbm/MMSCF	Saturation Temperature		105 °F
Pressure Drop		0 psi	Fraction of Saturant Flow		4.71959 %
Saturant Pressure Drop		0 psi			
Remarks					

		Blocks SPLT-100 Mixer/Splitter Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 2:04 PM, 5/24/2022	
Flowsheet:	ThermOx			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	SAT-1	5	Outlet	MIX-101
4	Outlet	MIX-102			
Block Parameters					
Pressure Drop	0	psi	Fraction to Stream 5	55.8163	%
Flow Multiplier	100	%	Fraction to Stream 4	44.1837	%
Pressure Balancing Mode Properties					
Pressure Balancing Mode	False				
Remarks					

Blocks Thermal Oxidizer Reactor Report		
Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 11:01 AM, 2/14/2023
Flowsheet:	ThermOx	Status: Solved 12:36 PM, 3/7/2025

Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
8	Inlet	MIX-102	9	Outlet	

Block Parameters			
* Type	Gibbs Minimization	Mole Fraction Light Liquid	0 %
* Gibbs Set	Burner	Mole Fraction Heavy Liquid	0 %
Pressure Drop	1 psi	* Bypass Fraction	1 %
Pressure Drop Correlation	User Input	Maximum Phases	1
Holdup	0 %	First Phase	Vapor
Heat Duty	0 Btu/h	Heat Release Curve Increments	10
Maximum Temperature	1607.95 °F	Reactor Increment Type	by Bypass
Temperature Change	402.696 °F	Maximum Available Constraints	22
Mole Fraction Vapor	100 %	Yield Component	

Tabulated Block Data				
Index	Conversion %	Yield	Gibbs Reactive	
H2O	-17.5702		True	
H2S			True	
CO2	-3.68755		True	
N2	-0.101033		True	
C1	99		True	
C2	99		True	
C3	99		True	
iC4	99		True	
nC4	99		True	
iC5			True	
nC5			True	
C6			True	
C7			True	
C8			True	
C9			True	
C10			True	
Benzene			True	
Toluene			True	
Ethylbenzene			True	
para-Xylene			True	
MDEA			True	
O2	36.042		True	
CO	98.9973		True	
NO	94.4963		True	
NO2	21.2326		True	
SO2			True	
S2			True	

Remarks

		Blocks VLVE-100 JT-Valve Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II			Modified: 11:00 AM, 2/14/2023	
Flowsheet:	ThermOx			Status: Solved 12:36 PM, 3/7/2025	
Connections					
Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
1	Inlet	Acid Gas to TO	10	Outlet	MIX-102
Block Parameters					
Pressure Drop		9 psi	Simple Compressible Cv		77.148
Joule-Thomson Coefficient		0.121203 °F/psi	Valve Diameter		in
Pressure Drop Method		User Set	Valve F_L, Liquid Pressure Recovery Factor		
Allow Pressure Increase		True	Valve F_D, Style Modifier		
Calculate Flow		False	Valve X_T, Rated Pressure Drop Ratio Factor		
? Simple Incompressible Cv		68.9407			
Remarks					

Blocks
VLVE-101
JT-Valve Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	Modified: 3:48 PM, 4/11/2023
Flowsheet:	ThermOx	Status: Solved 12:26 PM, 3/7/2025

Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
11	Inlet	Fuel to TO	2	Outlet	MIX-101

Block Parameters

Pressure Drop	205 psi	? Simple Compressible Cv	0.369502
Joule-Thomson Coefficient	0.0621521 °F/psi	Valve Diameter	in
Pressure Drop Method	User Set	Valve F_L, Liquid Pressure Recovery Factor	
Allow Pressure Increase	True	Valve F_D, Style Modifier	
Calculate Flow	False	Valve X_T, Rated Pressure Drop Ratio Factor	
? Simple Incompressible Cv	0.223494		

Remarks

**Flowsheet Environment
Combustion Enviro**

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	
Flowsheet:	ThermOx	

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
O2	True	False				
CO	True	False				
NO	True	False				
NO2	True	False				
SO2	True	False				
S2	False	False				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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		Flowsheet Environment Combustion Enviro					
Client Name:	Energy Transfer				Job: Plan Approval Application		
Location:	Cryo II						
Flowsheet:	ThermOx						
Henry's Law Component							
Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2	
iC4	False	False					
nC4	False	False					
iC5	False	False					
nC5	False	False					
C6	False	False					
C7	False	False					
C8	False	False					
C9	False	False					
C10	False	False					
Benzene	False	False					
Toluene	False	False					
Ethylbenzene	False	False					
para-Xylene	False	False					
MDEA	False	False					
O2	False	False					
CO	False	False					
NO	False	False					
NO2	False	False					
SO2	False	False					
S2	False	False					
Phases							
Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %		
Total	Total	True					
Vapor	Vapor	True	-441.67	17540.3			
Light Liquid	Light Liquid	True					
Heavy Liquid	Heavy Liquid	True					
Mixed Liquid	Mixed Liquid	True					
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3			
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70		
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75		
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75		
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75		
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75		
Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model		
Total				True			
Vapor			Peng-Robinson	True			
Light Liquid				False			
Heavy Liquid				False			
Mixed Liquid				False			
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)		
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)		
Sulfur Liquid	10	Sulfur		False			
Mercury Liquid	10	Mercury		False			
Custom Liquid 1	10			False			
Custom Liquid 2	10			False			

		Flowsheet Environment Combustion Enviro			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Flowsheet:	ThermOx				
Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					
Physical Property Method Sets					
Liquid Molar Volume	COSTALD		Overall Package	Peng-Robinson	
Vapor Package	Peng-Robinson		Nonspecific Liquid Package	Peng-Robinson	
Aqueous Liquid Package	Peng-Robinson		Sulfur Liquid Package		
Mercury Liquid Package			Custom Liquid 1 Package		
Custom Liquid 2 Package			Solid Package		
Remarks					

Environments Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Project-Wide Constants

Atmospheric Pressure	13.2 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 [Closed Drain Enviro]

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model Evaluation Temperature	77 °F
Freeze Out Temperature Threshold Difference	10 °F	Enable Mixed Liquid Phase Emulsion Viscosity	False
Apply Poynting Correction Factor	True	Minimum Mole Fraction Compositional Threshold	2.22045E-14 %
Number of Poynting Intervals	0		

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
Piperazine	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				

* User Specified Values

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Environments Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
MDEA	False	False				
Piperazine	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					

* User Specified Values

? Extrapolated or Approximate Values

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Environments Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	Peng-Robinson
Vapor Package	Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson
Aqueous Liquid Package	Peng-Robinson	Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package	
Custom Liquid 2 Package		Solid Package	

Remarks

Environment [Hydrocarbon Enviro]

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				

* User Specified Values

? Extrapolated or Approximate Values

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Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
Methanol	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	

* User Specified Values

? Extrapolated or Approximate Values

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Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	Peng-Robinson
Vapor Package	Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson
Aqueous Liquid Package	Peng-Robinson	Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package	
Custom Liquid 2 Package		Solid Package	

Remarks

Environment [Combustion Enviro]

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm	False	Initial Guess Tolerance	0.001 %

* User Specified Values

? Extrapolated or Approximate Values

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Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Flash Settings

Only		
Favor First Guess Algorithm	True	Minimum Phase Threshold 0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold 0.1 %
* Flash Polish Step	True	Validate Phases True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
O2	True	False				
CO	True	False				
NO	True	False				
NO2	True	False				
SO2	True	False				
S2	False	False				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	False				
CO2	False	False				
N2	False	False				
C1	False	False				
C2	False	False				
C3	False	False				
iC4	False	False				
nC4	False	False				
iC5	False	False				
nC5	False	False				
C6	False	False				
C7	False	False				
C8	False	False				
C9	False	False				
C10	False	False				
Benzene	False	False				
Toluene	False	False				
Ethylbenzene	False	False				
para-Xylene	False	False				
MDEA	False	False				

* User Specified Values

? Extrapolated or Approximate Values

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Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
O2	False	False				
CO	False	False				
NO	False	False				
NO2	False	False				
SO2	False	False				
S2	False	False				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-441.67	17540.3	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

* User Specified Values

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Environments Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	Peng-Robinson
Vapor Package	Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson
Aqueous Liquid Package	Peng-Robinson	Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package	
Custom Liquid 2 Package		Solid Package	

Remarks

Environment [HMO Enviro]

Environment Settings

Perform Freeze Out Check	True	Gibbs Excess Model	77 °F
Freeze Out Temperature	10 °F	Evaluation Temperature	
Threshold Difference		Enable Mixed Liquid Phase	False
Apply Poynting Correction Factor	True	Emulsion Viscosity	
Number of Poynting Intervals	0	Minimum Mole Fraction	2.22045E-14 %
		Compositional Threshold	

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
CHEMOTHERM 550	True					

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
CHEMOTHERM 550	False					

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	False	-441.67	17540.3	90
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75

* User Specified Values

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Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Peng-Robinson	False	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	Peng-Robinson
Vapor Package	Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson
Aqueous Liquid Package	Peng-Robinson	Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package	
Custom Liquid 2 Package		Solid Package	

Warnings

ProMax:ProMax!Project!Environments!HMO Enviro

Warning: Calculated stream Heating Values are approximate due to the presence of component(s) with unknown chemical formula: CHEMTHERM 550. These component(s) have an assumed ideal gas heating value of 0.0

Warning: It is recommended to use a Heat Transfer Fluid property package in a dedicated flowsheet for the following components: CHEMTHERM 550.

Remarks

Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Environment [Amine Enviro]

Environment Settings

Perform Freeze Out Check	False	Gibbs Excess Model Evaluation Temperature	77 °F
Apply Poynting Correction Factor	True	Enable Mixed Liquid Phase Emulsion Viscosity	False
Number of Poynting Intervals	0	Minimum Mole Fraction Compositional Threshold	1E-10 %

Flash Settings

Use Submitted Guess	True	* Rachford-Rice Style Algorithm	True
Reverse Guess Algorithm Order	False	* Boston-Britt Style Algorithm	True
Use First Guess Algorithm Only	False	Initial Guess Tolerance	0.001 %
Favor First Guess Algorithm	True	Minimum Phase Threshold	0.000251189 %
* Only Isothermal Property Flash	False	Distinct Phase Composition Threshold	0.1 %
* Flash Polish Step	True	Validate Phases	True

Liked Phases

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	True				
H2S	True	False				
CO2	True	False				
N2	True	False				
C1	True	False				
C2	True	False				
C3	True	False				
iC4	True	False				
nC4	True	False				
iC5	True	False				
nC5	True	False				
C6	True	False				
C7	True	False				
C8	True	False				
C9	True	False				
C10	True	False				
Benzene	True	False				
Toluene	True	False				
Ethylbenzene	True	False				
para-Xylene	True	False				
MDEA	False	True				
Piperazine	False	True				
Methanol	False	True				

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
H2O	False	False				
H2S	False	True				
CO2	False	True				
N2	False	True				
C1	False	True				
C2	False	True				
C3	False	True				
iC4	False	True				
nC4	False	True				
iC5	False	True				

* User Specified Values

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Environments Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Henry's Law Component

Component Name	Nonspecific Liquid	Aqueous Liquid	Sulfur Liquid	Mercury Liquid	Custom Liquid 1	Custom Liquid 2
nC5	False	True				
C6	False	True				
C7	False	True				
C8	False	True				
C9	False	True				
C10	False	True				
Benzene	False	True				
Toluene	False	True				
Ethylbenzene	False	True				
para-Xylene	False	True				
MDEA	False	True				
Piperazine	False	True				
Methanol	False	True				

Phases

Name	Label	Active	Minimum Temperature °F	Maximum Temperature °F	Minimum Liked Fraction %
Total	Total	True			
Vapor	Vapor	True	-441.67	17540.3	
Light Liquid	Light Liquid	True			
Heavy Liquid	Heavy Liquid	True			
Mixed Liquid	Mixed Liquid	True			
Nonspecific Liquid	Nonspecific Liquid	True	-441.67	17540.3	
Aqueous Liquid	Aqueous Liquid	True	-9.67	704.93	70
Sulfur Liquid	Sulfur Liquid	False	-441.67	17540.3	75
Mercury Liquid	Mercury Liquid	False	-441.67	17540.3	75
Custom Liquid 1	Custom Liquid 1	False	-441.67	17540.3	75
Custom Liquid 2	Custom Liquid 2	False	-441.67	17540.3	75

Name	Maximum Liked Elsewhere %	Solvent	Phase Property Package	Visible	Phase Density Model
Total				True	
Vapor			Peng-Robinson	True	
Light Liquid				False	
Heavy Liquid				False	
Mixed Liquid				False	
Nonspecific Liquid			Peng-Robinson	True	COSTALD (HBT)
Aqueous Liquid	10	Water	Electrolytic ELR	True	COSTALD (HBT)
Sulfur Liquid	10	Sulfur		False	
Mercury Liquid	10	Mercury		False	
Custom Liquid 1	10			False	
Custom Liquid 2	10			False	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Total					
Vapor	Chapman-Enskog	Lindsay-Bromley			
Light Liquid					
Heavy Liquid					
Mixed Liquid					
Nonspecific Liquid	Teja-Thurner	Li	Parachor		

* User Specified Values

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Environments Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Name	Phase Viscosity Model	Phase Thermal Conductivity Model	Phase Surface Tension Model		
Aqueous Liquid	Teja-Thurner	Li	Parachor		
Sulfur Liquid					
Mercury Liquid					
Custom Liquid 1					
Custom Liquid 2					

Electrolytic Reactions

Dissociation of Water	$\text{H}_2\text{O} = \text{H}^+ + \text{HO}^-$
First Dissociation of CO_2	$\text{CO}_2 + \text{H}_2\text{O} = (\text{CHO}_3)^- + \text{H}^+$
First Dissociation of H_2S	$\text{H}_2\text{S} = \text{H}^+ + \text{HS}^-$
MDEAH ⁺ Proton Transfer	$(\text{C}_5\text{H}_{14}\text{NO}_2)^+ = \text{C}_5\text{H}_{13}\text{NO}_2 + \text{H}^+$
Piperazine Dicarbamate Hydrolysis	$(\text{C}_5\text{H}_9\text{N}_2\text{O}_2)^- + (\text{CHO}_3)^- = (\text{C}_6\text{H}_8\text{N}_2\text{O}_4)^{2-} + \text{H}_2\text{O}$
Piperazine Monocarbamate Hydrolysis	$(\text{CHO}_3)^- + \text{C}_4\text{H}_{10}\text{N}_2 = (\text{C}_5\text{H}_9\text{N}_2\text{O}_2)^- + \text{H}_2\text{O}$
Piperazine Monocarbamate Protonation	$(\text{C}_5\text{H}_9\text{N}_2\text{O}_2)^- + \text{H}^+ = \text{C}_5\text{H}_{10}\text{N}_2\text{O}_2$
Second Dissociation of CO_2	$(\text{CHO}_3)^- = \text{H}^+ + (\text{CO}_3)^{2-}$
Second Dissociation of H_2S	$\text{HS}^- = \text{H}^+ + (\text{S})^{2-}$
1st Protonation of Piperazine	$(\text{C}_4\text{H}_{11}\text{N}_2)^+ = \text{C}_4\text{H}_{10}\text{N}_2 + \text{H}^+$
2nd Protonation of Piperazine	$(\text{C}_4\text{H}_{12}\text{N}_2)^{2+} = (\text{C}_4\text{H}_{11}\text{N}_2)^+ + \text{H}^+$

Physical Property Method Sets

Liquid Molar Volume	COSTALD	Overall Package	Amine Sweetening - PR
Vapor Package	Peng-Robinson	Nonspecific Liquid Package	Peng-Robinson
Aqueous Liquid Package	Electrolytic ELR	Sulfur Liquid Package	
Mercury Liquid Package		Custom Liquid 1 Package	
Custom Liquid 2 Package		Solid Package	

Remarks

Calculator Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Simple Solver 1

Source Code

Residual Error (for CV1) = $x/4300-1$

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!PStreams!38!Phases!Total!Properties!Temperature
Value 91.5324
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!Blocks!E-201!QManager!Properties!Effective UA
Value 4298.04
Unit

Solver Properties

Status: Solved

Error	-0.000456091	Weighting	1
Calculated Value	91.5324 °F	* Priority	0
* Lower Bound	50 °F	* Solver State	Active
* Upper Bound	150 °F	Group	
Step Size	°F	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	12
* Algorithm	Secant	Recycle Dependencies	0
Iterations	3	Solver Dependencies	1
Max Iterations	20		

Remarks

Simple Solver 2

Source Code

Residual Error (for CV1) = $1-x/4$

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!ThermOx!PStreams!4!Phases!Total!Properties!Molar Flow
Value 89.0285
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!ThermOx!PStreams!9!Phases!Total!Composition!Mole Fraction!O2
Value 4.00027
Unit

Solver Properties

Status: Solved

Error	-6.80975E-05	Weighting	1
Calculated Value	89.0285 lbmol/h	* Priority	0
Lower Bound	lbmol/h	Solver State	Active
Upper Bound	lbmol/h	Group	
Step Size	lbmol/h	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	5
Algorithm	Default	Recycle Dependencies	0
Iterations	1	Solver Dependencies	1
Max Iterations	20		

Remarks

Calculator Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Simple Solver 3

Source Code

Residual Error (for CV1) = Side_RB_UA/350000-1

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-E205!Energy Rate
Value 19.5
Unit

Solver Properties

Status: Unsolved

Error		Weighting	1
* Calculated Value	1E+07 Btu/h	Priority	0
Lower Bound	Btu/h	* Solver State	Ignored
Upper Bound	Btu/h	Group	
Step Size	Btu/h	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	0
Algorithm	Default	Recycle Dependencies	0
Iterations	0	Solver Dependencies	0
Max Iterations	20		

Warnings

ProMax:ProMax!Project!Calculators!Simple Solver 3!Calculated Variables!CV1!PropertySolver
Warning: PropertySolver is not active.

Remarks

Simple Solver 4

Source Code

Residual Error (for CV1) = Incin_Temp/1600-1

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!ThermOx!PStreams!2!Phases!Total!Properties!Std Vapor Volumetric Flow
Value 0.09
Unit

Measured Variable [Incin_Temp]

Source Moniker ProMax:ProMax!Project!Flowsheets!ThermOx!PStreams!9!Phases!Total!Properties!Temperature
Value 1607.95
Unit

Solver Properties

Status: Unsolved

Error		Weighting	1
* Calculated Value	0.09 MMSCFD	* Priority	1
Lower Bound	MMSCFD	* Solver State	Disabled
Upper Bound	MMSCFD	Group	
Step Size	MMSCFD	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	4
* Algorithm	Default	Recycle Dependencies	0
Iterations	0	Solver Dependencies	1
Max Iterations	20		

Warnings

* User Specified Values
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Calculator Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

ProMax:ProMax!Project!Calculators!Simple Solver 4!Calculated Variables!CV1!PropertySolver
Warning: PropertySolver is not active.

Remarks

Simple Solver 5

Source Code

Residual Error (for CV1) = EX201 UA/1650000-1

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!PStreams!3!Phases!Total!Properties!Temperature
Value 6.88701
Unit

Solver Properties

Status: Unsolved

Error		Weighting	1
* Calculated Value	0 °F	Priority	0
Lower Bound	°F	* Solver State	Ignored
Upper Bound	°F	Group	
Step Size	°F	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	0
Algorithm	Default	Recycle Dependencies	0
Iterations	0	Solver Dependencies	0
Max Iterations	20		

Warnings

ProMax:ProMax!Project!Calculators!Simple Solver 5!Calculated Variables!CV1!PropertySolver
Warning: PropertySolver is not active.

Remarks

Simple Solver 6

Source Code

Residual Error (for CV1) = E206 UA/860000-1

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!PStreams!22!Phases!Total!Properties!Temperature
Value -119
Unit

Solver Properties

Status: Unsolved

Error		Weighting	1
Calculated Value	-96.4518 °F	Priority	0
Lower Bound	°F	* Solver State	Ignored
Upper Bound	°F	Group	
Step Size	°F	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	0
Algorithm	Default	Recycle Dependencies	0
Iterations	0	Solver Dependencies	0
Max Iterations	20		

Calculator Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Warnings

ProMax:ProMax!Project!Calculators!Simple Solver 6!Calculated Variables!CV1!PropertySolver
Warning: PropertySolver is not active.

Remarks

Simple Solver 7

Source Code

Residual Error (for CV1) = x/500-1

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!11!Phases!Total!Properties!Std Vapor Volumetric Flow
Value 2.98653
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!15!Phases!Total!Properties!Temperature
Value 499.889
Unit

Solver Properties

Status: Solved

Error	-0.000222137	Weighting	1
Calculated Value	2.98653	Priority	0
Lower Bound	MMSCFD	Solver State	Active
Upper Bound	MMSCFD	Group	
Step Size	MMSCFD	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	4
Algorithm	Default	Recycle Dependencies	0
Iterations	2	Solver Dependencies	3
Max Iterations	20		

Remarks

Simple Solver 8

Source Code

CV1 = x*1.15/.21

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!7!Phases!Total!Properties!Molar Flow
Value 266.072
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!6!Analyses!Combustion Analysis 1!Properties!Required
Combustion Oxygen
Value 48.587
Unit

Remarks

Calculator Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Simple Solver 9

Source Code

Residual Error (for CV1) = $x/700-1$

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!6!Phases!Total!Properties!Std Vapor Volumetric Flow
Value 9.25731
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!10!Phases!Total!Properties!Temperature
Value 699.987
Unit

Solver Properties

Status: Solved

Error	-1.842E-05	Weighting	1
Calculated Value	0.222175	Priority	0
Lower Bound	MMSCFD	Solver State	Active
Upper Bound	MMSCFD	Group	
Step Size	MMSCFD	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	4
Algorithm	Default	Recycle Dependencies	0
Iterations	2	Solver Dependencies	3
Max Iterations	20		

Remarks

Simple Solver 10

Source Code

Residual Error (for CV1) = $x/700-1$

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!1!Phases!Total!Properties!Std Vapor Volumetric Flow
Value 0.295239
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!5!Phases!Total!Properties!Temperature
Value 699.987
Unit

Solver Properties

Status: Solved

Error	-1.83045E-05	Weighting	1
Calculated Value	0.295239	Priority	0
Lower Bound	MMSCFD	Solver State	Active
Upper Bound	MMSCFD	Group	
Step Size	MMSCFD	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	4
Algorithm	Default	Recycle Dependencies	0
Iterations	2	Solver Dependencies	3
Max Iterations	20		

* User Specified Values

? Extrapolated or Approximate Values

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Calculator Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Remarks

Simple Solver 11

Source Code

Residual Error (for CV1) = 1-x/400

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!PStreams!32!Phases!Total!Properties!Temperature
Value 73.7691
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!Blocks!E-202!QManager!Properties!Effective UA
Value 399.943
Unit

Solver Properties

Status: Solved

Error	0.000141828	Weighting	1
Calculated Value	73.7691 °F	* Priority	1
Lower Bound	°F	Solver State	Active
Upper Bound	°F	Group	
Step Size	°F	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	2
* Algorithm	Secant	Recycle Dependencies	0
Iterations	1	Solver Dependencies	1
Max Iterations	20		

Remarks

Simple Solver 12

Source Code

Residual Error (for CV1) = 1-x/300

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!HMO!PStreams!23!Phases!Total!Properties!Temperature
Value 278.897
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!NGL Amine!Blocks!E-1117 Amine Reboiler!QManager!Properties!Effective UA
Value 300.144
Unit

Solver Properties

Status: Solved

Error	-0.000479593	Weighting	1
Calculated Value	278.897 °F	Priority	0
Lower Bound	°F	Solver State	Active
Upper Bound	°F	Group	
Step Size	°F	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	2

* User Specified Values

? Extrapolated or Approximate Values

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Calculator Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Solver Properties

Status: Solved

Algorithm	Default	Recycle Dependencies	0
Iterations	1	Solver Dependencies	1
Max Iterations	20		

Remarks

Simple Solver 13

Source Code

Residual Error (for CV1) = 1-x/750

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!HMO!PStreams!19!Phases!Total!Properties!Temperature
Value 217.3
Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!DeC2!Blocks!E-232!QManager!Properties!Effective UA
Value 749.999
Unit

Solver Properties

Status: Solved

Error	6.9886E-07	Weighting	1
Calculated Value	217.3 °F	Priority	0
Lower Bound	°F	Solver State	Active
Upper Bound	°F	Group	
Step Size	°F	Skip Dependency Check	False
Is Minimizer	False	Block Dependencies	2
Algorithm	Default	Recycle Dependencies	0
Iterations	2	Solver Dependencies	1
Max Iterations	20		

Remarks

Simple Solver 14

Source Code

Residual Error (for CV1) = MeOH - 10

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!Inlet!PStreams!Methanol injection!Phases!Total!Properties!Std Liquid Volumetric Flow
Value 0.0285337
Unit

Measured Variable [MeOH]

Source Moniker ProMax:ProMax!Project!Flowsheets!Inlet!PStreams!3!Phases!Total!Composition!Mass Fraction!Methanol
Value 10
Unit

Solver Properties

Status: Solved

Error	-2.27887E-07	Weighting	1
Calculated Value	0.0285337 sgpm	Priority	0

		Calculator Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Solver Properties				Status: Solved	
Lower Bound		sgpm	Solver State		Active
Upper Bound		sgpm	Group		
Step Size		sgpm	Skip Dependency Check		False
Is Minimizer		False	Block Dependencies		2
Algorithm		Default	Recycle Dependencies		0
Iterations		3	Solver Dependencies		1
Max Iterations		20			
Remarks					
Simple Specifier 1					
Source Code					
CV1 = x/.82					
Calculated Variable [CV1]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!Fired Heaters!QStreams!Q-H-781 Release!Energy Rate			
Value		99.3806			
Unit					
Measured Variable [x]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!Fired Heaters!QStreams!Q-H-781!Energy Rate			
Value		81.4921			
Unit					
Remarks					
Simple Specifier 2					
Source Code					
CV1 = x*1.2/.21					
Calculated Variable [CV1]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!ThermOx!PStreams!5!Phases!Total!Properties!Molar Flow			
Value		112.468			
Unit					
Measured Variable [x]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!ThermOx!PStreams!2!Analyses!Combustion Analysis 1!Properties!Required Combustion Oxygen			
Value		19.6819			
Unit					
Remarks					
Simple Specifier 3					
Source Code					
CV1 = DEC1_TOWER_PSI+2					

Calculator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Simple Specifier 3**Source Code****Calculated Variable [CV1]**

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!19!Phases!Total!Properties!Pressure
Value	232.2
Unit	

Measured Variable [DEC1_TOWER_PSIA]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!Blocks!T-501 Demethanizer!Stages!1!Properties!Pressure
Value	230.2
Unit	

Remarks**Simple Specifier 4****Source Code**

CV1 =
DEC1_TOWER_PSIA+3

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!15!Phases!Total!Properties!Pressure
Value	233.2
Unit	

Measured Variable [DEC1_TOWER_PSIA]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!Blocks!T-501 Demethanizer!Stages!1!Properties!Pressure
Value	230.2
Unit	

Remarks**Simple Specifier 5****Source Code**

CV1 = Expander_hp*0.95

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-EC101C!Energy Rate
Value	3800
Unit	

Measured Variable [Expander_hp]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-EC101E!Energy Rate
Value	4000
Unit	

Remarks

Calculator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Simple Specifier 6**Source Code**
$$CV1 = (CO2 - 0.015 * TOT) / (0.015 - 1)$$
Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Amine!PStreams!CO2!Phases!Total!Properties!Molar Flow
Value	101.693
Unit	

Measured Variable [TOT]

Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Amine!PStreams!13!Phases!Total!Properties!Molar Flow
Value	7395.52
Unit	

Measured Variable [CO2]

Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Amine!PStreams!13!Phases!Total!Composition!Molar Flow!CO2
Value	10.7649
Unit	

Remarks**Simple Specifier 7****Source Code**
$$CV1 =$$
$$DEC1\_TOWER\_PSIA + 0$$
Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!52!Phases!Total!Properties!Pressure
Value	230.2
Unit	

Measured Variable [DEC1_TOWER_PSIA]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!Blocks!T-501 Demethanizer!Stages!1!Properties!Pressure
Value	230.2
Unit	

Remarks**Simple Specifier 8****Source Code**
$$CV1 = x + 1$$
Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!23!Phases!Total!Properties!Pressure
Value	231.2

Calculator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Unit

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!Blocks!T-501 Demethanizer!Stages!1!Properties!Pressure
Value	230.2
Unit	

Remarks**Simple Specifier 9****Source Code**

CV1 = E206_GSP_TEMP_OUT

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!51!Phases!Total!Properties!Temperature
Value	-119
Unit	

Measured Variable [E206_GSP_TEMP_OUT]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!22!Phases!Total!Properties!Temperature
Value	-119
Unit	

Remarks**Simple Specifier 10****Source Code**

CV1 = x1+x2

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!User Value Sets!Compression!Total HP!Properties!Parameter
Value	24693.8
Unit	

Measured Variable [x1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-Stage1!Energy Rate
Value	14922.4
Unit	

Measured Variable [x2]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-Stage2!Energy Rate
Value	9771.41
Unit	

Remarks

		Calculator Report		
Client Name:	Energy Transfer		Job: Plan Approval Application	
Location:	Cryo II			
Simple Specifier 11				
Source Code				
CV1 = x				
Calculated Variable [CV1]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Sieve!PStreams!4!Phases!Total!Properties!Pressure			
Value	745.475			
Unit				
Measured Variable [x]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!NGL Sieve!PStreams!9!Phases!Total!Properties!Pressure			
Value	745.475			
Unit				
Remarks				
Simple Specifier 12				
Source Code				
CV1 = x				
Calculated Variable [CV1]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!PStreams!11!Phases!Total!Properties!Pressure			
Value	120			
Unit				
Measured Variable [x]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!PStreams!4!Phases!Total!Properties!Pressure			
Value	120			
Unit				
Remarks				
Simple Specifier 13				
Source Code				
CV1 = x				
Calculated Variable [CV1]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!Cryo Refrig!PStreams!11!Phases!Total!Properties!Pressure			
Value	75			
Unit				
Measured Variable [x]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!Cryo Refrig!PStreams!4!Phases!Total!Properties!Pressure			
Value	75			
Unit				
Remarks				

Calculator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Simple Specifier 14**Source Code**CV1 = $x \cdot 1.15 / 0.21$ **Calculated Variable [CV1]**

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!12!Phases!Total!Properties!Molar Flow
Value	3576.6
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!11!Analyses!Combustion Analysis 1!Properties!Required Combustion Oxygen
Value	653.118
Unit	

Remarks**Simple Specifier 15****Source Code**CV1 = $x / .82$ **Calculated Variable [CV1]**

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!QStreams!Q-H-742 Release!Energy Rate
Value	6.80435
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!QStreams!Q-H-742!Energy Rate
Value	5.57957
Unit	

Remarks**Simple Specifier 16****Source Code**CV1 = $x / .82$ **Calculated Variable [CV1]**

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!QStreams!Q-H-741 Release!Energy Rate
Value	9.04199
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!QStreams!Q-H-741!Energy Rate
Value	7.41443
Unit	

Calculator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Remarks

Simple Specifier 17

Source Code

CV1 = x*1.15/.21

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!2!Phases!Total!Properties!Molar Flow
Value	353.57
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Fired Heaters!PStreams!1!Analyses!Combustion Analysis 1!Properties!Required Combustion Oxygen
Value	64.565
Unit	

Remarks

Simple Specifier 18

Source Code

CV1 = x-10

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!PStreams!7!Phases!Total!Properties!Temperature
Value	31.0936
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2!PStreams!4!Phases!Total!Properties!Temperature
Value	41.0936
Unit	

Remarks

Simple Specifier 19

Source Code

CV1 = x-10

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Cryo Refrig!PStreams!6!Phases!Total!Properties!Temperature
Value	-29
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!12!Phases!Total!Properties!Temperature
Value	-19

Calculator Report

Client Name: Energy Transfer

Job: Plan Approval Application

Location: Cryo II

Measured Variable [x]

Unit

Remarks**Simple Specifier 20****Source Code**

CV1 = x

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!Flowsheets!DeC2!PStreams!9!Phases!Total!Properties!Pressure

Value 400

Unit

Measured Variable [x]

Source Moniker ProMax:ProMax!Project!Flowsheets!DeC2!PStreams!3!Phases!Total!Properties!Pressure

Value 400

Unit

Remarks**Specifier for C2 Recovery****Source Code**

CV1 = Out/In*100

Calculated Variable [CV1]

Source Moniker ProMax:ProMax!Project!User Value Sets!Recoveries!C2 Recovery!Properties!Parameter

Value 99.5675

Unit

Measured Variable [Out]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!PStreams!35!Phases!Total!Composition!Mass Flow!C2

Value 148028

Unit

Measured Variable [In]

Source Moniker ProMax:ProMax!Project!Flowsheets!RSV!PStreams!1!Phases!Total!Composition!Mass Flow!C2

Value 148671

Unit

Remarks**Specifier for C3 Recovery****Source Code**

CV1 = Out/In*100

Calculator Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!User Value Sets!Recoveries!C3 Recovery!Properties!Parameter
Value	100
Unit	

Measured Variable [In]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!1!Phases!Total!Composition!Mass Flow!C3
Value	73239.5
Unit	

Measured Variable [Out]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!PStreams!35!Phases!Total!Composition!Mass Flow!C3
Value	73239.5
Unit	

Remarks**Specifier for DeC2 Refrig Power****Source Code**

CV1 = x+y

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!User Value Sets!DeC2 Refrig Power!DeC2 Refrig Power!Properties!Parameter
Value	10611.5
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!QStreams!Q-Hi!Energy Rate
Value	5949.72
Unit	

Measured Variable [y]

Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!QStreams!Q-Lo!Energy Rate
Value	4661.79
Unit	

Remarks**Specifier for Refrig Power****Source Code**

CV1 = x+y

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!User Value Sets!Refrigeration!Refrig Power!Properties!Parameter
Value	3385.12
Unit	

Measured Variable [x]

Source Moniker	ProMax:ProMax!Project!Flowsheets!Cryo Refrig!QStreams!1st Stg!Energy Rate
Value	1595.15

		Calculator Report		
Client Name:	Energy Transfer		Job: Plan Approval Application	
Location:	Cryo II			
Measured Variable [x]				
Unit				
Measured Variable [y]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!Cryo Refrig!QStreams!2nd Stg!Energy Rate			
Value	1789.97			
Unit				
Remarks				

User Value Sets Report

Client Name: Energy Transfer

Job: Plan Approval Application

Location: Cryo II

VRU Power

User Value [VRU Total Power]

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

Remarks

Compression

User Value [Total HP]

* Parameter	24693.8	hp	Upper Bound	hp
Lower Bound		hp	* Enforce Bounds	False

Source Code

CV1 = x1+x2

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!User Value Sets!Compression!Total HP!Properties!Parameter
Value	24693.8
Unit	

Measured Variable [x1]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-Stage1!Energy Rate
Value	14922.4
Unit	

Measured Variable [x2]

Source Moniker	ProMax:ProMax!Project!Flowsheets!RSV!QStreams!Q-Stage2!Energy Rate
Value	9771.41
Unit	

Calculator (Simple Specifier 10) Remarks

Remarks

Recoveries

User Value [C2 Recovery]

* Parameter	99.5675	Upper Bound	
Lower Bound		* Enforce Bounds	False

Source Code

CV1 = Out/In*100

Calculated Variable [CV1]

Source Moniker	ProMax:ProMax!Project!User Value Sets!Recoveries!C2 Recovery!Properties!Parameter
Value	99.5675
Unit	

		User Value Sets Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Measured Variable [Out]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!RSV!PStreams!35!Phases!Total!Composition!Mass Flow!C2			
Value		148028			
Unit					
Measured Variable [In]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!RSV!PStreams!1!Phases!Total!Composition!Mass Flow!C2			
Value		148671			
Unit					
Calculator (Specifier for C2 Recovery) Remarks					
User Value [C3 Recovery]					
* Parameter		100		Upper Bound	
Lower Bound				* Enforce Bounds False	
Source Code					
CV1 = Out/In*100					
Calculated Variable [CV1]					
Source Moniker		ProMax:ProMax!Project!User Value Sets!Recoveries!C3 Recovery!Properties!Parameter			
Value		100			
Unit					
Measured Variable [In]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!RSV!PStreams!1!Phases!Total!Composition!Mass Flow!C3			
Value		73239.5			
Unit					
Measured Variable [Out]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!RSV!PStreams!35!Phases!Total!Composition!Mass Flow!C3			
Value		73239.5			
Unit					
Calculator (Specifier for C3 Recovery) Remarks					
Remarks					
Refrigeration					
User Value [Refrig Power]					
* Parameter		3385.12 hp		Upper Bound hp	
Lower Bound		hp		* Enforce Bounds False	
Source Code					
CV1 = x+y					

		User Value Sets Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Calculated Variable [CV1]					
Source Moniker		ProMax:ProMax!Project!User Value Sets!Refrigeration!Refrig Power!Properties!Parameter			
Value		3385.12			
Unit					
Measured Variable [x]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!Cryo Refrig!QStreams!1st Stg!Energy Rate			
Value		1595.15			
Unit					
Measured Variable [y]					
Source Moniker		ProMax:ProMax!Project!Flowsheets!Cryo Refrig!QStreams!2nd Stg!Energy Rate			
Value		1789.97			
Unit					
Calculator (Specifier for Refrig Power) Remarks					
Remarks					
REFRIG_HP					
User Value [User Value-1]					
Parameter		hp	Upper Bound		hp
Lower Bound		hp	* Enforce Bounds		False
Remarks					
RECOMP_TOTAL_HP					
User Value [User Value-1]					
Parameter		hp	Upper Bound		hp
Lower Bound		hp	* Enforce Bounds		False
Remarks					
DeC2 Refrig Power					
User Value [DeC2 Refrig Power]					
* Parameter	10611.5	hp	Upper Bound		hp
Lower Bound		hp	* Enforce Bounds		False
Source Code					
CV1 = x+y					
Calculated Variable [CV1]					
Source Moniker		ProMax:ProMax!Project!User Value Sets!DeC2 Refrig Power!DeC2 Refrig Power!Properties!Parameter			
Value		10611.5			
Unit					

		User Value Sets Report		
Client Name:	Energy Transfer		Job: Plan Approval Application	
Location:	Cryo II			
Measured Variable [x]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!QStreams!Q-Hi!Energy Rate			
Value	5949.72			
Unit				
Measured Variable [y]				
Source Moniker	ProMax:ProMax!Project!Flowsheets!DeC2 Refrig!QStreams!Q-Lo!Energy Rate			
Value	4661.79			
Unit				
Calculator (Specifier for DeC2 Refrig Power) Remarks				
Remarks				

Reaction Sets Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Reaction Set [All Reactions]

Reaction [LOCAT RXN]

Equations To Use	Forward+Reverse	Rate Basis	Moles Per Volume
Concentration Type		Rate Units	lbmol/(ft ³ *s)
Concentration Units		Approach Temperature	0 °F
Reaction Phase	Total	* Conversion Base	H2S
Kinetic Base			
Reaction Equation	2 H2S + O2 -> 2 H2O + S2		

Reactant Component: H2S

* Stoichiometry	-2	Rev Order
Fwd Order		Keq Order

Reactant Component: O2

* Stoichiometry	-1	Rev Order
Fwd Order		Keq Order

Product Component: H2O

* Stoichiometry	2	Rev Order
Fwd Order		Keq Order

Product Component: S2

* Stoichiometry	1	Rev Order
Fwd Order		Keq Order

Forward Rate Constant: $k = k_0 * T^n * \exp(-E_a/(R*T))$

* Units	K	* Ea	0 Btu/lbmol
k0		Ea/R	0
ln(k0)		n	0

Reverse Rate Constant: $k = k_0 * T^n * \exp(-E_a/(R*T))$

Units	K	Ea	Btu/lbmol
k0		Ea/R	
ln(k0)		n	0

Conversion Equation: $x = A + B*T + C*T^2$

* Units	°F	B	0
* A	0.99	C	0

Reaction [LOCAT RXN_x1]

Equations To Use	Forward+Reverse	Rate Basis	Moles Per Volume
Concentration Type		Rate Units	lbmol/(ft ³ *s)
Concentration Units		Approach Temperature	0 °F
Reaction Phase	Total	* Conversion Base	H2S
Kinetic Base			
Reaction Equation	2 H2S + O2 -> 2 H2O + S2		

Reactant Component: H2S

* Stoichiometry	-2	Rev Order
Fwd Order		Keq Order

Reactant Component: O2

* Stoichiometry	-1	Rev Order
Fwd Order		Keq Order

Product Component: H2O

* Stoichiometry	2	Rev Order

* User Specified Values

? Extrapolated or Approximate Values

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Reaction Sets Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Product Component: H2O

Fwd Order	Keq Order

Product Component: S2

* Stoichiometry 1	Rev Order
Fwd Order	Keq Order

Forward Rate Constant: $k = k_0 \cdot T^n \cdot \exp(-E_a/(R \cdot T))$

* Units K	* Ea 0 Btu/lbmol
k0	Ea/R 0
ln(k0)	n 0

Reverse Rate Constant: $k = k_0 \cdot T^n \cdot \exp(-E_a/(R \cdot T))$

Units K	Ea Btu/lbmol
k0	Ea/R
ln(k0)	n 0

Conversion Equation: $x = A + B \cdot T + C \cdot T^2$

* Units °F	B 0
* A 0.99	C 0

Reaction [LOCAT RXN_x2]

Equations To Use Forward+Reverse	Rate Basis Moles Per Volume
Concentration Type	Rate Units lbmol/(ft^3*s)
Concentration Units	Approach Temperature 0 °F
Reaction Phase Total	* Conversion Base H2S
Kinetic Base	
Reaction Equation 2 H2S + O2 -> 2 H2O + S2	

Reactant Component: H2S

* Stoichiometry -2	Rev Order
Fwd Order	Keq Order

Reactant Component: O2

* Stoichiometry -1	Rev Order
Fwd Order	Keq Order

Product Component: H2O

* Stoichiometry 2	Rev Order
Fwd Order	Keq Order

Product Component: S2

* Stoichiometry 1	Rev Order
Fwd Order	Keq Order

Forward Rate Constant: $k = k_0 \cdot T^n \cdot \exp(-E_a/(R \cdot T))$

* Units K	* Ea 0 Btu/lbmol
k0	Ea/R 0
ln(k0)	n 0

Reverse Rate Constant: $k = k_0 \cdot T^n \cdot \exp(-E_a/(R \cdot T))$

Units K	Ea Btu/lbmol
k0	Ea/R
ln(k0)	n 0

		Reaction Sets Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Conversion Equation: $x = A + B \cdot T + C \cdot T^2$					
* Units		°F		B 0	
* A		0.99		C 0	
Remarks					
Reaction Set [LOCAT]					
Reaction [LOCAT RXN]					
* Active		True			
Remarks					

Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Component Recoveries - Project Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	2	Inlet	x2
Fired Heaters	7	NGL Amine	CO2
Fired Heaters	12	NGL Amine	x1
Inlet	Methanol injection	ThermOx	x1
Inlet	x1	ThermOx	x2

Parameters

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

Tabulated Data

Index	Fired Heaters:2 lbmol/h	Fired Heaters:7 lbmol/h	Fired Heaters:12 lbmol/h	Inlet:Methanol injection lbmol/h
H2O	0	0	0	0
H2S	0	0	0	0
CO2	0	0	0	0
N2	279.321	210.197	2825.51	0
C1	0	0	0	0
C2	0	0	0	0
C3	0	0	0	0
iC4	0	0	0	0
nC4	0	0	0	0
iC5	0	0	0	0
nC5	0	0	0	0
C6	0	0	0	0
C7	0	0	0	0
C8	0	0	0	0
C9	0	0	0	0
C10	0	0	0	0
Benzene	0	0	0	0
Toluene	0	0	0	0
Ethylbenzene	0	0	0	0
para-Xylene	0	0	0	0
MDEA	0	0	0	0
O2	74.2498	55.8751	751.086	0
CO	0	0	0	0
NO	0	0	0	0
NO2	0	0	0	0
SO2	0	0	0	0
S2	0	0	0	0
Methanol	0	0	0	0.354567
Piperazine	0	0	0	0
Total	353.57	266.072	3576.6	0.354567

Index	Inlet:x1 lbmol/h	Inlet:x2 lbmol/h	NGL Amine:CO2 lbmol/h	NGL Amine:x1 lbmol/h
H2O	0	11.5618	0	15.6745
H2S	0	0	0	0
CO2	24.2603	0	101.693	0
N2	196.442	0	0	0
C1	42403.5	0	0	0
C2	8240.54	0	0	0
C3	2768.25	0	0	0
iC4	278.993	0	0	0
nC4	638.397	0	0	0
iC5	108.458	0	0	0
nC5	139.03	0	0	0

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Index	Inlet:x1 lbmol/h	Inlet:x2 lbmol/h	NGL Amine:CO2 lbmol/h	NGL Amine:x1 lbmol/h
C6	77.5561	0	0	0
C7	5.65342	0	0	0
C8	2.03084	0	0	0
C9	0.274438	0	0	0
C10	2.52483	0	0	0
Benzene	0.603763	0	0	0
Toluene	0.493988	0	0	0
Ethylbenzene	0.164663	0	0	0
para-Xylene	0.329325	0	0	0
MDEA	0	0	0	0.0839561
O2	0	0	0	0
CO	0	0	0	0
NO	0	0	0	0
NO2	0	0	0	0
SO2	0	0	0	0
S2	0	0	0	0
Methanol	0	0	0	0
Piperazine	0	0	0	0.0344939
Total	54887.5	11.5618	101.693	15.7929

Index	ThermOx:x1 lbmol/h	ThermOx:x2 lbmol/h	Summary Table lbmol/h	
H2O	0	9.08121	36.3175	
H2S	0	0	0	
CO2	0	0	125.954	
N2	152.008	0	3663.48	
C1	0	0	42403.5	
C2	0	0	8240.54	
C3	0	0	2768.25	
iC4	0	0	278.993	
nC4	0	0	638.397	
iC5	0	0	108.458	
nC5	0	0	139.03	
C6	0	0	77.5561	
C7	0	0	5.65342	
C8	0	0	2.03084	
C9	0	0	0.274438	
C10	0	0	2.52483	
Benzene	0	0	0.603763	
Toluene	0	0	0.493988	
Ethylbenzene	0	0	0.164663	
para-Xylene	0	0	0.329325	
MDEA	0	0	0.0839561	
O2	40.4072	0	921.618	
CO	0	0	0	
NO	0	0	0	
NO2	0	0	0	
SO2	0	0	0	
S2	0	0	0	
Methanol	0	0	0.354567	
Piperazine	0	0	0.0344939	
Total	192.415	9.08121	59414.7	

Remarks

Component Recoveries - Project Outlets

Status: Solved

Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	9	Fired Heaters	5
Closed Drain	12	Fired Heaters	10
Closed Drain	13	Fired Heaters	15
Cryo Refrig	9	Gas Sieve	2
Cryo Refrig	16	HMO	26
DeC2	5	Inlet	2
DeC2	13	Inlet	4
DeC2	16	NGL Amine	x3
DeC2	22	NGL Amine	29
DeC2	25	NGL Sieve	17
DeC2 Refrig	9	RSV	47
DeC2 Refrig	16	ThermOx	9

Parameters

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

Tabulated Data

Index	Closed Drain:9 lbmol/h	Closed Drain:12 lbmol/h	Closed Drain:13 lbmol/h	Cryo Refrig:9 lbmol/h
H2O	0.000505087	0.000140621	13.4598	
H2S	0	0	0	
CO2	0.00186373	0.000409435	0.00155709	
N2	1.70958E-05	4.69696E-07	5.10312E-08	
C1	0.00602038	0.000299336	6.50217E-05	
C2	0.00466488	0.000289799	8.43624E-05	
C3	0.000522387	2.53556E-05	5.48208E-06	
iC4	1.71474E-05	5.5866E-07	7.63413E-08	
nC4	5.63296E-05	2.7725E-06	6.16274E-07	
iC5	3.44938E-06	1.13802E-07	1.596E-08	
nC5	2.7614E-06	6.87799E-08	7.03723E-09	
C6	5.61046E-07	9.30928E-09	6.1969E-10	
C7	1.67351E-08	2.05522E-10	1.00428E-11	
C8	2.10401E-09	1.50807E-11	4.25216E-13	
C9	1.11436E-10	5.38053E-13	1.02301E-14	
C10	2.52435E-10	6.09162E-13	5.77994E-15	
Benzene	3.52545E-07	9.04703E-08	2.07232E-06	
Toluene	1.6015E-07	4.05738E-08	8.46958E-07	
Ethylbenzene	2.95308E-08	7.41424E-09	1.51626E-07	
para-Xylene	5.30626E-08	1.31947E-08	2.30828E-07	
MDEA	4.29339E-07	1.12716E-07	0.0547983	
Piperazine	2.32024E-09	6.23972E-10	0.0168582	
Methanol	0	0	0	
O2	0	0	0	
CO	0	0	0	
NO	0	0	0	
NO2	0	0	0	
SO2	0	0	0	
S2	0	0	0	
CHEMTHERM 550	0	0	0	
Total	0.0136749	0.0011688	13.5331	

Index	Cryo Refrig:16 lbmol/h	DeC2:5 lbmol/h	DeC2:13 lbmol/h	DeC2:16 lbmol/h
H2O				0
H2S				0
CO2				0.00283457
N2				8.9413E-07

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Index	Cryo Refrig:16 lbmol/h	DeC2:5 lbmol/h	DeC2:13 lbmol/h	DeC2:16 lbmol/h
C1				47.6649
C2				4901.95
C3				2.53848
iC4				1.84183E-05
nC4				8.99262E-06
iC5				2.78044E-10
nC5				3.26045E-11
C6				0
C7				0
C8				0
C9				0
C10				0
Benzene				0
Toluene				0
Ethylbenzene				0
para-Xylene				0
MDEA				0
Piperazine				0
Methanol				0
O2				0
CO				0
NO				0
NO2				0
SO2				0
S2				0
CHEMTHERM 550				0
Total				4952.16

Index	DeC2:22 lbmol/h	DeC2:25 lbmol/h	DeC2 Refrig:9 lbmol/h	DeC2 Refrig:16 lbmol/h
H2O		0		
H2S		0		
CO2		2.27761E-08		
N2		0		
C1		5.59859E-07		
C2		17.3382		
C3		1657.16		
iC4		167.369		
nC4		382.956		
iC5		65.0587		
nC5		83.3937		
C6		46.5039		
C7		3.38834		
C8		1.21635		
C9		0.164236		
C10		1.51034		
Benzene		0.361074		
Toluene		0.295783		
Ethylbenzene		0.0985862		
para-Xylene		0.197136		
MDEA		0		
Piperazine		0		
Methanol		0.073129		
O2		0		
CO		0		
NO		0		
NO2		0		
SO2		0		
S2		0		
CHEMTHERM 550		0		
Total		2427.08		

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Index	Fired Heaters:5 lbmol/h	Fired Heaters:10 lbmol/h	Fired Heaters:15 lbmol/h	Gas Sieve:2 lbmol/h
H2O	63.906	48.0911	656.56	
H2S	0	0	0	
CO2	31.3499	23.5917	322.186	
N2	278.843	209.837	2820.72	
C1	0.322352	0.242579	3.26166	
C2	0.000270571	0.000203612	0.0311878	
C3	9.22485E-10	6.94196E-10	0.00315719	
iC4	0	0	0.000107654	
nC4	0	0	0.000281588	
iC5	0	0	1.50303E-05	
nC5	0	0	1.87758E-05	
C6	0	0	2.796E-06	
C7	0	0	5.3069E-08	
C8	0	0	6.96566E-09	
C9	0	0	1.38224E-10	
C10	0	0	2.7401E-10	
Benzene	0	0	2.07443E-07	
Toluene	0	0	7.02006E-08	
Ethylbenzene	0	0	9.55466E-09	
para-Xylene	0	0	1.79622E-08	
MDEA	0	0	5.88707E-09	
Piperazine	0	0	0	
Methanol	0	0	0	
O2	10.0134	7.5354	90.3508	
CO	0.621317	0.467559	8.07327	
NO	1.25404	0.943699	12.6175	
NO2	0.000603196	0.000453922	0.00550774	
SO2	0	0	0	
S2	0	0	0	
CHEMTERM 550	0	0	0	
Total	386.311	290.71	3913.8	

Index	HMO:26 lbmol/h	Inlet:2 lbmol/h	Inlet:4 lbmol/h	NGL Amine:x3 lbmol/h
H2O			4.6247	
H2S			0	
CO2			9.70405	
N2			78.5765	
C1			16961.3	
C2			3296.19	
C3			1107.29	
iC4			111.597	
nC4			255.357	
iC5			43.3828	
nC5			55.6117	
C6			31.0222	
C7			2.26135	
C8			0.81233	
C9			0.109774	
C10			1.00992	
Benzene			0.241504	
Toluene			0.197594	
Ethylbenzene			0.0658646	
para-Xylene			0.131729	
MDEA			0	
Piperazine			0	
Methanol			0.141826	
O2			0	
CO			0	

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Index	HMO:26 lbmol/h	Inlet:2 lbmol/h	Inlet:4 lbmol/h	NGL Amine:x3 lbmol/h
NO			0	
NO2			0	
SO2			0	
S2			0	
CHEMTHERM 550			0	
Total			21959.6	

Index	NGL Amine:29 lbmol/h	NGL Sieve:17 lbmol/h	RSV:47 lbmol/h	ThermOx:9 lbmol/h
H2O			0	44.0801
H2S			0	0
CO2			3.74081	126.446
N2			116.046	152.045
C1			25002	0.00239625
C2			20.9858	0.0182806
C3			7.15489E-05	0.00152463
iC4			2.8241E-10	3.30159E-05
nC4			1.51015E-10	0.000128566
iC5			0	0
nC5			0	0
C6			0	0
C7			0	0
C8			0	0
C9			0	0
C10			0	0
Benzene			0	0
Toluene			0	0
Ethylbenzene			0	0
para-Xylene			0	0
MDEA			0	0
Piperazine			0	0
Methanol			0	0
O2			0	13.4432
CO			0	0.00124957
NO			0	0.0178738
NO2			0	0.000133889
SO2			0	0
S2			0	0
CHEMTHERM 550			0	0
Total			25142.7	336.056

Index	Summary Table lbmol/h			
H2O	830.722			
H2S	0			
CO2	517.025			
N2	3656.06			
C1	42014.8			
C2	8236.52			
C3	2767			
iC4	278.966			
nC4	638.313			
iC5	108.442			
nC5	139.005			
C6	77.5261			
C7	5.64969			
C8	2.02868			
C9	0.27401			
C10	2.52027			
Benzene	0.60258			

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Index	Summary Table lbmol/h			
Toluene	0.493378			
Ethylbenzene	0.164451			
para-Xylene	0.328866			
MDEA	0.0547989			
Piperazine	0.0168582			
Methanol	0.214955			
O2	121.343			
CO	9.1634			
NO	14.8331			
NO2	0.00669874			
SO2	0			
S2	0			
CHEMTHERM 550	0			
Total	59422			

Remarks

Component Recoveries - Project Losses

Status: Solved

Reference Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	9	Fired Heaters	5
Closed Drain	12	Fired Heaters	10
Closed Drain	13	Fired Heaters	15
Cryo Refrig	9	Gas Sieve	2
Cryo Refrig	16	HMO	26
DeC2	5	Inlet	2
DeC2	13	Inlet	4
DeC2	16	NGL Amine	x3
DeC2	22	NGL Amine	29
DeC2	25	NGL Sieve	17
DeC2 Refrig	9	RSV	47
DeC2 Refrig	16	ThermOx	9

Recovery Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	2	Inlet	x2
Fired Heaters	7	NGL Amine	CO2
Fired Heaters	12	NGL Amine	x1
Inlet	Methanol injection	ThermOx	x1
Inlet	x1	ThermOx	x2

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
H2O	-794.404			
H2S	0			
CO2	-391.071			
N2	7.4187			
C1	388.763			
C2	4.0152			
C3	1.25594			

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Summary Table lbmol/h			
iC4	0.0274791			
nC4	0.0837762			
iC5	0.0162393			
nC5	0.0247066			
C6	0.0299604			
C7	0.00372547			
C8	0.00215839			
C9	0.000427615			
C10	0.0045611			
Benzene	0.00118264			
Toluene	0.000610008			
Ethylbenzene	0.000211546			
para-Xylene	0.000459669			
MDEA	0.0291572			
Piperazine	0.0176357			
Methanol	0.139612			
O2	800.275			
CO	-9.1634			
NO	-14.8331			
NO2	-0.00669874			
SO2	0			
S2	0			
CHEMTHERM 550	0			
Total	-7.3693			

Remarks

Component Recoveries - Project Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Project

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	2	Inlet	x2
Fired Heaters	7	NGL Amine	CO2
Fired Heaters	12	NGL Amine	x1
Inlet	Methanol injection	ThermOx	x1
Inlet	x1	ThermOx	x2

Recovery Stream Data Source - All Outlets in Project

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	9	Fired Heaters	5
Closed Drain	12	Fired Heaters	10
Closed Drain	13	Fired Heaters	15
Cryo Refrig	9	Gas Sieve	2
Cryo Refrig	16	HMO	26
DeC2	5	Inlet	2
DeC2	13	Inlet	4
DeC2	16	NGL Amine	x3
DeC2	22	NGL Amine	29
DeC2	25	NGL Sieve	17
DeC2 Refrig	9	RSV	47
DeC2 Refrig	16	ThermOx	9

Parameters

* Composition Basis Molar Flow * Summation Option Streams and Summation

* User Specified Values
? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II

Job: Plan Approval Application

Parameters

* Calculate Ratios True * Atomic Basis False

Tabulated Data

Index	Closed Drain:9 %	Closed Drain:12 %	Closed Drain:13 %	Cryo Refrig:9 %
H2O	0.00139075	0.000387199	37.0613	
H2S				
CO2	0.00147969	0.000325068	0.00123624	
N2	4.66653E-07	1.2821E-08	1.39297E-09	
C1	1.41978E-05	7.05923E-07	1.5334E-07	
C2	5.66089E-05	3.51674E-06	1.02375E-06	
C3	1.88706E-05	9.15941E-07	1.98034E-07	
iC4	6.14618E-06	2.00241E-07	2.73631E-08	
nC4	8.82359E-06	4.34291E-07	9.65347E-08	
iC5	3.18039E-06	1.04927E-07	1.47154E-08	
nC5	1.98619E-06	4.94712E-08	5.06166E-09	
C6	7.23407E-07	1.20033E-08	7.99022E-10	
C7	2.96018E-07	3.63536E-09	1.77642E-10	
C8	1.03603E-07	7.42587E-10	2.0938E-11	
C9	4.06053E-08	1.96057E-10	3.72766E-12	
C10	9.99811E-09	2.41269E-11	2.28924E-13	
Benzene	5.83912E-05	1.49844E-05	0.000343235	
Toluene	3.24198E-05	8.21352E-06	0.000171453	
Ethylbenzene	1.79341E-05	4.50268E-06	9.20831E-05	
para-Xylene	1.61125E-05	4.00659E-06	7.00913E-05	
MDEA	0.000511385	0.000134256	65.2702	
O2	0	0	0	
CO				
NO				
NO2				
SO2				
S2				
Methanol	0	0	0	
Piperazine	6.72652E-06	1.80893E-06	48.8729	
CHEMTHERM 550				
Total	2.3016E-05	1.9672E-06	0.0227774	

Index	Cryo Refrig:16 %	DeC2:5 %	DeC2:13 %	DeC2:16 %
H2O				0
H2S				
CO2				0.00225049
N2				2.44066E-08
C1				0.112408
C2				59.4858
C3				0.0916998
iC4				6.60171E-06
nC4				1.40863E-06
iC5				2.56361E-10
nC5				2.34514E-11
C6				0
C7				0
C8				0
C9				0
C10				0
Benzene				0
Toluene				0
Ethylbenzene				0
para-Xylene				0
MDEA				0
O2				0

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Index	Cryo Refrig:16 %	DeC2:5 %	DeC2:13 %	DeC2:16 %
CO				
NO				
NO2				
SO2				
S2				
Methanol				0
Piperazine				0
CHEMTHERM 550				
Total				8.33491

Index	DeC2:22 %	DeC2:25 %	DeC2 Refrig:9 %	DeC2 Refrig:16 %
H2O		0		
H2S				
CO2		1.80829E-08		
N2		0		
C1		1.32031E-09		
C2		0.210401		
C3		59.863		
iC4		59.9903		
nC4		59.9871		
iC5		59.9853		
nC5		59.9825		
C6		59.9616		
C7		59.9344		
C8		59.894		
C9		59.8444		
C10		59.8196		
Benzene		59.8039		
Toluene		59.8765		
Ethylbenzene		59.8717		
para-Xylene		59.8606		
MDEA		0		
O2		0		
CO				
NO				
NO2				
SO2				
S2				
Methanol		20.6249		
Piperazine		0		
CHEMTHERM 550				
Total		4.08499		

Index	Fired Heaters:5 %	Fired Heaters:10 %	Fired Heaters:15 %	Gas Sieve:2 %
H2O	175.965	132.418	1807.83	
H2S				
CO2	24.89	18.7305	255.797	
N2	7.61142	5.72781	76.9955	
C1	0.0007602	0.000572072	0.00769194	
C2	3.28341E-06	2.47086E-06	0.000378468	
C3	3.33237E-11	2.5077E-11	0.00011405	
iC4	0	0	3.85864E-05	
nC4	0	0	4.41087E-05	
iC5	0	0	1.38582E-05	
nC5	0	0	1.35048E-05	
C6	0	0	3.60513E-06	
C7	0	0	9.38707E-07	
C8	0	0	3.42994E-07	

* User Specified Values
 ? Extrapolated or Approximate Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Index	Fired Heaters:5 %	Fired Heaters:10 %	Fired Heaters:15 %	Gas Sieve:2 %
C9	0	0	5.03662E-08	
C10	0	0	1.08526E-08	
Benzene	0	0	3.43584E-05	
Toluene	0	0	1.4211E-05	
Ethylbenzene	0	0	5.80257E-06	
para-Xylene	0	0	5.45424E-06	
MDEA	0	0	7.01208E-06	
O2	1.08651	0.817627	9.80349	
CO				
NO				
NO2				
SO2				
S2				
Methanol	0	0	0	
Piperazine	0	0	0	
CHEMTHERM 550				
Total	0.650194	0.48929	6.58727	

Index	HMO:26 %	Inlet:2 %	Inlet:4 %	NGL Amine:x3 %
H2O			12.7341	
H2S				
CO2			7.70446	
N2			2.14486	
C1			39.9997	
C2			39.9997	
C3			39.9997	
iC4			39.9997	
nC4			39.9997	
iC5			39.9997	
nC5			39.9997	
C6			39.9997	
C7			39.9997	
C8			39.9997	
C9			39.9997	
C10			39.9997	
Benzene			39.9997	
Toluene			39.9997	
Ethylbenzene			39.9997	
para-Xylene			39.9997	
MDEA			0	
O2			0	
CO				
NO				
NO2				
SO2				
S2				
Methanol			39.9997	
Piperazine			0	
CHEMTHERM 550				
Total			36.96	

Index	NGL Amine:29 %	NGL Sieve:17 %	RSV:47 %	ThermOx:9 %
H2O			0	121.374
H2S				
CO2			2.96999	100.391
N2			3.16764	4.15028
C1			58.962	5.65106E-06
C2			0.254665	0.000221837

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Index	NGL Amine:29 %	NGL Sieve:17 %	RSV:47 %	ThermOx:9 %
C3			2.58462E-06	5.50756E-05
iC4			1.01225E-10	1.18339E-05
nC4			2.36554E-11	2.01389E-05
iC5			0	0
nC5			0	0
C6			0	0
C7			0	0
C8			0	0
C9			0	0
C10			0	0
Benzene			0	0
Toluene			0	0
Ethylbenzene			0	0
para-Xylene			0	0
MDEA			0	0
O2			0	1.45865
CO				
NO				
NO2				
SO2				
S2				
Methanol			0	0
Piperazine			0	0
CHEMTHERM 550				
Total			42.3174	0.565611

Index	Summary Table %			
H2O	2287.39			
H2S				
CO2	410.488			
N2	99.7975			
C1	99.0832			
C2	99.9513			
C3	99.9546			
iC4	99.9902			
nC4	99.9869			
iC5	99.985			
nC5	99.9822			
C6	99.9614			
C7	99.9341			
C8	99.8937			
C9	99.8442			
C10	99.8194			
Benzene	99.8041			
Toluene	99.8765			
Ethylbenzene	99.8715			
para-Xylene	99.8604			
MDEA	65.2709			
O2	13.1663			
CO				
NO				
NO2				
SO2				
S2				
Methanol	60.6246			
Piperazine	48.8729			
CHEMTHERM 550				
Total	100.012			

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Remarks

Component Recoveries - Inlet Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Inlet	Methanol injection	Inlet	x2
Inlet	x1		

Parameters

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

Tabulated Data

Index	Inlet:Methanol injection lbmol/h	Inlet:x1 lbmol/h	Inlet:x2 lbmol/h	Summary Table lbmol/h
H2O	0	0	11.5618	11.5618
H2S	0	0	0	0
CO2	0	24.2603	0	24.2603
N2	0	196.442	0	196.442
C1	0	42403.5	0	42403.5
C2	0	8240.54	0	8240.54
C3	0	2768.25	0	2768.25
iC4	0	278.993	0	278.993
nC4	0	638.397	0	638.397
iC5	0	108.458	0	108.458
nC5	0	139.03	0	139.03
C6	0	77.5561	0	77.5561
C7	0	5.65342	0	5.65342
C8	0	2.03084	0	2.03084
C9	0	0.274438	0	0.274438
C10	0	2.52483	0	2.52483
Benzene	0	0.603763	0	0.603763
Toluene	0	0.493988	0	0.493988
Ethylbenzene	0	0.164663	0	0.164663
para-Xylene	0	0.329325	0	0.329325
Methanol	0.354567	0	0	0.354567
Total	0.354567	54887.5	11.5618	54899.5

Remarks

Component Recoveries - Inlet Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Inlet	2	Inlet	5
Inlet	4		

Parameters

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

Recoveries Report		
Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Tabulated Data				
Index	Inlet:2 lbmol/h	Inlet:4 lbmol/h	Inlet:5 lbmol/h	Summary Table lbmol/h
H2O		4.6247	6.93712	11.5618
H2S		0	0	0
CO2		9.70405	14.5562	24.2603
N2		78.5765	117.866	196.442
C1		16961.3	25442.2	42403.5
C2		3296.19	4944.35	8240.54
C3		1107.29	1660.96	2768.25
iC4		111.597	167.397	278.993
nC4		255.357	383.04	638.397
iC5		43.3828	65.0749	108.458
nC5		55.6117	83.4184	139.03
C6		31.0222	46.5339	77.5561
C7		2.26135	3.39206	5.65342
C8		0.81233	1.21851	2.03084
C9		0.109774	0.164663	0.274438
C10		1.00992	1.5149	2.52483
Benzene		0.241504	0.362259	0.603763
Toluene		0.197594	0.296394	0.493988
Ethylbenzene		0.0658646	0.098798	0.164663
para-Xylene		0.131729	0.197596	0.329325
Methanol		0.141826	0.212741	0.354567
Total		21959.6	32939.8	54899.5

Remarks

Component Recoveries - Inlet Losses	Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet			
Flowsheet	PStream	Flowsheet	PStream
Inlet	2	Inlet	5
Inlet	4		

Recovery Stream Data Source - All Inlets in Flowsheet			
Flowsheet	PStream	Flowsheet	PStream
Inlet	Methanol injection	Inlet	x2
Inlet	x1		

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

Tabulated Data				
Index	Summary Table lbmol/h			
H2O	3.52458E-15			
H2S	0			
CO2	1.05737E-14			
N2	5.63932E-14			
C1	1.44367E-11			
C2	1.80458E-12			
C3	9.02292E-13			
iC4	1.12786E-13			
nC4	2.25573E-13			
iC5	4.22949E-14			

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Summary Table lbmol/h			
nC5	2.81966E-14			
C6	2.81966E-14			
C7	1.76229E-15			
C8	4.40572E-16			
C9	5.50715E-17			
C10	8.81144E-16			
Benzene	1.10143E-16			
Toluene	5.50715E-17			
Ethylbenzene	5.50715E-17			
para-Xylene	1.10143E-16			
Methanol	5.50715E-17			
Total	1.44367E-11			

Remarks

Component Recoveries - Inlet Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Inlet	Methanol injection	Inlet	x2
Inlet	x1		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Inlet	2	Inlet	5
Inlet	4		

Parameters

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

Tabulated Data

Index	Inlet:2 %	Inlet:4 %	Inlet:5 %	Summary Table %
H2O		39.9997	60.0003	100
H2S				
CO2		39.9997	60.0003	100
N2		39.9997	60.0003	100
C1		39.9997	60.0003	100
C2		39.9997	60.0003	100
C3		39.9997	60.0003	100
iC4		39.9997	60.0003	100
nC4		39.9997	60.0003	100
iC5		39.9997	60.0003	100
nC5		39.9997	60.0003	100
C6		39.9997	60.0003	100
C7		39.9997	60.0003	100
C8		39.9997	60.0003	100
C9		39.9997	60.0003	100
C10		39.9997	60.0003	100
Benzene		39.9997	60.0003	100
Toluene		39.9997	60.0003	100
Ethylbenzene		39.9997	60.0003	100

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Inlet:2 %	Inlet:4 %	Inlet:5 %	Summary Table %
para-Xylene		39.9997	60.0003	100
Methanol		39.9997	60.0003	100
Total		39.9997	60.0003	100

Remarks

Component Recoveries - RSV Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
RSV	1		

Parameters

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

Tabulated Data

Index	RSV:1 lbmol/h	Summary Table lbmol/h		
H2O	0	0		
H2S	0	0		
CO2	14.5562	14.5562		
N2	117.867	117.867		
C1	25442.4	25442.4		
C2	4944.33	4944.33		
C3	1660.93	1660.93		
iC4	167.389	167.389		
nC4	383.017	383.017		
iC5	65.0677	65.0677		
nC5	83.4072	83.4072		
C6	46.5193	46.5193		
C7	3.39025	3.39025		
C8	1.21746	1.21746		
C9	0.164456	0.164456		
C10	1.51269	1.51269		
Benzene	0.362159	0.362159		
Toluene	0.296234	0.296234		
Ethylbenzene	0.0987109	0.0987109		
para-Xylene	0.197418	0.197418		
Methanol	0.203773	0.203773		
Total	32932.9	32932.9		

Remarks

Component Recoveries - RSV Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
RSV	35	RSV	47
RSV	39	RSV	53

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Parameters

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

Tabulated Data

Index	RSV:35 lbmol/h	RSV:39 lbmol/h	RSV:47 lbmol/h	RSV:53 lbmol/h
H2O	0	0	0	0
H2S	0	0	0	0
CO2	10.7649	0.00147025	3.74081	0.0572409
N2	9.62096E-07	0.0456095	116.046	1.7757
C1	48.0478	9.82651	25002	382.573
C2	4922.94	0.00824803	20.9858	0.321119
C3	1660.93	2.81208E-08	7.15489E-05	1.09482E-06
iC4	167.389	1.10996E-13	2.8241E-10	4.32136E-12
nC4	383.017	5.93535E-14	1.51015E-10	2.3108E-12
iC5	65.0677	0	0	0
nC5	83.4072	0	0	0
C6	46.5193	0	0	0
C7	3.39025	0	0	0
C8	1.21746	0	0	0
C9	0.164456	0	0	0
C10	1.51269	0	0	0
Benzene	0.362159	0	0	0
Toluene	0.296234	0	0	0
Ethylbenzene	0.0987109	0	0	0
para-Xylene	0.197418	0	0	0
Methanol	0.203773	0	0	0
Total	7395.52	9.88184	25142.7	384.727

Index	Summary Table lbmol/h			
H2O	0			
H2S	0			
CO2	14.5644			
N2	117.867			
C1	25442.4			
C2	4944.26			
C3	1660.93			
iC4	167.389			
nC4	383.017			
iC5	65.0677			
nC5	83.4072			
C6	46.5193			
C7	3.39025			
C8	1.21746			
C9	0.164456			
C10	1.51269			
Benzene	0.362159			
Toluene	0.296234			
Ethylbenzene	0.0987109			
para-Xylene	0.197418			
Methanol	0.203773			
Total	32932.9			

Remarks

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Component Recoveries - RSV Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
RSV	35	RSV	47
RSV	39	RSV	53

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
RSV	1		

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
H2O	0			
H2S	0			
CO2	-0.00820652			
N2	-0.000371177			
C1	-0.0603183			
C2	0.0688542			
C3	-1.67843E-05			
iC4	-8.718E-07			
nC4	-1.71452E-06			
iC5	-1.53748E-07			
nC5	-1.63434E-07			
C6	-3.34635E-08			
C7	-1.01676E-09			
C8	-1.4115E-10			
C9	-5.04942E-12			
C10	-2.03727E-11			
Benzene	-3.72006E-10			
Toluene	-1.18432E-10			
Ethylbenzene	-1.45857E-11			
para-Xylene	-2.72747E-11			
Methanol	-5.48061E-10			
Total	-6.15648E-05			

Remarks

Component Recoveries - RSV Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
RSV	1		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
RSV	35	RSV	47
RSV	39	RSV	53

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Parameters

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

Tabulated Data

Index	RSV:35 %	RSV:39 %	RSV:47 %	RSV:53 %
H2O				
H2S				
CO2	73.954	0.0101005	25.6991	0.39324
N2	8.16257E-07	0.0386958	98.4551	1.50653
C1	0.18885	0.0386226	98.2691	1.50369
C2	99.5675	0.000166818	0.424442	0.00649469
C3	100	1.69308E-09	4.30778E-06	6.59164E-08
iC4	100	6.63098E-14	1.68715E-10	2.58163E-12
nC4	100	1.54963E-14	3.94279E-11	6.03314E-13
iC5	100	0	0	0
nC5	100	0	0	0
C6	100	0	0	0
C7	100	0	0	0
C8	100	0	0	0
C9	100	0	0	0
C10	100	0	0	0
Benzene	100	0	0	0
Toluene	100	0	0	0
Ethylbenzene	100	0	0	0
para-Xylene	100	0	0	0
Methanol	100	0	0	0
Total	22.4564	0.030006	76.3454	1.16822

Index	Summary Table %			
H2O				
H2S				
CO2	100.056			
N2	100			
C1	100			
C2	99.9986			
C3	100			
iC4	100			
nC4	100			
iC5	100			
nC5	100			
C6	100			
C7	100			
C8	100			
C9	100			
C10	100			
Benzene	100			
Toluene	100			
Ethylbenzene	100			
para-Xylene	100			
Methanol	100			
Total	100			

Remarks

		Recoveries Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Component Recoveries - Cryo Refrig Inlets					Status: Solved
Parameters					
* Composition Basis		Molar Flow	* Summation Option		Streams and Summation
* Calculate Ratios		False	* Atomic Basis		False
Tabulated Data					
Index	Summary Table lbmol/h				
Total	0				
Remarks					
Component Recoveries - Cryo Refrig Outlets					Status: Solved
Recovery Stream Data Source - All Outlets in Flowsheet					
Flowsheet	PStream		Flowsheet	PStream	
Cryo Refrig	9		Cryo Refrig	16	
Parameters					
* Composition Basis		Molar Flow	* Summation Option		Streams and Summation
* Calculate Ratios		False	* Atomic Basis		False
Tabulated Data					
Index	Cryo Refrig:9 lbmol/h	Cryo Refrig:16 lbmol/h	Summary Table lbmol/h		
H2O			0		
H2S			0		
CO2			0		
N2			0		
C1			0		
C2			0		
C3			0		
iC4			0		
nC4			0		
iC5			0		
nC5			0		
C6			0		
C7			0		
C8			0		
C9			0		
C10			0		
Benzene			0		
Toluene			0		
Ethylbenzene			0		
para-Xylene			0		
Methanol			0		
Total			0		
Remarks					
Component Recoveries - Cryo Refrig Losses					Status: Solved

		Recoveries Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				

Reference Stream Data Source - All Outlets in Flowsheet			
Flowsheet	PStream	Flowsheet	PStream
Cryo Refrig	9	Cryo Refrig	16

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

Tabulated Data				
Index	Summary Table lbmol/h			
H2O	0			
H2S	0			
CO2	0			
N2	0			
C1	0			
C2	0			
C3	0			
iC4	0			
nC4	0			
iC5	0			
nC5	0			
C6	0			
C7	0			
C8	0			
C9	0			
C10	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
para-Xylene	0			
Methanol	0			
Total	0			

Remarks

Component Recoveries - Cryo Refrig Recoveries			Status: Solved
Recovery Stream Data Source - All Outlets in Flowsheet			
Flowsheet	PStream	Flowsheet	PStream
Cryo Refrig	9	Cryo Refrig	16

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

Tabulated Data				
Index	Cryo Refrig:9 %	Cryo Refrig:16 %	Summary Table %	
H2O				
H2S				
CO2				
N2				
C1				
C2				
C3				

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Cryo Refrig:9 %	Cryo Refrig:16 %	Summary Table %	
iC4				
nC4				
iC5				
nC5				
C6				
C7				
C8				
C9				
C10				
Benzene				
Toluene				
Ethylbenzene				
para-Xylene				
Methanol				
Total				

Remarks

Component Recoveries - Gas Sieve Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Gas Sieve	1		

Parameters

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

Tabulated Data

Index	Gas Sieve:1 lbmol/h	Summary Table lbmol/h		
H2O	6.93712	6.93712		
H2S	0	0		
CO2	14.5562	14.5562		
N2	117.866	117.866		
C1	25442.2	25442.2		
C2	4944.35	4944.35		
C3	1660.96	1660.96		
iC4	167.397	167.397		
nC4	383.04	383.04		
iC5	65.0749	65.0749		
nC5	83.4184	83.4184		
C6	46.5339	46.5339		
C7	3.39206	3.39206		
C8	1.21851	1.21851		
C9	0.164663	0.164663		
C10	1.5149	1.5149		
Benzene	0.362259	0.362259		
Toluene	0.296394	0.296394		
Ethylbenzene	0.098798	0.098798		
para-Xylene	0.197596	0.197596		
Methanol	0.212741	0.212741		
Total	32939.8	32939.8		

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Remarks

Component Recoveries - Gas Sieve Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Gas Sieve	2	Gas Sieve	17
Gas Sieve	9		

Parameters

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

Tabulated Data

Index	Gas Sieve:2 lbmol/h	Gas Sieve:9 lbmol/h	Gas Sieve:17 lbmol/h	Summary Table lbmol/h
H2O		0	6.93728	6.93728
H2S		0	0	0
CO2		14.5562	5.12183E-05	14.5563
N2		117.867	1.76165E-05	117.867
C1		25442.4	0.00626967	25442.4
C2		4944.33	0.00105228	4944.33
C3		1660.93	0.000181826	1660.93
iC4		167.389	7.86802E-06	167.389
nC4		383.017	2.90513E-05	383.017
iC5		65.0677	2.12415E-06	65.0677
nC5		83.4072	1.57119E-06	83.4073
C6		46.5193	4.05662E-07	46.5193
C7		3.39025	1.39467E-08	3.39025
C8		1.21746	1.83546E-09	1.21746
C9		0.164456	1.05984E-10	0.164456
C10		1.51269	2.42E-10	1.51269
Benzene		0.362159	1.80495E-06	0.362161
Toluene		0.296234	8.59224E-07	0.296235
Ethylbenzene		0.0987109	1.68817E-07	0.0987111
para-Xylene		0.197418	2.54609E-07	0.197418
Methanol		0.203773	0.000589213	0.204362
Total		32932.9	6.94549	32939.8

Remarks

Component Recoveries - Gas Sieve Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Gas Sieve	2	Gas Sieve	17
Gas Sieve	9		

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Gas Sieve	1		

Recoveries Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
H2O	-0.00015911			
H2S	0			
CO2	-4.01935E-05			
N2	-0.000836332			
C1	-0.13037			
C2	0.0176685			
C3	0.0332588			
iC4	0.00743638			
nC4	0.0229196			
iC5	0.0072769			
nC5	0.0111831			
C6	0.0145233			
C7	0.00181044			
C8	0.00104713			
C9	0.000207481			
C10	0.00221508			
Benzene	9.84346E-05			
Toluene	0.000159022			
Ethylbenzene	8.69156E-05			
para-Xylene	0.000177896			
Methanol	0.0083786			
Total	-0.00295831			

Remarks

Component Recoveries - Gas Sieve Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Gas Sieve	1		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Gas Sieve	2	Gas Sieve	17
Gas Sieve	9		

Parameters

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

Tabulated Data

Index	Gas Sieve:2 %	Gas Sieve:9 %	Gas Sieve:17 %	Summary Table %
H2O		0	100.002	100.002
H2S				
CO2		99.9999	0.000351865	100
N2		100.001	1.49462E-05	100.001
C1		100	2.46428E-05	100.001
C2		99.9996	2.12824E-05	99.9996

* User Specified Values

? Extrapolated or Approximate Values

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		Recoveries Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Tabulated Data					
Index	Gas Sieve:2 %	Gas Sieve:9 %	Gas Sieve:17 %	Summary Table %	
C3		99.998	1.0947E-05	99.998	
iC4		99.9956	4.70022E-06	99.9956	
nC4		99.994	7.58439E-06	99.994	
iC5		99.9888	3.26416E-06	99.9888	
nC5		99.9866	1.88351E-06	99.9866	
C6		99.9688	8.71756E-07	99.9688	
C7		99.9466	4.11155E-07	99.9466	
C8		99.9141	1.50631E-07	99.9141	
C9		99.874	6.43643E-08	99.874	
C10		99.8538	1.59746E-08	99.8538	
Benzene		99.9723	0.000498249	99.9728	
Toluene		99.9461	0.000289893	99.9463	
Ethylbenzene		99.9119	0.000170871	99.912	
para-Xylene		99.9098	0.000128853	99.91	
Methanol		95.7846	0.276963	96.0616	
Total		99.9789	0.0210854	100	
Remarks					
Component Recoveries - RSV_data Inlets				Status: Solved	
Parameters					
* Composition Basis		Molar Flow	* Summation Option		Streams and Summation
* Calculate Ratios		False	* Atomic Basis		False
Tabulated Data					
Index	Summary Table lbmol/h				
Total	0				
Remarks					
Component Recoveries - RSV_data Outlets				Status: Solved	
Parameters					
* Composition Basis		Molar Flow	* Summation Option		Streams and Summation
* Calculate Ratios		False	* Atomic Basis		False
Tabulated Data					
Index	Summary Table lbmol/h				
Total	0				
Remarks					
Component Recoveries - RSV_data Losses				Status: Solved	

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
Total	0			

Remarks

Component Recoveries - RSV_data Recoveries

Status: Solved

Parameters

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

Tabulated Data

Index	Summary Table %			
Total				

Remarks

Component Recoveries - NGL Amine Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Amine	CO2	NGL Amine	13
NGL Amine	x1		

Parameters

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

Tabulated Data

Index	NGL Amine:CO2 lbmol/h	NGL Amine:x1 lbmol/h	NGL Amine:13 lbmol/h	Summary Table lbmol/h
H2O	0	15.6745	0	15.6745
H2S	0	0	0	0
CO2	101.693	0	10.7649	112.458
N2	0	0	9.62096E-07	9.62096E-07
C1	0	0	48.0478	48.0478
C2	0	0	4922.94	4922.94
C3	0	0	1660.93	1660.93
iC4	0	0	167.389	167.389
nC4	0	0	383.017	383.017
iC5	0	0	65.0677	65.0677
nC5	0	0	83.4072	83.4072
C6	0	0	46.5193	46.5193
C7	0	0	3.39025	3.39025

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	NGL Amine:CO2 lbmol/h	NGL Amine:x1 lbmol/h	NGL Amine:13 lbmol/h	Summary Table lbmol/h
C8	0	0	1.21746	1.21746
C9	0	0	0.164456	0.164456
C10	0	0	1.51269	1.51269
Benzene	0	0	0.362159	0.362159
Toluene	0	0	0.296234	0.296234
Ethylbenzene	0	0	0.0987109	0.0987109
para-Xylene	0	0	0.197418	0.197418
MDEA	0	0.0839561	0	0.0839561
Piperazine	0	0.0344939	0	0.0344939
Methanol	0	0	0.203773	0.203773
Total	101.693	15.7929	7395.52	7513.01

Remarks

Component Recoveries - NGL Amine Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Amine	x3	NGL Amine	29
NGL Amine	15	NGL Amine	30
NGL Amine	21	NGL Amine	34

Parameters

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

Tabulated Data

Index	NGL Amine:x3 lbmol/h	NGL Amine:15 lbmol/h	NGL Amine:21 lbmol/h	NGL Amine:29 lbmol/h
H2O		0.0238291	9.12712	
H2S		0	0	
CO2		0.0204239	112.426	
N2		0	0	
C1		0.0855161	0.0430945	
C2		2.84508	1.82789	
C3		0.315718	0.152463	
iC4		0.0107654	0.00330159	
nC4		0.0281588	0.0128566	
iC5		0.00150303	0.000377018	
nC5		0.00187758	0.00056792	
C6		0.0002796	5.36295E-05	
C7		5.3069E-06	5.55855E-07	
C8		6.96566E-07	6.16755E-08	
C9		1.38224E-08	0	
C10		2.7401E-08	0	
Benzene		2.07443E-05	0.000963321	
Toluene		7.02006E-06	0.000279687	
Ethylbenzene		9.55466E-07	3.18526E-05	
para-Xylene		1.79622E-06	9.23026E-05	
MDEA		5.88707E-07	1.48004E-13	
Piperazine		1.26013E-07	1.32878E-13	
Methanol		1.77989E-05	0.120172	
Total		3.3332	123.716	

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Index	NGL Amine:30 lbmol/h	NGL Amine:34 lbmol/h	Summary Table lbmol/h	
H2O	2.47381	4.04975	15.6745	
H2S	0	0	0	
CO2	0.00377893	0.00769487	112.458	
N2	1.08413E-12	9.59594E-07	9.59595E-07	
C1	5.03396E-05	47.9191	48.0478	
C2	0.0016646	4918.27	4922.94	
C3	0.000158867	1660.46	1660.93	
iC4	4.40262E-06	167.375	167.389	
nC4	1.24334E-05	382.976	383.017	
iC5	5.65309E-07	65.0658	65.0677	
nC5	7.20137E-07	83.4048	83.4072	
C6	9.38399E-08	46.519	46.5193	
C7	1.58049E-09	3.39025	3.39025	
C8	1.7745E-10	1.21746	1.21746	
C9	3.28117E-12	0.164456	0.164456	
C10	7.20832E-12	1.51269	1.51269	
Benzene	2.97352E-07	0.361175	0.362159	
Toluene	8.23994E-08	0.295947	0.296234	
Ethylbenzene	8.71423E-09	0.0986781	0.0987109	
para-Xylene	2.59164E-08	0.197324	0.197418	
MDEA	0.0547989	0.0290655	0.083865	
Piperazine	0.0168582	0.0176189	0.0344772	
Methanol	0.000187494	0.0833918	0.203769	
Total	2.55133	7383.41	7513.01	

Remarks

Component Recoveries - NGL Amine Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Amine	x3	NGL Amine	29
NGL Amine	15	NGL Amine	30
NGL Amine	21	NGL Amine	34

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Amine	CO2	NGL Amine	13
NGL Amine	x1		

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
H2O	-1.6834E-05			
H2S	0			
CO2	-0.000115506			
N2	2.50118E-09			
C1	1.83278E-13			
C2	1.5339E-11			
C3	6.76719E-13			
iC4	-2.81966E-14			
nC4	5.63932E-14			

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Tabulated Data

Index	Summary Table lbmol/h			
iC5	-1.40983E-14			
nC5	0			
C6	-1.40983E-14			
C7	-1.76229E-15			
C8	-2.20286E-16			
C9	5.32562E-10			
C10	4.63337E-10			
Benzene	1.33185E-12			
Toluene	3.5455E-13			
Ethylbenzene	3.274E-14			
para-Xylene	1.6348E-13			
MDEA	9.10885E-05			
Piperazine	1.66978E-05			
Methanol	4.195E-06			
Total	-2.03556E-05			

Remarks

Component Recoveries - NGL Amine Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Amine	CO2	NGL Amine	13
NGL Amine	x1		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Amine	x3	NGL Amine	29
NGL Amine	15	NGL Amine	30
NGL Amine	21	NGL Amine	34

Parameters

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

Tabulated Data

Index	NGL Amine:x3 %	NGL Amine:15 %	NGL Amine:21 %	NGL Amine:29 %
H2O		0.152025	58.2291	
H2S				
CO2		0.0181613	99.9717	
N2		0	0	
C1		0.177981	0.089691	
C2		0.0577922	0.0371301	
C3		0.0190086	0.00917942	
iC4		0.00643133	0.0019724	
nC4		0.00735185	0.00335667	
iC5		0.00230995	0.000579425	
nC5		0.0022511	0.0006809	
C6		0.00060104	0.000115284	
C7		0.000156534	1.63957E-05	
C8		5.72146E-05	5.06591E-06	
C9		8.40492E-06	0	

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	NGL Amine:x3 %	NGL Amine:15 %	NGL Amine:21 %	NGL Amine:29 %
C10		1.81141E-06	0	
Benzene		0.00572796	0.265994	
Toluene		0.00236977	0.0944141	
Ethylbenzene		0.000967944	0.0322686	
para-Xylene		0.000909856	0.0467549	
MDEA		0.000701208	1.76287E-10	
Piperazine		0.000365319	3.85223E-10	
Methanol		0.00873467	58.9733	
Total		0.0443657	1.64669	

Index	NGL Amine:30 %	NGL Amine:34 %	Summary Table %	
H2O	15.7824	25.8365	100	
H2S				
CO2	0.0033603	0.00684242	100	
N2	0.000112684	99.7399	99.74	
C1	0.00010477	99.7322	100	
C2	3.38131E-05	99.905	100	
C3	9.56495E-06	99.9718	100	
iC4	2.63017E-06	99.9916	100	
nC4	3.24618E-06	99.9893	100	
iC5	8.68801E-07	99.9971	100	
nC5	8.63399E-07	99.9971	100	
C6	2.01722E-07	99.9993	100	
C7	4.66188E-08	99.9998	100	
C8	1.45754E-08	99.9999	100	
C9	1.99517E-09	100	100	
C10	4.76524E-10	100	100	
Benzene	8.21054E-05	99.7282	100	
Toluene	2.78156E-05	99.9032	100	
Ethylbenzene	8.82804E-06	99.9668	100	
para-Xylene	1.31277E-05	99.9523	100	
MDEA	65.2709	34.6199	99.8915	
Piperazine	48.8729	51.0783	99.9516	
Methanol	0.092011	40.9238	99.9979	
Total	0.0339588	98.275	100	

Remarks

Component Recoveries - ThermOx Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
ThermOx	x1	ThermOx	1
ThermOx	x2	ThermOx	11

Parameters

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

Tabulated Data

Index	ThermOx:x1 lbmol/h	ThermOx:x2 lbmol/h	ThermOx:1 lbmol/h	ThermOx:11 lbmol/h
H2O	0	9.08121	9.12712	0

* User Specified Values

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Recoveries Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Tabulated Data

Index	ThermOx:x1 lbmol/h	ThermOx:x2 lbmol/h	ThermOx:1 lbmol/h	ThermOx:11 lbmol/h
H2S	0	0	0	0
CO2	0	0	112.426	0.00147025
N2	152.008	0	0	0.0456095
C1	0	0	0.0430945	9.82651
C2	0	0	1.82789	0.00824803
C3	0	0	0.152463	2.81208E-08
iC4	0	0	0.00330159	1.10996E-13
nC4	0	0	0.0128566	5.93535E-14
iC5	0	0	0	0
nC5	0	0	0	0
C6	0	0	0	0
C7	0	0	0	0
C8	0	0	0	0
C9	0	0	0	0
C10	0	0	0	0
Benzene	0	0	0	0
Toluene	0	0	0	0
Ethylbenzene	0	0	0	0
para-Xylene	0	0	0	0
MDEA	0	0	0	0
O2	40.4072	0	0	0
CO	0	0	0	0
NO	0	0	0	0
NO2	0	0	0	0
SO2	0	0	0	0
S2	0	0	0	0
Total	192.415	9.08121	123.593	9.88184

Index	Summary Table lbmol/h			
H2O	18.2083			
H2S	0			
CO2	112.428			
N2	152.054			
C1	9.8696			
C2	1.83614			
C3	0.152463			
iC4	0.00330159			
nC4	0.0128566			
iC5	0			
nC5	0			
C6	0			
C7	0			
C8	0			
C9	0			
C10	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
para-Xylene	0			
MDEA	0			
O2	40.4072			
CO	0			
NO	0			
NO2	0			
SO2	0			
S2	0			
Total	334.971			

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Remarks

Component Recoveries - ThermOx Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
ThermOx	9		

Parameters

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

Tabulated Data

Index	ThermOx:9 lbmol/h	Summary Table lbmol/h		
H2O	44.0801	44.0801		
H2S	0	0		
CO2	126.446	126.446		
N2	152.045	152.045		
C1	0.00239625	0.00239625		
C2	0.0182806	0.0182806		
C3	0.00152463	0.00152463		
iC4	3.30159E-05	3.30159E-05		
nC4	0.000128566	0.000128566		
iC5	0	0		
nC5	0	0		
C6	0	0		
C7	0	0		
C8	0	0		
C9	0	0		
C10	0	0		
Benzene	0	0		
Toluene	0	0		
Ethylbenzene	0	0		
para-Xylene	0	0		
MDEA	0	0		
O2	13.4432	13.4432		
CO	0.00124957	0.00124957		
NO	0.0178738	0.0178738		
NO2	0.000133889	0.000133889		
SO2	0	0		
S2	0	0		
Total	336.056	336.056		

Remarks

Component Recoveries - ThermOx Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
ThermOx	9		

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II

Job: Plan Approval Application

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
ThermOx	x1	ThermOx	1
ThermOx	x2	ThermOx	11

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
H2O	-25.8717			
H2S	0			
CO2	-14.0185			
N2	0.00900383			
C1	9.86721			
C2	1.81786			
C3	0.150939			
iC4	0.00326857			
nC4	0.0127281			
iC5	0			
nC5	0			
C6	0			
C7	0			
C8	0			
C9	0			
C10	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
para-Xylene	0			
MDEA	0			
O2	26.964			
CO	-0.00124957			
NO	-0.0178738			
NO2	-0.000133889			
SO2	0			
S2	0			
Total	-1.08442			

Remarks

Component Recoveries - ThermOx Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
ThermOx	x1	ThermOx	1
ThermOx	x2	ThermOx	11

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
ThermOx	9		

Parameters

* Composition Basis Molar Flow * Summation Option Streams and Summation
? Extrapolated or Approximate Values

* User Specified Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Parameters

* Calculate Ratios True * Atomic Basis False

Tabulated Data

Index	ThermOx:9 %	Summary Table %		
H2O	242.087	242.087		
H2S				
CO2	112.469	112.469		
N2	99.9941	99.9941		
C1	0.0242791	0.0242791		
C2	0.995598	0.995598		
C3	1	1		
iC4	1	1		
nC4	1	1		
iC5				
nC5				
C6				
C7				
C8				
C9				
C10				
Benzene				
Toluene				
Ethylbenzene				
para-Xylene				
MDEA				
O2	33.2692	33.2692		
CO				
NO				
NO2				
SO2				
S2				
Total	100.324	100.324		

Remarks

Component Recoveries - Fired Heaters Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	2	Fired Heaters	16
Fired Heaters	7	Fired Heaters	17
Fired Heaters	12		

Parameters

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

Tabulated Data

Index	Fired Heaters:2 lbmol/h	Fired Heaters:7 lbmol/h	Fired Heaters:12 lbmol/h	Fired Heaters:16 lbmol/h
H2O	0	0	0	0
H2S	0	0	0	0
CO2	0	0	0	0.0572409
N2	279.321	210.197	2825.51	1.7757

Recoveries Report

Client Name: Energy Transfer Job: Plan Approval Application
 Location: Cryo II

Tabulated Data

Index	Fired Heaters:2 lbmol/h	Fired Heaters:7 lbmol/h	Fired Heaters:12 lbmol/h	Fired Heaters:16 lbmol/h
C1	0	0	0	382.573
C2	0	0	0	0.321119
C3	0	0	0	1.09482E-06
iC4	0	0	0	4.32136E-12
nC4	0	0	0	2.3108E-12
iC5	0	0	0	0
nC5	0	0	0	0
C6	0	0	0	0
C7	0	0	0	0
C8	0	0	0	0
C9	0	0	0	0
C10	0	0	0	0
Benzene	0	0	0	0
Toluene	0	0	0	0
Ethylbenzene	0	0	0	0
para-Xylene	0	0	0	0
MDEA	0	0	0	0
O2	74.2498	55.8751	751.086	0
CO	0	0	0	0
NO	0	0	0	0
NO2	0	0	0	0
SO2	0	0	0	0
S2	0	0	0	0
Total	353.57	266.072	3576.6	384.727

Index	Fired Heaters:17 lbmol/h	Summary Table lbmol/h		
H2O	0.0238291	0.0238291		
H2S	0	0		
CO2	0.0204239	0.0776647		
N2	0	3316.81		
C1	0.0855161	382.659		
C2	2.84508	3.16619		
C3	0.315718	0.315719		
iC4	0.0107654	0.0107654		
nC4	0.0281588	0.0281588		
iC5	0.00150303	0.00150303		
nC5	0.00187758	0.00187758		
C6	0.0002796	0.0002796		
C7	5.3069E-06	5.3069E-06		
C8	6.96566E-07	6.96566E-07		
C9	1.38224E-08	1.38224E-08		
C10	2.7401E-08	2.7401E-08		
Benzene	2.07443E-05	2.07443E-05		
Toluene	7.02006E-06	7.02006E-06		
Ethylbenzene	9.55466E-07	9.55466E-07		
para-Xylene	1.79622E-06	1.79622E-06		
MDEA	5.88707E-07	5.88707E-07		
O2	0	881.211		
CO	0	0		
NO	0	0		
NO2	0	0		
SO2	0	0		
S2	0	0		
Total	3.33319	4584.3		

Remarks

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Component Recoveries - Fired Heaters Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	5	Fired Heaters	15
Fired Heaters	10		

Parameters

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

Tabulated Data

Index	Fired Heaters:5 lbmol/h	Fired Heaters:10 lbmol/h	Fired Heaters:15 lbmol/h	Summary Table lbmol/h
H2O	63.906	48.0911	656.56	768.557
H2S	0	0	0	0
CO2	31.3499	23.5917	322.186	377.127
N2	278.843	209.837	2820.72	3309.4
C1	0.322352	0.242579	3.26166	3.82659
C2	0.000270571	0.000203612	0.0311878	0.0316619
C3	9.22485E-10	6.94196E-10	0.00315719	0.00315719
iC4	0	0	0.000107654	0.000107654
nC4	0	0	0.000281588	0.000281588
iC5	0	0	1.50303E-05	1.50303E-05
nC5	0	0	1.87758E-05	1.87758E-05
C6	0	0	2.796E-06	2.796E-06
C7	0	0	5.3069E-08	5.3069E-08
C8	0	0	6.96566E-09	6.96566E-09
C9	0	0	1.38224E-10	1.38224E-10
C10	0	0	2.7401E-10	2.7401E-10
Benzene	0	0	2.07443E-07	2.07443E-07
Toluene	0	0	7.02006E-08	7.02006E-08
Ethylbenzene	0	0	9.55466E-09	9.55466E-09
para-Xylene	0	0	1.79622E-08	1.79622E-08
MDEA	0	0	5.88707E-09	5.88707E-09
O2	10.0134	7.5354	90.3508	107.9
CO	0.621317	0.467559	8.07327	9.16215
NO	1.25404	0.943699	12.6175	14.8152
NO2	0.000603196	0.000453922	0.00550774	0.00656485
SO2	0	0	0	0
S2	0	0	0	0
Total	386.311	290.71	3913.8	4590.82

Remarks

Component Recoveries - Fired Heaters Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	5	Fired Heaters	15
Fired Heaters	10		

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	2	Fired Heaters	16
Fired Heaters	7	Fired Heaters	17
Fired Heaters	12		

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
H2O	-768.533			
H2S	0			
CO2	-377.049			
N2	7.41091			
C1	378.832			
C2	3.13453			
C3	0.312562			
iC4	0.0106577			
nC4	0.0278773			
iC5	0.001488			
nC5	0.0018588			
C6	0.000276804			
C7	5.25383E-06			
C8	6.896E-07			
C9	1.36842E-08			
C10	2.7127E-08			
Benzene	2.05369E-05			
Toluene	6.94986E-06			
Ethylbenzene	9.45911E-07			
para-Xylene	1.77826E-06			
MDEA	5.8282E-07			
O2	773.311			
CO	-9.16215			
NO	-14.8152			
NO2	-0.00656485			
SO2	0			
S2	0			
Total	-6.52285			

Remarks

Component Recoveries - Fired Heaters Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	2	Fired Heaters	16
Fired Heaters	7	Fired Heaters	17
Fired Heaters	12		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Fired Heaters	5	Fired Heaters	15
Fired Heaters	10		

Recoveries Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Parameters

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

Tabulated Data

Index	Fired Heaters:5 %	Fired Heaters:10 %	Fired Heaters:15 %	Summary Table %
H2O	268184	201816	2.75528E+06	3.22528E+06
H2S				
CO2	40365.7	30376.3	414841	485583
N2	8.40697	6.32649	85.0431	99.7766
C1	0.08424	0.063393	0.852367	1
C2	0.00854561	0.00643082	0.985024	1
C3	2.92185E-07	2.19878E-07	0.999999	1
iC4	0	0	1	1
nC4	0	0	1	1
iC5	0	0	1	1
nC5	0	0	1	1
C6	0	0	1	1
C7	0	0	1	1
C8	0	0	1	1
C9	0	0	1	1
C10	0	0	1	1
Benzene	0	0	1	1
Toluene	0	0	1	1
Ethylbenzene	0	0	1	1
para-Xylene	0	0	1	1
MDEA	0	0	1	1
O2	1.13633	0.855119	10.253	12.2445
CO				
NO				
NO2				
SO2				
S2				
Total	8.42682	6.34142	85.374	100.142

Remarks

Component Recoveries - NGL Sieve Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Sieve	1		

Parameters

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

Tabulated Data

Index	NGL Sieve:1 lbmol/h	Summary Table lbmol/h		
H2O	4.04975	4.04975		
H2S	0	0		
CO2	0.00769487	0.00769487		
N2	9.59594E-07	9.59594E-07		

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	NGL Sieve:1 lbmol/h	Summary Table lbmol/h		
C1	47.9191	47.9191		
C2	4918.27	4918.27		
C3	1660.46	1660.46		
iC4	167.375	167.375		
nC4	382.976	382.976		
iC5	65.0658	65.0658		
nC5	83.4048	83.4048		
C6	46.519	46.519		
C7	3.39025	3.39025		
C8	1.21746	1.21746		
C9	0.164456	0.164456		
C10	1.51269	1.51269		
Benzene	0.361175	0.361175		
Toluene	0.295947	0.295947		
Ethylbenzene	0.0986781	0.0986781		
para-Xylene	0.197324	0.197324		
Methanol	0.0833918	0.0833918		
Total	7383.36	7383.36		

Remarks

Component Recoveries - NGL Sieve Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Sieve	6	NGL Sieve	17
NGL Sieve	16		

Parameters

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

Tabulated Data

Index	NGL Sieve:6 lbmol/h	NGL Sieve:16 lbmol/h	NGL Sieve:17 lbmol/h	Summary Table lbmol/h
H2O	0	4.0493		4.0493
H2S	0	0		0
CO2	0.00768604	1.00467E-07		0.00768614
N2	9.42244E-07	1.37268E-12		9.42246E-07
C1	47.9189	6.47353E-05		47.919
C2	4918.38	0.00232216		4918.38
C3	1660.44	0.000212532		1660.44
iC4	167.369	5.51179E-06		167.369
nC4	382.956	1.82336E-05		382.956
iC5	65.0587	8.89684E-07		65.0587
nC5	83.3937	5.45884E-07		83.3937
C6	46.5039	7.14735E-08		46.5039
C7	3.38834	1.42354E-09		3.38834
C8	1.21635	1.06609E-10		1.21635
C9	0.164236	2.71897E-12		0.164236
C10	1.51034	3.84126E-12		1.51034
Benzene	0.361074	4.13032E-07		0.361074
Toluene	0.295783	1.06058E-07		0.295783
Ethylbenzene	0.0985862	1.10405E-08		0.0985863

* User Specified Values
? Extrapolated or Approximate Values

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		Recoveries Report			
Client Name:	Energy Transfer			Job: Plan Approval Application	
Location:	Cryo II				
Tabulated Data					
Index	NGL Sieve:6 lbmol/h	NGL Sieve:16 lbmol/h	NGL Sieve:17 lbmol/h	Summary Table lbmol/h	
para-Xylene	0.197136	1.65606E-08		0.197136	
Methanol	0.073129	0.000116928		0.0732459	
Total	7379.33	4.05204		7383.38	
Remarks					
Component Recoveries - NGL Sieve Losses					Status: Solved
Reference Stream Data Source - All Outlets in Flowsheet					
Flowsheet	PStream		Flowsheet	PStream	
NGL Sieve	6		NGL Sieve	17	
NGL Sieve	16				
Recovery Stream Data Source - All Inlets in Flowsheet					
Flowsheet	PStream		Flowsheet	PStream	
NGL Sieve	1				
Parameters					
* Composition Basis	Molar Flow		* Summation Option	Summation Only	
* Calculate Ratios	False		* Atomic Basis	False	
Tabulated Data					
Index	Summary Table lbmol/h				
H2O	0.000448283				
H2S	0				
CO2	8.72617E-06				
N2	1.73484E-08				
C1	0.000105956				
C2	-0.113611				
C3	0.0168233				
iC4	0.00610943				
nC4	0.0202516				
iC5	0.00709834				
nC5	0.0110979				
C6	0.0151074				
C7	0.00190926				
C8	0.00111052				
C9	0.000220121				
C10	0.002346				
Benzene	0.000100353				
Toluene	0.000164354				
Ethylbenzene	9.18327E-05				
para-Xylene	0.000187694				
Methanol	0.0101459				
Total	-0.0202841				
Remarks					
Component Recoveries - NGL Sieve Recoveries					Status: Solved

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Sieve	1		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
NGL Sieve	6	NGL Sieve	17
NGL Sieve	16		

Parameters

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

Tabulated Data

Index	NGL Sieve:6 %	NGL Sieve:16 %	NGL Sieve:17 %	Summary Table %
H2O	0	99.9889		99.9889
H2S				
CO2	99.8853	0.00130563		99.8866
N2	98.192	0.000143048		98.1921
C1	99.9996	0.000135093		99.9998
C2	100.002	4.7215E-05		100.002
C3	99.999	1.27996E-05		99.999
iC4	99.9963	3.29307E-06		99.9963
nC4	99.9947	4.76104E-06		99.9947
iC5	99.9891	1.36736E-06		99.9891
nC5	99.9867	6.54499E-07		99.9867
C6	99.9675	1.53644E-07		99.9675
C7	99.9437	4.19893E-08		99.9437
C8	99.9088	8.75668E-09		99.9088
C9	99.8662	1.65331E-09		99.8662
C10	99.8449	2.53936E-10		99.8449
Benzene	99.9721	0.000114358		99.9722
Toluene	99.9444	3.58368E-05		99.9445
Ethylbenzene	99.9069	1.11884E-05		99.9069
para-Xylene	99.9049	8.39262E-06		99.9049
Methanol	87.6932	0.140215		87.8334
Total	99.9454	0.0548807		100

Remarks

Component Recoveries - DeC2 Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2	1		

Parameters

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

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	DeC2:1 lbmol/h	Summary Table lbmol/h		
H2O	0	0		
H2S	0	0		
CO2	0.00768604	0.00768604		
N2	9.42244E-07	9.42244E-07		
C1	47.9189	47.9189		
C2	4918.38	4918.38		
C3	1660.44	1660.44		
iC4	167.369	167.369		
nC4	382.956	382.956		
iC5	65.0587	65.0587		
nC5	83.3937	83.3937		
C6	46.5039	46.5039		
C7	3.38834	3.38834		
C8	1.21635	1.21635		
C9	0.164236	0.164236		
C10	1.51034	1.51034		
Benzene	0.361074	0.361074		
Toluene	0.295783	0.295783		
Ethylbenzene	0.0985862	0.0985862		
para-Xylene	0.197136	0.197136		
Methanol	0.073129	0.073129		
Total	7379.33	7379.33		

Remarks

Component Recoveries - DeC2 Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2	5	DeC2	22
DeC2	13	DeC2	25
DeC2	16		

Parameters

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

Tabulated Data

Index	DeC2:5 lbmol/h	DeC2:13 lbmol/h	DeC2:16 lbmol/h	DeC2:22 lbmol/h
H2O			0	
H2S			0	
CO2			0.00283457	
N2			8.9413E-07	
C1			47.6649	
C2			4901.95	
C3			2.53848	
iC4			1.84183E-05	
nC4			8.99262E-06	
iC5			2.78044E-10	
nC5			3.26045E-11	
C6			0	
C7			0	
C8			0	

* User Specified Values

? Extrapolated or Approximate Values

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	DeC2:5 lbmol/h	DeC2:13 lbmol/h	DeC2:16 lbmol/h	DeC2:22 lbmol/h
C9			0	
C10			0	
Benzene			0	
Toluene			0	
Ethylbenzene			0	
para-Xylene			0	
Methanol			0	
Total			4952.16	

Index	DeC2:25 lbmol/h	Summary Table lbmol/h		
H2O	0	0		
H2S	0	0		
CO2	2.27761E-08	0.0028346		
N2	0	8.9413E-07		
C1	5.59859E-07	47.6649		
C2	17.3382	4919.29		
C3	1657.16	1659.7		
iC4	167.369	167.369		
nC4	382.956	382.956		
iC5	65.0587	65.0587		
nC5	83.3937	83.3937		
C6	46.5039	46.5039		
C7	3.38834	3.38834		
C8	1.21635	1.21635		
C9	0.164236	0.164236		
C10	1.51034	1.51034		
Benzene	0.361074	0.361074		
Toluene	0.295783	0.295783		
Ethylbenzene	0.0985862	0.0985862		
para-Xylene	0.197136	0.197136		
Methanol	0.073129	0.073129		
Total	2427.08	7379.24		

Remarks

Component Recoveries - DeC2 Losses

Status: Solved

Reference Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2	5	DeC2	22
DeC2	13	DeC2	25
DeC2	16		

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2	1		

Parameters

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

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Summary Table lbmol/h			
H2O	0			
H2S	0			
CO2	0.00485145			
N2	4.81141E-08			
C1	0.254027			
C2	-0.910105			
C3	0.742377			
iC4	7.90472E-06			
nC4	1.40118E-06			
iC5	-7.8116E-07			
nC5	-1.01098E-06			
C6	-5.93403E-07			
C7	-4.00395E-08			
C8	-1.23797E-08			
C9	-1.35259E-09			
C10	-9.50882E-09			
Benzene	-5.36852E-09			
Toluene	-4.02115E-09			
Ethylbenzene	-1.18193E-09			
para-Xylene	-2.30211E-09			
Methanol	-1.39503E-09			
Total	0.0911571			

Remarks

Component Recoveries - DeC2 Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2	1		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2	5	DeC2	22
DeC2	13	DeC2	25
DeC2	16		

Parameters

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

Tabulated Data

Index	DeC2:5 %	DeC2:13 %	DeC2:16 %	DeC2:22 %
H2O				
H2S				
CO2			36.8795	
N2			94.8937	
C1			99.4699	
C2			99.666	
C3			0.15288	
iC4			1.10046E-05	
nC4			2.34822E-06	

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Recoveries Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	DeC2:5 %	DeC2:13 %	DeC2:16 %	DeC2:22 %
iC5			4.27374E-10	
nC5			3.90971E-11	
C6			0	
C7			0	
C8			0	
C9			0	
C10			0	
Benzene			0	
Toluene			0	
Ethylbenzene			0	
para-Xylene			0	
Methanol			0	
Total			67.1085	

Index	DeC2:25 %	Summary Table %		
H2O				
H2S				
CO2	0.000296331	36.8798		
N2	0	94.8937		
C1	1.16835E-06	99.4699		
C2	0.352518	100.019		
C3	99.8024	99.9553		
iC4	100	100		
nC4	100	100		
iC5	100	100		
nC5	100	100		
C6	100	100		
C7	100	100		
C8	100	100		
C9	100	100		
C10	100	100		
Benzene	100	100		
Toluene	100	100		
Ethylbenzene	100	100		
para-Xylene	100	100		
Methanol	100	100		
Total	32.8903	99.9988		

Remarks

Component Recoveries - DeC2 Refrig Inlets

Status: Solved

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
Total	0			

Remarks

		Recoveries Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Component Recoveries - DeC2 Refrig Outlets					Status: Solved
Recovery Stream Data Source - All Outlets in Flowsheet					
Flowsheet		PStream		Flowsheet	
DeC2 Refrig		9		DeC2 Refrig	
				16	
Parameters					
* Composition Basis		Molar Flow		* Summation Option	
				Streams and Summation	
* Calculate Ratios		False		* Atomic Basis	
				False	
Tabulated Data					
Index	DeC2 Refrig:9 lbmol/h	DeC2 Refrig:16 lbmol/h	Summary Table lbmol/h		
H2O			0		
H2S			0		
CO2			0		
N2			0		
C1			0		
C2			0		
C3			0		
iC4			0		
nC4			0		
iC5			0		
nC5			0		
C6			0		
C7			0		
C8			0		
C9			0		
C10			0		
Benzene			0		
Toluene			0		
Ethylbenzene			0		
para-Xylene			0		
Methanol			0		
Total			0		
Remarks					
Component Recoveries - DeC2 Refrig Losses					Status: Solved
Reference Stream Data Source - All Outlets in Flowsheet					
Flowsheet		PStream		Flowsheet	
DeC2 Refrig		9		DeC2 Refrig	
				16	
Parameters					
* Composition Basis		Molar Flow		* Summation Option	
				Summation Only	
* Calculate Ratios		False		* Atomic Basis	
				False	
Tabulated Data					
Index	Summary Table lbmol/h				
H2O	0				
H2S	0				

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II

Job: Plan Approval Application

Tabulated Data

Index	Summary Table lbmol/h			
CO2	0			
N2	0			
C1	0			
C2	0			
C3	0			
iC4	0			
nC4	0			
iC5	0			
nC5	0			
C6	0			
C7	0			
C8	0			
C9	0			
C10	0			
Benzene	0			
Toluene	0			
Ethylbenzene	0			
para-Xylene	0			
Methanol	0			
Total	0			

Remarks

Component Recoveries - DeC2 Refrig Recoveries

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
DeC2 Refrig	9	DeC2 Refrig	16

Parameters

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

Tabulated Data

Index	DeC2 Refrig:9 %	DeC2 Refrig:16 %	Summary Table %	
H2O				
H2S				
CO2				
N2				
C1				
C2				
C3				
iC4				
nC4				
iC5				
nC5				
C6				
C7				
C8				
C9				
C10				
Benzene				
Toluene				

* User Specified Values

? Extrapolated or Approximate Values

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		Recoveries Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Tabulated Data					
Index	DeC2 Refrig:9 %	DeC2 Refrig:16 %	Summary Table %		
Ethylbenzene					
para-Xylene					
Methanol					
Total					
Remarks					
Component Recoveries - HMO Inlets					Status: Solved
Parameters					
* Composition Basis	Molar Flow	* Summation Option	Streams and Summation		
* Calculate Ratios	False	* Atomic Basis	False		
Tabulated Data					
Index	Summary Table lbmol/h				
Total	0				
Remarks					
Component Recoveries - HMO Outlets					Status: Solved
Recovery Stream Data Source - All Outlets in Flowsheet					
Flowsheet	PStream	Flowsheet	PStream		
HMO	26				
Parameters					
* Composition Basis	Molar Flow	* Summation Option	Streams and Summation		
* Calculate Ratios	False	* Atomic Basis	False		
Tabulated Data					
Index	HMO:26 lbmol/h	Summary Table lbmol/h			
CHEMTHERM 550		0			
Total		0			
Remarks					
Component Recoveries - HMO Losses					Status: Solved
Reference Stream Data Source - All Outlets in Flowsheet					
Flowsheet	PStream	Flowsheet	PStream		
HMO	26				

Recoveries Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Parameters

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

Tabulated Data

Index	Summary Table lbmol/h			
CHEMTHERM 550	0			
Total	0			

Remarks

Component Recoveries - HMO Recoveries

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
HMO	26		

Parameters

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

Tabulated Data

Index	HMO:26 %	Summary Table %		
CHEMTHERM 550				
Total				

Remarks

Component Recoveries - Closed Drain Inlets

Status: Solved

Recovery Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	1	Closed Drain	5
Closed Drain	3		

Parameters

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

Tabulated Data

Index	Closed Drain:1 lbmol/h	Closed Drain:3 lbmol/h	Closed Drain:5 lbmol/h	Summary Table lbmol/h
H2O	6.93728	2.47381	4.0493	13.4604
H2S	0	0	0	0
CO2	5.12183E-05	0.00377893	1.00467E-07	0.00383025
N2	1.76165E-05	1.08413E-12	1.37268E-12	1.76165E-05
C1	0.00626967	5.03396E-05	6.47353E-05	0.00638474
C2	0.00105228	0.0016646	0.00232216	0.00503904
C3	0.000181826	0.000158867	0.000212532	0.000553225

* User Specified Values

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Recoveries Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Tabulated Data

Index	Closed Drain:1 lbmol/h	Closed Drain:3 lbmol/h	Closed Drain:5 lbmol/h	Summary Table lbmol/h
iC4	7.86802E-06	4.40262E-06	5.51179E-06	1.77824E-05
nC4	2.90513E-05	1.24334E-05	1.82336E-05	5.97183E-05
iC5	2.12415E-06	5.65309E-07	8.89684E-07	3.57914E-06
nC5	1.57119E-06	7.20137E-07	5.45884E-07	2.83721E-06
C6	4.05662E-07	9.38399E-08	7.14735E-08	5.70975E-07
C7	1.39467E-08	1.58049E-09	1.42354E-09	1.69507E-08
C8	1.83546E-09	1.7745E-10	1.06609E-10	2.11951E-09
C9	1.05984E-10	3.28117E-12	2.71897E-12	1.11984E-10
C10	2.42E-10	7.20832E-12	3.84126E-12	2.5305E-10
Benzene	1.80495E-06	2.97352E-07	4.13032E-07	2.51534E-06
Toluene	8.59224E-07	8.23994E-08	1.06058E-07	1.04768E-06
Ethylbenzene	1.68817E-07	8.71423E-09	1.10405E-08	1.88571E-07
para-Xylene	2.54609E-07	2.59164E-08	1.65606E-08	2.97086E-07
MDEA	0	0.0547989	0	0.0547989
Piperazine	0	0.0168582	0	0.0168582
Total	6.9449	2.55114	4.05193	13.548

Remarks

Component Recoveries - Closed Drain Outlets

Status: Solved

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	9	Closed Drain	13
Closed Drain	12		

Parameters

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

Tabulated Data

Index	Closed Drain:9 lbmol/h	Closed Drain:12 lbmol/h	Closed Drain:13 lbmol/h	Summary Table lbmol/h
H2O	0.000505087	0.000140621	13.4598	13.4604
H2S	0	0	0	0
CO2	0.00186373	0.000409435	0.00155709	0.00383025
N2	1.70958E-05	4.69696E-07	5.10312E-08	1.76165E-05
C1	0.00602038	0.000299336	6.50217E-05	0.00638474
C2	0.00466488	0.000289799	8.43624E-05	0.00503904
C3	0.000522387	2.53556E-05	5.48208E-06	0.000553225
iC4	1.71474E-05	5.5866E-07	7.63413E-08	1.77824E-05
nC4	5.63296E-05	2.7725E-06	6.16274E-07	5.97183E-05
iC5	3.44938E-06	1.13802E-07	1.596E-08	3.57914E-06
nC5	2.7614E-06	6.87799E-08	7.03723E-09	2.83721E-06
C6	5.61046E-07	9.30928E-09	6.1969E-10	5.70975E-07
C7	1.67351E-08	2.05522E-10	1.00428E-11	1.69507E-08
C8	2.10401E-09	1.50807E-11	4.25216E-13	2.11951E-09
C9	1.11436E-10	5.38053E-13	1.02301E-14	1.11984E-10
C10	2.52435E-10	6.09162E-13	5.77994E-15	2.5305E-10
Benzene	3.52545E-07	9.04703E-08	2.07232E-06	2.51534E-06
Toluene	1.6015E-07	4.05738E-08	8.46958E-07	1.04768E-06
Ethylbenzene	2.95308E-08	7.41424E-09	1.51626E-07	1.88571E-07
para-Xylene	5.30626E-08	1.31947E-08	2.30828E-07	2.97086E-07
MDEA	4.29339E-07	1.12716E-07	0.0547983	0.0547989

* User Specified Values

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		Recoveries Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Tabulated Data					
Index	Closed Drain:9 lbmol/h	Closed Drain:12 lbmol/h	Closed Drain:13 lbmol/h	Summary Table lbmol/h	
Piperazine	2.32024E-09	6.23972E-10	0.0168582	0.0168582	
Total	0.0136749	0.0011688	13.5331	13.548	
Remarks					
Component Recoveries - Closed Drain Losses					Status: Solved
Reference Stream Data Source - All Outlets in Flowsheet					
Flowsheet	PStream	Flowsheet	PStream		
Closed Drain	9	Closed Drain	13		
Closed Drain	12				
Recovery Stream Data Source - All Inlets in Flowsheet					
Flowsheet	PStream	Flowsheet	PStream		
Closed Drain	1	Closed Drain	5		
Closed Drain	3				
Parameters					
* Composition Basis	Molar Flow	* Summation Option	Summation Only		
* Calculate Ratios	False	* Atomic Basis	False		
Tabulated Data					
Index	Summary Table lbmol/h				
H2O	1.76229E-15				
H2S	0				
CO2	4.30246E-19				
N2	-6.7226E-21				
C1	-8.60492E-19				
C2	0				
C3	0				
iC4	-3.3613E-21				
nC4	-6.7226E-21				
iC5	-4.20162E-22				
nC5	-4.20162E-22				
C6	-1.05041E-22				
C7	-3.28252E-24				
C8	-4.10315E-25				
C9	-1.28223E-26				
C10	-5.12893E-26				
Benzene	4.20162E-22				
Toluene	4.20162E-22				
Ethylbenzene	2.62601E-23				
para-Xylene	1.57561E-22				
MDEA	3.44197E-17				
Piperazine	3.44197E-18				
Total	1.76229E-15				
Remarks					

Recoveries Report

Client Name: Energy Transfer
Location: Cryo II

Job: Plan Approval Application

Component Recoveries - Closed Drain Recoveries

Status: Solved

Reference Stream Data Source - All Inlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	1	Closed Drain	5
Closed Drain	3		

Recovery Stream Data Source - All Outlets in Flowsheet

Flowsheet	PStream	Flowsheet	PStream
Closed Drain	9	Closed Drain	13
Closed Drain	12		

Parameters

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

Tabulated Data

Index	Closed Drain:9 %	Closed Drain:12 %	Closed Drain:13 %	Summary Table %
H2O	0.0037524	0.0010447	99.9952	100
H2S				
CO2	48.6582	10.6895	40.6523	100
N2	97.0441	2.66623	0.289679	100
C1	94.2933	4.6883	1.01839	100
C2	92.5748	5.75107	1.67418	100
C3	94.4258	4.58323	0.990932	100
iC4	96.4291	3.14164	0.429307	100
nC4	94.3254	4.64263	1.03197	100
iC5	96.3745	3.17958	0.445917	100
nC5	97.3278	2.42421	0.248033	100
C6	98.2611	1.63042	0.108532	100
C7	98.7283	1.21247	0.0592474	100
C8	99.2684	0.711519	0.020062	100
C9	99.5104	0.480471	0.00913528	100
C10	99.757	0.240728	0.00228411	100
Benzene	14.0158	3.59675	82.3875	100
Toluene	15.2861	3.87272	80.8412	100
Ethylbenzene	15.6603	3.93179	80.4079	100
para-Xylene	17.861	4.44138	77.6976	100
MDEA	0.000783481	0.00020569	99.999	100
Piperazine	1.37633E-05	3.7013E-06	100	100
Total	0.100937	0.00862716	99.8904	100

Remarks

Energy Budgets Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Power Budget - Project Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Project

Flowsheet	Block	Flowsheet	Block
Cryo Refrig	C-161/162/163 Hi Stage	HMO	P-681/682/683 HMO Pumps
Cryo Refrig	C-161/162/163 Low Stage	NGL Amine	P-621 Amine Booster Pump
DeC2	P-360 DeC2 Reflux Pump	NGL Amine	P-623 Amine Circ Pump
DeC2	P-634 Ethane Pipeline Pump	NGL Sieve	P-641/642 NGL Dehy Regen Pump
DeC2	P-637 C3+ Charge Pump	RSV	CR-201/202 Stage 1
DeC2	P-639 C3+ Pipeline Pump	RSV	CR-201/202 Stage 2
DeC2	P-643 Ethane Charge Pump	RSV	EC-101 Compressor
DeC2 Refrig	C-164/5/6/7 Hi Stage	RSV	EC-101 Expander
DeC2 Refrig	C-164/5/6/7 Lo Stage	RSV	P-600/1/2
Gas Sieve	C-141 Regen Gas Compressor	RSV	P-1205A/B/C

Parameters

Net Power	41064.7 hp	Total Power Required	45064.7 hp
Total Power Supplied	4000 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
Cryo Refrig:C-161/162/163 Hi Stage	1789.97	2.85827	163.899	19754
Cryo Refrig:C-161/162/163 Low Stage	1595.15	4.97444	70.4694	25393.8
DeC2:P-360 DeC2 Reflux Pump	121.811	1.12211	50.2105	300
DeC2:P-634 Ethane Pipeline Pump	723.895	3.19926	968.532	5800
DeC2:P-637 C3+ Charge Pump	10.7035	1.12207	22.4845	105
DeC2:P-639 C3+ Pipeline Pump	581.048	6.90815	1221.13	5700
DeC2:P-643 Ethane Charge Pump	19.3455	1.06243	25.8778	155
DeC2 Refrig:C-164/5/6/7 Hi Stage	5949.72	1.89264	118.899	10849.2
DeC2 Refrig:C-164/5/6/7 Lo Stage	4661.79	1.97394	65.7207	10758.2
Gas Sieve:C-141 Regen Gas Compressor	103.598	1.16426	150	5099.33
HMO:P-681/682/683 HMO Pumps	341.696	2.58228	100	257.145
NGL Amine:P-621 Amine Booster Pump	9.2968	2.88679	40	92.4327
NGL Amine:P-623 Amine Circ Pump	174.565	15.0037	759	1732.18
NGL Sieve:P-641/642 NGL Dehy Regen Pump	15.9114	1.13033	87.4748	500
RSV:CR-201/202 Stage 1	14922.4	2.31993	349.906	50284.5
RSV:CR-201/202 Stage 2	9771.41	1.82705	504.5	34124.5
RSV:EC-101 Compressor	3800	1.22659	49.8941	10752.7
RSV:EC-101 Expander	-4000	0.251041	-692.75	-29753.6
RSV:P-600/1/2	35.1674	1.17227	40	193.397
RSV:P-1205A/B/C	437.244	2.71198	466	2244.28

Remarks

Energy Budgets Report

Client Name:	Energy Transfer	Job: Plan Approval Application
Location:	Cryo II	

Heat Budget - Project Heat Budget

Status: Failed

Heat Budget Data Source - All Exchangers in Project

Flowsheet	Block	Flowsheet	Block
Cryo Refrig	A-361	HMO	E-207
Cryo Refrig	superht	HMO	H-781/782/783 HMO Heaters
DeC2	A-332 Deethanizer C3+ Cooler	NGL Amine	AC-1111 Amine Cooler
DeC2 Refrig	A-362 Refrigerant Condenser	NGL Amine	V-426/A-322
DeC2 Refrig	sprht	NGL Sieve	A-342 NGL Regen Condenser
Fired Heaters	H-741 Regen Gas Heater	NGL Sieve	Bed
Fired Heaters	H-742 NGL Dehy Regen Heater	NGL Sieve	H-742 NGL Dehy Regen Heater
Fired Heaters	H-781/782/783 HMO Heaters	RSV	AC-201/202-AC
Gas Sieve	A-341 Regen Gas Cooler	RSV	AC-201/202-IC
Gas Sieve	Bed Q	RSV	AC-301
Gas Sieve	H-741 Regen Gas Heater		

Parameters

Net Duty	-2.32171E+08 Btu/h	Total Duty Required	9.54561E+07 Btu/h
Total Duty Supplied	3.27627E+08 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F
Cryo Refrig:A-361	-1.72481E+07	240.25 ?	120 ?
Cryo Refrig:superht	125820	-25.5298 ?	-30.5298 ?
DeC2:A-332 Deethanizer C3+ Cooler	-7.53519E+06	198.06 ?	120 ?
DeC2 Refrig:A-362 Refrigerant Condenser	-8.42996E+07	184.882 ?	120 ?
DeC2 Refrig:sprht	844217	36.0936 ?	31.0936 ?
Fired Heaters:H-741 Regen Gas Heater	-9.04199E+06	3294.45 ?	699.987 ?
Fired Heaters:H-742 NGL Dehy Regen Heater	-6.80435E+06	3294.45 ?	699.987 ?
Fired Heaters:H-781/782/783 HMO Heaters	-9.93806E+07	3335.47 ?	499.889 ?
Gas Sieve:A-341 Regen Gas Cooler	-4.58043E+06	350 ?	120 ?
Gas Sieve:Bed Q	-2.59569E+06	475.062 ?	350 ?
Gas Sieve:H-741 Regen Gas Heater	7.41443E+06	485 ?	111.265 ?
HMO:E-207	0	?	?
HMO:H-781/782/783 HMO Heaters	8.14921E+07	350 ?	263.337 ?
NGL Amine:AC-1111 Amine Cooler	-5.3381E+06	158.893 ?	120 ?
NGL Amine:V-426/A-322	-8.60716E+06	223.666 ?	120 ?
NGL Sieve:A-342 NGL Regen Condenser	-1.22855E+06	144.122 ?	120 ?
NGL Sieve:Bed	-3.63951E+06	495.54 ?	350 ?
NGL Sieve:H-742 NGL Dehy Regen Heater	5.57957E+06	500 ?	275 ?
RSV:AC-201/202-AC	-3.17606E+07	220.619 ?	120 ?
RSV:AC-201/202-IC	-4.29557E+07	263.652 ?	120 ?
RSV:AC-301	-2.61184E+06	129.733 ?	120 ?

Remarks

* User Specified Values

? Extrapolated or Approximate Values

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Energy Budgets Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Power Budget - Inlet 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 - Inlet Heat Budget

Status: Solved

Parameters

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

Remarks

Power Budget - RSV Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
RSV	CR-201/202 Stage 1	RSV	EC-101 Expander
RSV	CR-201/202 Stage 2	RSV	P-600/1/2
RSV	EC-101 Compressor	RSV	P-1205A/B/C

Parameters

Net Power	24966.2 hp	Total Power Required	28966.2 hp
Total Power Supplied	4000 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
RSV:CR-201/202 Stage 1	14922.4	2.31993	349.906	50284.5
RSV:CR-201/202 Stage 2	9771.41	1.82705	504.5	34124.5
RSV:EC-101 Compressor	3800	1.22659	49.8941	10752.7
RSV:EC-101 Expander	-4000	0.251041	-692.75	-29753.6
RSV:P-600/1/2	35.1674	1.17227	40	193.397
RSV:P-1205A/B/C	437.244	2.71198	466	2244.28

Remarks

Heat Budget - RSV Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
RSV	AC-201/202-AC	RSV	AC-301
RSV	AC-201/202-IC	RSV	E-203

Parameters

Net Duty	-8.58372E+07 Btu/h	Total Duty Required	0 Btu/h
Total Duty Supplied	8.58372E+07 Btu/h	External Energy Only	True

Energy Budgets Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
RSV:AC-201/202-AC	-3.17606E+07	220.619	120	
RSV:AC-201/202-IC	-4.29557E+07	263.652	120	
RSV:AC-301	-2.61184E+06	129.733	120	
RSV:E-203	-8.50908E+06	-8.84255	-19	

Remarks

Power Budget - Cryo Refrig Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Cryo Refrig	C-161/162/163 Hi Stage	Cryo Refrig	C-161/162/163 Low Stage

Parameters

Net Power	3385.12 hp	Total Power Required	3385.12 hp
Total Power Supplied	0 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
Cryo Refrig:C-161/162/163 Hi Stage	1789.97	2.85827	163.899	19754
Cryo Refrig:C-161/162/163 Low Stage	1595.15	4.97444	70.4694	25393.8

Remarks

Heat Budget - Cryo Refrig Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Cryo Refrig	A-361	Cryo Refrig	superht
Cryo Refrig	E-203		

Parameters

Net Duty	-8.61322E+06 Btu/h	Total Duty Required	8.6349E+06 Btu/h
Total Duty Supplied	1.72481E+07 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
Cryo Refrig:A-361	-1.72481E+07	240.25	120	
Cryo Refrig:E-203	8.50908E+06	-29	-30.5298	
Cryo Refrig:superht	125820	-25.5298	-30.5298	

Remarks

Energy Budgets Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Power Budget - Gas Sieve Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Gas Sieve	C-141 Regen Gas Compressor		

Parameters

Net Power	103.598 hp	Total Power Required	103.598 hp
Total Power Supplied	0 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
Gas Sieve:C-141 Regen Gas Compressor	103.598	1.16426	150	5099.33

Remarks

Heat Budget - Gas Sieve Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
Gas Sieve	A-341 Regen Gas Cooler	Gas Sieve	E-208 Inlet Gas Preheater
Gas Sieve	Bed Q	Gas Sieve	H-741 Regen Gas Heater

Parameters

Net Duty	4.86412E+06 Btu/h	Total Duty Required	1.20402E+07 Btu/h
Total Duty Supplied	7.17612E+06 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F
Gas Sieve:A-341 Regen Gas Cooler	-4.58043E+06	350	120
Gas Sieve:Bed Q	-2.59569E+06	475.062	350
Gas Sieve:E-208 Inlet Gas Preheater	4.62581E+06	90	79.9948
Gas Sieve:H-741 Regen Gas Heater	7.41443E+06	485	111.265

Remarks

Power Budget - RSV_data Power Budget

Status: Solved

Parameters

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

Remarks

Energy Budgets Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Heat Budget - RSV_data Heat Budget

Status: Solved

Parameters

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

Remarks

Power Budget - NGL Amine Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
NGL Amine	P-621 Amine Booster Pump	NGL Amine	P-623 Amine Circ Pump

Parameters

Net Power	183.862 hp	Total Power Required	183.862 hp
Total Power Supplied	0 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
NGL Amine:P-621 Amine Booster Pump	9.2968	2.88679	40	92.4327
NGL Amine:P-623 Amine Circ Pump	174.565	15.0037	759	1732.18

Remarks

Heat Budget - NGL Amine Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
NGL Amine	AC-1111 Amine Cooler	NGL Amine	V-426/A-322
NGL Amine	E-1117 Amine Reboiler		

Parameters

Net Duty	4.87475E+06 Btu/h	Total Duty Required	1.882E+07 Btu/h
Total Duty Supplied	1.39453E+07 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
NGL Amine:AC-1111 Amine Cooler	-5.3381E+06	158.893	120	
NGL Amine:E-1117 Amine Reboiler	1.882E+07	245.398	245.398	
NGL Amine:V-426/A-322	-8.60716E+06	223.666	120	

		Energy Budgets Report			
Client Name:		Energy Transfer		Job: Plan Approval Application	
Location:		Cryo II			
Remarks					
Power Budget - ThermOx 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 - ThermOx Heat Budget				Status: Solved	
Parameters					
Net Duty		0 Btu/h		Total Duty Required 0 Btu/h	
Total Duty Supplied		0 Btu/h		External Energy Only True	
Remarks					
Power Budget - Fired Heaters 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 - Fired Heaters Heat Budget				Status: Solved	
Heat Budget Data Source - All Exchangers in Flowsheet					
Flowsheet		Block		Flowsheet	
Fired Heaters		H-741 Regen Gas Heater		Fired Heaters	
Fired Heaters		H-742 NGL Dehy Regen Heater		H-781/782/783 HMO Heaters	
Parameters					
Net Duty		-1.15227E+08 Btu/h		Total Duty Required 0 Btu/h	
Total Duty Supplied		1.15227E+08 Btu/h		External Energy Only True	
Tabulated Data					
Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F		
Fired Heaters:H-741 Regen Gas Heater	-9.04199E+06	3294.45	699.987		
Fired Heaters:H-742 NGL Dehy Regen Heater	-6.80435E+06	3294.45	699.987		
Fired Heaters:H-781/782/783 HMO Heaters	-9.93806E+07	3335.47	499.889		

Energy Budgets Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Remarks

Power Budget - NGL Sieve Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
NGL Sieve	P-641/642 NGL Dehy Regen Pump		

Parameters

Net Power	15.9114 hp	Total Power Required	15.9114 hp
Total Power Supplied	0 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
NGL Sieve:P-641/642 NGL Dehy Regen Pump	15.9114	1.13033	87.4748	500

Remarks

Heat Budget - NGL Sieve Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
NGL Sieve	A-342 NGL Regen Condenser	NGL Sieve	H-742 NGL Dehy Regen Heater
NGL Sieve	Bed		

Parameters

Net Duty	711514 Btu/h	Total Duty Required	5.57957E+06 Btu/h
Total Duty Supplied	4.86806E+06 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
NGL Sieve:A-342 NGL Regen Condenser	-1.22855E+06	144.122	120	
NGL Sieve:Bed	-3.63951E+06	495.54	350	
NGL Sieve:H-742 NGL Dehy Regen Heater	5.57957E+06	500	275	

Remarks

Power Budget - DeC2 Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
DeC2	P-360 DeC2 Reflux Pump	DeC2	P-639 C3+ Pipeline Pump
DeC2	P-634 Ethane Pipeline Pump	DeC2	P-643 Ethane Charge Pump
DeC2	P-637 C3+ Charge Pump		

Energy Budgets Report

Client Name: Energy Transfer Job: Plan Approval Application
Location: Cryo II

Parameters

Net Power	1456.8 hp	Total Power Required	1456.8 hp
Total Power Supplied	0 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
DeC2:P-360 DeC2 Reflux Pump	121.811	1.12211	50.2105	300
DeC2:P-634 Ethane Pipeline Pump	723.895	3.19926	968.532	5800
DeC2:P-637 C3+ Charge Pump	10.7035	1.12207	22.4845	105
DeC2:P-639 C3+ Pipeline Pump	581.048	6.90815	1221.13	5700
DeC2:P-643 Ethane Charge Pump	19.3455	1.06243	25.8778	155

Remarks

Heat Budget - DeC2 Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
DeC2	A-332 Deethanizer C3+ Cooler	DeC2	E-263
DeC2	E-232		

Parameters

Net Duty	-5.07457E+06 Btu/h	Total Duty Required	5.89157E+07 Btu/h
Total Duty Supplied	6.39903E+07 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F
DeC2:A-332 Deethanizer C3+ Cooler	-7.53519E+06	198.06	120
DeC2:E-232	5.89157E+07	198.06	184.86
DeC2:E-263	-5.64551E+07	43.8889	41.0936

Remarks

Power Budget - DeC2 Refrig Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
DeC2 Refrig	C-164/5/6/7 Hi Stage	DeC2 Refrig	C-164/5/6/7 Lo Stage

Parameters

Net Power	10611.5 hp	Total Power Required	10611.5 hp
Total Power Supplied	0 hp	External Energy Only	True

Energy Budgets Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
DeC2 Refrig:C-164/5/6/7 Hi Stage	5949.72	1.89264	118.899	10849.2
DeC2 Refrig:C-164/5/6/7 Lo Stage	4661.79	1.97394	65.7207	10758.2

Remarks

Heat Budget - DeC2 Refrig Heat Budget

Status: Solved

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
DeC2 Refrig	A-362 Refrigerant Condenser	DeC2 Refrig	sprht
DeC2 Refrig	E-263		

Parameters

Net Duty	-2.70003E+07 Btu/h	Total Duty Required	5.72993E+07 Btu/h
Total Duty Supplied	8.42996E+07 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F
DeC2 Refrig:A-362 Refrigerant Condenser	-8.42996E+07	184.882	120
DeC2 Refrig:E-263	5.64551E+07	31.3204	31.0936
DeC2 Refrig:sprht	844217	36.0936	31.0936

Remarks

Power Budget - HMO Power Budget

Status: Solved

Power Budget Data Source - All Fluid Drivers in Flowsheet

Flowsheet	Block	Flowsheet	Block
HMO	P-681/682/683 HMO Pumps		

Parameters

Net Power	341.696 hp	Total Power Required	341.696 hp
Total Power Supplied	0 hp	External Energy Only	True

Tabulated Data

Index	Block Power hp	Compression Ratio	Delta P psi	Head ft
HMO:P-681/682/683 HMO Pumps	341.696	2.58228	100	257.145

Remarks

Energy Budgets Report

Client Name: Energy Transfer
Location: Cryo II
Job: Plan Approval Application

Heat Budget - HMO Heat Budget

Status: Failed

Heat Budget Data Source - All Exchangers in Flowsheet

Flowsheet	Block	Flowsheet	Block
HMO	E-207	HMO	E-1117
HMO	E-208	HMO	H-781/782/783 HMO Heaters
HMO	E-232		

Parameters

Net Duty	-869424 Btu/h	Total Duty Required	8.14921E+07 Btu/h
Total Duty Supplied	8.23615E+07 Btu/h	External Energy Only	True

Tabulated Data

Index	Block Duty Btu/h	Block Highest Temperature °F	Block Lowest Temperature °F	
HMO:E-207	0	?	?	
HMO:E-208	-4.62581E+06	350 ?	150 ?	
HMO:E-232	-5.89157E+07	350 ?	217.3 ?	
HMO:E-1117	-1.882E+07	350 ?	278.897 ?	
HMO:H-781/782/783 HMO Heaters	8.14921E+07	350 ?	263.337 ?	

Remarks

Power Budget - Closed Drain 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 - Closed Drain Heat Budget

Status: Solved

Parameters

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

Remarks

1.4 Natural Gas Combustion

1.4.1 General¹⁻²

Natural gas is one of the major combustion fuels used throughout the country. It is mainly used to generate industrial and utility electric power, produce industrial process steam and heat, and heat residential and commercial space. Natural gas consists of a high percentage of methane (generally above 85 percent) and varying amounts of ethane, propane, butane, and inerts (typically nitrogen, carbon dioxide, and helium). The average gross heating value of natural gas is approximately 1,020 British thermal units per standard cubic foot (Btu/scf), usually varying from 950 to 1,050 Btu/scf.

1.4.2 Firing Practices³⁻⁵

There are three major types of boilers used for natural gas combustion in commercial, industrial, and utility applications: watertube, firetube, and cast iron. Watertube boilers are designed to pass water through the inside of heat transfer tubes while the outside of the tubes is heated by direct contact with the hot combustion gases and through radiant heat transfer. The watertube design is the most common in utility and large industrial boilers. Watertube boilers are used for a variety of applications, ranging from providing large amounts of process steam, to providing hot water or steam for space heating, to generating high-temperature, high-pressure steam for producing electricity. Furthermore, watertube boilers can be distinguished either as field erected units or packaged units.

Field erected boilers are boilers that are constructed on site and comprise the larger sized watertube boilers. Generally, boilers with heat input levels greater than 100 MMBtu/hr, are field erected. Field erected units usually have multiple burners and, given the customized nature of their construction, also have greater operational flexibility and NO_x control options. Field erected units can also be further categorized as wall-fired or tangential-fired. Wall-fired units are characterized by multiple individual burners located on a single wall or on opposing walls of the furnace while tangential units have several rows of air and fuel nozzles located in each of the four corners of the boiler.

Package units are constructed off-site and shipped to the location where they are needed. While the heat input levels of packaged units may range up to 250 MMBtu/hr, the physical size of these units are constrained by shipping considerations and generally have heat input levels less than 100 MMBtu/hr. Packaged units are always wall-fired units with one or more individual burners. Given the size limitations imposed on packaged boilers, they have limited operational flexibility and cannot feasibly incorporate some NO_x control options.

Firetube boilers are designed such that the hot combustion gases flow through tubes, which heat the water circulating outside of the tubes. These boilers are used primarily for space heating systems, industrial process steam, and portable power boilers. Firetube boilers are almost exclusively packaged units. The two major types of firetube units are Scotch Marine boilers and the older firebox boilers. In cast iron boilers, as in firetube boilers, the hot gases are contained inside the tubes and the water being heated circulates outside the tubes. However, the units are constructed of cast iron rather than steel. Virtually all cast iron boilers are constructed as package boilers. These boilers are used to produce either low-pressure steam or hot water, and are most commonly used in small commercial applications.

Natural gas is also combusted in residential boilers and furnaces. Residential boilers and furnaces generally resemble firetube boilers with flue gas traveling through several channels or tubes with water or air circulated outside the channels or tubes.

1.4.3 Emissions³⁻⁴

The emissions from natural gas-fired boilers and furnaces include nitrogen oxides (NO_x), carbon monoxide (CO), and carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), volatile organic compounds (VOCs), trace amounts of sulfur dioxide (SO₂), and particulate matter (PM).

Nitrogen Oxides -

Nitrogen oxides formation occurs by three fundamentally different mechanisms. The principal mechanism of NO_x formation in natural gas combustion is thermal NO_x. The thermal NO_x mechanism occurs through the thermal dissociation and subsequent reaction of nitrogen (N₂) and oxygen (O₂) molecules in the combustion air. Most NO_x formed through the thermal NO_x mechanism occurs in the high temperature flame zone near the burners. The formation of thermal NO_x is affected by three furnace-zone factors: (1) oxygen concentration, (2) peak temperature, and (3) time of exposure at peak temperature. As these three factors increase, NO_x emission levels increase. The emission trends due to changes in these factors are fairly consistent for all types of natural gas-fired boilers and furnaces. Emission levels vary considerably with the type and size of combustor and with operating conditions (e.g., combustion air temperature, volumetric heat release rate, load, and excess oxygen level).

The second mechanism of NO_x formation, called prompt NO_x, occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. Prompt NO_x reactions occur within the flame and are usually negligible when compared to the amount of NO_x formed through the thermal NO_x mechanism. However, prompt NO_x levels may become significant with ultra-low-NO_x burners.

The third mechanism of NO_x formation, called fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Due to the characteristically low fuel nitrogen content of natural gas, NO_x formation through the fuel NO_x mechanism is insignificant.

Carbon Monoxide -

The rate of CO emissions from boilers depends on the efficiency of natural gas combustion. Improperly tuned boilers and boilers operating at off-design levels decrease combustion efficiency resulting in increased CO emissions. In some cases, the addition of NO_x control systems such as low NO_x burners and flue gas recirculation (FGR) may also reduce combustion efficiency, resulting in higher CO emissions relative to uncontrolled boilers.

Volatile Organic Compounds -

The rate of VOC emissions from boilers and furnaces also depends on combustion efficiency. VOC emissions are minimized by combustion practices that promote high combustion temperatures, long residence times at those temperatures, and turbulent mixing of fuel and combustion air. Trace amounts of VOC species in the natural gas fuel (e.g., formaldehyde and benzene) may also contribute to VOC emissions if they are not completely combusted in the boiler.

Sulfur Oxides -

Emissions of SO₂ from natural gas-fired boilers are low because pipeline quality natural gas typically has sulfur levels of 2,000 grains per million cubic feet. However, sulfur-containing odorants are added to natural gas for detecting leaks, leading to small amounts of SO₂ emissions. Boilers combusting unprocessed natural gas may have higher SO₂ emissions due to higher levels of sulfur in the natural gas. For these units, a sulfur mass balance should be used to determine SO₂ emissions.

Particulate Matter -

Because natural gas is a gaseous fuel, filterable PM emissions are typically low. Particulate matter from natural gas combustion has been estimated to be less than 1 micrometer in size and has filterable and condensable fractions. Particulate matter in natural gas combustion are usually larger molecular weight hydrocarbons that are not fully combusted. Increased PM emissions may result from poor air/fuel mixing or maintenance problems.

Greenhouse Gases ⁻⁶⁻⁹

CO₂, CH₄, and N₂O emissions are all produced during natural gas combustion. In properly tuned boilers, nearly all of the fuel carbon (99.9 percent) in natural gas is converted to CO₂ during the combustion process. This conversion is relatively independent of boiler or combustor type. Fuel carbon not converted to CO₂ results in CH₄, CO, and/or VOC emissions and is due to incomplete combustion. Even in boilers operating with poor combustion efficiency, the amount of CH₄, CO, and VOC produced is insignificant compared to CO₂ levels.

Formation of N₂O during the combustion process is affected by two furnace-zone factors. N₂O emissions are minimized when combustion temperatures are kept high (above 1475°F) and excess oxygen is kept to a minimum (less than 1 percent).

Methane emissions are highest during low-temperature combustion or incomplete combustion, such as the start-up or shut-down cycle for boilers. Typically, conditions that favor formation of N₂O also favor emissions of methane.

1.4.4 Controls^{4,10}

NO_x Controls -

Currently, the two most prevalent combustion control techniques used to reduce NO_x emissions from natural gas-fired boilers are flue gas recirculation (FGR) and low NO_x burners. In an FGR system, a portion of the flue gas is recycled from the stack to the burner windbox. Upon entering the windbox, the recirculated gas is mixed with combustion air prior to being fed to the burner. The recycled flue gas consists of combustion products which act as inerts during combustion of the fuel/air mixture. The FGR system reduces NO_x emissions by two mechanisms. Primarily, the recirculated gas acts as a diluent to reduce combustion temperatures, thus suppressing the thermal NO_x mechanism. To a lesser extent, FGR also reduces NO_x formation by lowering the oxygen concentration in the primary flame zone. The amount of recirculated flue gas is a key operating parameter influencing NO_x emission rates for these systems. An FGR system is normally used in combination with specially designed low NO_x burners capable of sustaining a stable flame with the increased inert gas flow resulting from the use of FGR. When low NO_x burners and FGR are used in combination, these techniques are capable of reducing NO_x emissions by 60 to 90 percent.

Low NO_x burners reduce NO_x by accomplishing the combustion process in stages. Staging partially delays the combustion process, resulting in a cooler flame which suppresses thermal NO_x formation. The two most common types of low NO_x burners being applied to natural gas-fired boilers are staged air burners and staged fuel burners. NO_x emission reductions of 40 to 85 percent (relative to uncontrolled emission levels) have been observed with low NO_x burners.

Other combustion control techniques used to reduce NO_x emissions include staged combustion and gas reburning. In staged combustion (e.g., burners-out-of-service and overfire air), the degree of staging is a key operating parameter influencing NO_x emission rates. Gas reburning is similar to the use of overfire in the use of combustion staging. However, gas reburning injects additional amounts of natural gas in the upper furnace, just before the overfire air ports, to provide increased reduction of NO_x to NO₂.

Two postcombustion technologies that may be applied to natural gas-fired boilers to reduce NO_x emissions are selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR). The SNCR system injects ammonia (NH₃) or urea into combustion flue gases (in a specific temperature zone) to reduce NO_x emission. The Alternative Control Techniques (ACT) document for NO_x emissions from utility boilers, maximum SNCR performance was estimated to range from 25 to 40 percent for natural gas-fired boilers.¹² Performance data available from several natural gas fired utility boilers with SNCR show a 24 percent reduction in NO_x for applications on wall-fired boilers and a 13 percent reduction in NO_x for applications on tangential-fired boilers.¹¹ In many situations, a boiler may have an SNCR system installed to trim NO_x emissions to meet permitted levels. In these cases, the SNCR system may not be operated to achieve maximum NO_x reduction. The SCR system involves injecting NH₃ into the flue gas in the presence of a catalyst to reduce NO_x emissions. No data were available on SCR performance on natural gas fired boilers at the time of this publication. However, the ACT Document for utility boilers estimates NO_x reduction efficiencies for SCR control ranging from 80 to 90 percent.¹²

Emission factors for natural gas combustion in boilers and furnaces are presented in Tables 1.4-1, 1.4-2, 1.4-3, and 1.4-4.¹¹ Tables in this section present emission factors on a volume basis (lb/10⁶ scf). To convert to an energy basis (lb/MMBtu), divide by a heating value of 1,020 MMBtu/10⁶ scf. For the purposes of developing emission factors, natural gas combustors have been organized into three general categories: large wall-fired boilers with greater than 100 MMBtu/hr of heat input, boilers and residential furnaces with less than 100 MMBtu/hr of heat input, and tangential-fired boilers. Boilers within these categories share the same general design and operating characteristics and hence have similar emission characteristics when combusting natural gas.

Emission factors are rated from A to E to provide the user with an indication of how “good” the factor is, with “A” being excellent and “E” being poor. The criteria that are used to determine a rating for an emission factor can be found in the Emission Factor Documentation for AP-42 Section 1.4 and in the introduction to the AP-42 document.

1.4.5 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. Revisions to this section are summarized below. For further detail, consult the Emission Factor Documentation for this section. These and other documents can be found on the Emission Factor and Inventory Group (EFIG) home page (<http://www.epa.gov/ttn/chief>).

Supplement D, March 1998

- Text was revised concerning Firing Practices, Emissions, and Controls.
- All emission factors were updated based on 482 data points taken from 151 source tests. Many new emission factors have been added for speciated organic compounds, including hazardous air pollutants.

July 1998 - minor changes

- Footnote D was added to table 1.4-3 to explain why the sum of individual HAP may exceed VOC or TOC, the web address was updated, and the references were reordered.

Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NO_x) AND CARBON MONOXIDE (CO)
FROM NATURAL GAS COMBUSTION^a

Combustor Type (MMBtu/hr Heat Input) [SCC]	NO _x ^b		CO	
	Emission Factor (lb/10 ⁶ scf)	Emission Factor Rating	Emission Factor (lb/10 ⁶ scf)	Emission Factor Rating
Large Wall-Fired Boilers (>100) [1-01-006-01, 1-02-006-01, 1-03-006-01]				
Uncontrolled (Pre-NSPS) ^c	280	A	84	B
Uncontrolled (Post-NSPS) ^c	190	A	84	B
Controlled - Low NO _x burners	140	A	84	B
Controlled - Flue gas recirculation	100	D	84	B
Small Boilers (<100) [1-01-006-02, 1-02-006-02, 1-03-006-02, 1-03-006-03]				
Uncontrolled	100	B	84	B
Controlled - Low NO _x burners	50	D	84	B
Controlled - Low NO _x burners/Flue gas recirculation	32	C	84	B
Tangential-Fired Boilers (All Sizes) [1-01-006-04]				
Uncontrolled	170	A	24	C
Controlled - Flue gas recirculation	76	D	98	D
Residential Furnaces (<0.3) [No SCC]				
Uncontrolled	94	B	40	B

^a Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. To convert from lb/10⁶ scf to kg/10⁶ m³, multiply by 16. Emission factors are based on an average natural gas higher heating value of 1,020 Btu/scf. To convert from lb/10⁶ scf to lb/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. SCC = Source Classification Code. ND = no data. NA = not applicable.

^b Expressed as NO₂. For large and small wall fired boilers with SNCR control, apply a 24 percent reduction to the appropriate NO_x emission factor. For tangential-fired boilers with SNCR control, apply a 13 percent reduction to the appropriate NO_x emission factor.

^c NSPS=New Source Performance Standard as defined in 40 CFR 60 Subparts D and Db. Post-NSPS units are boilers with greater than 250 MMBtu/hr of heat input that commenced construction modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction modification, or reconstruction after June 19, 1984.

TABLE 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION^a

Pollutant	Emission Factor (lb/10 ⁶ scf)	Emission Factor Rating
CO ₂ ^b	120,000	A
Lead	0.0005	D
N ₂ O (Uncontrolled)	2.2	E
N ₂ O (Controlled-low-NO _x burner)	0.64	E
PM (Total) ^c	7.6	D
PM (Condensable) ^c	5.7	D
PM (Filterable) ^c	1.9	B
SO ₂ ^d	0.6	A
TOC	11	B
Methane	2.3	B
VOC	5.5	C

^a Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from lb/10⁶ scf to kg/10⁶ m³, multiply by 16. To convert from lb/10⁶ scf to lb/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. TOC = Total Organic Compounds.

VOC = Volatile Organic Compounds.

^b Based on approximately 100% conversion of fuel carbon to CO₂. CO₂[lb/10⁶ scf] = (3.67) (CON) (C)(D), where CON = fractional conversion of fuel carbon to CO₂, C = carbon content of fuel by weight (0.76), and D = density of fuel, 4.2x10⁴ lb/10⁶ scf.

^c All PM (total, condensable, and filterable) is assumed to be less than 1.0 micrometer in diameter. Therefore, the PM emission factors presented here may be used to estimate PM₁₀, PM_{2.5} or PM₁ emissions. Total PM is the sum of the filterable PM and condensable PM. Condensable PM is the particulate matter collected using EPA Method 202 (or equivalent). Filterable PM is the particulate matter collected on, or prior to, the filter of an EPA Method 5 (or equivalent) sampling train.

^d Based on 100% conversion of fuel sulfur to SO₂.

Assumes sulfur content is natural gas of 2,000 grains/10⁶ scf. The SO₂ emission factor in this table can be converted to other natural gas sulfur contents by multiplying the SO₂ emission factor by the ratio of the site-specific sulfur content (grains/10⁶ scf) to 2,000 grains/10⁶ scf.

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM
NATURAL GAS COMBUSTION^a

CAS No.	Pollutant	Emission Factor (lb/10 ⁶ scf)	Emission Factor Rating
91-57-6	2-Methylnaphthalene ^{b, c}	2.4E-05	D
56-49-5	3-Methylcholanthrene ^{b, c}	<1.8E-06	E
	7,12-Dimethylbenz(a)anthracene ^{b, c}	<1.6E-05	E
83-32-9	Acenaphthene ^{b, c}	<1.8E-06	E
203-96-8	Acenaphthylene ^{b, c}	<1.8E-06	E
120-12-7	Anthracene ^{b, c}	<2.4E-06	E
56-55-3	Benz(a)anthracene ^{b, c}	<1.8E-06	E
71-43-2	Benzene ^b	2.1E-03	B
50-32-8	Benzo(a)pyrene ^{b, c}	<1.2E-06	E
205-99-2	Benzo(b)fluoranthene ^{b, c}	<1.8E-06	E
191-24-2	Benzo(g,h,i)perylene ^{b, c}	<1.2E-06	E
207-08-9	Benzo(k)fluoranthene ^{b, c}	<1.8E-06	E
106-97-8	Butane	2.1E+00	E
218-01-9	Chrysene ^{b, c}	<1.8E-06	E
53-70-3	Dibenzo(a,h)anthracene ^{b, c}	<1.2E-06	E
25321-22-6	Dichlorobenzene ^b	1.2E-03	E
74-84-0	Ethane	3.1E+00	E
206-44-0	Fluoranthene ^{b, c}	3.0E-06	E
86-73-7	Fluorene ^{b, c}	2.8E-06	E
50-00-0	Formaldehyde ^b	7.5E-02	B
110-54-3	Hexane ^b	1.8E+00	E
193-39-5	Indeno(1,2,3-cd)pyrene ^{b, c}	<1.8E-06	E
91-20-3	Naphthalene ^b	6.1E-04	E
109-66-0	Pentane	2.6E+00	E
85-01-8	Phenanthrene ^{b, c}	1.7E-05	D
74-98-6	Propane	1.6E+00	E

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM
NATURAL GAS COMBUSTION (Continued)

CAS No.	Pollutant	Emission Factor (lb/10 ⁶ scf)	Emission Factor Rating
129-00-0	Pyrene ^{b, c}	5.0E-06	E
108-88-3	Toluene ^b	3.4E-03	C

^a Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from lb/10⁶ scf to kg/10⁶ m³, multiply by 16. To convert from lb/10⁶ scf to lb/MMBtu, divide by 1,020. Emission Factors preceded with a less-than symbol are based on method detection limits.

^b Hazardous Air Pollutant (HAP) as defined by Section 112(b) of the Clean Air Act.

^c HAP because it is Polycyclic Organic Matter (POM). POM is a HAP as defined by Section 112(b) of the Clean Air Act.

^d The sum of individual organic compounds may exceed the VOC and TOC emission factors due to differences in test methods and the availability of test data for each pollutant.

TABLE 1.4-4. EMISSION FACTORS FOR METALS FROM NATURAL GAS COMBUSTION^a

CAS No.	Pollutant	Emission Factor (lb/10 ⁶ scf)	Emission Factor Rating
7440-38-2	Arsenic ^b	2.0E-04	E
7440-39-3	Barium	4.4E-03	D
7440-41-7	Beryllium ^b	<1.2E-05	E
7440-43-9	Cadmium ^b	1.1E-03	D
7440-47-3	Chromium ^b	1.4E-03	D
7440-48-4	Cobalt ^b	8.4E-05	D
7440-50-8	Copper	8.5E-04	C
7439-96-5	Manganese ^b	3.8E-04	D
7439-97-6	Mercury ^b	2.6E-04	D
7439-98-7	Molybdenum	1.1E-03	D
7440-02-0	Nickel ^b	2.1E-03	C
7782-49-2	Selenium ^b	<2.4E-05	E
7440-62-2	Vanadium	2.3E-03	D
7440-66-6	Zinc	2.9E-02	E

^a Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. Emission factors preceded by a less-than symbol are based on method detection limits. To convert from lb/10⁶ scf to kg/10⁶ m³, multiply by 16. To convert from lb/10⁶ scf to 1b/MMBtu, divide by 1,020.

^b Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

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5.3 Natural Gas Processing

5.3.1 General¹

Natural gas from high-pressure wells is usually passed through field separators at the well to remove hydrocarbon condensate and water. Natural gasoline, butane, and propane are usually present in the gas, and gas processing plants are required for the recovery of these liquefiable constituents (see Figure 5.3-1). Natural gas is considered "sour" if hydrogen sulfide (H_2S) is present in amounts greater than 5.7 milligrams per normal cubic meters (mg/Nm^3) (0.25 grains per 100 standard cubic feet [$\text{gr}/100\text{ scf}$]). The H_2S must be removed (called "sweetening" the gas) before the gas can be utilized. If H_2S is present, the gas is usually sweetened by absorption of the H_2S in an amine solution. Amine processes are used for over 95 percent of all gas sweetening in the United States. Other methods, such as carbonate processes, solid bed absorbents, and physical absorption, are employed in the other sweetening plants. Emission data for sweetening processes other than amine types are very meager, but a material balance on sulfur will give accurate estimates for sulfur dioxide (SO_2).

The major emission sources in the natural gas processing industry are compressor engines, acid gas wastes, fugitive emissions from leaking process equipment and if present, glycol dehydrator vent streams. Compressor engine emissions are discussed in Section 3.3.2. Fugitive leak emissions are detailed in *Protocol For Equipment Leak Emission Estimates*, EPA-453/R-95-017, November 1995. Regeneration of the glycol solutions used for dehydrating natural gas can release significant quantities of benzene, toluene, ethylbenzene, and xylene, as well as a wide range of less toxic organics. These emissions can be estimated by a thermodynamic software model (*GRI-GLYCalcTM*) available from the Gas Research Institute. Only the SO_2 emissions from gas sweetening operations are discussed here.

5.3.2 Process Description²⁻³

Many chemical processes are available for sweetening natural gas. At present, the amine process (also known as the Girdler process), is the most widely used method for H_2S removal. The process is summarized in reaction 1 and illustrated in Figure 5.3-2.



where:

R = mono, di, or tri-ethanol
N = nitrogen
H = hydrogen
S = sulfur

The recovered hydrogen sulfide gas stream may be: (1) vented, (2) flared in waste gas flares or modern smokeless flares, (3) incinerated, or (4) utilized for the production of elemental sulfur or sulfuric acid. If the recovered H_2S gas stream is not to be utilized as a feedstock for commercial applications, the gas is usually passed to a tail gas incinerator in which the H_2S is oxidized to SO_2 and is then passed to the atmosphere out a stack. For more details, the reader should consult Reference 8.

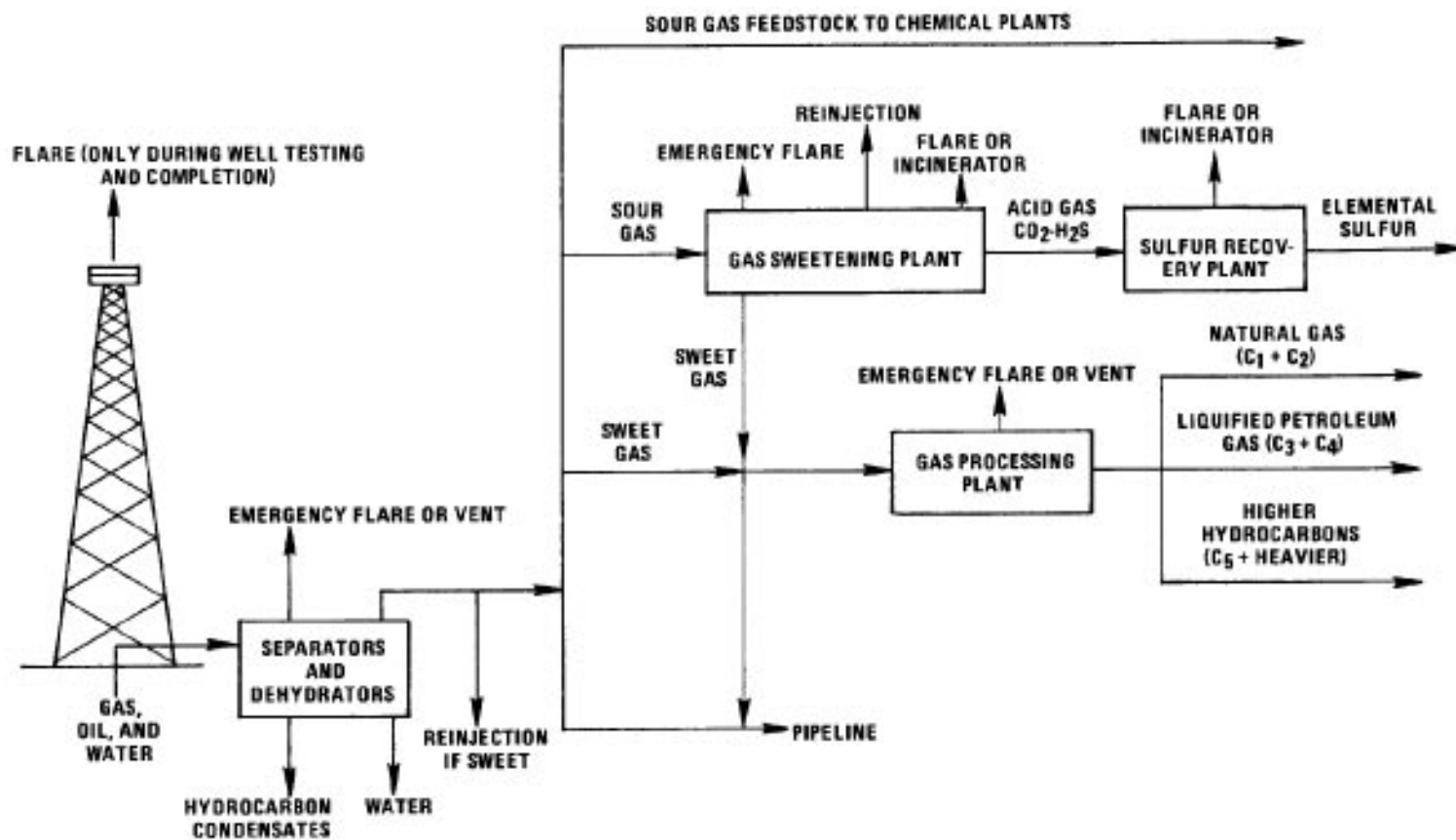


Figure 5.3-1. General flow diagram of the natural gas industry.

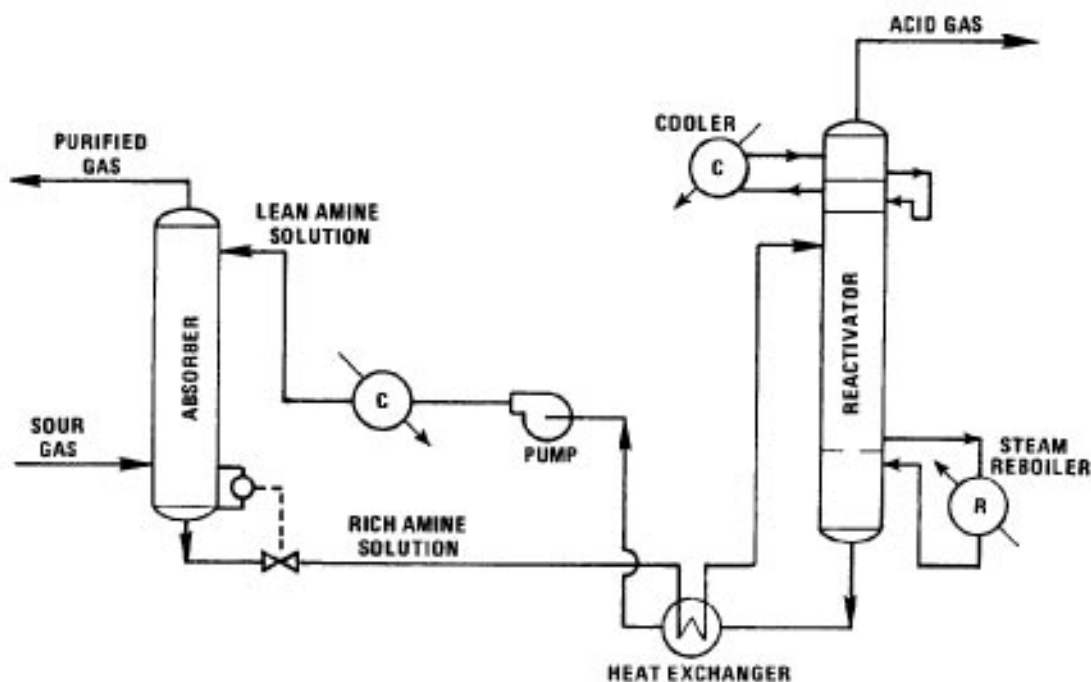


Figure 5.3-2. Flow diagram of the amine process for gas sweetening.

5.3.3 Emissions⁴⁻⁵

Emissions will result from gas sweetening plants only if the acid waste gas from the amine process is flared or incinerated. Most often, the acid waste gas is used as a feedstock in nearby sulfur recovery or sulfuric acid plants. See Sections 8.13 "Sulfur Recovery", or 8.10, "Sulfuric Acid", respectively, for these associated processes.

When flaring or incineration is practiced, the major pollutant of concern is SO_2 . Most plants employ elevated smokeless flares or tail gas incinerators for complete combustion of all waste gas constituents, including virtually 100 percent conversion of H_2S to SO_2 . Little particulate, smoke, or hydrocarbons result from these devices, and because gas temperatures do not usually exceed 650°C (1200°F), significant quantities of nitrogen oxides are not formed. Emission factors for gas sweetening plants with smokeless flares or incinerators are presented in Table 5.3-1. Factors are expressed in units of kilograms per 1000 cubic meters ($\text{kg}/10^3 \text{ m}^3$) and pounds per million standard cubic feet ($\text{lb}/10^6 \text{ scf}$).

Some plants still use older, less-efficient waste gas flares. Because these flares usually burn at temperatures lower than necessary for complete combustion, larger emissions of hydrocarbons and particulate, as well as H_2S , can occur. No data are available to estimate the magnitude of these emissions from waste gas flares.

Table 5.3.1 (Metric And English Units). EMISSION FACTORS FOR
GAS SWEETENING PLANTS^a

EMISSION FACTOR RATING: SULFUR OXIDES: A
ALL OTHERS: C

Process ^b	Particulate	Sulfur Oxides ^c (SO ₂)	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Amine					
kg/10 ³ m ³ gas processed	Neg	26.98 S ^d	Neg	— ^e	Neg
lb/10 ⁶ scf gas processed	Neg	1685 S ^d	Neg	— ^e	Neg

- ^a Factors are presented only for smokeless flares and tail gas incinerators on the amine gas sweetening process with no sulfur recovery or sulfuric acid production present. Too little information exists to characterize emissions from older, less-efficient waste gas flares on the amine process or from other, less common gas sweetening processes. Factors for various internal combustion engines used in a gas processing plant are given in Section 3.3, "Gasoline and Diesel Industrial Engines". Factors for sulfuric acid plants and sulfur recovery plants are given in Section 8.10, "Sulfuric Acid", and Section 8.13, "Sulfur Recovery", respectively. Neg = negligible.
- ^b References 2,4-7. Factors are for emissions after smokeless flares (with fuel gas and steam injection) or tail gas incinerators.
- ^c Assumes that 100% of the H₂S in the acid gas stream is converted to SO₂ during flaring or incineration and that the sweetening process removes 100% of the H₂S in the feedstock.
- ^d S is the H₂S content of the sour gas entering the gas sweetening plant, in mole or volume percent. For example, if the H₂S content is 2%, the emission factor would be 26.98 times 2, or 54.0 kg/1000 m³ (3370 lb/10⁶ scf) of sour gas processed. If the H₂S mole % is unknown, average values from Table 5.3-2 may be substituted. Note: If H₂S contents are reported in ppm or grains (gr) per 100 scf, use the following factors to convert to mole %:
10,000 ppm H₂S = 1 mole % H₂S
627 gr H₂S/100 scf = 1 mole % H₂S
The m³ or scf are to be measured at 60°F and 760 mm Hg for this application (1 lb-mol = 379.5 scf).
- ^e Flare or incinerator stack gases are expected to have negligible hydrocarbon emissions. To estimate fugitive hydrocarbon emissions from leaking compressor seals, valves, and flanges, see "Protocol For Equipment Leak Emission Estimates", EPA-453/R-95-017, November 1995 (or updates).

Table 5.3-2. AVERAGE HYDROGEN SULFIDE CONCENTRATIONS
IN NATURAL GAS BY AIR QUALITY CONTROL REGION^a

State	AQCR Name	AQCR Number	Average H ₂ S, mole %
Alabama	Mobile-Pensacola-Panama City-Southern Mississippi (FL, MS)	5	3.30
Arizona	Four Corners (CO, NM, UT)	14	0.71
Arkansas	Monroe-El Dorado (LA)	19	0.15
	Shreveport-Texarkana-Tyler (LA, OK, TX)	22	0.55
California	Metropolitan Los Angeles	24	2.09
	San Joaquin Valley	31	0.89
	South Central Coast	32	3.66
	Southeast Desert	33	1.0
Colorado	Four Corners (AZ, NM, UT)	14	0.71
	Metropolitan Denver	36	0.1
	Pawnee	37	0.49
	San Isabel	38	0.3
	Yampa	40	0.31
Florida	Mobile-Pensacola-Panama City-Southern Mississippi (AL, MS)	5	3.30
Kansas	Northwest Kansas	97	0.005
	Southwest Kansas	100	0.02
Louisiana	Monroe-El Dorado (AR)	19	0.15
	Shreveport-Texarkana-Tyler (AR, OK, TX)	22	0.55
Michigan	Upper Michigan	126	0.5
Mississippi	Mississippi Delta	134	0.68
	Mobile-Pensacola-Panama City-Southern Mississippi (AL, FL)	5	3.30
Montana	Great Falls	141	3.93
	Miles City	143	0.4
New Mexico	Four Corners (AZ, CO, UT)	14	0.71
	Pecos-Permian Basin	155	0.83
North Dakota	North Dakota	172	1.74 ^b

Table 5.3-2 (cont.).

State	AQCR Name	AQCR Number	Average H ₂ S, mole %
Oklahoma	Northwestern Oklahoma	187	1.1
	Shreveport-Texarkana-Tyler (AR, LA, TX)	22	0.55
	Southeastern Oklahoma	188	0.3
Texas	Abilene-Wichita Falls	210	0.055
	Amarillo-Lubbock	211	0.26
	Austin-Waco	212	0.57
	Corpus Christi-Victoria	214	0.59
	Metropolitan Dallas-Fort Worth	215	2.54
	Metropolitan San Antonio	217	1.41
	Midland-Odessa-San Angelo	218	0.63
	Shreveport-Texarkana-Tyler (AR, LA, OK)	22	0.55
	Four Corners (AZ, CO, NM)	14	0.71
Utah			
Wyoming	Casper	241	1.262
	Wyoming (except Park, Bighorn, and Washakie Counties)	243	2.34 ^c

^a Reference 9. AQCR = Air Quality Control Region.

^b Sour gas only reported for Burke, Williams, and McKenzie Counties, ND.

^c Park, Bighorn, and Washakie Counties, WY, report gas with an average H₂S content of 23 mole %.

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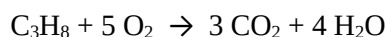
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13.5 Industrial Flares

13.5.1 General

Flaring is a high-temperature oxidation process used to burn combustible components, mostly hydrocarbons, of waste gases from industrial operations. Natural gas, propane, ethylene, propylene, butadiene and butane constitute over 95 percent of the waste gases flared. In combustion, gaseous hydrocarbons react with atmospheric oxygen to form carbon dioxide (CO₂) and water. In some waste gases, carbon monoxide (CO) is the major combustible component. Presented below, as an example, is the combustion reaction of propane.



During a combustion reaction, several intermediate products are formed, and eventually, most are converted to CO₂ and water. Some quantities of stable intermediate products such as carbon monoxide, hydrogen, and hydrocarbons will escape as emissions.

Flares are used extensively to dispose of (1) purged and wasted products from refineries, (2) unrecoverable gases emerging with oil from oil wells, (3) vented gases from blast furnaces, (4) unused gases from coke ovens, and (5) gaseous wastes from chemical industries. Gases flared from refineries, petroleum production, chemical industries, and to some extent, from coke ovens, are composed largely of low molecular weight hydrocarbons with high heating value. Blast furnace flare gases are largely of inert species and CO, with low heating value. Flares are also used for burning waste gases generated by sewage digesters, coal gasification, rocket engine testing, nuclear power plants with sodium/water heat exchangers, heavy water plants, and ammonia fertilizer plants.

There are two types of flares, elevated and ground flares. Elevated flares, the more common type, have larger capacities than ground flares. In elevated flares, a waste gas stream is fed through a stack anywhere from 10 to over 100 meters tall and is combusted at the tip of the stack. The flame is exposed to atmospheric disturbances such as wind and precipitation. In ground flares, combustion takes place at ground level and is almost always unassisted. Ground flares vary in complexity, and they may consist either of conventional flare burners with no enclosures or of multiple burners in refractory-lined steel enclosures. Ground flares may also be known as shielded flares.^a Ground flares should not be mistaken for thermal oxidizers or incinerators. Ground flares operate under the same principals as elevated flares and combustion is achieved through the natural draft of combustion air. Thermal oxidizers and incinerators have combustion air blowers and can be tuned to control combustion chamber temperature, thereby allowing for more effective combustion control.

The typical flare system consists of (1) a gas collection header and piping for collecting gases from processing units, (2) a knockout drum (disentrainment drum) to remove and store condensables and entrained liquids, (3) a proprietary seal, water seal, or purge gas supply to prevent flash-back, (4) a single- or multiple-burner unit and a flare stack, (5) gas pilots and an ignitor to ignite the mixture of waste gas and air, and, if required, (6) a provision for external momentum force (steam injection or forced air) for

^a For the purposes of 40 CFR part 60 subparts OOOO and OOOOa and 40 CFR part 63 subparts HH and HHH, these units are not considered flares. The definition of flare in these subparts specifically exclude these units. In these subparts, a flare is defined as a thermal oxidation system using an open flame (without enclosure). Under these subparts, these units are considered combustion devices that must be field-tested. Alternatively, a unit tested by a manufacturer may be installed.

smokeless flaring. Natural gas, fuel gas, inert gas, or nitrogen can be used as purge gas. Figure 13.5-1 is a diagram of a typical steam-assisted elevated smokeless flare system.

Combustion requires three ingredients: fuel, an oxidizing agent (typically oxygen in air), and heat (or ignition source). Flares typically operate with pilot flames to provide the ignition source, and they use ambient air as the oxidizing agent. The waste gases to be flared typically provide the fuel necessary for combustion. Combustible gases generally have an upper and lower flammability limit. The upper flammability limit (UFL) is the highest concentration of a gas in air that is capable of burning. Above this flammability limit, the fuel is too rich to burn. The lower flammability limit (LFL) is the lowest concentration of the gas in air that is capable of burning. Below the LFL, the fuel is too lean to burn. Between the upper and lower flammability limits, combustion can occur. Flare waste gases with concentrations above the UFL will become more dilute as the waste gas mixes with ambient air above the flare tip. As this dilution occurs, the air-waste gas mixture will pass through the flammability region, and combustion will occur. However, if flare waste gas concentrations are near the LFL prior to mixing with air, the air-waste gas mixture can fall below the flammability region, and reduced combustion efficiencies can occur. If steam is added to the flare waste gas at or prior to the flare tip (i.e., prior to the “combustion zone” where the mixing with air occurs), the steam will act to dilute the waste gas. Thus, even if there are adequate concentrations of combustibles in the waste gas, if too much steam is added to the waste gas so that the combustibles concentration becomes diluted to near the LFL as the steam-waste gas mixture enters the combustion zone, reduced combustion efficiencies will result. Consequently, critical considerations of flare combustion include the net heating value and the combustibles concentration in the flare gas and in the combustion zone (e.g., accounting for the amount of dilution by steam or other assist gas that occurs to the waste gas prior to the combustion zone).

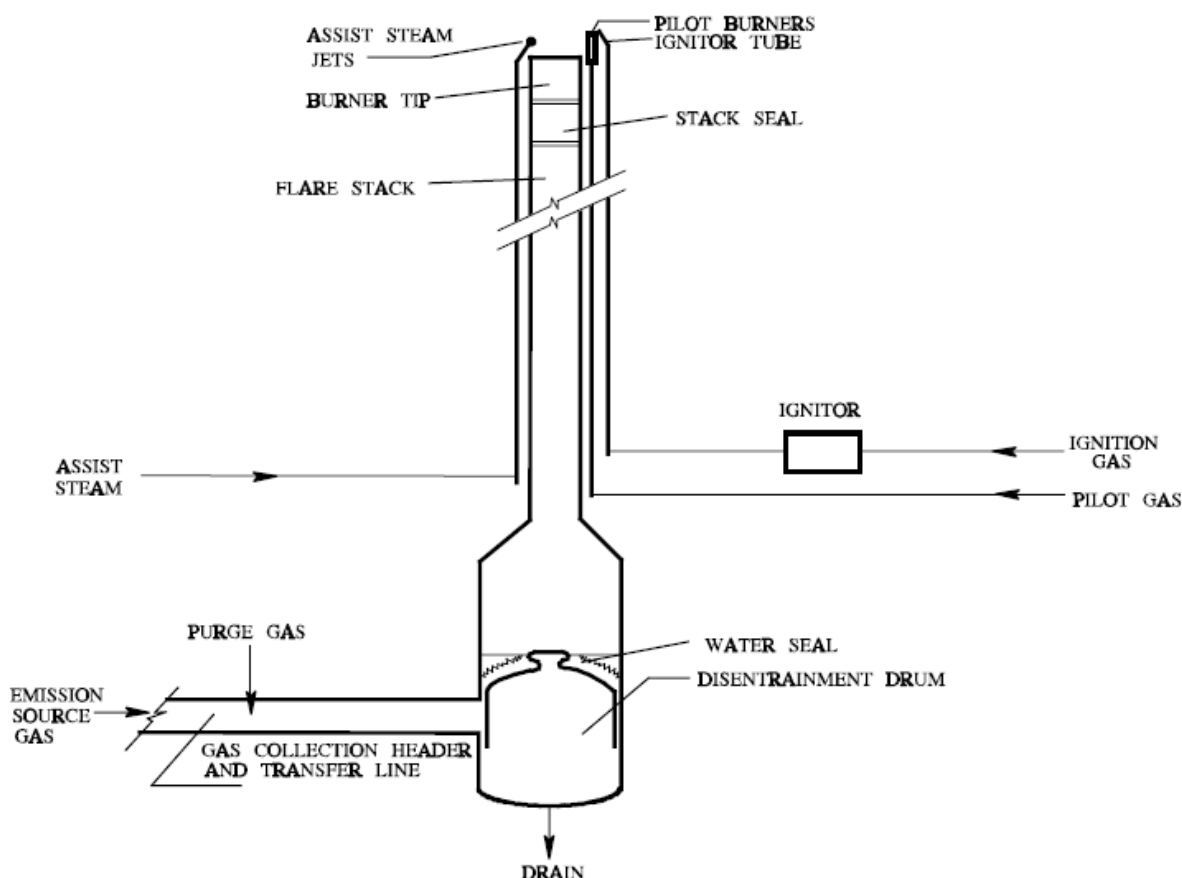


Figure 13.5-1. Diagram of a typical steam-assisted smokeless elevated flare.

Combustion efficiency is the percentage of hydrocarbon in the flare vent gas that is completely converted to CO₂ and water vapor. Destruction efficiency is the percentage of a specific pollutant in the flare vent gas that is converted to a different compound (such as CO₂, CO or other hydrocarbon intermediate). The destruction efficiency of a flare will always be greater than the combustion efficiency of a flare. It is generally estimated that a combustion efficiency of 96.5 percent is equivalent to a destruction efficiency of 98 percent.¹⁰

Smoking may result from combustion, depending upon waste gas components and the quantity and distribution of combustion air. Waste gases containing methane, hydrogen, CO, and ammonia usually burn without smoke. Waste gases containing heavy hydrocarbons such as paraffins above methane, olefins, and aromatics, have a higher tendency to smoke. An external momentum force, such as steam injection or blowing air, is used for efficient air/waste gas mixing and turbulence, which promotes smokeless flaring of heavy hydrocarbon waste gas. Other external forces may be used for this purpose, including water spray, high velocity vortex action, or natural gas. External momentum force is rarely required in ground flares.

Steam injection is accomplished either by nozzles on an external ring around the top of the flare tip or by a single nozzle located concentrically within the tip. At installations where waste gas flow varies, both are used. The internal nozzle provides steam at low waste gas flow rates, and the external jets are used with large waste gas flow rates. Several other special-purpose flare tips are commercially available, one of which is for injecting both steam and air.

Flares are generally designed to handle large quantities of waste gases that may be intermittently generated during plant emergencies, although they may also be used routinely to dispose of low-volume continuous or intermittent emissions from various sources at the plant. Flare gas volumes can vary from a few cubic meters per hour during regular operations up to several thousand cubic meters per hour during major upsets. Flow rates at a refinery could be 45 to 90 kilograms per hour (kg/hr) (100 - 200 pounds per hour [lb/hr]) during regular operation but could reach a full plant emergency rate of 700 megagrams per hour (Mg/hr) (750 tons/hr). Normal process blowdowns may release 450 to 900 kg/hr (1000 - 2000 lb/hr), and unit maintenance or minor failures may release 25 to 35 Mg/hr (27 - 39 tons/hr). Thus, the required flare turndown ratio can be over 15,000 to 1.

Many plants have 2 or more flares, in parallel or in series. In the former, 1 flare can be shut down for maintenance while the other serves the system. In systems of flares in series, 1 flare is intended to handle regular gas volumes and the other flare is generally intended to handle excess gas flows from emergencies.

13.5.2 Emissions

Noise, heat, and visible flame and/or smoke are the most apparent undesirable effects of flare operation. Flares are usually located away from populated areas or are sufficiently isolated, thus minimizing their effects on populations. Because the flame in a ground flare is generally not visible, and they reduce noise and thermal radiation to the surrounding area, these flares are common in populated areas. Emissions from flaring may include carbon particles (soot), unburned hydrocarbons, CO, and partially burned and altered hydrocarbons. Also emitted are nitrogen oxides (NO_x) and, if sulfur-containing material such as hydrogen sulfide or mercaptans is flared, sulfur dioxide (SO₂). The quantities of hydrocarbon emissions generated relate to the degree of combustion. The degree of combustion depends largely on the rate and extent of fuel-air mixing and on the flame temperatures achieved and maintained. Properly operated flares achieve at least 98 percent destruction efficiency in the flare plume, meaning that hydrocarbon emissions amount to less than 2 percent of the hydrocarbons in the gas stream.

The tendency of a fuel to smoke or make soot is influenced by fuel characteristics and by the amount and distribution of oxygen in the combustion zone. For complete combustion, at least the stoichiometric amount of oxygen must be provided in the combustion zone. The theoretical amount of oxygen required increases with the molecular weight of the gas burned. The oxygen supplied as air ranges from 9.6 units of air per unit of methane to 38.3 units of air per unit of pentane, by volume. Air is supplied to the flame as primary air and secondary air. Primary air is mixed with the gas before combustion, whereas secondary air is drawn into the flame. For smokeless combustion, sufficient primary air must be supplied, this varying from about 20 percent of stoichiometric air for a paraffin to about 30 percent for an olefin. If the amount of primary air is insufficient, the gases entering the base of the flame are preheated by the combustion zone, and larger hydrocarbon molecules crack to form hydrogen, unsaturated hydrocarbons, and carbon. The carbon particles may escape further combustion and cool down to form soot or smoke. Olefins and other unsaturated hydrocarbons may polymerize to form larger molecules which crack, in turn forming more carbon.

The fuel characteristics influencing soot formation include the carbon-to-hydrogen (C-to-H) ratio and the molecular structure of the gases to be burned. All hydrocarbons above methane, i. e., those with a C-to-H ratio of greater than 0.33, tend to soot. Branched chain paraffins smoke more readily than corresponding normal isomers. The more highly branched the paraffin, the greater the tendency to smoke. Unsaturated hydrocarbons tend more toward soot formation than do saturated ones. Soot is eliminated by adding steam or air; hence, most industrial flares are steam-assisted and some are air-assisted. Flare gas composition is a critical factor in determining the amount of steam necessary.

Since elevated flares do not lend themselves to conventional emission testing techniques, until recently only a few attempts have been made to characterize elevated flare emissions. Early EPA tests using propylene as flare gas indicated that efficiencies of 98 percent can be achieved when burning an offgas with at least 11,200 kJ/m³ (300 Btu/ft³).¹ However, recent studies on flare performance using passive Fourier Transform Infrared (pFTIR) spectroscopy have been performed on a number of different flares.⁴⁻⁸ The studies cover a number of flares at refineries, chemical plants and flare test facilities with varying waste gas compositions. The pFTIR studies support the conclusion that the combustion zone properties of the steam-waste gas mixture are predictive of proper flare combustion.¹⁰ There have also been recent studies on sources, including flares, using differential infrared absorption LIDAR [light detection and ranging] (DIAL). To date, many of these studies do not provide the data necessary to isolate the emissions from a particular flare. But enough data existed in one study that the emissions measured by DIAL could be attributed to the flare.⁹ For flares operated at petroleum refineries, EPA has determined that the net heating value of the gas in the combustion zone of the flare should be greater than or equal to 270 Btu/ft³ to obtain a destruction efficiency of at least 98%.^b

Table 13.5-1 presents flare emissions factors from the EPA tests¹; Table 13.5-2 presents flare emissions factors from pFTIR and DIAL studies.⁴⁻⁹ Crude propylene was used as flare gas during the early EPA tests. Methane was a major fraction of hydrocarbons in the flare emissions, and acetylene was the dominant intermediate hydrocarbon species. Many other reports on flares indicate that acetylene is always formed as a stable intermediate product. The acetylene formed in the combustion reactions may react further with hydrocarbon radicals to form polyacetylenes followed by polycyclic hydrocarbons.² Typical refinery waste gas feeds were used as flare gas during the pFTIR and DIAL studies.

In flaring waste gases containing no nitrogen compounds, NO is formed either by the fixation of atmospheric nitrogen (N) with oxygen (O) or by the reaction between the hydrocarbon radicals present in

^b See Petroleum Refinery Sector Risk and Technology Review and New Source Performance Standards Final Rule, December 1, 2015 (80 FR 75183). Net heating value of the combustion zone is determined on a 15-minute average, and refinery owners and operators may use a corrected heat content for hydrogen when determining the combustion zone heat value.

the combustion products and atmospheric nitrogen, by way of the intermediate stages, HCN, CN, and OCN.² Sulfur compounds contained in a flare gas stream are converted to SO₂ when burned. The amount of SO₂ emitted depends directly on the quantity of sulfur in the flared gases.

With the promulgation of the New Source Performance Standards for Crude Oil and Natural Gas Production, Transmission, and Distribution, EPA developed a manufacturer testing program for combustion control devices. These units are generally equivalent to enclosed ground flares, although they are explicitly excluded from the definition of flare in those subpart (see footnote a to this section). The manufacturer testing program requires performance testing be conducted using pure propylene under four different test conditions. Emissions data from these manufacturer tests have been used to develop emissions factors for enclosed ground flares. Because the factors are representative of enclosed ground flares burning propylene, the factors are included in Table 13.5-1, which are the flare factors developed from the EPA testing of elevated flares using crude propylene. Two factors are representative of enclosed ground flares operating at a low percent load, and two factors are representative of enclosed ground flares operating at a normal to high percent load.^c

Additionally, the Oil and Gas sector rules, as well as some state programs, are requiring more testing for these types of units in the field. As a result, emissions data are available from enclosed ground flares burning field gas. Table 13.5-3 presents two enclosed ground flare emissions factors for total hydrocarbons (THC) applicable to natural gas production.

Table 13.5-4 presents the description of the source classification codes (SCCs) to which the emissions factors in Tables 13.5-1 through 13.5-3 are applicable.

^c Because it is possible to test enclosed ground flares, the EPA recommends testing sources and using site-specific data in lieu of emissions factors whenever possible.

Table 13.5-1 (English Units). THC, NO_x AND SOOT EMISSIONS FACTORS FOR FLARE OPERATIONS FOR CERTAIN CHEMICAL MANUFACTURING PROCESSES^a

Pollutant	SCC ^e	Emissions Factor Value	Emissions Factor Units	Grade or Representativeness
THC, elevated flares ^c	30190099; 30119701; 30119705; 30119709; 30119741	0.14 ^{b,f}	lb/10 ⁶ Btu	B
THC, enclosed ground flares ^{g,h} Low Percent Load ⁱ		8.37 ^j or 3.88e-3 ^f	lb/10 ⁶ scf gas burned lb/10 ⁶ Btu heat input	Moderately
THC, enclosed ground flares ^{g,h} Normal to High Percent Load ⁱ		2.56 ^j or 1.20e-3 ^f	lb/10 ⁶ scf gas burned lb/10 ⁶ Btu heat input	Moderately
Nitrogen oxides, elevated flares ^d		0.068 ^{b,k}	lb/10 ⁶ Btu	B
Soot, elevated flares ^d		0 – 274 ^b	µg/L	B

^a All of the emissions factors in this table represent the emissions exiting the flare. Since the flare is not the originating source of the THC emissions, but rather the device controlling these pollutants routed from a process at the facility, the emissions factors are representative of controlled emissions rates for THC. These values are not representative of the uncontrolled THC routed to the flare from the associated process, and as such, they may not be appropriate for estimating the uncontrolled THC emissions or potential to emit from the associated process.

^b Reference 1. Based on tests using crude propylene containing 80% propylene and 20% propane.

^c Measured as methane equivalent. The THC emissions factor may not be appropriate for reporting volatile organic compounds (VOC) emissions when a VOC emissions factor exists.

^d Soot in concentration values: nonsmoking flares, 0 micrograms per liter (µg/L); lightly smoking flares, 40 µg/L; average smoking flares, 177 µg/L; and heavily smoking flares, 274 µg/L.

^e See Table 13.5-4 for a description of these SCCs.

^f Factor developed using the lower (net) heating value of the vent gas.

^g THC measured as propane by US EPA Method 25A.

^h These factors apply to well operated ground flares achieving at least 98% destruction efficiency and operating in compliance with the current General Provisions requirements of 40 CFR Part 60, i.e. >200 btu/scf net heating value in the vent gas and less than the specified maximum exit velocity. The emissions factor data set had an average destruction efficiency of 99.99%. Based on tests using pure propylene fuel. References 12 through 33 and 39 through 45.

ⁱ The dataset for these tests were broken into four different test conditions: ramping back and forth between 0 and 30% of load; ramping back and forth between 30% and 70% of load; ramping back and forth between 70% and 100% of load; and a fixed rate maximum load condition. Analyses determined that only the first condition was statistically different. Low percent load is represented by a unit operating at approximately less than 30% of maximum load.

^j Heat input is an appropriate basis for combustion emissions factor. However, based on available data, heat input data is not always known, but gas flowrate is generally available. Therefore, the emissions factor is presented in two different forms.

^k Factor developed using the higher (gross) heating value of the vent gas.

Table 13.5-2 (English Units). VOC and CO EMISSIONS FACTORS FOR ELEVATED FLARE OPERATIONS FOR CERTAIN REFINERY AND CHEMICAL MANUFACTURING PROCESSES^{a,b}

Pollutant	SCC ^e	Emissions Factor (lb/10 ⁶ Btu) ^f	Representativeness
Volatile organic compounds ^c	30190099; 30600904; 30119701; 30119705; 30119709; 30119741; 30119799; 30130115;	0.66	Poorly
Carbon monoxide ^d	30600201; 30600401; 30600508; 30600903; 30600999; 30601701; 30601801; 30688801; 40600240	0.31	Poorly

^a The emissions factors in this table represent the emissions exiting the flare. Since the flare is not the originating source of the VOC emissions, but rather the device controlling these pollutants routed from a process at the facility, the emissions factor is representative of controlled emissions rates for VOC. This values is not representative of the uncontrolled VOC routed to the flare from the associated process, and as such, it may not be appropriate for estimating the uncontrolled VOC emissions or potential to emit from the associated process.

^b These factors apply to well operated flares achieving at least 98% destruction efficiency and operating in compliance with the current General Provisions requirements of 40 CFR Part 60, i.e. >300 btu/scf net heating value in the vent gas and less than the specified maximum flare tip velocity. The VOC emissions factor data set had an average destruction efficiency of 98.9%, and the CO emissions factor data set had an average destruction efficiency of 99.1% (based on test reports where destruction efficiency was provided). These factors are based on steam-assisted and air-assisted flares burning a variety of vent gases.

^c References 4 through 9 and 11.

^d References 1, 4 through 8, and 11.

^e See Table 13.5-4 for a description of these SCCs.

^f Factor developed using the lower (net) heating value of the vent gas.

Table 13.5-3 (English Units). THC EMISSIONS FACTOR FOR ENCLOSED GROUND FLARES AT NATURAL GAS PRODUCTION SITES^a

Pollutant	SCC ^e	Emissions Factor ^f	Representativeness
THC ^{b,c,d}	31000205 31000212 31000227	332 lb/10 ⁶ scf gas burned or 0.335 lb/10 ⁶ Btu heat input ^g	Poorly

^a The emissions factor in this table represents the emissions exiting the flare. Since the flare is not the originating source of the THC emissions, but rather the device controlling these pollutants routed from a process at the facility, the emissions factor is representative of controlled emissions rates for THC. This value is not representative of the uncontrolled THC routed to the flare from the associated process, and as such, it may not be appropriate for estimating the uncontrolled THC emissions or potential to emit from the associated process.

^b THC measured as propane by US EPA Method 25A.

^c These factors apply to well operated flares achieving at least 95% destruction efficiency, as required by the Oil and Gas sector rules in 40 CFR parts 60 and 63. Although the Oil and Gas sector rules in parts 60 and 63 do not require ground flares to operate in compliance with the current General Provisions requirements of 40 CFR Part 60 or 63, i.e. >200 btu/scf net heating value in the vent gas and less than the specified maximum exit velocity, the reference flares do meet these requirements. The emissions factor data set had an average destruction efficiency of 99.33% for the gas volume basis and an average destruction efficiency of 99.23% for the heat input basis. Based on tests using natural gas production field gas, e.g. tank vents, dehydrator vents. References 32 through 38.

^d For enclosed ground flares with the SCCs specified in this table, the EPA recommends the use of this THC emissions factor instead of the VOC emissions factor in WebFIRE, as background documentation for this new emissions factor is available and the factor is based on field data from similar units.

^e See Table 13.5-4 for a description of these SCCs. For the purposes of 40 CFR part 60 subparts OOOO and OOOOa and 40 CFR part 63 subparts HH and HHH, these units are not considered flares. The definition of flare in these subparts specifically exclude these units. In these subparts, a flare is defined as a thermal oxidation system using an open flame (without enclosure).

^f Heat input is an appropriate basis for combustion emissions factor. However, based on available data, heat input data is not always known, but gas flowrate is generally available. Additionally, based on the available reports, there was a more robust dataset to develop an emissions factor on a gas volume basis. Therefore, the emissions factor is presented in two different forms.

^g Factor developed using the lower (net) heating value of the vent gas.

Table 13.5-4. SCC Descriptions

SCC	Level 1 Description	Level 2 Description	Level 3 Description	Level 4 Description
30600903	Industrial Processes	Petroleum Industry	Flares	Natural Gas
30600904	Industrial Processes	Petroleum Industry	Flares	Process Gas
30190099	Industrial Processes	Chemical Manufacturing	Fuel Fired Equipment	User Specified
30600999	Industrial Processes	Petroleum Industry	Flares	Not Classified
30600201	Industrial Processes	Petroleum Industry	Catalytic Cracking Units	Fluid Catalytic Cracking Unit
30130115	Industrial Processes	Chemical Manufacturing	Chlorobenzene	Atmospheric Distillation Vents
30688801	Industrial Processes	Petroleum Industry	Fugitive Emissions	User Specified
30600401	Industrial Processes	Petroleum Industry	Blowdown Systems	Blowdown System with Vapor Recovery System with Flaring
30601801	Industrial Processes	Petroleum Industry	Hydrogen Generation Unit	General
30601701	Industrial Processes	Petroleum Industry	Catalytic Hydrotreating Unit	General
30600508	Industrial Processes	Petroleum Industry	Wastewater Treatment	Oil/Water Separator
40600240	Petroleum and Solvent Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels	Gasoline: Barge Loading - Average Tank Condition
30119701	Industrial Processes	Chemical Manufacturing	Butylene, Ethylene, Propylene, Olefin Production	Ethylene: General
30119741	Industrial Processes	Chemical Manufacturing	Butylene, Ethylene, Propylene, Olefin Production	Ethylene: Flue Gas Vent
30119705	Industrial Processes	Chemical Manufacturing	Butylene, Ethylene, Propylene, Olefin Production	Propylene: General
30119709	Industrial Processes	Chemical Manufacturing	Butylene, Ethylene, Propylene, Olefin Production	Propylene: Fugitive Emissions
30119799	Industrial Processes	Chemical Manufacturing	Butylene, Ethylene, Propylene, Olefin Production	Other Not Classified
31000205	Industrial Processes	Oil and Gas Production	Natural Gas Production	Flares
31000212	Industrial Processes	Oil and Gas Production	Natural Gas Production	Condensate Storage Tank
31000227	Industrial Processes	Oil and Gas Production	Natural Gas Production	Glycol Dehydrator Reboiler Still Stack

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39. [Stack Emissions Study EPA 40 CFR Part 60 Subpart OOOO for the Power Generating Combustor, PGC: Prepared for Alphabet Energy, Inc. at the Enid Facility. Enid, Oklahoma. Air Hygiene International, Inc. January 31-February 2, 2017.](#)
40. [Source Emissions Survey of COMM Engineering Model 2 Thermal Combustor Inlet Duct and Outlet Stack. Lafayette, Louisiana. METCO Environmental. September 2016.](#)
41. [Source Emissions Survey of COMM Engineering Model 3 Thermal Combustor Inlet Duct and Outlet Stack. Lafayette, Louisiana. METCO Environmental. September 2016.](#)
42. [Source Emissions Survey of COMM Engineering Model 4 Thermal Combustor Inlet Duct and Outlet Stack. Lafayette, Louisiana. METCO Environmental. September and October 2016.](#)
43. [Stack Emissions Study EPA 40 CFR Part 60 Subpart OOOO for the Combustion Device SCD-36 Model: Prepared for Superior Fabrication, Inc. at the Elk City Facility. Elk City, Oklahoma. Air Hygiene International, Inc. October 4-7, 2016.](#)

44. [Stack Emissions Study EPA 40 CFR Part 60 Subpart OOOO for the Combustion Device SCD-48 Model: Prepared for Superior Fabrication, Inc. at the Elk City Facility. Elk City, Oklahoma. Air Hygiene International, Inc. September 13-15, 2016.](#)
45. [Stack Emissions Study EPA 40 CFR Part 60 Subpart OOOO for the Combustion Device SCD-60 Model: Prepared for Superior Fabrication, Inc. at the Elk City Facility. Elk City, Oklahoma. Air Hygiene International, Inc. October 7-12, 2016.](#)

ATTACHMENT F – MUNICIPAL AND COUNTY NOTIFICATIONS



20 June 2024

Tracking Number 9405503699300695782341

Washington County Board of Commissioners
Courthouse Square
100 West Beau Street
Suite 702
Washington, PA 15301

Dear Commissioners:

ETC Northeast Pipeline, LLC is submitting this notification to the board regarding a request to obtain a plan approval from the Pennsylvania Department of Environmental Protection's Air Quality Program for the construction of new emission sources at its existing natural gas processing facility (Revolution Cryo Plant) located in Smith Township, Washington County, Pennsylvania.

This application for a plan approval proposes the addition of a second cryogenic unit (Cryo II) at the facility. New air emissions sources proposed for the Cryo II unit include the following:

- One (1) 68.3 MMSCFD amine sweetening unit with a vent controlled by a 6.81 MMBtu/hr thermal oxidizer;
- One (1) 1,359 MMBtu/hr emergency flare;
- One (1) 9.04 MMBtu/hr inlet gas sieve regen heater;
- One (1) 6.64 MMBtu/hr regen heater;
- Three (3) Heat Medium Oil (HMO) heaters rated at 34.65 MMBtu/hr;
- Fifteen (15) catalytic heaters rated at 0.06 MMBtu/hr;
- Miscellaneous storage tanks of various sizes; and
- Associated piping and components.

Pennsylvania Code Title 25 (Environmental Protection – Air Resources) Section 127.43a requires municipal notifications including a 30-day comment period regarding the permit application, which begins upon receipt of this formal notification. During this comment period, DEP will accept such comments. Comments are to be sent to:

Air Quality Program
PADEP – Southwest Regional Office
400 Waterfront Dr.
Pittsburgh PA 15222
Phone: (412) 442-4436

If you have any further questions regarding this matter, please do not hesitate to contact me at 570-505-3700 or via email at Doug.Frisco@energytransfer.com.

Sincerely,

ETC Northeast Pipeline, LLC

Douglas L Frisco

Douglas L. Frisco
Sr. Manager, Environmental Compliance

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FAQs



20 June 2024

Tracking Number 9405503699300695782334

Smith Township Supervisors
1848 Smith Township State Rd
P.O. Box 94
Slovan, PA 15078

Dear Supervisors:

ETC Northeast Pipeline, LLC is submitting this notification to the board regarding a request to obtain a plan approval from the Pennsylvania Department of Environmental Protection's Air Quality Program for the construction of new emission sources at its existing natural gas processing facility (Revolution Cryo Plant) located in Smith Township, Washington County, Pennsylvania.

This application for a plan approval proposes the addition of a second cryogenic unit (Cryo II) at the facility. New air emissions sources proposed for the Cryo II unit include the following:

- One (1) 68.3 MMSCFD amine sweetening unit with a vent controlled by a 6.81 MMBtu/hr thermal oxidizer;
- One (1) 1,359 MMBtu/hr emergency flare;
- One (1) 9.04 MMBtu/hr inlet gas sieve regen heater;
- One (1) 6.64 MMBtu/hr regen heater;
- Three (3) Heat Medium Oil (HMO) heaters rated at 34.65 MMBtu/hr;
- Fifteen (15) catalytic heaters rated at 0.06 MMBtu/hr;
- Miscellaneous storage tanks of various sizes; and
- Associated piping and components.

Pennsylvania Code Title 25 (Environmental Protection – Air Resources) Section 127.43a requires municipal notifications including a 30-day comment period regarding the permit application, which begins upon receipt of this formal notification. During this comment period, DEP will accept such comments. Comments are to be sent to:

Air Quality Program
PADEP – Southwest Regional Office
400 Waterfront Dr.
Pittsburgh PA 15222
Phone: (412) 442-4436

If you have any further questions regarding this matter, please do not hesitate to contact me at 570-505-3700 or via email at Doug.Frisco@energytransfer.com.

Sincerely,

ETC Northeast Pipeline, LLC

Douglas L Frisco

Douglas L. Frisco
Sr. Manager, Environmental Compliance

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ATTACHMENT G – APPLICATION FEE



AIR QUALITY FEES SCHEDULE

There are four different Fees Schedules.

1. Fees Schedule for New Plan Approval
2. Fees Schedule for Pending or Issued Plan Approval
3. Fees Schedule for State-Only Operating Permit
4. Fees Schedule for Title V Operating Permit

If the company is submitting a new plan approval application, the fees schedule for a "New Plan Approval" should be used. In this form, the company should check the appropriate boxes depending on the types of review requested and pay accordingly.

Similarly, if the company is submitting an Operating Permit application, the company should use the respective fees schedule for an Operating Permit, check all the appropriate boxes, and pay the fees required.

Please make the check payable to the "Commonwealth of Pennsylvania Clean Air Fund." Submit this fees schedule and the check with the application package to the appropriate regional office.



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR QUALITY FEES FOR NEW PLAN APPROVAL

Company Information				
Federal Tax ID: 26-2863376-3		Firm Name: ETC Northeast Pipeline LLC		
Permit # (If any): GP1-63-01001A; AG5-63-00004A		Facility Name: Revolution Cryogenic Plant		
Municipality: Smith		County: Washington		
Contact Person Name: Alyssa Laird		Telephone Number: (713) 989-7158		
E-mail: Alyssa.Laird@energytransfer.com				
New Plan Approval (The following fees are cumulative.)				
Line #	Check the appropriate boxes below	Type of review requested	Fee 2021 - 2025	Total Fees
1	Base Fee	Subchapter B	\$2,500	\$2,500
2	☐	New Source Review, Subchapter E	\$7,500	
3	☐	NSPS/NESHAP /MACT standard A. # of NSPS: 2 B. # of NESHAP/MACT: _____ C. Add lines A and B: 2 D. Maximum applicable standards: 3 E. Enter smaller of line C or line D: 2 Multiply line E by \$2,500 and enter the amount in the "Total Fees" column.	\$2,500	\$5,000
4	☐	Case-by-Case MACT	\$9,500	
5	☐	Prevention of Significant Deterioration (PSD) requirements. Subchapter D	\$32,500	
6	☐	Plantwide Applicability Limit (PAL) for NSR regulated pollutants or PAL for PSD regulated pollutants or both	\$7,500	
7	☐	Risk Assessment Analysis – Inhalation only	\$10,000	
8	☐	Risk Assessment Analysis – Multi-pathway	\$25,000	
Add Lines 1 thru 8 of Total Fees column and write it here. —————→				\$7,500



AIR QUALITY FEES FOR PENDING* OR ISSUED** PLAN APPROVAL

Company Information				
Federal Tax ID:		Firm Name:		
Permit # (If any):		Facility Name:		
Municipality:		County:		
Contact Person Name:		Telephone Number:		
E-mail:				
Pending or Issued Plan Approval ***				
Line #	Check the appropriate boxes below	Type of Authorization	Fee 2021 - 2025	Total Fees
1	☐	Minor Modification	\$1,500	
2	☐	Extension	\$750	
3	☐	Transfer of Ownership	\$750	
4	☐	Significant Modification, Ambient Impact Analysis	\$9,000	
5	☐	Significant Modification, Reassessment of Control Technology	\$2,500	

* Pending plan approval is such that the Department has completed the technical review and published a notice in the *Pennsylvania Bulletin*. This is applicable only to Lines 4 and 5.

** Issued plan approval is such that the conditions of the plan approval have not been incorporated into an operating permit.

*** Pay maximum amount of fee when one or more authorizations are requested. For example, when a minor modification of a plan approval and a transfer of ownership are needed, please pay only the highest amount of fee (\$1,500).



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

AIR QUALITY FEES FOR STATE-ONLY OPERATING PERMIT (NON-TITLE V)

Company Information				
Federal Tax ID:		Firm Name:		
Permit # (If any):		Facility Name:		
Municipality:		County:		
Contact Person Name:		Telephone Number:		
E-mail:				
State-Only Operating Permit				
Line #	Check the appropriate box below	Type of Authorization	Fee 2021 - 2025	Total Fees
1	☐	New Application, Subchapter F	\$2,500	
2	☐	Renewal	\$2,100	
3	☐	Minor Modification	\$1,500	
4	☐	Significant Modification	\$2,000	
5	☐	Administrative Amendment / Change of Ownership	\$1,500	

Pay maximum amount of fee when one or more authorizations are requested. For example, when a renewal application and a change of ownership forms are submitted, please pay only the highest amount of fee (\$2,100).



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

QUALITY FEES FOR TITLE V OPERATING PERMIT

Company Information				
Federal Tax ID:		Firm Name:		
Permit # (If any):		Facility Name:		
Municipality:		County:		
Contact Person Name:		Telephone Number:		
E-mail:				
Title V Operating Permit				
Line #	Check the appropriate box below	Type of Authorization	Fee 2021 - 2025	Total Fees
1	☐	New Application, Subchapter G	\$5,000	
2	☐	Renewal	\$4,000	
3	☐	Minor Modification	\$1,500	
4	☐	Significant Modification	\$4,000	
5	☐	Administrative Amendment / Change of Ownership	\$1,500	
6	☐	Plantwide Applicability Limit (PAL) for NSR regulated pollutants or PAL for PSD regulated pollutants or both	\$10,000	

Pay maximum amount of fee when one or more authorizations are requested. For example, when a renewal application and a change of ownership forms are submitted, please pay only the highest amount of fee (\$4,000).

ATTACHMENT H – BAT ANALYSIS

1. INTRODUCTION

ETC Northeast Pipeline, LLC (ETC) is submitting a Plan Approval application to the Pennsylvania Department of Environmental Protection (PADEP) for the construction of new emissions sources at its existing natural gas plant in Smith Township, Washington County, Pennsylvania (i.e., Revolution Cryogenic Plant). The existing equipment is a minor source under the New Source Review and Title V programs. As part of the project, ETC is proposing to install one (1) 68.3 MMSCFD amine sweetening unit controlled by a 6.81 MMBtu/hr thermal oxidizer, one (1) 1,359 MMBtu/hr emergency flare, one (1) 9.04 MMBtu/hr inlet gas sieve regen heater, one (1) 6.64 MMBtu/hr regen heater, three (3) 34.65 MMBtu/hr Heat Medium Oil (HMO) heaters, various miscellaneous catalytic heaters, miscellaneous storage tanks, liquid loading, and associated piping and fugitive components.

Based on potential emissions, the Revolution Cryogenic Plant will not become a major stationary source of NO_x and VOC (i.e. sitewide potential to emit is, and will continue to be, less than 100 tons per year of NO_x and less than 50 tpy of VOC). As part of the Plan Approval application process, ETC must evaluate Best Available Technology (BAT) per 25 Pa Code §127.1.

Under PADEP air permitting regulations in 25 Pa Code §127.1, new sources of air emissions must implement BAT. Sources applicable to this requirement must be deemed by PADEP to satisfy this requirement before a Plan Approval can be issued. The BAT analysis for this project was performed using the traditional “top-down” approach generally following EPA’s methodology for Prevention of Significant Deterioration (PSD) projects. This methodology is outlined in Section 2 of this Attachment.

2. BAT METHODOLOGY

This section describes the process used for developing the BAT analysis for the sources affected by the proposed project. BAT is an emission limitation based on the maximum degree of reduction which the Department determines is achievable, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs. ETC has conducted this analysis generally using the “top-down” process outlined in a December 1, 1987, memorandum from the EPA Assistant Administrator for Air and Radiation.

For purposes of this Plan Approval application, ETC has prepared this BAT analysis consistent with EPA's top down approach, which consists of the following steps:

- ▶ Step 1 – Identify all potential control technologies;
- ▶ Step 2 – Determine technical feasibility (of potential technologies);
- ▶ Step 3 – Rank control technologies by control effectiveness ;
- ▶ Step 4 – Evaluate most effective controls and document results; and
- ▶ Step 5 – Select BAT.

Each of these steps is discussed below.

Step 1: Identify All Control Technologies

The first step in a “top-down” analysis is to identify, for all applicable emission units, all “available” control options. Available control options are defined as those air pollution control technologies or techniques that have a practical potential for application to the emissions unit and the regulated pollutant under evaluation and have been demonstrated in practice. Air pollution control technologies and techniques include the application of production processes or available methods, systems, and techniques, including innovative fuel combustion techniques and add-on controls.

Step 2: Eliminate Technically Infeasible Options

In the second step, the technical feasibility of the control options identified in Step 1 are evaluated with respect to source-specific factors. A demonstration of technical infeasibility should be documented and should show, based on physical, chemical, and engineering principles, that technical difficulties would preclude the successful use of the control option on the emissions unit under review. Technically infeasible control options are then eliminated from further consideration in the BAT analysis.

Step 3: Rank Remaining Control Technologies by Effectiveness

All remaining control alternatives not eliminated in Step 2 are ranked and then listed in order of overall control effectiveness for the pollutant under review, with the most effective control alternative at the top. A list should be prepared for each pollutant and for each emissions unit (or grouping of similar units) subject to a BAT analysis.

Step 4: Evaluate Most Effective Controls and Document Results

After the identification of available and technically feasible control technology options, the energy, environmental, and economic impacts are taken into account in this step. For each control option, an objective evaluation of each impact is presented. Both beneficial and adverse impacts should be discussed

and, where possible, quantified. If the permittee accepts the top alternative in the listing as BAT, the permittee proceeds to consider whether impacts of unregulated air pollutants or impacts in other media would justify selection of an alternative control option. If there are no outstanding issues regarding collateral environmental impacts, the analysis ends, and the results are proposed as BAT. If the top candidate is shown to be inappropriate due to energy, environmental, or economic impacts, the rationale for this finding is documented and the next level of control is analyzed.

Step 5: Select BAT

The final BAT determination is presented in this Step. The BAT analysis for the Project is also based on the following concepts:

- ▶ Emission limits are defined on a “case-by-case” analysis that considers site specific factors.
- ▶ Emission limits must be “achievable” on a long-term, day in and day out, basis.
- ▶ The technology must be available and feasible for a specific project.
- ▶ BAT does not redefine the facility as proposed (including fuels).

The BAT determination must account for a full range of operating conditions and the inherent variability of complex processes and air pollution control systems.

To be considered in the permitting process, control technology must be commercially available (i.e., it must be offered for sale on a commercial scale through commercial channels). Permittees are not required to explore research and development projects to determine whether a specific technology is suitable. In addition, to be considered feasible technology for purposes of inclusion in an analysis, a particular technology must have been previously demonstrated on a long-term basis and at commercial scale. In fact, even 2-3 years of operating history on a commercial scale has been determined to be insufficient to demonstrate that a particular technology is feasible.

3. SOURCE 202 (AMINE UNIT) - VOC BAT ASSESSMENT

The proposed project includes the addition of one (1) amine unit, that will be identified in the updated plan approval as Source ID 202. The amine unit's flash tank will be controlled by a VRU and the facility flare as back up (when VRU is down). The regenerator vent will be controlled by a thermal oxidizer. The amine unit will remove CO₂ from the NGLs by putting the NGL stream in contact with a lean amine solution in a contact tower. The amine solution has a natural affinity for CO₂ via absorption. The rich amine solution leaving the contactor tower will be sent to a flash tank and then an amine regeneration system where through heat and distillation, the CO₂ will be removed from the rich amine solution. Both the flash tank and regenerator vent are emission points from the process.

Step 1: Identify Potential Control Technologies

Step 1 in a top-down analysis is to identify all available control technologies. The evaluation of potential for VOC emissions from the amine unit includes an investigation of the various solutions to VOC emissions control for amine units. The following table outlines the generally accepted methods of VOC control from amine units.

Table 3-1. Potential VOC Control Technologies – Amine Units

Control Technologies
Thermal Oxidizer, or similar thermal destruction device
Vapor Combustor (Flare)
Vapor Recovery Units
Good Operating Practices

Review of Potentially Applicable VOC Control Technologies

Thermal Oxidizer (or similar thermal destruction device)

Thermal Oxidizers combust VOC's from the inlet vapor stream. Through combustion, VOCs are converted into carbon dioxide, water vapor and small quantities of other compounds. Often thermal oxidizers require supplemental fuel in order to continuously operate when the vent stream is not being sent to the incinerator or when the vapor stream VOC concentration is too variable for self-sustained ignition. Thermal oxidizers can achieve VOC control efficiencies ranging from 90-99%.

Facility Flare

A vapor combustor (also known as a flare) is a combustion device that destroys vapors, such as VOCs. The VOCs are converted to carbon dioxide and water through a combustion reaction. Flares are often employed for processes with varying amounts of flow and can handle high volumes at once.

Vapor Recovery Units (VRU)

Vapor Recovery Units (VRU's) remove any vapors that could be emitted from the vessel that they are controlling. The VRU is able to create suction pressure on the vapor and then compresses the gas back into a pipeline. In the case of a amine unit, the vapors released from the flash tank and still vent would be compressed and sent back into the pipeline for further processing. Based on regulatory requirements for the industry such as NSPS OOOOa, VRU's have a generally accepted control efficiency of 95% which accounts for 5% VRU downtime. Typically, VRU are driven by natural gas fired engines, which result in combustion emissions.

Good Operating Practices

Good operating practices for amine units include following all owner's manuals to ensure that the amine unit is maintained and operating under optimal conditions. ETC assumes this is the base case for BAT.

Step 2: Eliminate Technically Infeasible Control Strategies

Step 2 in a top down process is to eliminate the control options in Step 1 which are technically infeasible. The remaining technologies are carried into Step 3.

Thermal Oxidizer (or similar thermal destruction device)

Thermal oxidizers require relatively high VOC concentrations to sustain combustion reactions; therefore, the flash tank and still vapors stream are suitable for this technology. This control device is **technically feasible** for the proposed amine unit.

Facility Flare

Flares combust gas streams with high VOC concentrations, which enable them to sustain combustion reactions. The composition of the flash tank stream have the corresponding high VOC content required; therefore, this control device is **technically feasible** for the flash tank off gas stream.

Vapor Recovery Units (VRU)

A vapor recovery unit will send the compressed gas streams from still vent to the pipeline or back to the amine unit. Being that the unit's purpose is to remove CO₂ from the NGL stream, this will nullify the purpose of the unit if the recovered vapor contains CO₂ in excess of pipeline specifications. Therefore, vapor recovery units for control of the amine unit still vent stream is **technically infeasible**. However, the flash gas stream is not CO₂ rich and would be appropriate to be routed to the process, sales line, or the inlet of the amine unit. Routing the flash gas back to process using a VRU is **technically feasible**.

Step 3: Rank Remaining Controls by Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency.

Table 3-2 VOC Control Technology Effectiveness

Control Technologies	Control Efficiency	Ranking
Thermal Oxidizer	95 -99%	1
VRU	95% (flash gas only)	2
Facility Flare	95 – 99%	3
Good Operating Practices	Varies	4

Step 4: Evaluate Most Effective Controls and Document Results

Both routing the regenerator vent to the thermal oxidizer and using a VRU for the flash gas vent is technically feasible. ETC will control the flash gas vent with a VRU and use a facility flare for control as a back up to maximize control. The regenerator vent will be controlled by a thermal oxidizer, as it is technically infeasible to route the regenerator vent to a VRU, and there is no cost benefit of recycling carbon dioxide.

Step 5: Select BAT

ETC will use the VRU (flash gas stream), with the VRU stream going to the facility flare when the VRU is down, and thermal oxidizer (regenerator vent) for control of the amine process streams to satisfy the BAT requirements. ETC will operate the VRU and thermal oxidizer / facility flare using best operating practices and will follow all manufacturer specifications.

4. SOURCE 802 (VENTING / BLOWDOWNS) - VOC BAT ASSESSMENT

The proposed project includes sources that vent gas as part of their normal operation, such as compressor venting, and miscellaneous blowdowns (planned [e.g., maintenance related] or unplanned)¹. Some of these blowdowns cannot be safely routed to a pipeline for control due to safety concerns. These facility maintenance blowdowns account for less than 1% of the total potential blowdown volume for the project.

Step 1: Identify Potential Control Technologies

Step 1 in a top-down analysis is to identify all available control technologies. Evaluation of the various control technology for the blowdown events are as follows:

Table 4-1. Potential VOC Control Technologies – Venting/Blowdowns

Control Technologies
Vapor Combustor (Flare)
Thermal Oxidizer
Vapor Recovery Units
Good Operating Practices

Review of Potentially Applicable VOC Control Technologies

Facility Flare

A vapor combustor (also known as a flare) is a combustion device that destroys vapors, such as VOCs. The VOCs are converted to carbon dioxide and water through a combustion reaction. Flares are often employed for processes with varying amounts of flow and can handle high volumes at once.

¹ Moisture analyzers are a part of this source, but are exempt from Plan Approval permitting as trivial activities (“Equipment used for quality control / assurance or inspection purposes, include sampling equipment used to withdraw materials for analysis”).

Thermal Oxidizer (or similar thermal destruction device)

Thermal Oxidizers combust VOC's from the inlet vapor stream. Through combustion, VOCs are converted into carbon dioxide, water vapor and small quantities of other compounds. Often thermal oxidizers require supplemental fuel in order to continuously operate when the vent stream is not being sent to the incinerator or when the vapor stream VOC concentration is too variable for self-sustained ignition. Thermal oxidizers can achieve VOC control efficiencies ranging from 90-99%.

Vapor Recovery Units (VRU)

Vapor Recovery Units (VRU's) remove any vapors that could be emitted from the process that they are controlling. The VRU is able to create suction pressure on the vapor and then compresses the gas back into a pipeline. A VRU could be used, in the case of certain vent streams (typically continuous vents from process vessels as opposed to maintenance and unplanned blowdowns), to route the vented gas back into the pipeline. Typically, VRU are driven by natural gas fired engines, which result in combustion emissions.

Good Operating Practices

Good Operating Practices for blowdown operations would be to minimize the volume of gas vented, where possible, as well as reduce the frequency and duration of blowdowns. Minimization of blowdown emissions is the base case for BAT.

Step 2: Eliminate Technically Infeasible Control Strategies

Step 2 in a top down process is to eliminate the control options in Step 1 which are technically infeasible. The remaining technologies are carried into Step 3.

Facility Flare

A flare is able to combust gas streams that have high VOC concentrations, which enable them to continue the combustion reactions. Due to the nature of operation, flares are well suited for infrequent, non-steady state operations; therefore, this control technology is **technically feasible**.

Thermal Oxidizer (or similar thermal destruction device)

Similar to flares, thermal oxidizers combust high VOC concentration streams to sustain combustion reactions. Thermal oxidizers are more suitable for steady state streams. Additionally, to be designed to adequately handle and control large volumes of blowdowns in a short period of time (e.g., station blowdowns) the size of the unit (before considering the significant supplemental fuel to maintain proper operating temperature at all times) would require a complete re-design of the current scope of the proposed process. Therefore, a thermal oxidizer is **technically infeasible** for blowdown operations.

Vapor Recovery Units (VRU)

A vapor recovery unit will send the compressed gas streams to the pipeline or to another process unit. This option is **technically feasible** for most streams as noted earlier in this section.

Step 3: Rank Remaining Controls by Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency.

Table 4-2 VOC Control Technology Effectiveness

Control Technologies	Control Efficiency	Ranking
VRU	95%	1
Flare	95 - 98%	2
Good Operating Practices	Varies	3

Step 4: Evaluate Most Effective Controls and Document Results

To maximize control efficiency, ETC will control blowdown emissions (where appropriate) by utilizing a VRU and flare. ETC will implement based management practices to minimize maintenance blowdown emissions. Note that for facility maintenance blowdowns, emissions are unable to be capture and controlled for safety reasons. Table 4-3 highlights the streams that are controlled by VRU and the facility flare as back up.

Table 4-3 Blowdown Control Summary

Stream	Emission Unit	Control Type	Notes
Purge Gas	Venting / Blowdowns	FLARE-002	Stream can contain oxygen, therefore not useful to route back to the inlet of the plant for processing
Residue Gas Compressor Blowdowns	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime
Closed Drain Vapors	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime
Residue Compressor Rod Packing	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime
Centrifugal Dry Compressor Seal	Venting / Blowdowns	VRU / FLARE-002	Calculations assume 5% VRU downtime

Step 5: Select BAT

ETC will utilize good operating practices to limit blowdown emissions and will route these streams (where feasible) to a VRU and utilize the flare as back up. ETC will develop and implement a blowdown best management practice that will result in the minimization of blowdown emissions.

5. SOURCE 703 (FUGITIVE LEAKS) - VOC BAT ASSESSMENT

The proposed project contains emissions from various fugitive component leaks, such as, but not limited to flanges, connectors, valves, etc.). The main sources of VOC emissions from the fugitive sources are the

venting of gas in the pipeline. The gas contains VOC and when the various fugitive components leak, the gas is emitted to the atmosphere.

Step 1: Identify Potential Control Technologies

Step 1 in a top-down analysis is to identify all available control technologies. The only potential control technology associated with the fugitive components is implementing a Leak Detection and Repair (LDAR) program, such as those outlined in NSPS OOOOa / NSPS OOOOb, NSPS VVa, or 40 CFR part 60 Appendix K. The control efficiency for a LDAR program can range between 40 to 80² percent depending on the frequency of the surveys.

Step 2: Eliminate Technically Infeasible Control Strategies

Step 2 in a top down process is to eliminate the control options in Step 1 which are technically infeasible. The remaining technologies are carried into Step 3.

Implementing an LDAR program is required for all facilities subject to NSPS OOOOa or NSPS OOOOb applicable sites. While NSPS VVa and 40 CFR part 60 Appendix K are viable LDAR programs, they are not directly applicable to the plant. Therefore, they are not carried forward in this top-down analysis. Being that most, if not all, gas plants implement a LDAR program pursuant to federal and / or state rules, this control technology is **technically feasible**.

Step 3: Rank Remaining Controls by Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. Being that implementation of a LDAR program is technically feasible and is the only available option, this is the best option for control.

Step 4: Evaluate Most Effective Controls and Document Results

Implementing an LDAR program is the most effective, and only, control technology option.

Step 5: Select BAT

ETC will follow the Leak Detection and Repair requirements of NSPS OOOOb to satisfy BAT. Note that EPA recently completed an evaluation of emission reductions and determined the LDAR program finalized under NSPS OOOOb is the best system of emissions reduction.

6. SOURCE 034 – 036 (HEATERS) - NO_x BAT ASSESSMENT

The proposed project includes the addition of three (3) Heat Medium Oil (HMO) heaters. These heaters will provide heat to various users throughout the plant. The users will include the gas preheater, condensate stabilization system, deMethanizer trim reboiler, deEthanizer reboiler, and amine regeneration reboiler.

² U.S. EPA estimation per Table 4-17 of the "Background Technical Support Document for the Final New Source Performance Standards 40 CFR Part 60, Subpart OOOOa" dated May 2016.

Step 1: Identify Potential Control Technologies

Step 1 in a top-down analysis is to identify all available control technologies. The following table contains a list of the various technologies that have been identified for the control of NO_x emissions:

Table 4-1. Potential NO_x Control Technologies – HMO Heaters

Control Technologies
Low NO _x Burners
Flue Gas Recirculation
Selective Non-Catalytic Reduction (SNCR)
Selective Catalytic Reduction (SCR)
Good Combustion Practices

Review of Potentially Applicable VOC Control Technologies

Low NO_x Burners

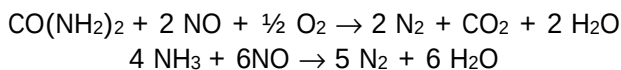
Low NO_x burners (LNBs) incorporate staged combustion and utilize localized exhaust gas recirculation where the flame is employed. LNBs control the fuel and air mixing to create larger branching flames. Peak flame temperatures are reduced, and the flame structure reduces oxygen supply to the hottest part of the flame, thus resulting in less NO_x formation.

Flue Gas Recirculation

Flue gas recirculation (FGR) is where the flue gas is recycled back to the burner windbox. Flue gas recirculation reduces NO_x emissions in two ways. The first way is that the flue gas reduces the combustion temperatures which results in suppressing the thermal conversion to NO_x. The second mechanism is by recycling the flue gas, the oxygen concentration is lowered in the flame zone, thus reducing NO_x emissions.

Selective Non-Catalytic Reduction (SNCR)

SNCR uses ammonia (NH₃) or a urea solution [CO(NH₂)₂], injected into the gas stream to reduce NO_x to for N₂ and water. Typically, high temperatures (between 1,600 and 2,400 °F) promote the reaction via the following equation:

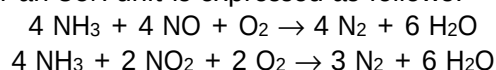


Temperatures underneath the optimal range result in unreacted ammonia passing through the SNCR and is emitted from the stack, this is otherwise known as ammonia slip. If the temperatures rise above the optimal range, the ammonia may combust and generate additional NO_x emissions. SNCR operation is generally not suitable for low residence time operation (gas stream slow down the reaction kinetics), the reagent would contaminate the product, or there are no suitable locations for installing reagent injection ports. Removal efficiencies of SNCR range anywhere from 25 to 65 percent³ and are dependent on various operating parameters.

Selective Catalytic Reduction (SCR)

Similar to SNCR, SCR is a post-combustion NO_x control technology that removes the pollutant from the gas vapor stream via a chemical reaction of NO_x and a reducing agent (typically ammonia). The difference between them is that the SCR reaction takes place using a metal-based catalyst. An ammonia or urea reagent is injected into the exhaust gas stream and the reaction of NO_x and oxygen occurs at the surface of the catalyst. The catalyst lowers the activation energy for the chemical reaction to occur between NO_x decomposition into N₂ and water. Similar to SNCR, SCR has some of the same operational concerns (i.e. ammonia slip).

The primary chemical reactions for an SCR unit is expressed as follows:



The optimum temperature range for the majority of commercial SCR system catalysts is 480 to 800°F; operation outside the optimum temperature range can result in increased ammonia slip or increased NO_x emissions. Application of SCR technology can result in removal efficiencies of over 90 percent⁴ depending on the source conditions.

Good Combustion Practices

NO_x formation can be minimized by proper heater operation. This can be achieved through minimizing operating temperatures and controlling excess air sent to the unit. As outlined in the recently finalized GP-1 permit, ETC will ensure proper operation and maintenance according to good engineering and air pollution control practices (including annual tune up / inspection).

Step 2: Eliminate Technically Infeasible Control Strategies

Step 2 in a top down process is to eliminate the control options in Step 1 which are technically infeasible. The remaining technologies are carried into Step 3.

Low NO_x Burners

LNBs are considered to be **technically feasible** for controlling NO_x emissions from the HMO Heaters at the plant, as the devices will be intrinsically designed with LNBs. The heater emission rates will meet those recently developed as BAT under the PADEP GP-1 requirements.

³ [snrcostmanualchapter7thedition20162017revisions.pdf \(epa.gov\)](#)

⁴ [snrcostmanualchapter7thedition_2016revisions2017.pdf \(epa.gov\)](#)

Flue Gas Recirculation

FGR is considered to be **technically feasible**, however, this emission reduction methodology is not carried down, as specifically designed LNBs will be used to demonstrate compliance with the BAT limits outlined in PADEP's GP-1 permit.

SNCR / SCR

SNCR and SCR are theoretically applicable, however, upon review of RACT/BACT/LAER Clearinghouse (RBLC) of similarly sized units and PADEP's GP-1 permit, a limit of 9 ppm NO_x without application of SNCR/SCR is considered to be BAT. It is important to note that the similarly sized heaters in the RBLC did not apply a SNCR or SCR when implementing limits. Therefore, these options will not be carried down for further consideration under BAT and SNCR and SCR are considered **technically infeasible**.

Step 3: Rank Remaining Controls by Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency.

Table 4-2 NO_x Control Technology Effectiveness

Control Technologies	Control Efficiency	Ranking
LNB	Varies	1
Good Combustion Practices	Varies	2

Step 4: Evaluate Most Effective Controls and Document Results

The only remaining options for control are LNB technology for the heaters as well as utilizing good combustion practices.

Step 5: Select BAT

The BAT for the HMO heaters is utilizing LNBs for the heaters as well as conducting good combustion practices. The LNB will be designed to meet an emission rate of 9 ppm_{dv} NO_x at 3% O₂. ETC will conduct annual tune ups as well as conduct portable analyzer tests for NO_x, every 3 years, as outlined in the GP-1 permit.

7. SOURCE C203 (FACILITY FLARE) - BAT ASSESSMENT

The proposed project at the facility include a facility flare that will control various streams at the facility related to the additional equipment installed at the plant. Products of combustion such as NO_x, CO, PM, SO_x, etc. are produced from the facility flare.

Step 1: Identify Potential Control Technologies

Step 1 in a top-down analysis is to identify all available control technologies. The only potential control technology associated with the facility flare is compliance with the requirements outlined in 40 CFR 60 Subpart A 60.18 and good operating practices.

Step 2: Eliminate Technically Infeasible Control Strategies

Step 2 in a top down process is to eliminate the control options in Step 1 which are technically infeasible. The remaining technologies are carried into Step 3.

Flares are subject (as referenced) to the requirements of 40 CFR 60 Subpart A, 60.18, which renders it **technically feasible**.

Step 3: Rank Remaining Controls by Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. ETC will follow NSPS Subpart A 60.18 and conduct good operating practices

Step 4: Evaluate Most Effective Controls and Document Results

Following NSPS Subpart A 60.18 and operating with good operating practices are the most effective forms of control of NO_x.

Step 5: Select BAT

ETC will follow the provisions as outline in NSPS Subpart A 60.18 and will operate the facility flare utilizing best engineering practices.

8. SOURCE 034 - 036 (HEATERS) – CO & VOC BAT ASSESSMENT

The proposed project includes the addition of three Heat Medium Oil (HMO) heaters. These heaters will provide heat to various users throughout the plant. The main sources of CO and VOC emissions from the HMO heaters are from combustion of fuel gas.

Step 1: Identify Potential Control Technologies

Step 1 in a top-down analysis is to identify all available control technologies. There are control technologies employed CO and VOC emissions, but after research of EPA's RBLC database, such technologies are not applied to heaters of this size. The only such remaining control technology would be good combustion practices for the heaters.

Step 2: Eliminate Technically Infeasible Control Strategies

Step 2 in a top down process is to eliminate the control options in Step 1 which are technically infeasible. The remaining technologies are carried into Step 3.

Good combustion practices are the only viable option carried down, therefore, these are deemed **technically feasible**.

Step 3: Rank Remaining Controls by Effectiveness

In Step 3, the remaining control technology options are ranked based on their control effectiveness, from highest to lowest control efficiency. ETC will follow good combustion practices for the HMO heaters to control both VOC and CO at the plant.

Step 4: Evaluate Most Effective Controls and Document Results

Conducting good combustion practices is considered to be BAT for the HMO heaters. Heaters will comply with standards as outlined in PADEP's GP-1 permit.

Step 5: Select BAT

ETC will conduct good combustion practices while operating the HMO heaters at the plant. ETC will comply with the 130 ppm CO at 3% O₂ as recently established in the GP-1 permit as BAT for CO. ETC will conduct an annual tune up as well as periodic monitoring on the heaters every three years.

9. SOURCE 034 - 036 (HEATERS) –SO₂ & PM BAT ASSESSMENT

Potential add-on controls for SO₂ include wet/dry scrubbing and add-on controls for PM species include cyclones, baghouses and electrostatic precipitators (ESP). There is very little sulfur and filterable PM contained in the exhaust gas. A review of the RBLC indicated that no add-on controls have been implemented on similar units of any size. Therefore, these add-on technologies are eliminated as technically infeasible. Low sulfur fuel (i.e., natural gas) is the most effective way to minimize sulfur emissions from the unit. The use of this fuel also results in very low, and largely very fine, quantities of PM. As such, the use of natural gas as fuel is determined to be BAT for these pollutants.

ATTACHMENT I – AREA MAP

Area Map

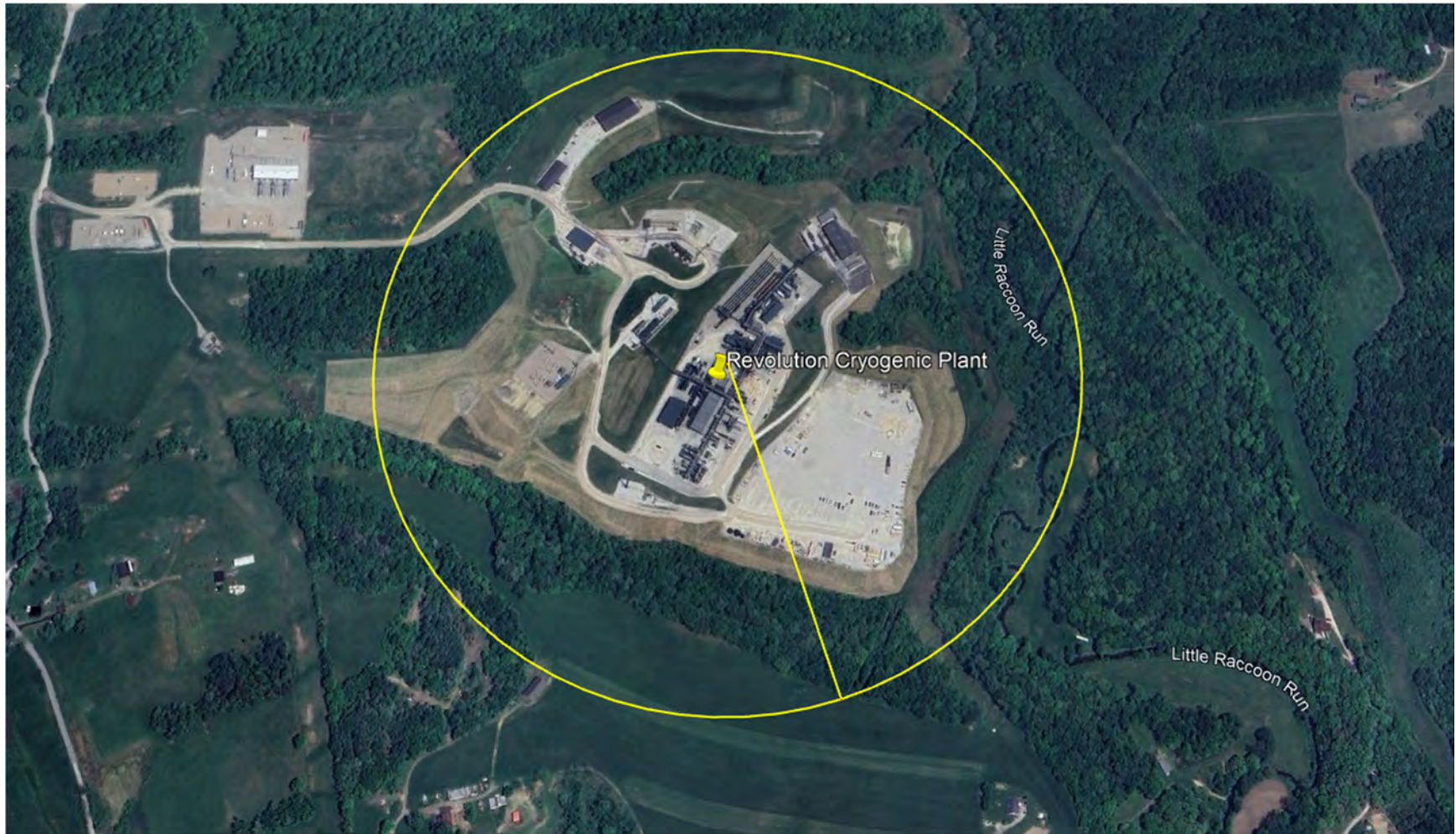


Figure 1 - 0.25 mi Radius of the Revolution Cryogenic Plant