

June 25, 2024

Submitted via OnBase

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Mr. Gorog:

ETC Northeast Pipeline, LLC (ETC) owns and operates the Revolution Cryogenic Plant located in Smith Township, Washington County Pennsylvania. The facility is currently operating under General Permits GP5-63-01001A and GP1-63-01001A, both issued on August 8th, 2018. As determined by conversations between PADEP and ETC, a state only operating permit was submitted for the continued operation of its existing sources was submitted on June 9, 2023. ETC is submitting this plan approval application for addition of various emission sources at the plant.

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.

The enclosed application contains the required application forms and supporting materials including the application fee of \$7,500. The attachments to this letter are organized as outlined below:

- Attachment A: General Information Form (GIF)
- Attachment B: Compliance Review Form
- Attachment C: Plan Approval Forms
- Attachment D: Process Flow Diagram
- Attachment E: Detailed Emission Calculations
- Attachment F: Municipal and County Notifications
- Attachment G: Application Fee
- Attachment H: BAT Analysis
- Attachment I: Area Map

Local municipal and county notifications describing the sources are also included in the attached application package. Proof of delivery of these notifications will be submitted to PADEP upon receipt of the delivery receipts.

If you have any further questions regarding this application, please do not hesitate to contact me at 713-989-7158 or via email at Hanh.Duong@energytransfer.com.

Sincerely,

Energy Transfer LP

Hanh Duong
Staff Engineer – E&C Environmental



PLAN APPROVAL APPLICATION
ETC Northeast Pipeline, LLC



**ENERGY
TRANSFER**

Revolution Cryogenic Plant

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June 2024

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ATTACHMENT A – GENERAL INFORMATION FORM **A**

ATTACHMENT B – COMPLIANCE REVIEW FORM **B**

ATTACHMENT C – PLAN APPROVAL FORMS **C**

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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 6.81 million British thermal units per hour (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.

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 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)

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. Both the flash vapors and the regenerator overheads stream from the proposed unit will be controlled by a 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-006 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-007 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 residue gas compressor blowdowns, purge gas, closed drain vapors, pressure relief valves, and miscellaneous blowdowns.

- ▶ THERM-002 – This new thermal oxidizer will control emissions from the new amine regenerator vent and flash tank

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. Maximum potential emissions for VOC from the Revolution Cryogenic Plant will exceed the major source threshold for Title V applicability after the proposed project. Therefore, the Revolution Cryogenic Plant will be major source with respect to the Title V Program with respect to VOC. A Title V permit application must be submitted within one year of commencing operation of the proposed project per 40 CFR 70.5(a)(1)(i).

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 https://www3.epa.gov/airquality/greenbook/anayo_pa.html as of May 31, 2024.

trigger major NSR review. Once the project is completed, the Revolution Cryogenic Plant will become a major source of VOC under the NNSR program but will remain a minor source for the remaining programs as emissions will remain below major source thresholds.

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 result in an increase in condensate throughput through the 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 Compliance Assurance Monitoring

EPA developed the Compliance Assurance Monitoring (CAM) regulations as a means for providing reasonable assurance that an emissions unit is in continuous compliance with applicable requirements for affected units located at major stationary sources subject to Title V permitting. As noted previously, the Revolution Cryo Plant will be a Title V facility once the proposed project begins operation. CAM requirements apply to units that are subject to an emission limitation or standard, use a control device to meet these limits, and have potential pre-control emissions equal to or greater than 100% of the amount required for a source to be classified as major. Certain limits (e.g., NSPS) are exempt based on existing monitoring required by the regulation. The regulatory requirement for assessing CAM applicability is do so either at the time of the first Title V operating permit application or the first Title V operating permit renewal, depending on the post-control potential emissions of the source. ETC will address CAM, as needed, with the initial Title V operating permit application

2.5 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 proposed project will make the Revolution Cryo plant a major source with respect to VOC, but the facility will remain a minor source with respect to NO_x.

As the Revolution Cryo Plant will become a major VOC emitting facility, ETC is required to provide a notification outlined in §129.115(a) to the Department within 6 months of becoming a major source that shall identify and list the sources subject to this rule, as outlined in §129.111(b).

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? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
|---|---|---|

| | |
|--|--|
| State of Incorporation or Registration of Fictitious Name | <input type="checkbox"/> Corporation <input checked="" type="checkbox"/> LLC <input type="checkbox"/> Partnership <input type="checkbox"/> LLP <input type="checkbox"/> LP <input type="checkbox"/> Sole Proprietorship <input type="checkbox"/> Association/Organization <input type="checkbox"/> Estate/Trust <input type="checkbox"/> 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 |
| | | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | PA |
| | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |

| | | |
|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|--------------------------|--------------------------|--------------------------|

| | |
|--|-----------------------------|
| Site Location Line 1 Point Pleasant Road | Site Location Line 2 |
|--|-----------------------------|

| | | |
|---|--------------------|-----------------------|
| Site Location Last Line – City Bulger | State PA | ZIP+4 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 Laird | First Name Alyssa | MI | Suffix |
|--|-----------------------------|-----------|---------------|

| | |
|---|--------------------------|
| Site Contact Title Sr. Specialist - Environmental | Site Contact Firm |
|---|--------------------------|

| | |
|---|-------------------------------|
| Mailing Address Line 1 6051 Wallace Rd Extension, Suite 300 | Mailing Address Line 2 |
|---|-------------------------------|

| | | |
|--|--------------------|-----------------------|
| Mailing Address Last Line – City Wexford | State PA | ZIP+4 15090 |
|--|--------------------|-----------------------|

| | | | |
|------------------------------|------------|------------|---|
| Phone 412-522-2846 | Ext | FAX | Email Address Alyssa.Laird@energytransfer.com |
|------------------------------|------------|------------|---|

| | |
|--|---|
| NAICS Codes (Two- & Three-Digit Codes – List All That Apply) 21 & 23 | 6-Digit Code (Optional) 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? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 2. Will this project involve an addition to an existing facility, system, or activity? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

If "Yes", check all relevant facility types and provide DEP facility identification numbers below.

| Facility Type | DEP Fac ID# | Facility Type | DEP Fac ID# |
|---|-------------|--|-------------|
| <input checked="" type="checkbox"/> Air Emission Plant | 805136 | <input type="checkbox"/> Industrial Minerals Mining Operation | |
| <input type="checkbox"/> Beneficial Use (water) | | <input type="checkbox"/> Laboratory Location | |
| <input type="checkbox"/> Blasting Operation | | <input type="checkbox"/> Land Recycling Cleanup Location | |
| <input type="checkbox"/> Captive Hazardous Waste Operation | | <input type="checkbox"/> Mine Drainage Treatment / Land Recycling Project Location | |
| <input type="checkbox"/> Coal Ash Beneficial Use Operation | | <input type="checkbox"/> Municipal Waste Operation | |
| <input type="checkbox"/> Coal Mining Operation | | <input type="checkbox"/> Oil & Gas Encroachment Location | |
| <input type="checkbox"/> Coal Pillar Location | | <input type="checkbox"/> Oil & Gas Location | |
| <input type="checkbox"/> Commercial Hazardous Waste Operation | | <input type="checkbox"/> Oil & Gas Water Poll Control Facility | |
| <input type="checkbox"/> Dam Location | | <input type="checkbox"/> Public Water Supply System | |
| <input type="checkbox"/> Deep Mine Safety Operation -Anthracite | | <input type="checkbox"/> Radiation Facility | |
| <input type="checkbox"/> Deep Mine Safety Operation -Bituminous | | <input type="checkbox"/> Residual Waste Operation | |
| <input type="checkbox"/> Deep Mine Safety Operation -Ind Minerals | | <input type="checkbox"/> Storage Tank Location | |
| <input type="checkbox"/> Encroachment Location (water, wetland) | | <input type="checkbox"/> Water Pollution Control Facility | |
| <input type="checkbox"/> Erosion & Sediment Control Facility | | <input type="checkbox"/> Water Resource | |
| <input type="checkbox"/> Explosive Storage Location | | <input type="checkbox"/> 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 | <input type="checkbox"/> | North American Datum of 1927 | | | | |
| | <input checked="" type="checkbox"/> | North American Datum of 1983 | | | | |
| | <input type="checkbox"/> | World Geodetic System of 1984 | | | | |
| Horizontal Collection Method Code | | | | | | |
| Reference Point Code | | | | | | |
| Altitude | Feet | 1,140 | --or-- | | Meters | |
| Altitude Datum Name | <input type="checkbox"/> | The National Geodetic Vertical Datum of 1929 | | | | |
| | <input type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 1.4 | For this coal mining project, will sewage treatment facilities be constructed and treated waste water discharged to surface waters? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 1.6 | Will this coal mining project involve underground coal mining to be conducted within 500 feet of an oil or gas well? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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)? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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. | <input checked="" type="checkbox"/> | Yes | <input type="checkbox"/> | 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)? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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> . | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | No |
| 3.3 | Will the oil- or gas-related project involve the construction and operation of industrial waste treatment facilities? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | No |
| 4.0 | Will the project involve a construction activity that results in earth disturbance? If "Yes", specify the total disturbed acreage. | <input checked="" type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 5.4 | Is your project an interstate transmission natural gas pipeline? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 5.6 | Does your project utilize Floodplain Restoration as a best management practice for Post Construction Stormwater Management? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 5.7 | Does your project utilize Class V Gravity / Injection Wells as a best management practice for Post Construction Stormwater Management? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 7.0 | Will the project involve the construction and operation of industrial waste treatment facilities? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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). | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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.)? | <input checked="" type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 13.0.1 | If "Yes", is the operation subject to the agricultural exemption in 35 P.S. § 4004.1? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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 | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 14.0.5 | Sub-Fac: Water Treatment Plant | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 14.0.6 | Sub-Fac: Source | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 14.0.7 | Sub-Fac: Pump Station | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 14.0.8 | Sub-Fac: Transmission Main | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 14.0.9 | Sub-Fac: Storage Facility | <input type="checkbox"/> | Yes | <input type="checkbox"/> | 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? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | No |
| 16.0.1 | Supplier's Name | _____ | | | |
| 16.0.2 | Letter of Approval from Supplier is Attached | <input type="checkbox"/> | Yes | <input type="checkbox"/> | No |
| 17.0 | Will this project be served by on-lot drinking water wells? | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> | Yes | <input checked="" type="checkbox"/> | 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. | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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. | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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. | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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. | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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. | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> 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

Stephen Schuman
Signature

VP Operations – East Division
Title

6/24/24
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)

- | | |
|--|---|
| <input type="checkbox"/> Original Filing | Date of Last Compliance Review Form Filing: |
| <input checked="" type="checkbox"/> Amended Filing | <u>July 2023</u> |

Type of Submittal

- | | | |
|---|---|--|
| <input checked="" type="checkbox"/> New Plan Approval | <input type="checkbox"/> New Operating Permit | <input type="checkbox"/> Renewal of Operating Permit |
| <input type="checkbox"/> Extension of Plan Approval | <input type="checkbox"/> Change of Ownership | <input type="checkbox"/> Periodic Submission (@ 6 mos) |
| <input type="checkbox"/> 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)

- | | | |
|---|--|---|
| <input type="checkbox"/> Individual | <input type="checkbox"/> Syndicate | <input type="checkbox"/> Government Agency |
| <input type="checkbox"/> Municipality | <input type="checkbox"/> Municipal Authority | <input type="checkbox"/> Joint Venture |
| <input type="checkbox"/> Proprietorship | <input type="checkbox"/> Fictitious Name | <input type="checkbox"/> Association |
| <input type="checkbox"/> Public Corporation | <input type="checkbox"/> Partnership | <input type="checkbox"/> Other Type of Business, specify below: |
| <input checked="" type="checkbox"/> Private Corporation | <input type="checkbox"/> 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 exceedances 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.

Stephen Schuman

Signature

6/25/24

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



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): Stephen Schuman

Date: 6/24/24

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: <input type="checkbox"/> Silo <input type="checkbox"/> Storage Bin <input type="checkbox"/> 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.

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 and Flash Tank will be controlled by thermal oxidizer (THERM-002).

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 Outlet Volume _____ ACFM
 @ _____ °F _____ % Moisture @ _____ °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 <input type="checkbox"/> Yes <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Pressurized Design |
| | | | <input type="checkbox"/> Suction Design |
| Number of Compartments _____ | Number of Filters Per Compartment _____ | Is Baghouse Insulated? | |
| | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| Can each compartment be isolated for repairs and/or filter replacement? | | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Are temperature controls provided? (Describe in detail) | | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Dew point at maximum moisture _____ °F | | Design inlet volume _____ SCFM | |
| Type of Fabric | | | |
| Material _____ | <input type="checkbox"/> Felted | <input type="checkbox"/> Membrane | |
| Weight _____ oz/sq.yd | <input type="checkbox"/> Woven | <input type="checkbox"/> Others: List: _____ | |
| Thickness _____ in | <input type="checkbox"/> 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 | | | |
| <input type="checkbox"/> Manual Cleaning | <input type="checkbox"/> Bag Collapse | <input type="checkbox"/> Reverse Air Jets | |
| <input type="checkbox"/> Mechanical Shakers | <input type="checkbox"/> Sonic Cleaning | <input type="checkbox"/> Other: _____ | |
| <input type="checkbox"/> Pneumatic Shakers | <input type="checkbox"/> Reverse Air Flow | | |
| Describe the equipment provided if dry oil free air is required for collector operation | | | |
| Cleaning Initiated By | | | |
| <input type="checkbox"/> Timer | | Frequency if timer actuated _____ | |
| <input type="checkbox"/> Expected pressure drop range _____ in. of water | | <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |
| Gas distribution grids <input type="checkbox"/> Yes <input type="checkbox"/> 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 collecting electrode rappers _____ | |
| Number of discharge electrodes _____ | | Number of collecting electrode rappers _____ | |
| Rapper control <input type="checkbox"/> Magnetic <input type="checkbox"/> Pneumatic <input type="checkbox"/> 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 <input type="checkbox"/> Counter-current <input type="checkbox"/> Cross flow <input type="checkbox"/> 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 <input checked="" type="checkbox"/> Thermal <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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) 6.81 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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Fax: +1 918 251 5519
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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| 6.0 | ATTACHMENTS | |

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:

Section C - Air Cleaning Device (Continued)

12. Flares (NOT APPLICABLE)

Equipment Specifications

| | | |
|---|---|----------------|
| Manufacturer | Type <input type="checkbox"/> Elevated flare <input type="checkbox"/> Ground flare <input type="checkbox"/> 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 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 dates in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from exempted source(s), etc. **(NOT APPLICABLE)**

| Permit number (if applicable) | Date issued | Indicate Yes or No if emission increases and decreases were used previously for netting | Source I. D. or Name | VOCs | | NOx | |
|----------------------------------|-------------|---|----------------------|---|---|---|---|
| | | | | Emission increases in potential to emit (tpy) | Creditable emission decreases in actual emissions (tpy) | Emission increases in potential to emit (tpy) | Creditable emission decreases in actual emissions (tpy) |
| | | | | | | | |
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- If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,
- Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
 - Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be employed (if applicable).
 - 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 Article III and applicable requirements of the Clean Air Act adopted thereunder. The Department may request additional information to evaluate the application such as a standby 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 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):
- 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

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

| | | |
|----------------------------|--|--|
| 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, Closed Drian 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: <input type="checkbox"/> Silo <input type="checkbox"/> Storage Bin <input type="checkbox"/> 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.

Residue gas compressor blowdowns, purge gas, closed drain vapors, and misc. blowdowns will be controlled by FLARE-002

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 Outlet Volume _____ ACFM
@ _____ °F _____ % Moisture @ _____ °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 <input type="checkbox"/> Yes <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Pressurized Design <input type="checkbox"/> Suction Design |
| Number of Compartments _____ | Number of Filters Per Compartment _____ | Is Baghouse Insulated? <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Can each compartment be isolated for repairs and/or filter replacement? | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Are temperature controls provided? (Describe in detail) | | <input type="checkbox"/> Yes <input type="checkbox"/> No |

| | |
|--|--------------------------------|
| Dew point at maximum moisture _____ °F | Design inlet volume _____ SCFM |
|--|--------------------------------|

| | | | |
|-----------------------|---------------------------------------|--|--|
| Type of Fabric | | | |
| Material _____ | <input type="checkbox"/> Felted | <input type="checkbox"/> Membrane | |
| Weight _____ oz/sq.yd | <input type="checkbox"/> Woven | <input type="checkbox"/> Others: List: _____ | |
| Thickness _____ in | <input type="checkbox"/> Felted-Woven | | |

| |
|---|
| Fabric permeability (clean) @ 1/2" 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 | | |
| <input type="checkbox"/> Manual Cleaning | <input type="checkbox"/> Bag Collapse | <input type="checkbox"/> Reverse Air Jets |
| <input type="checkbox"/> Mechanical Shakers | <input type="checkbox"/> Sonic Cleaning | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Pneumatic Shakers | <input type="checkbox"/> Reverse Air Flow | |

Describe the equipment provided if dry oil free air is required for collector operation

| | |
|--|--|
| Cleaning Initiated By | |
| <input type="checkbox"/> Timer | Frequency if timer actuated _____ |
| <input type="checkbox"/> Expected pressure drop range _____ in. of water | <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |
| Gas distribution grids <input type="checkbox"/> Yes <input type="checkbox"/> 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 <input type="checkbox"/> Magnetic <input type="checkbox"/> Pneumatic <input type="checkbox"/> 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 <input type="checkbox"/> Counter-current <input type="checkbox"/> Cross flow <input type="checkbox"/> 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 <input type="checkbox"/> Thermal <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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 <input checked="" type="checkbox"/> Elevated flare <input type="checkbox"/> Ground flare <input type="checkbox"/> 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 | | | |



- 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 ET NE Pipeline End users name _____

Street address 6051 Wallace Rd Ext Street address _____

Post office box _____ Post office box _____

City/State/Country/Zip Wexford, PA, 15090 City/State/Country/Zip _____

Contact name Dustin Tindall Contact name _____

Phone number 806-282-7263 Phone number _____

Facsimile number _____ Facsimile number _____



- 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 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 <input type="checkbox"/> YES <input type="checkbox"/> 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 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 Outlet Volume _____ ACFM
 @ _____ °F _____ % Moisture @ _____ °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 <input type="checkbox"/> Yes <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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)

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. _____ | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |
| Gas distribution grids <input type="checkbox"/> Yes <input type="checkbox"/> 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 <input type="checkbox"/> Magnetic <input type="checkbox"/> Pneumatic <input type="checkbox"/> 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 <input type="checkbox"/> Counter-current <input type="checkbox"/> Cross flow <input type="checkbox"/> 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 <input type="checkbox"/> Thermal <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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 <input checked="" type="checkbox"/> Elevated flare <input type="checkbox"/> Ground flare <input type="checkbox"/> 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? | <input type="checkbox"/> | YES | | <input type="checkbox"/> | NO |
| b. New Source Review (NSR), 25 Pa. Code Chapter 127, Subchapter E? | <input type="checkbox"/> | YES | | <input type="checkbox"/> | 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> | <input checked="" type="checkbox"/> | YES | | <input type="checkbox"/> | NO |
| d. National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61? (If Yes, which subpart) _____ | <input type="checkbox"/> | YES | | <input type="checkbox"/> | NO |
| e. Maximum Achievable Control Technology (MACT) 40 CFR Part 63? (If Yes, which part) _____ | <input type="checkbox"/> | YES | | <input type="checkbox"/> | 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 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 dates in instructions). The emissions increases include all emissions including stack, fugitive, material transfer, other emission generating activities, quantifiable emissions from exempted source(s), etc. **(NOT APPLICABLE)**

| Permit number (if applicable) | Date issued | Indicate Yes or No if emission increases and decreases were used previously for netting | Source I. D. or Name | VOCs | | NOx | |
|----------------------------------|-------------|---|----------------------|---|---|---|---|
| | | | | Emission increases in potential to emit (tpy) | Creditable emission decreases in actual emissions (tpy) | Emission increases in potential to emit (tpy) | Creditable emission decreases in actual emissions (tpy) |
| | | | | | | | |
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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 employed (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 Article III and applicable requirements of the Clean Air Act adopted thereunder. The Department may request additional information to evaluate the application such as a standby 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 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 <input type="checkbox"/> YES <input type="checkbox"/> 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.

Liquid Loading Slop

| | | |
|----------------------------|------------------------------------|----------------------------------|
| Manufacturer N/A | Model No. N/A | Number of Sources 1 |
| Source Designation P704 | Maximum Capacity 262,800 gal/yr | Rated Capacity 262,800 gal/yr |

Type of Material Processed

Waste Fluids

Maximum Operating Schedule

| | | | |
|----------------|----------------|-----------------|-------------------|
| Hours/Day 2 | Days/Week 1 | Days/Year 52 | Hours/Year 104 |
|----------------|----------------|-----------------|-------------------|

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

Capacity (specify units)

| | | | |
|--------------------|--------------------|-----------------------|-------------------------|
| Per Hour 30 gal | Per Day 720 gal | Per Week 5,054 gal | Per Year 262,800 gal |
|--------------------|--------------------|-----------------------|-------------------------|

Operating Schedule

| | | | |
|---------------------|---------------------|---------------------|----------------------|
| Hours/Day Varies | Days/Week Varies | Days/Year Varies | Hours/Year Varies |
|---------------------|---------------------|---------------------|----------------------|

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: <input type="checkbox"/> Silo <input type="checkbox"/> Storage Bin <input type="checkbox"/> 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.

N/A

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* (NOT APPLICABLE)

| Pollutant | Maximum Emission Rate | | | Calculation/ Estimation Method |
|----------------------|-----------------------|-------------|------------|--------------------------------------|
| | Specify Units | Pounds/Hour | Hours/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 Outlet Volume _____ ACFM
 @ _____ °F _____ % Moisture @ _____ °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 <input type="checkbox"/> Yes <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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)

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. _____ | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |
| Gas distribution grids <input type="checkbox"/> Yes <input type="checkbox"/> 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 <input type="checkbox"/> Magnetic <input type="checkbox"/> Pneumatic <input type="checkbox"/> 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 <input type="checkbox"/> Counter-current <input type="checkbox"/> Cross flow <input type="checkbox"/> 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 <input type="checkbox"/> Thermal <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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 (NOT APPLICABLE)

Equipment Specifications

| | | |
|---|---|----------------|
| Manufacturer | Type <input type="checkbox"/> Elevated flare <input type="checkbox"/> Ground flare <input type="checkbox"/> 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 (NOT APPLICABLE)

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 |
|--------|-------------|---------------|------------|-----------------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

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.

N/A

Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

N/A

Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase air contaminant emissions.

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
Z704 Storage Tanks

| | | |
|--|---|--|
| List Source(s) or source ID exhausted to this stack: P704 | % 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 <input type="checkbox"/> YES <input type="checkbox"/> 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

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF AIR QUALITY

Submit in Triplicate

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): Stephen Schuman

Date: 6/24/24

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 - 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 | |
| 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Pressurized Design <input type="checkbox"/> Suction Design |
| Number of Compartments _____ | Number of Filters Per Compartment _____ | Is Baghouse Insulated? <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Can each compartment be isolated for repairs and/or filter replacement? | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Are temperature controls provided? (Describe in detail) | | <input type="checkbox"/> Yes <input type="checkbox"/> No |

| | |
|--|--------------------------------|
| Dew point at maximum moisture _____ °F | Design inlet volume _____ SCFM |
|--|--------------------------------|

| | | |
|-----------------------|---------------------------------------|--|
| Type of Fabric | | |
| Material _____ | <input type="checkbox"/> Felted | <input type="checkbox"/> Membrane |
| Weight _____ oz/sq.yd | <input type="checkbox"/> Woven | <input type="checkbox"/> Others: List: _____ |
| Thickness _____ in | <input type="checkbox"/> Felted-Woven | |

Fabric permeability (clean) @ 1/2" 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 | | |
| <input type="checkbox"/> Manual Cleaning | <input type="checkbox"/> Bag Collapse | <input type="checkbox"/> Reverse Air Jets |
| <input type="checkbox"/> Mechanical Shakers | <input type="checkbox"/> Sonic Cleaning | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Pneumatic Shakers | <input type="checkbox"/> 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 | |
| <input type="checkbox"/> Timer | Frequency if timer actuated _____ |
| <input type="checkbox"/> Expected pressure drop range _____ in. of water | <input type="checkbox"/> 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. | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |

| | |
|--|--|
| Gas distribution grids <input type="checkbox"/> YES <input type="checkbox"/> 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) _____ Outlet gas temperature (°F) _____ | State pressure drop range (water gauge) across collector only. 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 | 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: <input type="checkbox"/> Counter-current <input type="checkbox"/> Cross flow <input type="checkbox"/> 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 |
|--------|-------------|---------------|------------|----------------|
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
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| | | | | |

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) NSPS Subpart Dc 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)**

| Permit number (if applicable) | Date issued | Indicate Yes or No if emission increases and decreases were used previously for netting | Source I.D. or Name | VOCs | | NOx | |
|-------------------------------|-------------|---|---------------------|---|---|---|---|
| | | | | Emission increases in potential to emit (tpy) | Creditable emission decreases in actual emissions (tpy) | Emission increases in potential to emit (tpy) | Creditable emission decreases in actual emissions (tpy) |
| | | | | | | | |
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If the source is subject to 25 Pa. Code Chapter 127, Subchapter E, New Source Review requirements,

- Identify Emission Reduction Credits (ERCs) for emission offsets or demonstrate ability to obtain suitable ERCs for emission offsets.
- Provide a demonstration that the lowest achievable emission rate (LAER) control techniques will be implemented (if applicable).
- 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
- ii. Steam Blown
- iii. Brushed and Vacuumed
- iv. Other _____
- v. Frequency of Cleaning _____

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 | |
| 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Pressurized Design <input type="checkbox"/> Suction Design |
| Number of Compartments _____ | Number of Filters Per Compartment _____ | Is Baghouse Insulated? <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Can each compartment be isolated for repairs and/or filter replacement? | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Are temperature controls provided? (Describe in detail) | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Dew point at maximum moisture _____ °F | Design inlet volume _____ SCFM | |

| | | |
|-----------------------|---------------------------------------|--|
| Type of Fabric | | |
| Material _____ | <input type="checkbox"/> Felted | <input type="checkbox"/> Membrane |
| Weight _____ oz/sq.yd | <input type="checkbox"/> Woven | <input type="checkbox"/> Others: List: _____ |
| Thickness _____ in | <input type="checkbox"/> Felted-Woven | |

Fabric permeability (clean) @ 1/2" 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 | | |
| <input type="checkbox"/> Manual Cleaning | <input type="checkbox"/> Bag Collapse | <input type="checkbox"/> Reverse Air Jets |
| <input type="checkbox"/> Mechanical Shakers | <input type="checkbox"/> Sonic Cleaning | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Pneumatic Shakers | <input type="checkbox"/> 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. | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |

| | |
|--|--|
| Gas distribution grids <input type="checkbox"/> YES <input type="checkbox"/> 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) _____ Outlet gas temperature (°F) _____ | State pressure drop range (water gauge) across collector only. 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 | 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) Subpart Dc 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 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: _____

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? <input type="checkbox"/> Yes <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Pressurized Design <input type="checkbox"/> Suction Design |
| Number of Compartments _____ | Number of Filters Per Compartment _____ | Is Baghouse Insulated? <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Can each compartment be isolated for repairs and/or filter replacement? | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Are temperature controls provided? (Describe in detail) | | <input type="checkbox"/> Yes <input type="checkbox"/> No |

| | |
|--|--------------------------------|
| Dew point at maximum moisture _____ °F | Design inlet volume _____ SCFM |
|--|--------------------------------|

| | | |
|-----------------------|---------------------------------------|--|
| Type of Fabric | | |
| Material _____ | <input type="checkbox"/> Felted | <input type="checkbox"/> Membrane |
| Weight _____ oz/sq.yd | <input type="checkbox"/> Woven | <input type="checkbox"/> Others: List: _____ |
| Thickness _____ in | <input type="checkbox"/> Felted-Woven | |

Fabric permeability (clean) @ 1/2" 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 | | |
| <input type="checkbox"/> Manual Cleaning | <input type="checkbox"/> Bag Collapse | <input type="checkbox"/> Reverse Air Jets |
| <input type="checkbox"/> Mechanical Shakers | <input type="checkbox"/> Sonic Cleaning | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Pneumatic Shakers | <input type="checkbox"/> 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. | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |

| | |
|--|--|
| Gas distribution grids <input type="checkbox"/> YES <input type="checkbox"/> 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) _____ Outlet gas temperature (°F) _____ | State pressure drop range (water gauge) across collector only. 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 | 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: <input type="checkbox"/> Counter-current <input type="checkbox"/> Cross flow <input type="checkbox"/> 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 |
|--------|-------------|---------------|------------|----------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |

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 <input type="checkbox"/> YES <input type="checkbox"/> 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
- ii. Steam Blown
- iii. Brushed and Vacuumed
- iv. Other _____
- v. Frequency of Cleaning _____

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 | |
| 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Pressurized Design <input type="checkbox"/> Suction Design |
| Number of Compartments _____ | Number of Filters Per Compartment _____ | Is Baghouse Insulated? <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Can each compartment be isolated for repairs and/or filter replacement? | | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Are temperature controls provided? (Describe in detail) | | <input type="checkbox"/> Yes <input type="checkbox"/> No |

| | |
|--|--------------------------------|
| Dew point at maximum moisture _____ °F | Design inlet volume _____ SCFM |
|--|--------------------------------|

| | | |
|-----------------------|---------------------------------------|--|
| Type of Fabric | | |
| Material _____ | <input type="checkbox"/> Felted | <input type="checkbox"/> Membrane |
| Weight _____ oz/sq.yd | <input type="checkbox"/> Woven | <input type="checkbox"/> Others: List: _____ |
| Thickness _____ in | <input type="checkbox"/> Felted-Woven | |

Fabric permeability (clean) @ 1/2" 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 | | |
| <input type="checkbox"/> Manual Cleaning | <input type="checkbox"/> Bag Collapse | <input type="checkbox"/> Reverse Air Jets |
| <input type="checkbox"/> Mechanical Shakers | <input type="checkbox"/> Sonic Cleaning | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Pneumatic Shakers | <input type="checkbox"/> 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. _____ | <input type="checkbox"/> Wet | <input type="checkbox"/> Dry |
| | | <input type="checkbox"/> Single-Stage | <input type="checkbox"/> Two-Stage |
| Gas distribution grids <input type="checkbox"/> YES <input type="checkbox"/> 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 _____ | |
| Maximum gas velocity _____ ft/sec. | | Spacing between collector plates _____ inches. | |
| Total discharge electrode length _____ ft. | | Minimum gas treatment time: _____ sec. | |
| Number of discharge electrodes _____ | | Number collecting electrode rappers _____ | |
| Rapper control | <input type="checkbox"/> Magnetic | <input type="checkbox"/> Pneumatic | <input type="checkbox"/> 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

| | | | | | |
|----|---------------|------------------------------|-----------------|---------------|-----|
| 1 | | | | | |
| 2 | Owner: | Energy Transfer | Owner Ref.: | H-781/782/783 | |
| 3 | Purchaser: | Energy Transfer | Purchaser Ref.: | TBD | |
| 4 | Manufacturer: | Tulsa Heaters Midstream, LLC | THM Ref.: | P24-0504A | |
| 5 | Service: | Heat Medium Heater | Project: | Revolution 2 | |
| 6 | Quantity: | 3 | Location: | Bulger, PA | |
| 7 | SHO Duty: | 29.92 MMBTU/ hr | SHO Model: | SHO3000 | |
| 8 | BMS Release: | 36.38 MMBTU/ hr | BMS Model: | BMS5500 | |
| 9 | SHOS Flow: | 680 USgpm @ 200 ft TDH | SHOS.Model: | SHOS770 | |
| 10 | | | | | Rev |

PROCESS DESIGN CONDITIONS

| | | Radiant / Convection | Radiant / Convection | Radiant / Convection | Radiant / Convection |
|----|--|----------------------|----------------------|----------------------|----------------------|
| 14 | Heater Section | --- | Over Design | Design | |
| 15 | Operating Case | --- | Heat Medium Heat | Heat Medium Heat | |
| 16 | Service | --- | Therminol 55 | Therminol 55 | |
| 17 | Heat Absorption (R/C) | MMBTU/ hr | 20.15 / 9.77 | 18.58 / 8.62 | |
| 18 | Process Fluid | --- | Therminol 55 | Therminol 55 | |
| 19 | Process Mass Flow Rate, Total | Lb/ hr | 267,322 | 243,020 | |
| 20 | Process Bulk Velocity (calc. R/C) | ft/ s | 9 / 9 | 9 / 8 | |
| 21 | Process Mass Velocity (calc. R/C) | Lb/ s ft2 | 420 / 420 | 382 / 382 | |
| 22 | Coking Allowance (dP calcs) | in | | | |
| 23 | Pressure Drop, Clean (allow. / calc.) | psi | 40 / 33 | 40 / 28 | |
| 24 | Pressure Drop, Fouled (allow. / calc.) | psi | | | |
| 25 | Average Heat Flux (allowable) | BTU/ hr ft2 | 13,000 | 13,000 | |
| 26 | Average Heat Flux (calculated) | BTU/ hr ft2 | 11,460 | 10,570 | |
| 27 | Maximum Heat Flux (allowable) | BTU/ hr ft2 | | | |
| 28 | Maximum Heat Flux (calc. R/C) | BTU/ hr ft2 | 20,600 / 30,500 | 19,000 / 27,200 | |
| 29 | Fouling Factor, Internal | hr ft2 °F/ BTU | 0.002 | 0.002 | |
| 30 | Corrosion or Erosion Characteristics | --- | | | |
| 31 | Max. Film Temperature (allow. / calc.) | °F | 635 / 551 | 635 / 551 | |
| 32 | | | | | |
| 33 | Inlet Conditions: | | | | |
| 34 | Temperature | °F | 290 | 290 | |
| 35 | Pressure | psig | 75 | 75 | |
| 36 | Mass Flow Rate, Liquid | Lb/ hr | 267,322 | 243,020 | |
| 37 | Mass Flow Rate, Vapor | Lb/ hr | 0 | 0 | |
| 38 | Weight Percent, Liquid / Vapor | wt% | 100% / 0% | 100% / 0% | |
| 39 | Density, Liquid / Vapor | Lb/ ft3 | 49.20 / 0.00 | 49.20 / 0.00 | |
| 40 | Molecular Weight, Liquid / Vapor | Lb/ Lbmole | --- / 0.0 | --- / 0.0 | |
| 41 | Viscosity, Liquid / Vapor | cp | 1.4001 / 0.000 | 1.400 / 0.000 | |
| 42 | Specific Heat, Liquid / Vapor | BTU/ Lb °F | 0.56 / 0.000 | 0.560 / 0.000 | |
| 43 | Thermal Conductivity, Liq./Vap. | BTU/hr ft °F | 0.066 / 0.000 | 0.066 / 0.000 | |
| 44 | | | | | |
| 45 | Outlet Conditions: | | | | |
| 46 | Temperature | °F | 475 | 475 | |
| 47 | Pressure | psig | 42 | 47 | |
| 48 | Mass Flow Rate, Liquid | Lb/ hr | 267,322 | 243,020 | |
| 49 | Mass Flow Rate, Vapor | Lb/ hr | 0 | 0 | |
| 50 | Weight Percent, Liquid / Vapor | wt% | 100% / 0% | 100% / 0% | |
| 51 | Density, Liquid / Vapor | Lb/ ft3 | 44.50 / 0.00 | 44.50 / 0.00 | |
| 52 | Molecular Weight, Liquid / Vapor | Lb/ Lbmole | --- / 0.0 | --- / 0.0 | |
| 53 | Viscosity, Liquid / Vapor | cp | 0.490 / 0.000 | 0.49 / 0.000 | |
| 54 | Specific Heat, Liquid / Vapor | BTU/ Lb °F | 0.650 / 0.000 | 0.65 / 0.000 | |
| 55 | Thermal Conductivity, Liq./Vap. | BTU/hr ft °F | 0.059 / 0.000 | 0.0588 / 0.000 | |

| | | | | | |
|----|----------|-----------|----------------------|-----|---------------|
| 57 | | | | | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | B | 23-May-24 | Revised CO emissions | dcb | |
| 63 | A | 14-May-24 | Issued with Proposal | dcb | |
| 64 | revision | date | description | by | chk'd app'v'd |



SHO = Superior Quality, Flexibility, Dependability & Modularity

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HEATER DATA SHEET
AMERICAN ENGINEERING SYSTEM of UNITS

P24-0504A-HTRDS

Pg 1 of 6

COMBUSTION DESIGN CONDITIONS

| | | | | | | | |
|----|----------------------------------|-------------|------------------|------------------|--|--|--|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | Overall Performance: | | | | | | |
| 4 | Operating Case | --- | Over Design | Design | | | |
| 5 | Service | --- | Heat Medium Heat | Heat Medium Heat | | | |
| 6 | Excess Air | mol% | 15.0% | 15.0% | | | |
| 7 | Calculated Heat Release (LHV) | MMBTU/ hr | 34.65 | 31.23 | | | |
| 8 | Guaranteed Efficiency | HR% | 84.4% | 85.1% | | | |
| 9 | Calculated Efficiency | HR% | 86.4% | 87.1% | | | |
| 10 | Radiation Loss | HR% | 2.00% | 2.00% | | | |
| 11 | Flow Rate, Combustion Gen./ Imp. | Lb/ hr | 33,768 | 30,440 | | | |
| 12 | Flue Gas Temp. Leaving (R/C) | °F | 1,482 / 509 | 1,437 / 481 | | | |
| 13 | Flue Gas Mass Velocity | Lb/ sec ft2 | 0.430 | 0.388 | | | |
| 14 | | | | | | | |

| | | | | | | | |
|----|-------------------|------------|---------|---------|----------|----------------|---|
| 15 | Fuel(s) Data: | Gas 1 | Gas 2 | Gas 3 | Design | Burner Design: | |
| 16 | | Mol.Wt. | Mol.Wt. | Mol.Wt. | Fuel Oil | OEM | --- Callidus Technologies, LLC |
| 17 | LHV | BTU/ scf | 927 | | --- | Type | --- External FGR w IFGR(internal) |
| 18 | LHV | BTU/ Lb | 20,483 | | | Quantities | --- 1 ULTRA Low NOx |
| 19 | P @ Burner | psig | 150 | | | Model No. | --- CUBP-10W-HC-HZ Cylindrical |
| 20 | T @ Burner | °F | 100 | | | Windbox | --- yes ... |
| 21 | MW | Lb/ Lbmole | 17.18 | | --- | Location | --- EndWall Center ... Horizontally Fired |
| 22 | Flow @ design | lb/hr | 1,691 | | | Pilot Design: | |
| 23 | Flow @ design | scfh | 37,360 | | | Type / Model | Self-Inspiring / by O.E.M. |
| 24 | Atomizing Media | | --- | | | Ignition | --- Electric requires elec.ign.system |
| 25 | Atom. Media P & T | | --- | | | Heat Release | --- > 350000 BTU/ hr on ... Gas 1 |
| 26 | | | | | | | |

| | | | | | | | |
|----|-------------|------|-------|--|-----|---------------------------|-------------------|
| 27 | Components: | | | | | Burner Performance: | |
| 28 | N | wt% | --- | | | Minimum Heat Release | MMBTU/ hr 7.28 |
| 29 | S | wt% | --- | | | Design Heat Release | MMBTU/ hr 34.65 |
| 30 | Ash | wt% | --- | | | Maximum Heat Release | MMBTU/ hr 36.38 |
| 31 | Ni | ppm | --- | | | Burner Turndown | Max:Min 5.00 |
| 32 | Va | ppm | --- | | | Volumetric Ht. Release | BTU/ hr ft3 8,055 |
| 33 | Na | ppm | --- | | | Pressure @ Arch | inH2O 0.50 |
| 34 | Fe | ppm | --- | | | Pressure @ Burner | inH2O 4.84 |
| 35 | | | | | | Combustion Air T @ Burner | °F 60 |
| 36 | H2 | mol% | 0.0% | | --- | Flue Gas T @ Burner | °F 1,290 |
| 37 | O2 | mol% | 0.0% | | --- | | |
| 38 | N2 + Ar | mol% | 2.3% | | --- | | |
| 39 | CO | mol% | 0.0% | | --- | | |
| 40 | CO2 | mol% | 0.2% | | --- | | |
| 41 | CH4 | mol% | 92.2% | | --- | | |
| 42 | C2H6 | mol% | 4.8% | | --- | | |
| 43 | C2H4 | mol% | 0.0% | | --- | | |
| 44 | C3H8 | mol% | 0.4% | | --- | | |
| 45 | C3H6 | mol% | 0.0% | | --- | | |
| 46 | C4H10 | mol% | 0.0% | | --- | | |
| 47 | C4H8 | mol% | 0.0% | | --- | | |
| 48 | C5H12 | mol% | 0.0% | | --- | | |
| 49 | C5H10 | mol% | 0.0% | | --- | | |
| 50 | C6+ | mol% | 0.0% | | --- | | |
| 51 | H2S | ppmv | 0.0% | | --- | | |
| 52 | SO2 | mol% | 0.0% | | --- | | |
| 53 | NH3 | mol% | 0.0% | | --- | | |
| 54 | H2O | mol% | 0.0% | | --- | | |
| 55 | spare | mol% | 0.0% | | --- | | |
| 56 | | | | | | | |
| 57 | | | | | | | |

| | | | | | | | |
|----|---------|------|-------|--|-----|-----------------------|------------------------|
| 38 | N2 + Ar | mol% | 2.3% | | --- | Guaranteed Emissions: | |
| 39 | CO | mol% | 0.0% | | --- | Basis of Guarantee | --- 3.0% O2, dry (LHV) |
| 40 | CO2 | mol% | 0.2% | | --- | NOx Emissions | Lb/MMBTU 0.012 9 ppm |
| 41 | CH4 | mol% | 92.2% | | --- | SOx Emissions | Lb/MMBTU no quote |
| 42 | C2H6 | mol% | 4.8% | | --- | CO Emissions | Lb/MMBTU 0.041 50 ppm |
| 43 | C2H4 | mol% | 0.0% | | --- | VOC Emissions | Lb/MMBTU 0.019 15 ppm |
| 44 | C3H8 | mol% | 0.4% | | --- | UHC Emissions | Lb/MMBTU 0.007 15 ppm |
| 45 | C3H6 | mol% | 0.0% | | --- | SPM10 Emissions | Lb/MMBTU 0.013 15 ppm |
| 46 | C4H10 | mol% | 0.0% | | --- | Noise Emissions | dBA @ 3ft 85 |
| 47 | C4H8 | mol% | 0.0% | | --- | | |
| 48 | C5H12 | mol% | 0.0% | | --- | | |
| 49 | C5H10 | mol% | 0.0% | | --- | | |
| 50 | C6+ | mol% | 0.0% | | --- | | |
| 51 | H2S | ppmv | 0.0% | | --- | | |
| 52 | SO2 | mol% | 0.0% | | --- | | |
| 53 | NH3 | mol% | 0.0% | | --- | | |
| 54 | H2O | mol% | 0.0% | | --- | | |
| 55 | spare | mol% | 0.0% | | --- | | |
| 56 | | | | | | | |
| 57 | | | | | | | |

| | | | | | | | |
|----|-------------------------|------|--------------|--|--|-----------------------|---|
| 58 | Blower/Fan Performance: | | | | | Net Flame Clearances: | |
| 59 | Volumetric Flow | acfm | 7,400 | | | Est. Flame Size | approx. 23 ft L x 4.5 ft Diameter |
| 60 | Rated Power | HP | 25 | | | Hor Clearance | 3.5 ft NET Tube Clearance |
| 61 | Fan Speed | RPM | 1,800 | | | Vert. Clearance | 3.5 ft NET Tube Clearance |
| 62 | Sound Pressure | dBA | < 85 | | | Axial Clearance | 5.17 ft NET Refractory Clearance (to Target hot face) |
| 63 | Area Classification | NEC | Unclassified | | | | |
| 64 | | | | | | | |

| | | | | | | | |
|----|-------------------------|------|--------------|--|--|---------------------------|---------------------|
| 58 | Blower/Fan Performance: | | | | | Nominal Flame Clearances: | |
| 59 | Volumetric Flow | acfm | 7,400 | | | from burner CL ... | Vertical Horizontal |
| 60 | Rated Power | HP | 25 | | | to Tube CL, API | ft 15.89 10.59 |
| 61 | Fan Speed | RPM | 1,800 | | | to Tube CL, calc. | ft 5.75 5.75 |
| 62 | Sound Pressure | dBA | < 85 | | | to Refrac., calc. | ft n / a 28.17 |
| 63 | Area Classification | NEC | Unclassified | | | | |
| 64 | | | | | | | |

PRESSURE PARTS DESIGN

| | | | | |
|----|---|-----------------------------|-------------------------|-------------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | Coil Design: | | <u>RADIANT</u> | <u>SHIELD</u> |
| 4 | Service | | <u>Heat Medium Heat</u> | <u>Heat Medium Heat</u> |
| 5 | Design Basis for Tube Temperature | | <u>API 530</u> | <u>API 530</u> |
| 6 | Design Basis for Tube Wall Thickness | | <u>ASME Sec. VIII-1</u> | <u>ASME Sec. VIII-1</u> |
| 7 | Design Life | hr | <u>100,000</u> | <u>100,000</u> |
| 8 | Design Pressure (elastic / rupture) | psig | <u>150 /</u> | <u>150 /</u> |
| 9 | Design Fluid Temperature | °F | <u>475</u> | <u>475</u> |
| 10 | Design Temperature Allowance | °F | <u>25</u> | <u>25</u> |
| 11 | Design Corrosion Allowance (tubes/fittings) | in | <u>0.063 / 0.063</u> | <u>0.063 / 0.063</u> |
| 12 | | | | |
| 13 | Maximum Tube Temperature (clean) | °F | <u>569</u> | |
| 14 | Maximum Tube Temperature (fouled) | °F | <u>616</u> | <u>517</u> |
| 15 | Design Tube Temperature | °F | <u>641</u> | <u>642</u> |
| 16 | Inside Film Coefficient | BTU/ hr ft ² °F | <u>301</u> | <u>210</u> |
| 17 | Weld Inspection | RT or Other | <u>100 of 10%</u> | <u>100 of 10%</u> |
| 18 | Weld Heat Treatment | s.rel., t.stab. or none | <u>None</u> | <u>None</u> |
| 19 | Hydrostatic Test Pressure | psig | <u>per API</u> | <u>per API</u> |
| 20 | | | | |
| 21 | Coil Arrangement: | | <u>Horizontal</u> | <u>Horizontal</u> |
| 22 | Coil Type | --- | <u>Helical</u> | <u>Serpentine</u> |
| 23 | Tube Material (pipe or tube spec) | ASTM | <u>SA106GrB</u> | <u>SA106GrB</u> |
| 24 | Supplementary Mfg Requirements | ASTM | <u>None</u> | <u>None</u> |
| 25 | Tube Outside Diameter | in | <u>4.500</u> | <u>4.500</u> |
| 26 | Tube Wall Thickness (aw / mw) | in | <u>0.237 / 0.207</u> | <u>0.237 / 0.207</u> |
| 27 | Number of Cells (radiant or convection) | --- | <u>1</u> | <u>1</u> |
| 28 | Number of Flow Passes (total / cell) | --- | <u>2 / 2</u> | <u>2 / 2</u> |
| 29 | Number of Tubes per Row (total / cell) | --- | <u>6 / 6</u> | <u>6 / 6</u> |
| 30 | Overall Tube (1 turn in radiant) Length | ft | <u>36.13</u> | <u>14.04</u> |
| 31 | Effective Tube Length / Helix Diameter | ft | <u>36.13 / 11.50</u> | <u>12.46</u> |
| 32 | Number of Turns or Tubes (total / pass) | | <u>42.0 / 21.0</u> | <u>6.0 / 6.0</u> |
| 33 | Total Exposed Surface | ft ² | <u>1,758</u> | <u>88</u> |
| 34 | Number of Ext.Surf. Tubes (total / cell) | --- | <u>0 / 0.0</u> | <u>0 / 0.0</u> |
| 35 | Total Exposed Surface | ft ² | <u>0</u> | <u>4,993</u> |
| 36 | Tube Spacing (horiz. / tube centers) | in | <u>--- / 7.75</u> | <u>8.00 / 8.00</u> |
| 37 | Tube Spacing (horiz. to refractory) | in | <u>6.00</u> | <u>4.00</u> |
| 38 | Coil Fluid Volume | USgal | <u>1012</u> | <u>60</u> |
| 39 | | | | |
| 40 | Coil Fittings: | | <u>Heat Medium Heat</u> | <u>Heat Medium Heat</u> |
| 41 | Fitting Type | --- | <u>SR 90° Elbows</u> | <u>SR 180° U-Bends</u> |
| 42 | Fitting Material | ASTM | <u>SA234 WPB</u> | <u>SA234 WPB</u> |
| 43 | Supplementary Mfg Requirements | ASTM | <u>None</u> | <u>None</u> |
| 44 | Fitting Outside Diameter | in | <u>4.500</u> | <u>4.500</u> |
| 45 | Fitting Wall Thickness (aw / mw) | in | <u>0.237 / 0.207</u> | <u>0.237 / 0.207</u> |
| 46 | Fitting Location | internal or external | <u>Internal</u> | <u>External</u> |
| 47 | Tube Attachment | welded or rolled | <u>Welded</u> | <u>Welded</u> |
| 48 | | | | |
| 49 | Coil Terminals: | | <u>Outlet</u> | <u>Inlet</u> |
| 50 | Terminal Type | beveled or flanged | <u>Flanged</u> | <u>Flanged</u> |
| 51 | Flange Material | ASTM | <u>SA105N</u> | <u>SA105N</u> |
| 52 | Supplementary Mfg Requirements | ASTM | <u>None</u> | <u>None</u> |
| 53 | Flange Size and Rating | NPS/ ASME | <u>4" / 300#</u> | <u>4" / 300#</u> |
| 54 | Flange Type | RFWN or RTJ | <u>RFWN</u> | <u>RFWN</u> |
| 55 | Location | --- | <u>Burner Endwall</u> | <u>Terminal End</u> |
| 56 | | | | |
| 57 | Extended Surface: | | <u>CONVECTION</u> | <u>CONVECTION</u> |
| 58 | Service | --- | <u>Heat Medium Heat</u> | <u>Heat Medium Heat</u> |
| 59 | Fin or Stud Row Number | starting @ bottom | <u>No.1 / No.2</u> | <u>No.3-5 /</u> |
| 60 | Ext. Surface Type | seg.fins, solid fins, studs | <u>Segmented</u> | <u>Segmented</u> |
| 61 | Fin/Stud Material | --- | <u>C.S. / C.S.</u> | <u>C.S. /</u> |
| 62 | Fin/Stud Height | in | <u>0.75 / 1.00</u> | <u>1.00 /</u> |
| 63 | Fin/Stud Thickness | in | <u>0.06 / 0.06</u> | <u>0.06 /</u> |
| 64 | Fin/Stud Density | fin/ in | <u>3.00 / 4.00</u> | <u>5.00 /</u> |
| 65 | | | | |



PRESSURE PARTS DESIGN (continued)

| | | | | |
|----|---|-----------------------|--------------------------|--------------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | Crossovers: | | <u>RADIANT</u> | <u>SHIELD</u> |
| 4 | Type, location / connections | --- | <u>External</u> | <u>Flanged</u> |
| 5 | Tube / Fittings Material | ASTM | <u>SA106GrB</u> | <u>SA234 WPB</u> |
| 6 | Tube & Fitting OD / Thickness (aw) | in | <u>4.500</u> | <u>0.237</u> |
| 7 | | | | |
| 8 | Inlet Manifold(s): | type | | <u>Simple LOG</u> |
| 9 | Location | --- | | <u>Top - Term. End</u> |
| 10 | Design Basis for Manifold Thickness | --- | | <u>ASME B31.3</u> |
| 11 | Design Conditions (temp./press.) | °F/ psig | | <u>642 / 150</u> |
| 12 | Pipe Material | ASTM | | <u>SA106GrB</u> |
| 13 | Fittings Material | ASTM | | <u>SA234 WPB</u> |
| 14 | Flange Material / Style | ASTM | | <u>SA105N/ RFWN</u> |
| 15 | Outside Diameters, each Branch | in | | <u>8" NPS</u> |
| 16 | Wall Thickness(es); aw or mw | in | | <u>SCH40 (0.322)</u> |
| 17 | End Types (terminal/ dead) | beveled or flanged | | <u>Flanged / W.Cap</u> |
| 18 | Manifold Terminal Type | NPS/ ASME | | <u>8" NPS / 300# Flg</u> |
| 19 | Coil Connection Type | extrusion, olet, etc. | | <u>Weld-O-Let</u> |
| 20 | Coil Terminal Type | NPS/ ASME | | <u>4" NPS / 300# Flg</u> |
| 21 | | | | |
| 22 | Outlet Manifold(s): | type | <u>Simple LOG</u> | |
| 23 | Location | --- | <u>Burner Endwall</u> | |
| 24 | Design Basis for Manifold Thickness | --- | <u>ASME B31.3</u> | |
| 25 | Design Conditions (temp./press.) | °F/ psig | <u>641 / 150</u> | |
| 26 | Pipe Material | ASTM | <u>SA106GrB</u> | |
| 27 | Fittings Material | ASTM | <u>SA234 WPB</u> | |
| 28 | Flange Material / Style | ASTM | <u>SA105N/ RFWN</u> | |
| 29 | Outside Diameters, each Branch | in | <u>8" NPS</u> | |
| 30 | Wall Thickness(es); aw or mw | in | <u>SCH40 (0.322)</u> | |
| 31 | End Types (terminal/ dead) | beveled or flanged | <u>Flanged / W.Cap</u> | |
| 32 | Manifold Terminal Type | NPS/ ASME | <u>8" NPS / 300# Flg</u> | |
| 33 | Coil Connection Type | extrusion, olet, etc. | <u>Weld-O-Let</u> | |
| 34 | Coil Terminal Type | NPS/ ASME | <u>4" NPS / 300# Flg</u> | |
| 35 | | | | |

COIL & MANIFOLD SUPPORTS DESIGN

| | | | | |
|----|---------------------------------------|--------------------------------|-------------------------|----------------------------|
| 36 | | | | |
| 37 | | | | |
| 38 | | | | |
| 39 | Tube Supports: | | <u>RADIANT</u> | <u>SHIELD</u> |
| 40 | Service | | <u>Heat Medium Heat</u> | <u>Heat Medium Heat</u> |
| 41 | Location | Top, Bottom, Ends | <u>Bottom</u> | <u>Ends</u> |
| 42 | Support Type | casting, tubesht, spring, etc. | <u>SS Pipe Rail</u> | <u>Welded Tbsheets</u> |
| 43 | Support Thicknesses | in | <u>SCH40</u> | <u>0.375</u> |
| 44 | Support Materials | ASTM | <u>A240 T304</u> | <u>A36 CS</u> |
| 45 | Support Temperatures (calc./ design) | °F / °F | <u>943 / 1,130</u> | <u>633 / 790</u> |
| 46 | TbSht Ferrules Thickness/Materials | in/ ASTM | <u>---</u> | <u>14 ga. / 304 SS</u> |
| 47 | Refractory & Anchor Materials & Types | | <u>none</u> | <u>per refrac. section</u> |
| 48 | | | | |
| 49 | Intermediate Guides & Supports: | | <u>None</u> | <u>None</u> |
| 50 | Location | --- | | |
| 51 | Guide/ Support Type | casting, spring, etc. | | |
| 52 | Material | ASTM | | |
| 53 | Spacing, average | ft | | |
| 54 | | | | |
| 55 | Tube Guides: | Top, Bottom, Ends | <u>None</u> | <u>None</u> |
| 56 | Material | ASTM | | |
| 57 | | | | |
| 58 | Manifold Supports: | | <u>Outlet Manifold</u> | <u>Intlet Manifold</u> |
| 59 | Material | ASTM | <u>A36</u> | <u>N/A</u> |
| 60 | Materials Design & Supply | --- | <u>by THM</u> | |
| 61 | Location | Top, Bottom, Ends | <u>Burner Endwall</u> | |
| 62 | Support Type | roller, shoe, spring, etc. | <u>Simple Shelf</u> | |
| 63 | Number of Supports | --- | <u>One (1)</u> | |
| 64 | | | | |



CASING / REFRACTORY SYSTEMS DESIGN

| | | | | |
|----|---------------------------------------|--------------------------------------|--------------------|------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | | BURNER | SHIELDED | TARGET |
| 4 | Radiant Section Design: | ENDWALL | SIDEWALLS | ENDWALL |
| 5 | Total Refractory Thickness | in 5.0 | 3.0 | 5.0 |
| 6 | Hot Face Temperature (design) | °F 2,000 | 2,000 | 2,000 |
| 7 | Hot Face Temperature (calculated) | °F 1,482 | 943 | 1,482 |
| 8 | Hot Face Layer | in/ --- 1/ 8# CF Blanket | 1/ 8# CF Blanket | 1/ 8# CF Blanket |
| 9 | Back-Up Layer No.1 | in/ --- 1/ 8# CF Blanket | 2/ 6# CF Blanket | 1/ 8# CF Blanket |
| 10 | Back-Up Layer No.2 | in/ --- 3/ 6# CF Blanket | None | 3/ 6# CF Blanket |
| 11 | Foil Vapor Barrier | in/ --- None | None | None |
| 12 | Castable Reinforcement (SS Needles) | wt% None | None | None |
| 13 | Anchors / Tie Backs: | --- Pins & Clips | Pins & Clips | Pins & Clips |
| 14 | Material | --- 310 S.S. | 310 S.S. | 310 S.S. |
| 15 | Attachment | --- Welded | Welded | Welded |
| 16 | Casing: | | | |
| 17 | Material | in/ ASTM 0.1875 / A36 | 0.1875 / A36 | 0.1875 / A36 |
| 18 | Internal Coating | --- None | None | None |
| 19 | External Temperature, Typical | °F 180 | 180 | 180 |
| 20 | Comments / Clarifications | --- w/ cfb wraps | w/o cfb wraps | w/ cfb wraps |
| 21 | | SHOP Installed | SHOP Installed | SHOP Installed |
| 22 | | | | |
| 23 | | | | |
| 24 | Convection Section Design: | | | |
| 25 | Total Refractory Thickness | in 3.0 | 3.0 | 2.0 |
| 26 | Hot Face Temperature (design) | °F 2,000 | 2,000 | 2,000 |
| 27 | Hot Face Temperature (calculated) | °F 996 | 996 | 749 |
| 28 | Hot Face Layer | in/ --- 1/ 8# CF Blanket | 1/ 8# CF Blanket | 3/ Sparlite HS |
| 29 | Back-Up Layer No.1 | in/ --- 2/ 6# CF Blanket | 2/ 6# CF Blanket | None |
| 30 | Back-Up Layer No.2 | in/ --- None | None | None |
| 31 | Foil Vapor Barrier | in/ --- None | None | None |
| 32 | Castable Reinforcement (SS Needles) | wt% None | None | None |
| 33 | Anchors / Tie Backs: | --- Pins & Clips | Pins & Clips | Bullhorns |
| 34 | Material | --- 310 S.S. | 304 S.S. | 304 S.S. |
| 35 | Attachment | --- Welded | Welded | Welded |
| 36 | Casing: | | | |
| 37 | Material | in/ ASTM 0.1875 / A36 | 0.1875 / A36 | 0.1345 / A36 |
| 38 | Internal Coating | --- None | None | None |
| 39 | External Temperature, Typical | °F 180 | 180 | 180 |
| 40 | Comments / Clarifications | --- Cleaning/Sootblowing lanes: none | | Bolted Assembly |
| 41 | | SHOP Installed | SHOP Installed | SHOP Installed |
| 42 | | | | |
| 43 | | | | |
| 44 | Stack & Uptakes Design: | | | |
| 45 | Quantity | BREECHING One | 15° TRANSITION One | DISCH. DUCT One |
| 46 | Type / Location | --- Full L / Conv | Full L / Conv | Self.Spt/ Grade |
| 47 | Length / Metal Outside Diameter (top) | ft/ ft 1.00 / n/a | 1.75 / n/a | 7 / 3.000 |
| 48 | Discharge Elev., minimum/ calculated | ft/ ft n/a / n/a | n/a / n/a | 20 / 27 |
| 49 | Total Refractory Thickness | in 3.0 | 0.0 | 0.0 |
| 50 | Hot Face Temperature (design) | °F 2,000 | | |
| 51 | Hot Face Temperature (calculated) | °F 509 | 509 | 509 |
| 52 | Hot Face Layer | in/ --- 1/ 8# CF Blanket | None | None |
| 53 | Back-Up Layer No.1 | in/ --- 2/ 6# CF Blanket | | |
| 54 | Castable Reinforcement (SS Needles) | None | | |
| 55 | Anchors / Tie Backs: | --- Pins & Clips | | |
| 56 | Material | --- 304 S.S. | | |
| 57 | Attachment | --- Welded | | |
| 58 | Casing: | | | |
| 59 | Minimum Thickness/ Material | in/ ASTM 0.1875 / A36 | 0.1875 / A36 | 0.1875 / A36 |
| 60 | Corrosion Allowance | in None | None | None |
| 61 | Internal Coating | --- None | None | None |
| 62 | External Temperature, Typical | °F 180 | 509 | 509 |
| 63 | Comments / Clarifications | --- SHOP Installed | | |
| 64 | | | | |



MECHANICAL / STRUCTURAL DESIGN BASIS

| | |
|----|---|
| 1 | |
| 2 | |
| 3 | Refractory & Coatings Design: |
| 4 | Refractory Design <u>Per Std560: 180°F Avg. Casing Temperature @ Ambient Conditions of 0 MPH & 80°F</u> |
| 5 | Refractory Dryout <u>SHOP dryout = None // FIELD dryout per THM standard.</u> |
| 6 | Coating, Internal <u>None</u> |
| 7 | Coating, External <u>Base Coat: 3-4 PPG Dimetcote 9 IOZ Silicate - Flat Green on SP-6</u> |
| 8 | <u>Int. Coat: None</u> |
| 9 | <u>Top Coat (casing): 1.5-2 PPG Hi-Temp 500 - Federal Standard 595B #16132 Gray</u> |
| 10 | <u>Top Coat (stack): 1.5-2 PPG Hi-Temp 1000 - Federal Standard 595B #16132 Gray</u> |
| 11 | |
| 12 | |
| 13 | Applicable Standards: |
| 14 | API <u>Std 560 (ISO 13705); Fired Heaters for ...</u> AISC <u>Specification for Design, ... Steel for Buildings</u> |
| 15 | API <u>Std 530 (ISO 13704); Calc. of Heater Tube ...</u> AWS <u>D 1.1; Structural Welding Code</u> |
| 16 | ASME <u>B31.3, Chemical Plant and ... Piping</u> ASTM <u>tube/ smls pipe/ fitting spec's noted herein</u> |
| 17 | ASME <u>Sections I, II, VIII, IX; ASME B&PV Code</u> ASTM <u>refractories per C27, C155, C401 & C612</u> |
| 18 | ASME <u>Section V; Non Destructive Examination</u> NFPA <u>NFPA 70; National Electrical Code</u> |
| 19 | |
| 20 | Wind Design: Seismic Design: |
| 21 | Spec. or Standard <u>ASCE 7-10</u> Spec. or Standard <u>ASCE 7-10</u> |
| 22 | Velocity/ Imp. Factor <u>150 mph / 1</u> Risk Cat./Imp. Factor <u>III / 1.25</u> |
| 23 | Site Exposure <u>"C"</u> Ss/S1/Soil Class <u>0.5 / 0.15 / D</u> |
| 24 | Physical Design: Site Design Basis: |
| 25 | Plot Limitations <u>None</u> Site Elevation <u>1300 ft AMSL</u> |
| 26 | Tube Limitations <u>None</u> Stack Design Temp. <u>90 °F</u> |
| 27 | Firebox Pressure <u>Positive; approximately +1.0 inH2O</u> FG Discharge Elev. <u>27 ft AG</u> |
| 28 | Ambient Temp's <u>-20 °F Min/ 60 °F Dsn/ 100 °F Max</u> Area Classification <u>Unclassified</u> |
| 29 | |

MAJOR SUBSYSTEMS & ACCESSORIES

| | |
|----|--|
| 30 | |
| 31 | |
| 32 | |
| 33 | Major Services & Subsystems Major Accessories: |
| 34 | Process Design <u>INCLUDED in base pricing</u> Casing/ Tube Seals <u>None</u> |
| 35 | Mechanical Design <u>INCLUDED in base pricing</u> Observation Doors <u>None</u> |
| 36 | Structural Design <u>INCLUDED in base pricing</u> Observation Doors <u>1 4 in Dia. w/ HT glass on Arch</u> |
| 37 | Radiant Section <u>INCLUDED in base pricing</u> Access Doors <u>1 Std 24" x 24"</u> |
| 38 | Convection Section <u>INCLUDED in base pricing</u> Expansion Joints <u>None</u> |
| 39 | Burner Mgmt <u>INCLUDED in base pricing</u> Ladders & Platforms <u>Not Included</u> |
| 40 | Burner Piping <u>INCLUDED in base pricing</u> L&P Coating <u>N/A</u> |
| 41 | Forced Draft System <u>INCLUDED in base pricing</u> |
| 42 | |
| 43 | Casing Penetrations Pressure Part Penetrations |
| 44 | Fbox Purge/ Snuff <u>None</u> Coil TSTC's, Radiant <u>None</u> |
| 45 | CA Temp/Pres <u>None</u> Coil TSTC's, Convection <u>None</u> |
| 46 | FG Temperature <u>2 1.5" 3000# Coupling</u> Process TI conn's <u>3 1.5" NPS 300# RFWN</u> |
| 47 | FG Pressure <u>2 1.5" 3000# Coupling</u> Process PI conn's <u>1 1.5" NPS 300# RFWN</u> |
| 48 | FG Comp. (Sample) <u>2 1.5" 3000# Coupling</u> PSV conn <u>N/A</u> |
| 49 | FG Sample <u>2 4" 150# RFWN</u> spare |
| 50 | O2 Analyzer Port <u>1 3" NPS 150# RFWN</u> spare |
| 51 | |
| 52 | Dampers |
| 53 | <u>FD Fan (blower) qty = 0 Uptake Ducts Stack qty = 0</u> |
| 54 | Function <u>Note:</u> Note: |
| 55 | Design <u>Fan inlet damper is inappropriate</u> <u>Stack Damper (which provides draft</u> |
| 56 | Materials <u>for forced draft SHO's where O2</u> <u>control) is inappropriate for forced</u> |
| 57 | Bearings <u>Control is provided by the BMS O2</u> <u>draft SHO's where the combustion</u> |
| 58 | Operator <u>Trim Module which controls the fan</u> <u>conditions are controlled real-time</u> |
| 59 | Positioner <u>(blower) motor's VFD/ VSD.</u> <u>via the BMS.</u> |
| 60 | Instruments |
| 61 | Sootblowers: Qty. Type Location FG T Material Steam T & P O.E.M. / Ref. |
| 62 | Lane 1: <u>None</u> |
| 63 | Lane 2 : <u>None</u> |
| 64 | |



| | | | | | |
|---|---------------|-------------------------|-----------------|---------------|--|
| 1 | | | | | |
| 2 | Owner: | Energy Transfer | Owner Ref.: | H-781/782/783 | |
| 3 | Purchaser: | Energy Transfer | Purchaser Ref.: | TBD | |
| 4 | Manufacturer: | Tulsa Heaters Midstream | THM Ref.: | P24-0504A | |
| 5 | Service: | Heat Medium Heater | Project: | Revolution 2 | |
| 6 | Number: | 3 | Location: | Bulger, PA | |
| 7 | SHO Duty: | 29.92 MMBTU/ hr | SHO Model: | SHO3000 | |
| 8 | | | | | |

| | | | | | |
|----|--------------------|----------|----------|----|-----|
| 9 | Guarantees: | | | | |
| 11 | NOx | 0.012 | Lb/MMBTU | 9 | ppm |
| 12 | SOx | no quote | Lb/MMBTU | - | ppm |
| 13 | CO | 0.0407 | Lb/MMBTU | 50 | ppm |
| 14 | VOC | 0.0192 | Lb/MMBTU | 15 | ppm |
| 15 | UHC | 0.007 | Lb/MMBTU | 15 | ppm |
| 16 | SPM | 0.0132 | Lb/MMBTU | 15 | ppm |

| | | Design Case | | | | Maximum Case | | | | |
|----|-------------------------------|-------------|--------|-----------|--------|--------------|------|-----------|----|-----|
| 21 | Heat Release | LHV Basis | 34.65 | MMBTU/hr | 36.38 | MMBTU/hr | | | | |
| 22 | | HHV Basis | 38.41 | MMBTU/hr | 40.33 | MMBTU/hr | | | | |
| 23 | Products of Combustion | | | | | | | | | |
| 24 | | MW | | | | | | | | |
| 25 | O2 | 32.00 | 961 | Lbm/ hr | 1,009 | Lbm/ hr | | | | |
| 26 | N2 + Ar | 28.15 | 24,571 | Lbm/ hr | 25,800 | Lbm/ hr | | | | |
| 27 | CO2 | 44.01 | 4,475 | Lbm/ hr | 4,699 | Lbm/ hr | | | | |
| 28 | H2O | 18.02 | 3,757 | Lbm/ hr | 3,944 | Lbm/ hr | | | | |
| 30 | NOx | 46.01 | 0.42 | Lbm/ hr / | 9 | ppm | 0.44 | Lbm/ hr / | 9 | ppm |
| 31 | SOx | 64.06 | 0.00 | Lbm/ hr / | 0 | ppm | 0.00 | Lbm/ hr / | 0 | ppm |
| 32 | CO | 28.01 | 1.41 | Lbm/ hr / | 50 | ppm | 1.48 | Lbm/ hr / | 50 | ppm |
| 33 | VOC | 44.10 | 0.67 | Lbm/ hr / | 15 | ppm | 0.70 | Lbm/ hr / | 15 | ppm |
| 34 | UHC | 16.04 | 0.24 | Lbm/ hr / | 15 | ppm | 0.25 | Lbm/ hr / | 15 | ppm |
| 35 | SPM | | 0.46 | Lbm/ hr / | 15 | ppm | 0.48 | Lbm/ hr / | 15 | ppm |
| 37 | Total | | 33,768 | Lbm/ hr | 35,456 | Lbm/ hr | | | | |
| 39 | Flue Gas Exit Temp. | | 509 | °F | | | | | | |
| 40 | Flue Gas Exit Velocity | | 36.2 | Ft/sec | 39.8 | Ft/sec | | | | |
| 41 | Stack Height | | 27.1 | ft | 27.1 | ft | | | | |
| 42 | Stack ID | | 36 | in | 36 | in | | | | |

NOTE:
 THM emissions guarantees applicable between 50-100% of Design Case combustion conditions w/ 15% excess air.
 THM emissions guarantees applicable for firebox temperatures above 1100°F.
 Emissions above are for Design Case operation with air and fuel in ratio control. Upset conditions, such as operation outside the design, high turndown or start-up are not considered as guaranteed emissions cases.
 The Maximum Case is the the specified heat release for the burner purchased. Extra duty is spec'd into the burner to ensure that the burner is never the limiting factor on duty.

| | | | | | |
|----|----------|-----------|------------------------|----|---------------|
| 57 | | | | | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | B | 23-May-24 | Revised CO emissions | | DCB |
| 63 | A | 14-May-24 | Issued w prelim design | | DCB |
| 64 | revision | date | description | by | chk'd app'v'd |



EMISSIONS PERMIT DATA SHEET
 AMERICAN ENGINEERING SYSTEM of UNITS

SHO = Superior Quality, Flexibility, Dependability & Modularity

P24-0504A-EMISSIONS

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| | | | | | |
|---|---------------|-------------------------|-----------------|--------------|--|
| 1 | | | | | |
| 2 | Owner: | Energy Transfer | Owner Ref.: | H-741 | |
| 3 | Purchaser: | Energy Transfer | Purchaser Ref.: | TBD | |
| 4 | Manufacturer: | Tulsa Heaters Midstream | THM Ref.: | P24-0504B | |
| 5 | Service: | Regen Gas Heater | Project: | Revolution 2 | |
| 6 | Number: | 1 | Location: | Bulger, PA | |
| 7 | SHO Duty: | 8.15 MMBTU/ hr | SHO Model: | SHO750 | |
| 8 | | | | | |

Guarantees:

| | | | | |
|-----|----------|----------|----|-----|
| NOx | 0.012 | Lb/MMBTU | 9 | ppm |
| SOx | no quote | Lb/MMBTU | - | ppm |
| CO | 0.0407 | Lb/MMBTU | 50 | ppm |
| VOC | 0.0192 | Lb/MMBTU | 15 | ppm |
| UHC | 0.007 | Lb/MMBTU | 15 | ppm |
| SPM | 0.0132 | Lb/MMBTU | 15 | ppm |

Design Case

Maximum Case

Heat Release

LHV Basis

9.04 MMBTU/hr

9.49 MMBTU/hr

HHV Basis

10.02 MMBTU/hr

10.52 MMBTU/hr

Products of Combustion

MW

| | | | | | |
|---------|-------|-------|-----------|----|-----|
| O2 | 32.00 | 251 | Lbm/ hr | | |
| N2 + Ar | 28.15 | 6,410 | Lbm/ hr | | |
| CO2 | 44.01 | 1,167 | Lbm/ hr | | |
| H2O | 18.02 | 980 | Lbm/ hr | | |
| NOx | 46.01 | 0.11 | Lbm/ hr / | 9 | ppm |
| SOx | 64.06 | 0.00 | Lbm/ hr / | 0 | ppm |
| CO | 28.01 | 0.37 | Lbm/ hr / | 50 | ppm |
| VOC | 44.10 | 0.17 | Lbm/ hr / | 15 | ppm |
| UHC | 16.04 | 0.06 | Lbm/ hr / | 15 | ppm |
| SPM | | 0.12 | Lbm/ hr / | 15 | ppm |

| | | | |
|-------|-----------|----|-----|
| 263 | Lbm/ hr | | |
| 6,730 | Lbm/ hr | | |
| 1,226 | Lbm/ hr | | |
| 1,029 | Lbm/ hr | | |
| 0.11 | Lbm/ hr / | 9 | ppm |
| 0.00 | Lbm/ hr / | 0 | ppm |
| 0.39 | Lbm/ hr / | 50 | ppm |
| 0.18 | Lbm/ hr / | 15 | ppm |
| 0.07 | Lbm/ hr / | 15 | ppm |
| 0.13 | Lbm/ hr / | 15 | ppm |

Total 8,809 Lbm/ hr

9,249 Lbm/ hr

| | | |
|------------------------|------|--------|
| Flue Gas Exit Temp. | 369 | °F |
| Flue Gas Exit Velocity | 32.6 | Ft/sec |
| Stack Height | 20.9 | ft |
| Stack ID | 18 | in |

| | |
|------|--------|
| 35.8 | Ft/sec |
| 20.9 | ft |
| 18 | in |

NOTE:

THM emissions guarantees applicable between 50-100% of Design Case combustion conditions w/ 15% excess air.

THM emissions guarantees applicable for firebox temperatures above 1100°F.

Emissions above are for Design Case operation with air and fuel in ratio control. Upset conditions, such as operation outside the design, high turndown or start-up are not considered as guaranteed emissions cases.

The Maximum Case is the the specified heat release for the burner purchased. Extra duty is spec'd into the burner to ensure that the burner is never the limiting factor on duty.

| | | | | | |
|----|----------|-----------|------------------------|-----|---------------|
| 57 | | | | | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | B | 23-May-24 | Changed CO emissions | DCB | |
| 63 | A | 14-May-24 | Issued w prelim design | DCB | |
| 64 | revision | date | description | by | chk'd app'v'd |



EMISSIONS PERMIT DATA SHEET
AMERICAN ENGINEERING SYSTEM of UNITS

P24-0504B-EMISSIONSDS

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| | | | | | |
|---|---------------|-------------------------|-----------------|--------------|--|
| 1 | | | | | |
| 2 | Owner: | Energy Transfer | Owner Ref.: | H-742 | |
| 3 | Purchaser: | Energy Transfer | Purchaser Ref.: | TBD | |
| 4 | Manufacturer: | Tulsa Heaters Midstream | THM Ref.: | P24-0504C | |
| 5 | Service: | Regen Gas Heater | Project: | Revolution 2 | |
| 6 | Number: | 1 | Location: | Bulger, PA | |
| 7 | SHO Duty: | 6.14 MMBTU/ hr | SHO Model: | SHO750 | |
| 8 | | | | | |

| | | | | | |
|----|--------------------|----------|----------|----|-----|
| 9 | Guarantees: | | | | |
| 11 | NOx | 0.012 | Lb/MMBTU | 9 | ppm |
| 12 | SOx | no quote | Lb/MMBTU | - | ppm |
| 13 | CO | 0.0407 | Lb/MMBTU | 50 | ppm |
| 14 | VOC | 0.0192 | Lb/MMBTU | 15 | ppm |
| 15 | UHC | 0.007 | Lb/MMBTU | 15 | ppm |
| 16 | SPM | 0.0132 | Lb/MMBTU | 15 | ppm |

| | | Design Case | | | | Maximum Case | | | |
|----|-------------------------------|-------------|-------|--------------|-------|--------------|-----|--|--|
| 21 | Heat Release | LHV Basis | 6.64 | MMBTU/hr | 6.97 | MMBTU/hr | | | |
| 22 | | HHV Basis | 7.36 | MMBTU/hr | 7.73 | MMBTU/hr | | | |
| 23 | Products of Combustion | | | | | | | | |
| 24 | | MW | | | | | | | |
| 25 | O2 | 32.00 | 184 | Lbm/ hr | 193 | Lbm/ hr | | | |
| 26 | N2 + Ar | 28.15 | 4,707 | Lbm/ hr | 4,942 | Lbm/ hr | | | |
| 27 | CO2 | 44.01 | 857 | Lbm/ hr | 900 | Lbm/ hr | | | |
| 28 | H2O | 18.02 | 720 | Lbm/ hr | 756 | Lbm/ hr | | | |
| 30 | NOx | 46.01 | 0.08 | Lbm/ hr / 9 | 0.08 | Lbm/ hr / 9 | ppm | | |
| 31 | SOx | 64.06 | 0.00 | Lbm/ hr / 0 | 0.00 | Lbm/ hr / 0 | ppm | | |
| 32 | CO | 28.01 | 0.27 | Lbm/ hr / 50 | 0.28 | Lbm/ hr / 50 | ppm | | |
| 33 | VOC | 44.10 | 0.13 | Lbm/ hr / 15 | 0.13 | Lbm/ hr / 15 | ppm | | |
| 34 | UHC | 16.04 | 0.05 | Lbm/ hr / 15 | 0.05 | Lbm/ hr / 15 | ppm | | |
| 35 | SPM | | 0.09 | Lbm/ hr / 15 | 0.09 | Lbm/ hr / 15 | ppm | | |
| 37 | Total | | 6,468 | Lbm/ hr | 6,792 | Lbm/ hr | | | |
| 39 | Flue Gas Exit Temp. | | 281 | °F | | | | | |
| 40 | Flue Gas Exit Velocity | | 21.4 | Ft/sec | 23.5 | Ft/sec | | | |
| 41 | Stack Height | | 20.9 | ft | 20.9 | ft | | | |
| 42 | Stack ID | | 18 | in | 18 | in | | | |

NOTE:
 THM emissions guarantees applicable between 50-100% of Design Case combustion conditions w/ 15% excess air.
 THM emissions guarantees applicable for firebox temperatures above 1100°F.
 Emissions above are for Design Case operation with air and fuel in ratio control. Upset conditions, such as operation outside the design, high turndown or start-up are not considered as guaranteed emissions cases.
 The Maximum Case is the the specified heat release for the burner purchased. Extra duty is spec'd into the burner to ensure that the burner is never the limiting factor on duty.

| | | | | | |
|----|----------|-----------|------------------------|-----|--------------|
| 57 | | | | | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | B | 23-May-24 | Changed CO emissions | DCB | |
| 63 | A | 14-May-24 | Issued w prelim design | DCB | |
| 64 | revision | date | description | by | chk'd appv'd |



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| | | | | | |
|----|---------------|------------------------------|-----------------|--------------|-----|
| 1 | | | | | |
| 2 | Owner: | Energy Transfer | Owner Ref.: | H-741 | |
| 3 | Purchaser: | Energy Transfer | Purchaser Ref.: | TBD | |
| 4 | Manufacturer: | Tulsa Heaters Midstream, LLC | THM Ref.: | P24-0504B | |
| 5 | Service: | Regen Gas Heater | Project: | Revolution 2 | |
| 6 | Quantity: | 1 | Location: | Bulger, PA | |
| 7 | SHO Duty: | 8.15 MMBTU/ hr | SHO Model: | SHO750 | |
| 8 | BMS Release: | 9.49 MMBTU/ hr | BMS Model: | BMS1500 | |
| 9 | | | | | |
| 10 | | | | | Rev |

PROCESS DESIGN CONDITIONS

| | | Radiant / Convection | Radiant / Convection | Radiant / Convection | Radiant / Convection |
|----|--|----------------------|----------------------|----------------------|----------------------|
| 14 | Heater Section | --- | --- | --- | --- |
| 15 | Operating Case | Over Design | Design | | |
| 16 | Service | Regen Gas Heater | Regen Gas Heater | | |
| 17 | Heat Absorption (R/C) | MMBTU/ hr | 5.14 / 3.01 | 4.74 / 2.67 | |
| 18 | Process Fluid | --- | Gas | Gas | |
| 19 | Process Mass Flow Rate, Total | Lb/ hr | 26,422 | 24,020 | |
| 20 | Process Bulk Velocity (calc. R/C) | ft/ s | 35 / 33 | 32 / 24 | |
| 21 | Process Mass Velocity (calc. R/C) | Lb/ s ft2 | 58 / 92 | 53 / 84 | |
| 22 | Coking Allowance (dP calcs) | in | | | |
| 23 | Pressure Drop, Clean (allow. / calc.) | psi | 12 / 10 | 12 / 8 | |
| 24 | Pressure Drop, Fouled (allow. / calc.) | psi | | | |
| 25 | Average Heat Flux (allowable) | BTU/ hr ft2 | 13,000 | 13,000 | |
| 26 | Average Heat Flux (calculated) | BTU/ hr ft2 | 12,280 | 11,320 | |
| 27 | Maximum Heat Flux (allowable) | BTU/ hr ft2 | | | |
| 28 | Maximum Heat Flux (calc. R/C) | BTU/ hr ft2 | 21,600 / 28,500 | 19,900 / 25,800 | |
| 29 | Fouling Factor, Internal | hr ft2 °F/ BTU | 0.001 | 0.001 | |
| 30 | Corrosion or Erosion Characteristics | --- | | | |
| 31 | Max. Film Temperature (allow. / calc.) | °F | 1000 / 695 | 1000 / 694 | |
| 32 | | | | | |
| 33 | Inlet Conditions: | | | | |
| 34 | Temperature | °F | 120 | 120 | |
| 35 | Pressure | psig | 845 | 845 | |
| 36 | Mass Flow Rate, Liquid | Lb/ hr | 0 | 0 | |
| 37 | Mass Flow Rate, Vapor | Lb/ hr | 26,422 | 24,020 | |
| 38 | Weight Percent, Liquid / Vapor | wt% | 0% / 100% | 0% / 100% | |
| 39 | Density, Liquid / Vapor | Lb/ ft3 | 0.00 / 3.48 | 0.00 / 3.48 | |
| 40 | Molecular Weight, Liquid / Vapor | Lb/ Lbmole | --- / 21.4 | --- / 21.4 | |
| 41 | Viscosity, Liquid / Vapor | cp | 0 / 0.014 | 0.001 / 0.014 | |
| 42 | Specific Heat, Liquid / Vapor | BTU/ Lb °F | 0 / 0.616 | 0.000 / 0.616 | |
| 43 | Thermal Conductivity, Liq./Vap. | BTU/hr ft °F | 0 / 0.022 | 0.000 / 0.022 | |
| 44 | | | | | |
| 45 | Outlet Conditions: | | | | |
| 46 | Temperature | °F | 575 | 575 | |
| 47 | Pressure | psig | 835 | 837 | |
| 48 | Mass Flow Rate, Liquid | Lb/ hr | 0 | 0 | |
| 49 | Mass Flow Rate, Vapor | Lb/ hr | 26,422 | 24,020 | |
| 50 | Weight Percent, Liquid / Vapor | wt% | 0% / 100% | 0% / 100% | |
| 51 | Density, Liquid / Vapor | Lb/ ft3 | 0.00 / 1.62 | 0.00 / 1.62 | |
| 52 | Molecular Weight, Liquid / Vapor | Lb/ Lbmole | --- / 21.4 | --- / 21.4 | |
| 53 | Viscosity, Liquid / Vapor | cp | 0.000 / 0.020 | 0 / 0.020 | |
| 54 | Specific Heat, Liquid / Vapor | BTU/ Lb °F | 0.000 / 0.740 | 0 / 0.740 | |
| 55 | Thermal Conductivity, Liq./Vap. | BTU/hr ft °F | 0.000 / 0.044 | 0 / 0.044 | |
| 56 | | | | | |

| | | | | | |
|----|----------|-----------|----------------------|-----|---------------|
| 57 | | | | | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | B | 23-May-24 | Changed CO emissions | dcb | |
| 63 | A | 14-May-24 | Issued with Proposal | dcb | |
| 64 | revision | date | description | by | chk'd app'v'd |



SHO = Superior Quality, Flexibility, Dependability & Modularity

HEATER DATA SHEET
AMERICAN ENGINEERING SYSTEM of UNITS

P24-0504B-HTRDS

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COMBUSTION DESIGN CONDITIONS

| | | | | | | | |
|----|----------------------------------|-------------|------------------|------------------|--|--|--|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | Overall Performance: | | | | | | |
| 4 | Operating Case | --- | Over Design | Design | | | |
| 5 | Service | --- | Regen Gas Heater | Regen Gas Heater | | | |
| 6 | Excess Air | mol% | 15.0% | 15.0% | | | |
| 7 | Calculated Heat Release (LHV) | MMBTU/ hr | 9.04 | 8.14 | | | |
| 8 | Guaranteed Efficiency | HR% | 85.2% | 86.0% | | | |
| 9 | Calculated Efficiency | HR% | 90.2% | 91.0% | | | |
| 10 | Radiation Loss | HR% | 2.00% | 2.00% | | | |
| 11 | Flow Rate, Combustion Gen./ Imp. | Lb/ hr | 8,809 | 7,937 | | | |
| 12 | Flue Gas Temp. Leaving (R/C) | °F | 1,525 / 369 | 1,480 / 337 | | | |
| 13 | Flue Gas Mass Velocity | Lb/ sec ft2 | 0.281 | 0.253 | | | |
| 14 | | | | | | | |

| | | | | | | | |
|----|-------------------|------------|---------|---------|----------|----------------|---|
| 15 | Fuel(s) Data: | Gas 1 | Gas 2 | Gas 3 | Design | Burner Design: | |
| 16 | | Mol.Wt. | Mol.Wt. | Mol.Wt. | Fuel Oil | OEM | --- Callidus Technologies, LLC |
| 17 | LHV | BTU/ scf | 927 | | --- | Type | --- External FGR w IFGR(internal) |
| 18 | LHV | BTU/ Lb | 20,483 | | | Quantities | --- 1 ULTRA Low NOx |
| 19 | P @ Burner | psig | 150 | | | Model No. | --- CUBP-3W-HC-HZ Cylindrical |
| 20 | T @ Burner | °F | 100 | | | Windbox | --- yes ... |
| 21 | MW | Lb/ Lbmole | 17.18 | | --- | Location | --- EndWall Center ... Horizontally Fired |
| 22 | Flow @ design | lb/hr | 441 | | | Pilot Design: | |
| 23 | Flow @ design | scfh | 9,746 | | | Type / Model | Self-Inspiring / by O.E.M. |
| 24 | Atomizing Media | | --- | | | Ignition | --- Electric requires elec.ign.system |
| 25 | Atom. Media P & T | | --- | | | Heat Release | --- > 350000 BTU/ hr on ... Gas 1 |
| 26 | | | | | | | |

| | | | | | | | |
|----|-------------|------|-------|--|-----|---------------------------|--------------------|
| 27 | Components: | | | | | Burner Performance: | |
| 28 | N | wt% | --- | | | Minimum Heat Release | MMBTU/ hr 1.90 |
| 29 | S | wt% | --- | | | Design Heat Release | MMBTU/ hr 9.04 |
| 30 | Ash | wt% | --- | | | Maximum Heat Release | MMBTU/ hr 9.49 |
| 31 | Ni | ppm | --- | | | Burner Turndown | Max:Min 5.00 |
| 32 | Va | ppm | --- | | | Volumetric Ht. Release | BTU/ hr ft3 12,694 |
| 33 | Na | ppm | --- | | | Pressure @ Arch | inH2O 0.40 |
| 34 | Fe | ppm | --- | | | Pressure @ Burner | inH2O 4.39 |
| 35 | | | | | | Combustion Air T @ Burner | °F 60 |
| 36 | H2 | mol% | 0.0% | | --- | Flue Gas T @ Burner | °F 1,330 |
| 37 | O2 | mol% | 0.0% | | --- | | |
| 38 | N2 + Ar | mol% | 2.3% | | --- | | |
| 39 | CO | mol% | 0.0% | | --- | | |
| 40 | CO2 | mol% | 0.2% | | --- | | |
| 41 | CH4 | mol% | 92.2% | | --- | | |
| 42 | C2H6 | mol% | 4.8% | | --- | | |
| 43 | C2H4 | mol% | 0.0% | | --- | | |
| 44 | C3H8 | mol% | 0.4% | | --- | | |
| 45 | C3H6 | mol% | 0.0% | | --- | | |
| 46 | C4H10 | mol% | 0.0% | | --- | | |
| 47 | C4H8 | mol% | 0.0% | | --- | | |
| 48 | C5H12 | mol% | 0.0% | | --- | | |
| 49 | C5H10 | mol% | 0.0% | | --- | | |
| 50 | C6+ | mol% | 0.0% | | --- | | |
| 51 | H2S | ppmv | 0.0% | | --- | | |
| 52 | SO2 | mol% | 0.0% | | --- | | |
| 53 | NH3 | mol% | 0.0% | | --- | | |
| 54 | H2O | mol% | 0.0% | | --- | | |
| 55 | spare | mol% | 0.0% | | --- | | |
| 56 | | | | | | | |
| 57 | | | | | | | |

| | | | | | | | |
|----|---------|------|-------|--|-----|-----------------------|------------------------|
| 38 | N2 + Ar | mol% | 2.3% | | --- | Guaranteed Emissions: | |
| 39 | CO | mol% | 0.0% | | --- | Basis of Guarantee | --- 3.0% O2, dry (LHV) |
| 40 | CO2 | mol% | 0.2% | | --- | NOx Emissions | Lb/MMBTU 0.012 9 ppm |
| 41 | CH4 | mol% | 92.2% | | --- | SOx Emissions | Lb/MMBTU no quote |
| 42 | C2H6 | mol% | 4.8% | | --- | CO Emissions | Lb/MMBTU 0.041 50 ppm |
| 43 | C2H4 | mol% | 0.0% | | --- | VOC Emissions | Lb/MMBTU 0.019 15 ppm |
| 44 | C3H8 | mol% | 0.4% | | --- | UHC Emissions | Lb/MMBTU 0.007 15 ppm |
| 45 | C3H6 | mol% | 0.0% | | --- | SPM10 Emissions | Lb/MMBTU 0.013 15 ppm |
| 46 | C4H10 | mol% | 0.0% | | --- | Noise Emissions | dBA @ 3ft 85 |
| 47 | C4H8 | mol% | 0.0% | | --- | | |
| 48 | C5H12 | mol% | 0.0% | | --- | | |
| 49 | C5H10 | mol% | 0.0% | | --- | | |
| 50 | C6+ | mol% | 0.0% | | --- | | |
| 51 | H2S | ppmv | 0.0% | | --- | | |
| 52 | SO2 | mol% | 0.0% | | --- | | |
| 53 | NH3 | mol% | 0.0% | | --- | | |
| 54 | H2O | mol% | 0.0% | | --- | | |
| 55 | spare | mol% | 0.0% | | --- | | |
| 56 | | | | | | | |
| 57 | | | | | | | |

| | | | | | | | |
|----|-------------------------|------|--------------|--|--|-----------------------|---|
| 58 | Blower/Fan Performance: | | | | | Net Flame Clearances: | |
| 59 | Volumetric Flow | acfm | 2,000 | | | Est. Flame Size | approx. 9.5 ft L x 3 ft Diameter |
| 60 | Rated Power | HP | 10 | | | Hor Clearance | 1.63 ft NET Tube Clearance |
| 61 | Fan Speed | RPM | 3,600 | | | Vert. Clearance | 1.63 ft NET Tube Clearance |
| 62 | Sound Pressure | dBA | < 85 | | | Axial Clearance | 3.67 ft NET Refractory Clearance (to Target hot face) |
| 63 | Area Classification | NEC | Unclassified | | | | |
| 64 | | | | | | | |

| | | | | | | | |
|----|-------------------------|------|--------------|--|--|---------------------------|---------------------|
| 58 | Blower/Fan Performance: | | | | | Nominal Flame Clearances: | |
| 59 | Volumetric Flow | acfm | 2,000 | | | from burner CL ... | Vertical Horizontal |
| 60 | Rated Power | HP | 10 | | | to Tube CL, API | ft 5.81 3.87 |
| 61 | Fan Speed | RPM | 3,600 | | | to Tube CL, calc. | ft 3.13 3.13 |
| 62 | Sound Pressure | dBA | < 85 | | | to Refrac., calc. | ft n / a 13.17 |
| 63 | Area Classification | NEC | Unclassified | | | | |
| 64 | | | | | | | |

PRESSURE PARTS DESIGN

| | | | | | |
|----|---|-----------------------------|-------------------|-------------------|-------------------|
| 1 | | | | | |
| 2 | | | | | |
| 3 | Coil Design: | | <u>RADIANT</u> | <u>SHIELD</u> | <u>CONVECTION</u> |
| 4 | Service | | Regen Gas Heater | Regen Gas Heater | Regen Gas Heater |
| 5 | Design Basis for Tube Temperature | | API 530 | API 530 | API 530 |
| 6 | Design Basis for Tube Wall Thickness | | ASME Sec. VIII-1 | ASME Sec. VIII-1 | ASME Sec. VIII-1 |
| 7 | Design Life | hr | 100,000 | 100,000 | 100,000 |
| 8 | Design Pressure (elastic / rupture) | psig | 1,100 / | 1,100 / | 1,100 / |
| 9 | Design Fluid Temperature | °F | 575 | 575 | 575 |
| 10 | Design Temperature Allowance | °F | 25 | 25 | 25 |
| 11 | Design Corrosion Allowance (tubes/fittings) | in | 0.063 / 0.063 | 0.063 / 0.063 | 0.063 / 0.063 |
| 12 | | | | | |
| 13 | Maximum Tube Temperature (clean) | °F | 725 | | |
| 14 | Maximum Tube Temperature (fouled) | °F | 751 | 418 | 480 |
| 15 | Design Tube Temperature | °F | 776 | 650 | 650 |
| 16 | Inside Film Coefficient | BTU/ hr ft ² °F | 208 | 260 | 222 |
| 17 | Weld Inspection | RT or Other | 100 of 10% | 100 of 10% | 100 of 10% |
| 18 | Weld Heat Treatment | s.rel., t.stab. or none | None | None | None |
| 19 | Hydrostatic Test Pressure | psig | per API | per API | per API |
| 20 | | | | | |
| 21 | Coil Arrangement: | | Horizontal | Horizontal | Horizontal |
| 22 | Coil Type | --- | Helical | Serpentine | Serpentine |
| 23 | Tube Material (pipe or tube spec) | ASTM | SA106GrB | SA106GrB | SA106GrB |
| 24 | Supplementary Mfg Requirements | ASTM | None | None | None |
| 25 | Tube Outside Diameter | in | 5.563 | 4.500 | 4.500 |
| 26 | Tube Wall Thickness (aw / mw) | in | 0.375 / 0.328 | 0.337 / 0.295 | 0.337 / 0.295 |
| 27 | Number of Cells (radiant or convection) | --- | 1 | 1 | 1 |
| 28 | Number of Flow Passes (total / cell) | --- | 1 / 1 | 1 / 1 | 1 / 1 |
| 29 | Number of Tubes per Row (total / cell) | --- | 4 / 4 | 4 / 4 | 4 / 4 |
| 30 | Overall Tube (1 turn in radiant) Length | ft | 19.64 | 9.04 | 9.04 |
| 31 | Effective Tube Length / Helix Diameter | ft | 19.64 / 6.25 | 7.46 | 7.46 |
| 32 | Number of Turns or Tubes (total / pass) | | 15.0 / 15.0 | 4.0 / 4.0 | 0.0 / 0.0 |
| 33 | Total Exposed Surface | ft ² | 419 | 35 | 0 |
| 34 | Number of Ext.Surf. Tubes (total / cell) | --- | 0 / 0.0 | 0 / 0.0 | 16 / 16.0 |
| 35 | Total Exposed Surface | ft ² | 0 | 0 | 1,601 |
| 36 | Tube Spacing (horiz. / tube centers) | in | --- / 10.00 | 8.00 / 8.00 | 8.00 / 8.00 |
| 37 | Tube Spacing (horiz. to refractory) | in | 7.50 | 4.00 | 4.00 |
| 38 | Coil Fluid Volume | USgal | 284 | 24 | 97 |
| 39 | | | | | |
| 40 | Coil Fittings: | | Regen Gas Heater | Regen Gas Heater | Regen Gas Heater |
| 41 | Fitting Type | --- | SR 90° Elbows | SR 180° U-Bends | SR 180° U-Bends |
| 42 | Fitting Material | ASTM | SA234 WPB | SA234 WPB | SA234 WPB |
| 43 | Supplementary Mfg Requirements | ASTM | None | None | None |
| 44 | Fitting Outside Diameter | in | 5.563 | 4.500 | 4.500 |
| 45 | Fitting Wall Thickness (aw / mw) | in | 0.375 / 0.328 | 0.337 / 0.295 | 0.337 / 0.295 |
| 46 | Fitting Location | internal or external | Internal | External | External |
| 47 | Tube Attachment | welded or rolled | Welded | Welded | Welded |
| 48 | | | | | |
| 49 | Coil Terminals: | | Outlet | | Inlet |
| 50 | Terminal Type | beveled or flanged | Flanged | | Flanged |
| 51 | Flange Material | ASTM | SA105N | | SA105N |
| 52 | Supplementary Mfg Requirements | ASTM | None | | None |
| 53 | Flange Size and Rating | NPS/ ASME | 5" / 900# | | 4" / 900# |
| 54 | Flange Type | RFWN or RTJ | RFWN | | RFWN |
| 55 | Location | --- | Burner Endwall | | Terminal End |
| 56 | | | | | |
| 57 | Extended Surface: | | <u>CONVECTION</u> | <u>CONVECTION</u> | <u>CONVECTION</u> |
| 58 | Service | --- | Regen Gas Heater | Regen Gas Heater | Regen Gas Heater |
| 59 | Fin or Stud Row Number | starting @ bottom | No.1 / No.2 | No.3-4 / | / |
| 60 | Ext. Surface Type | seg.fins, solid fins, studs | Segmented | Segmented | |
| 61 | Fin/Stud Material | --- | C.S. / C.S. | C.S. / | / |
| 62 | Fin/Stud Height | in | 1.00 / 1.00 | 1.00 / | / |
| 63 | Fin/Stud Thickness | in | 0.06 / 0.06 | 0.06 / | / |
| 64 | Fin/Stud Density | fin/ in | 3.00 / 4.00 | 5.00 / | / |
| 65 | | | | | |



PRESSURE PARTS DESIGN (continued)

| | | | | |
|----|---|-----------------------|-----------------|------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | Crossovers: | | <u>RADIANT</u> | <u>SHIELD</u> |
| 4 | Type, location / connections | --- | <u>External</u> | <u>Flanged</u> |
| 5 | Tube / Fittings Material | ASTM | <u>SA106GrB</u> | <u>SA234 WPB</u> |
| 6 | Tube & Fitting OD / Thickness (aw) | in | <u>5.563</u> | <u>0.375</u> |
| 7 | | | | |
| 8 | Inlet Manifold(s): | type | | <u>N/A</u> |
| 9 | Location | --- | | |
| 10 | Design Basis for Manifold Thickness | --- | | |
| 11 | Design Conditions (temp./press.) | °F/ psig | | <u>/</u> |
| 12 | Pipe Material | ASTM | | |
| 13 | Fittings Material | ASTM | | |
| 14 | Flange Material / Style | ASTM | | <u>/</u> |
| 15 | Outside Diameters, each Branch | in | | |
| 16 | Wall Thickness(es); aw or mw | in | | |
| 17 | End Types (terminal/ dead) | beveled or flanged | | |
| 18 | Manifold Terminal Type | NPS/ ASME | | <u>/</u> |
| 19 | Coil Connection Type | extrusion, olet, etc. | | |
| 20 | Coil Terminal Type | NPS/ ASME | | <u>/</u> |
| 21 | | | | |
| 22 | Outlet Manifold(s): | type | <u>N/A</u> | |
| 23 | Location | --- | | |
| 24 | Design Basis for Manifold Thickness | --- | | |
| 25 | Design Conditions (temp./press.) | °F/ psig | <u>/</u> | |
| 26 | Pipe Material | ASTM | | |
| 27 | Fittings Material | ASTM | | |
| 28 | Flange Material / Style | ASTM | <u>/</u> | |
| 29 | Outside Diameters, each Branch | in | | |
| 30 | Wall Thickness(es); aw or mw | in | | |
| 31 | End Types (terminal/ dead) | beveled or flanged | | |
| 32 | Manifold Terminal Type | NPS/ ASME | <u>/</u> | |
| 33 | Coil Connection Type | extrusion, olet, etc. | | |
| 34 | Coil Terminal Type | NPS/ ASME | <u>/</u> | |
| 35 | | | | |

COIL & MANIFOLD SUPPORTS DESIGN

| | | | | |
|----|---------------------------------------|--------------------------------|-------------------------|----------------------------|
| 36 | | | | |
| 37 | | | | |
| 38 | | | | |
| 39 | Tube Supports: | | <u>RADIANT</u> | <u>SHIELD</u> |
| 40 | Service | | <u>Regen Gas Heater</u> | <u>Regen Gas Heater</u> |
| 41 | Location | Top, Bottom, Ends | <u>Bottom</u> | <u>Ends</u> |
| 42 | Support Type | casting, tubesht, spring, etc. | <u>SS Pipe Rail</u> | <u>Welded Tbsheets</u> |
| 43 | Support Thicknesses | in | <u>SCH40</u> | <u>0.375</u> |
| 44 | Support Materials | ASTM | <u>A240 T304</u> | <u>A36 CS</u> |
| 45 | Support Temperatures (calc./ design) | °F / °F | <u>1,027 / 1,210</u> | <u>597 / 750</u> |
| 46 | TbSht Ferrules Thickness/Materials | in/ ASTM | <u>---</u> | <u>14 ga. / 304 SS</u> |
| 47 | Refractory & Anchor Materials & Types | | <u>none</u> | <u>per refrac. section</u> |
| 48 | | | | |
| 49 | Intermediate Guides & Supports: | | <u>None</u> | <u>None</u> |
| 50 | Location | --- | | |
| 51 | Guide/ Support Type | casting, spring, etc. | | |
| 52 | Material | ASTM | | |
| 53 | Spacing, average | ft | | |
| 54 | | | | |
| 55 | Tube Guides: | Top, Bottom, Ends | <u>None</u> | <u>None</u> |
| 56 | Material | ASTM | | |
| 57 | | | | |
| 58 | Manifold Supports: | | <u>Outlet Manifold</u> | <u>Intlet Manifold</u> |
| 59 | Material | ASTM | <u>A36</u> | <u>N/A</u> |
| 60 | Materials Design & Supply | --- | <u>by THM</u> | |
| 61 | Location | Top, Bottom, Ends | | |
| 62 | Support Type | roller, shoe, spring, etc. | <u>Simple Shelf</u> | |
| 63 | Number of Supports | --- | <u>One (1)</u> | |
| 64 | | | | |



CASING / REFRACTORY SYSTEMS DESIGN

| | | | | |
|----|---------------------------------------|--------------------------------------|--------------------|------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | | BURNER | SHIELDED | TARGET |
| 4 | Radiant Section Design: | ENDWALL | SIDEWALLS | ENDWALL |
| 5 | Total Refractory Thickness | in 5.0 | 3.0 | 5.0 |
| 6 | Hot Face Temperature (design) | °F 2,000 | 2,000 | 2,000 |
| 7 | Hot Face Temperature (calculated) | °F 1,525 | 1,027 | 1,525 |
| 8 | Hot Face Layer | in/ --- 1/ 8# CF Blanket | 1/ 8# CF Blanket | 1/ 8# CF Blanket |
| 9 | Back-Up Layer No.1 | in/ --- 1/ 8# CF Blanket | 2/ 6# CF Blanket | 1/ 8# CF Blanket |
| 10 | Back-Up Layer No.2 | in/ --- 3/ 6# CF Blanket | None | 3/ 6# CF Blanket |
| 11 | Foil Vapor Barrier | in/ --- None | None | None |
| 12 | Castable Reinforcement (SS Needles) | wt% None | None | None |
| 13 | Anchors / Tie Backs: | --- Pins & Clips | Pins & Clips | Pins & Clips |
| 14 | Material | --- 310 S.S. | 310 S.S. | 310 S.S. |
| 15 | Attachment | --- Welded | Welded | Welded |
| 16 | Casing: | | | |
| 17 | Material | in/ ASTM 0.1875 / A36 | 0.1345 / A36 | 0.1875 / A36 |
| 18 | Internal Coating | --- None | None | None |
| 19 | External Temperature, Typical | °F 180 | 180 | 180 |
| 20 | Comments / Clarifications | --- w/ cfb wraps | w/o cfb wraps | w/ cfb wraps |
| 21 | | SHOP Installed | SHOP Installed | SHOP Installed |
| 22 | | | | |
| 23 | | | | |
| 24 | Convection Section Design: | | | |
| 25 | Total Refractory Thickness | in 3.0 | 3.0 | 2.0 |
| 26 | Hot Face Temperature (design) | °F 2,000 | 2,000 | 2,000 |
| 27 | Hot Face Temperature (calculated) | °F 947 | 947 | 740 |
| 28 | Hot Face Layer | in/ --- 1/ 8# CF Blanket | 1/ 8# CF Blanket | 3/ Sparlite HS |
| 29 | Back-Up Layer No.1 | in/ --- 2/ 6# CF Blanket | 2/ 6# CF Blanket | None |
| 30 | Back-Up Layer No.2 | in/ --- None | None | None |
| 31 | Foil Vapor Barrier | in/ --- None | None | None |
| 32 | Castable Reinforcement (SS Needles) | wt% None | None | None |
| 33 | Anchors / Tie Backs: | --- Pins & Clips | Pins & Clips | Bullhorns |
| 34 | Material | --- 310 S.S. | 304 S.S. | 304 S.S. |
| 35 | Attachment | --- Welded | Welded | Welded |
| 36 | Casing: | | | |
| 37 | Material | in/ ASTM 0.1345 / A36 | 0.1345 / A36 | 0.1345 / A36 |
| 38 | Internal Coating | --- None | None | None |
| 39 | External Temperature, Typical | °F 180 | 180 | 180 |
| 40 | Comments / Clarifications | --- Cleaning/Sootblowing lanes: none | | Bolted Assembly |
| 41 | | SHOP Installed | SHOP Installed | SHOP Installed |
| 42 | | | | |
| 43 | | | | |
| 44 | Stack & Uptakes Design: | | | |
| 45 | Quantity | BREECHING One | 15° TRANSITION One | DISCH. DUCT One |
| 46 | Type / Location | --- Full L / Conv | Full L / Conv | Self.Spt/ Grade |
| 47 | Length / Metal Outside Diameter (top) | ft/ ft 1.00 / n/ a | 1.08 / n/ a | 7 / 1.500 |
| 48 | Discharge Elev., minimum/ calculated | ft/ ft n/ a / n/ a | n/ a / n/ a | 20 / 21 |
| 49 | Total Refractory Thickness | in 3.0 | 0.0 | 0.0 |
| 50 | Hot Face Temperature (design) | °F 2,000 | | |
| 51 | Hot Face Temperature (calculated) | °F 369 | 369 | 369 |
| 52 | Hot Face Layer | in/ --- 1/ 8# CF Blanket | None | None |
| 53 | Back-Up Layer No.1 | in/ --- 2/ 6# CF Blanket | | |
| 54 | Castable Reinforcement (SS Needles) | None | | |
| 55 | Anchors / Tie Backs: | --- Pins & Clips | | |
| 56 | Material | --- 304 S.S. | | |
| 57 | Attachment | --- Welded | | |
| 58 | Casing: | | | |
| 59 | Minimum Thickness/ Material | in/ ASTM 0.1345 / A36 | 0.1345 / A36 | 0.1345 / A36 |
| 60 | Corrosion Allowance | in None | None | None |
| 61 | Internal Coating | --- None | None | None |
| 62 | External Temperature, Typical | °F 180 | 369 | 369 |
| 63 | Comments / Clarifications | --- SHOP Installed | | |
| 64 | | | | |



MECHANICAL / STRUCTURAL DESIGN BASIS

| | |
|----|---|
| 1 | |
| 2 | |
| 3 | Refractory & Coatings Design: |
| 4 | Refractory Design <u>Per Std560: 180°F Avg. Casing Temperature @ Ambient Conditions of 0 MPH & 80°F</u> |
| 5 | Refractory Dryout <u>SHOP dryout = None // FIELD dryout per THM standard.</u> |
| 6 | Coating, Internal <u>None</u> |
| 7 | Coating, External <u>Base Coat: 3-4 PPG Dimetcote 9 IOZ Silicate - Flat Green on SP-6</u> |
| 8 | <u>Int. Coat: None</u> |
| 9 | <u>Top Coat (casing): 1.5-2 PPG Hi-Temp 500 - Federal Standard 595B #16132 Gray</u> |
| 10 | <u>Top Coat (stack): 1.5-2 PPG Hi-Temp 1000 - Federal Standard 595B #16132 Gray</u> |
| 11 | |
| 12 | |
| 13 | Applicable Standards: |
| 14 | API <u>Std 560 (ISO 13705); Fired Heaters for ...</u> AISC <u>Specification for Design, ... Steel for Buildings</u> |
| 15 | API <u>Std 530 (ISO 13704); Calc. of Heater Tube ...</u> AWS <u>D 1.1; Structural Welding Code</u> |
| 16 | ASME <u>B31.3, Chemical Plant and ... Piping</u> ASTM <u>tube/ smls pipe/ fitting spec's noted herein</u> |
| 17 | ASME <u>Sections I, II, VIII, IX; ASME B&PV Code</u> ASTM <u>refractories per C27, C155, C401 & C612</u> |
| 18 | ASME <u>Section V; Non Destructive Examination</u> NFPA <u>NFPA 70; National Electrical Code</u> |
| 19 | |
| 20 | Wind Design: <u>ASCE 7-10</u> Seismic Design: <u>ASCE 7-10</u> |
| 21 | Spec. or Standard <u>ASCE 7-10</u> Spec. or Standard <u>ASCE 7-10</u> |
| 22 | Velocity/ Imp. Factor <u>150 mph / 1</u> Risk Cat./Imp. Factor <u>III / 1.25</u> |
| 23 | Site Exposure <u>"C"</u> Ss/S1/Soil Class <u>0.5 / 0.15 / D</u> |
| 24 | Physical Design: <u>None</u> Site Design Basis: <u>1300 ft AMSL</u> |
| 25 | Plot Limitations <u>None</u> Site Elevation <u>90 °F</u> |
| 26 | Tube Limitations <u>None</u> Stack Design Temp. <u>21 ft AG</u> |
| 27 | Firebox Pressure <u>Positive; approximately +1.0 inH2O</u> FG Discharge Elev. <u>Unclassified</u> |
| 28 | Ambient Temp's <u>-20 °F Min/ 60 °F Dsn/ 100 °F Max</u> Area Classification |
| 29 | |

MAJOR SUBSYSTEMS & ACCESSORIES

| | |
|----|---|
| 30 | |
| 31 | |
| 32 | |
| 33 | Major Services & Subsystems |
| 34 | Process Design <u>INCLUDED in base pricing</u> |
| 35 | Mechanical Design <u>INCLUDED in base pricing</u> |
| 36 | Structural Design <u>INCLUDED in base pricing</u> |
| 37 | Radiant Section <u>INCLUDED in base pricing</u> |
| 38 | Convection Section <u>INCLUDED in base pricing</u> |
| 39 | Burner Mgmt <u>INCLUDED in base pricing</u> |
| 40 | Burner Piping <u>INCLUDED in base pricing</u> |
| 41 | Forced Draft System <u>INCLUDED in base pricing</u> |
| 42 | |
| 43 | Casing Penetrations |
| 44 | Fbox Purge/ Snuff <u>None</u> |
| 45 | CA Temp/Pres <u>None</u> |
| 46 | FG Temperature <u>2 1.5" 3000# Coupling</u> |
| 47 | FG Pressure <u>2 1.5" 3000# Coupling</u> |
| 48 | FG Comp. (Sample) <u>2 1.5" 3000# Coupling</u> |
| 49 | FG Sample <u>2 4" 150# RFWN</u> |
| 50 | O2 Analyzer Port <u>1 3" NPS 150# RFWN</u> |
| 51 | |
| 52 | Dampers |
| 53 | FD Fan (blower) <u>qty = 0</u> Uptake Ducts <u>Stack qty = 0</u> |
| 54 | Function <u>Note:</u> |
| 55 | Design <u>Fan inlet damper is inappropriate</u> <u>Stack Damper (which provides draft</u> |
| 56 | Materials <u>for forced draft SHO's where O2</u> <u>control) is inappropriate for forced</u> |
| 57 | Bearings <u>Control is provided by the BMS O2</u> <u>draft SHO's where the combustion</u> |
| 58 | Operator <u>Trim Module which controls the fan</u> <u>conditions are controlled real-time</u> |
| 59 | Positioner <u>(blower) motor's VFD/ VSD.</u> <u>via the BMS.</u> |
| 60 | Instruments |
| 61 | Sootblowers: <u>Qty. Type Location FG T Material Steam T & P O.E.M. / Ref.</u> |
| 62 | Lane 1: <u>None</u> |
| 63 | Lane 2: <u>None</u> |
| 64 | |





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 §60.48c | NSPS Dc - Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units | |
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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 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.



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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 §60.5401b | NSPS OOOOb - Process Unit Equipment Alternative GHG and VOC Standards | Same |
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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: _____

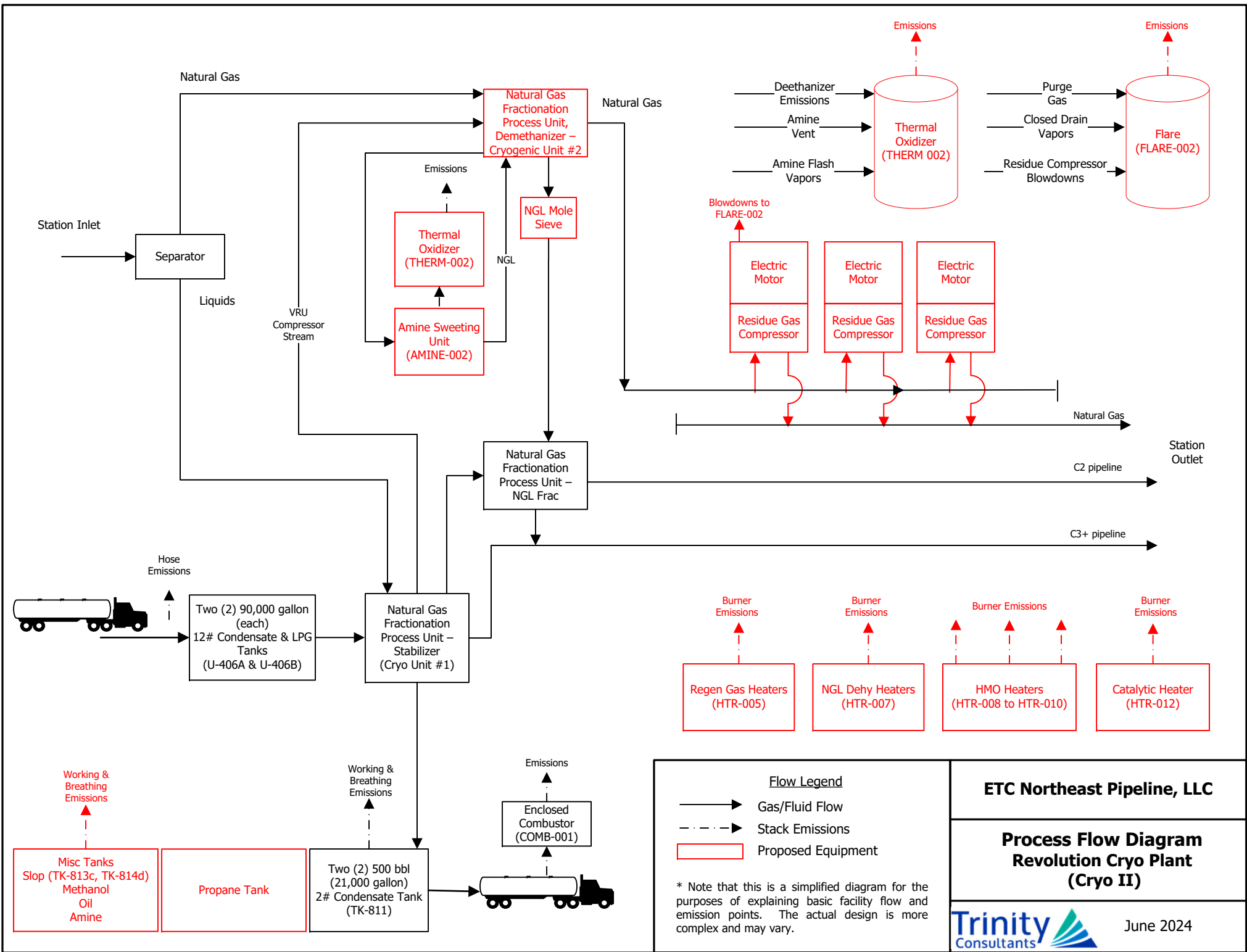
Section 6: Work Practice Standard

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.

ATTACHMENT D – PROCESS FLOW DIAGRAM



ATTACHMENT E – DETAILED EMISSION CALCULATIONS

**Table 1. Annual Potential To Emit (PTE) Summary
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant**

| Criteria Pollutants | | | | | | | | | | | | | |
|--|-------------------|------------------------------|-------------|-------------|-------------|-------------|--------------|--------------|----------------------|---------------|-------------|------------------|------------------|
| Proposed Facility Wide Allowables - Criteria Pollutants | | | | | | | | | | | | | |
| PA Unit ID | Source ID | Source | PM | PM10 | PM2.5 | SO2 | NOx | CO | VOC ^(1,2) | CH4 | N2O | CO2 | CO2e |
| P202 | AMINE-002 | Amine Sweetening Unit | -- | -- | -- | -- | -- | -- | 1.170 | 2.814 | -- | 238.45 | 308.81 |
| P302 | | Storage Tanks | -- | -- | -- | -- | -- | -- | 0.444 | 0.116 | -- | 0.06 | -- |
| P704 | | Liquid Loading Slop | -- | -- | -- | -- | -- | -- | 0.021 | -- | -- | -- | -- |
| C203 | Flare 002 | Emergency Flare 002 | -- | -- | -- | 0.008 | 0.513 | 2.337 | 3.193 | 0.006 | <0.01 | 260.76 | 252,473.46 |
| C204 | THERM-002 | Thermal Oxidizer 002 | -- | 0.231 | 0.231 | 0.018 | 3.040 | 2.554 | 0.167 | 0.003 | <0.01 | 137.53 | 3,765.85 |
| P703 | FUG | Fugitive Component Leaks | -- | -- | -- | -- | -- | -- | 7.689 | 96.101 | -- | 0.80 | 2,403.33 |
| P802 | | Compressor & Misc. Blowdowns | -- | -- | -- | -- | -- | -- | 18.938 | 56.751 | -- | 0.97 | 1,419.76 |
| P402 | HTR-006 | Inlet Gas Sieve Regen Heater | 0.523 | 0.523 | 0.523 | 0.024 | 0.475 | 0.178 | 0.760 | 0.087 | 0.009 | 4,631.85 | 4,636.63 |
| P403 | HTR-007 | NGL Regen Heater | 0.384 | 0.384 | 0.384 | 0.017 | 0.349 | 1.184 | 0.558 | 0.064 | 0.006 | 3,402.15 | 3,405.67 |
| P034, 035, 036 | HTR-008, 009, 010 | HMO Heaters (3) ³ | 0.692 | 0.692 | 0.692 | 0.271 | 5.464 | 18.531 | 8.742 | 1.004 | 0.100 | 53,261.11 | 53,316.12 |
| P037 | | Catalytic Heaters | 0.055 | 0.055 | 0.055 | 0.002 | 0.158 | 0.158 | 0.021 | 0.004 | <0.01 | 465.00 | 465.22 |
| Total Proposed Emissions (TPY) | | | 1.65 | 1.89 | 1.89 | 0.34 | 10.00 | 24.94 | 41.70 | 156.95 | 0.12 | 62398.68 | 322194.84 |
| Total Proposed Emissions (lb/hr) | | | 0.38 | 0.43 | 0.43 | 0.08 | 2.28 | 5.69 | 9.52 | 35.83 | 0.03 | 14,246.27 | 73,560.47 |

| | | | | | | | | | | | | | |
|-------------------------------|--|-------------|-------------|-------------|--------------|--------------|--------------|--|--|--|--|--|-------------------|
| Cryo I Emissions (TPY) | | 8.09 | 8.09 | 0.38 | 30.60 | 35.30 | 29.09 | | | | | | 80,998.00 |
| Total (TPY) | | 9.98 | 9.98 | 0.72 | 40.60 | 60.24 | 70.79 | | | | | | 403,192.84 |

(1) Total VOC emissions for Engine also include CH2O emissions (2) VOCs from Liquid Unloading Condensate and Unloading Hose were omitted from Cryo 2 total since they were already included within Cryo 1 PTE.

| Hazardous Air Pollutants (HAPs) | | | | | | | | | | | | | |
|---|-------------------|------------------------------|-----------|--------------|--------------|-----------------|-----------------|--------------|--------------|--------------|-----------|---------------|--------------|
| Proposed Facility Wide Allowables - HAPs | | | | | | | | | | | | | |
| PA Unit ID | Unit ID | Source | Methanol | Benzene | Toluene | Ethylbenzene | Xylene | n-Hexane | Formaldehyde | Acetaldehyde | Acrolein | 1,3-Butadiene | Total HAPs |
| P202 | AMINE-002 | Amine Sweetening Unit | -- | 0.004 | 0.001 | <0.01 | <0.01 | 0.002 | -- | -- | -- | -- | 0.007 |
| P302 | | Storage Tanks | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.020 |
| P704 | | Liquid Loading Slop | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| C203 | Flare 002 | Emergency Flare 002 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | <0.01 |
| C204 | THERM-002 | Thermal Oxidizer 002 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.060 |
| P703 | FUG | Fugitive Component Leaks | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.371 |
| P802 | | Compressor & Misc. Blowdowns | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.284 |
| P402 | HTR-006 | Inlet Gas Sieve Regen Heater | -- | <0.01 | <0.01 | -- | -- | 0.071 | 0.003 | -- | -- | -- | 0.074 |
| P403 | HTR-007 | NGL Regen Heater | -- | <0.01 | <0.01 | -- | -- | 0.052 | 0.002 | -- | -- | -- | 0.054 |
| P034, 035, 036 | HTR-008, 009, 010 | HMO Heaters (3) ³ | -- | 0.001 | 0.002 | -- | -- | 0.812 | 0.034 | -- | -- | -- | 0.853 |
| P037 | | Catalytic Heaters | -- | <0.01 | <0.01 | -- | -- | 0.007 | <0.01 | -- | -- | -- | 0.007 |
| | | Pneumatic Controllers | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Total Proposed Emissions (TPY) | | | -- | 0.005 | 0.003 | <0.01 | <0.01 | 0.944 | 0.039 | -- | -- | -- | 2.730 |
| Total Proposed Emissions (lb/hr) | | | -- | 0.001 | 0.001 | <0.01 | <0.01 | 0.215 | 0.009 | -- | -- | -- | 0.623 |

| | | | | | | | | | | | | | |
|-------------------------------|-------------|-------------|-----------------|-----------------|-----------------|-----------------|-------------|-------------|-----------|-----------|-----------|-----------|-------------|
| Cryo I Emissions (TPY) | 0.03 | 0.01 | | | | | | 0.05 | | | | | 2.51 |
| Total (TPY) | 0.03 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | 0.94 | 0.09 | -- | -- | -- | -- | 5.24 |

(3) HMO Heaters include Manufacturer Guaranteed emission factors where applicable.

Table 2. Amine-002 Amine Sweetening Unit Emissions
PA Unit ID: P202; Source ID: AMINE-002 ; Amine Still Vent and Flash Tank Stack ID: Z204
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant

Amine Unit Still Vent Emissions + Flash Tank Emissions

| Pollutant | PTE ⁽¹⁾ (lbs/hr) | PTE ⁽¹⁾ (tons/yr) | PTE ⁽¹⁾ (lbs/hr) | PTE ⁽¹⁾ (tons/yr) |
|----------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|
| Criteria Pollutants | Uncontrolled | | Controlled | |
| VOC | 26.713 | 117.004 | 0.267 | 1.170 |
| Hazardous Air Pollutants | | | | |
| Benzene | 0.084 | 0.366 | 0.001 | 0.004 |
| Toluene | 0.026 | 0.115 | 0.000 | 0.001 |
| Ethylbenzene | 0.004 | 0.015 | 0.000 | 0.000 |
| Xylenes | 0.010 | 0.044 | 0.000 | 0.000 |
| n-Hexane | 0.029 | 0.126 | 0.000 | 0.001 |
| Methanol | 0.000 | 0.000 | 0.000 | 0.000 |
| Total HAPs | 0.153 | 0.666 | 0.002 | 0.007 |
| Greenhouse Gas Emissions | | | | |
| CO ₂ | 5,444.03 | 23,844.86 | 54.442 | 238.45 |
| CH ₄ | 2.269 | 9.940 | 452.125 | 2.81 |
| N ₂ O | -- | | -- | -- |
| CO ₂ e ⁽³⁾ | 5,500.76 | 24,093.35 | 11357.563 | 308.81 |

| EMISSION ESTIMATE INPUTS | |
|--|------------------|
| Control Device for Still Vent & Flash Tank = | Thermal Oxidizer |
| Control Efficiency (%) = | 99.0 |
| Hours of Operation = | 8760 |

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

Global Warming Potential (GWP)

| | | |
|------------------|-----|-----|
| CO ₂ | 1 | (3) |
| CH ₄ | 25 | (3) |
| N ₂ O | 298 | (3) |

Notes:

(1) Controlled emissions are calculated by assuming specified control efficiencies for the combustion devices: TO = 99%

(2) Emissions of NOx, SOx, CO, PM, and GHG pollutants are the products of combustion of the vent streams in the combustion devices. Based on ProMax simulation.

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

Promax Emissions Data - Precontrol

| Pollutant | Scaled Still Vent ⁽²⁾ | Still Vent | Scaled Flash Tank ⁽²⁾ | Flash Tank |
|----------------------------|----------------------------------|-----------------|----------------------------------|---------------|
| lb/hr | lb/hr | lb/hr | lb/hr | lb/hr |
| CO2 | 5443.0420 | 4948.22 | 0.9895 | 0.8995 |
| Methane | 0.7601 | 0.691 | 1.5092 | 1.3720 |
| Ethane | 60.4725 | 54.975 | 94.1925 | 85.6295 |
| Propane | 7.3933 | 6.7212 | 15.3184 | 13.9258 |
| Isobutane | 0.2130 | 0.1936 | 0.6947 | 0.6315 |
| n-Butane | 0.8133 | 0.7394 | 1.7831 | 1.6210 |
| Isopentane | 0.0300 | 0.0273 | 0.1197 | 0.1088 |
| n-Pentane | 0.0453 | 0.0412 | 0.1498 | 0.1362 |
| n-Hexane | 0.0046 | 0.0042 | 0.0241 | 0.0219 |
| Cyclohexane | -- | -- | -- | -- |
| Heptanes | 0.0001 | 0.0001 | 0.0006 | 0.0005 |
| 2,2,4-Trimethylpentane | -- | -- | -- | -- |
| Benzene | 0.0817 | 0.0743 | 0.0018 | 0.0016 |
| Toluene | 0.0256 | 0.0233 | 0.0006 | 0.0005 |
| Ethylbenzene | 0.0034 | 0.0031 | 0.0001 | 0.0001 |
| Xylenes | 0.0099 | 0.009 | 0.0002 | 0.0002 |
| CH3OH | -- | -- | -- | -- |
| C8+ Heavier HC | 0.0000 | 0.0000 | 0.0001 | 0.0001 |
| Total Emissions | 5,512.89 | 5,011.72 | 114.78 | 104.35 |
| Total HC Emissions | 69.85 | 63.50 | 113.79 | 103.45 |
| Total VOC Emissions | 8.62 | 7.84 | 18.09 | 16.45 |
| Total HAP Emissions | 0.13 | 0.11 | 0.03 | 0.02 |

Notes:

(1) Emissions for closed drain are routed to a VRU and it is only operating total of 2,190 hrs/yr.

(2) Emissions have a 10% engineering safety factor applied.

Table 3. Storage Tank Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: P304, P303C, P303D; Source ID: TK-811C, TK-813C, TK-813D

| PA Unit ID / Site ID | Source Description | Tank Capacity (gal) | Tank Contents | Tank Type | Tank Throughput (gal/yr) each | Tank Throughput (bbls/day)each | Number of Tanks | Hours of Operation | Emissions Data (Working, Breathing, Flashing) | | | |
|----------------------|-----------------------|---------------------|-------------------------|-----------------------------|-------------------------------|--------------------------------|-----------------|--------------------|---|--|--------------------------------------|--|
| | | | | | | | | | VOC Emission Factor (lbs/bbls) | VOC Emissions (lbs/day) ^(a) | VOC Emissions (lb/hr) ^(b) | VOC Emissions (tons/yr) ^(c) |
| Misc. Tanks | Slop Tank | 21,000 | Waste Fluids | Fixed roof | 263,536 | 17.19 | 2.0 | 8,760 | 1.28E-03 | 0.02 | 0.001 | 0.004 |
| | Methanol Tank | 500 | Methyl Alcohol | Horizontal | 11,957 | 0.78 | 1.0 | 8,760 | -- | -- | -- | 0.020 |
| | Oil Tanks | 280-11760 | New/Used Compressor Oil | Fixed Roof / Horizontal | 547,894 | 35.74 | 10.0 | 8,760 | -- | -- | -- | -- |
| | RO Water Storage Tank | 16,800 | RO Water | Fixed Roof | 403,200 | 26.30 | 2.0 | 8,760 | -- | -- | -- | -- |
| | Amine Storage Tank | 8,820 | Amine/Water | Fixed roof with gas blanket | 211,680 | 13.81 | 1.0 | 8,760 | -- | -- | -- | 0.020 |
| | Amine Drain Tank | 4,200 | Amine/Water | Fixed Roof | 100,800 | 6.58 | 2.0 | 8,760 | -- | -- | -- | -- |
| | Propane Storage Tank | 5,000 | Propane | Pressurized | | NA | 1.0 | 8,760 | -- | -- | -- | -- |
| | Open Drain Tank | 4,000 | Oil/Water | Fixed Roof | 3,066 | 0.20 | 2.0 | 8,760 | 9.60 | 1.92 | 0.080 | 0.400 |
| Totals | | | | | | | | | 6.9821 | 0.2909 | 0.4440 | |

Calculations:

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

(b) VOC Emissions (lb/hr) = VOC Emissions (lbs/day) / (day/24hr)

(c) VOC Emissions (ton/yr) = VOC Emissions (lbs/hr) * (8760 hr/yr) * (1 ton/2000 lbs)

Notes:

(1) VOC emission factor includes flashing, working and breathing losses as simulated using ProMax EOS

| | Emissions Data (Working, Breathing, Flashing) | | | | | |
|------------------------------|---|---------------|---------------|----------------|--------------|---------------|
| | CH4 (lbs/hr) | CH4 (tons/yr) | HAPs (lbs/hr) | HAPs (tons/yr) | CO2 (lbs/hr) | CO2 (tons/yr) |
| Misc. Tanks | 0.004 | 0.016 | 0.000 | 0.000 | 0.013 | 0.056 |
| Methanol Tank | 0.000 | 0.000 | 0.000 | 0.020 | 0.000 | 0.000 |
| Oil Tanks | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| RO Water Storage Tank | -- | -- | -- | -- | -- | -- |
| Amine Storage Tank | 0.020 | 0.100 | 0.000 | 0.000 | 0.000 | 0.000 |
| Amine Drain Tank | -- | -- | -- | -- | -- | -- |
| Propane Storage Tank | -- | -- | -- | -- | -- | -- |
| Open Drain Tank | -- | -- | 0.000 | 0.000 | -- | -- |
| Totals | 0.024 | 0.116 | 0.000 | 0.020 | 0.013 | 0.056 |

Table 4. Liquid Loading Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
Source ID: P704, Liquid Loading - Slop Tanks

| Parameter | Value | Description |
|-----------------------|----------|---|
| S | 1.45 | saturation factor for splash loading - AP42 Table 5.2-1 |
| Collection Efficiency | | NA |
| Control Efficiency | | NA |
| P | 0.15 | true vapor pressure of liquid loaded psi - engineering estimate |
| M | 30.3263 | molecular weight of vapors lb/lb-mol - engineering estimate |
| T | 522.6258 | temperature of liquids loaded degR - engineering estimate |

| Description | Loading Losses | VOC | | | |
|--------------|------------------------|--------------------|------------------------|---------------|---------------|
| | | Maximum Throughput | Uncontrolled Emissions | VOC Emissions | VOC Emissions |
| | lb/10 ³ gal | gal/yr | tpy | lb/hr | tpy |
| Slop Hauling | 0.15726 | 262,800 | 0.0207 | 0.0047 | 0.0207 |

Notes:

- (1) Uncontrolled Loading losses: $LI \text{ (lb/10}^3 \text{ gal)} = 12.46 \text{ (SPM)/T}$
- (2) Although slop is expected to be <10% condensate, the loading slop liquid/vapor properties conservatively assumed equivalent to #2 condensate.
- (3) Emission summed with slop tank emissions on the table "Storage Tank Emissions Calculations".
- (4) Slop truck loading factor (lb/Mgal): 1.52

Table 5. FLARE-002 Emergency Flare Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: C203; Source ID: FLARE-002

Emissions from combustion

| Pollutant | Emission Factor (lb/MMBtu) | Units | Post-Control Emissions | | Estimation Basis / Emission Factor Source |
|------------------|----------------------------|----------|------------------------|------------|---|
| | | | lb/hr | tpy | |
| NOx | 0.068 | lb/MMBtu | 33.51 | 0.51 | AP42 Table 13.5-1 |
| CO | 0.310 | lb/MMBtu | 152.76 | 2.34 | AP42 Table 13.5-2 |
| VOC ² | 0.660 | lb/MMBtu | 0.73 | 3.19 | AP42 Table 13.5-2 |
| SOx | 0.001 | lb/MMBtu | 0.49 | 0.01 | AP42 Table 1.4-2 |
| PM10 | 0.000 | lb/MMBtu | -- | -- | Nonsmoking Flare |
| PM2.5 | 0.000 | lb/MMBtu | -- | -- | Nonsmoking Flare |
| GHG (CO2e) | See Table Below | | 57,582.81 | 252,212.70 | 40 CFR 98 Tables C-1,2 |

¹ - Emission factors converted by lb/MMscf to lb/MMBtu based on the HHV cited in AP42 (1020 btu/scf).

² - VOC load does not include contribution from Residue Gas Compressor Blowdowns because these VOC emissions are accounted for in the Amine Unit 002 and Compressor & Misc. Blowdowns sources, respectively.

Emissions from Closed Drain Process Vessel (Routed to VRU (95%), then to the FLARE 002 (98%))

| Pollutant | Pre-Control Emissions ¹ | | VRU Captured ² | | Post-Control Emissions | |
|-----------|------------------------------------|-------|---------------------------|-------|------------------------|------------------|
| | ProMax | | lbs/hr | tpy | lb/hr | tpy ³ |
| | lbs/hr | tpy | | | | |
| VOC | 0.028 | 0.122 | 0.026 | 0.116 | 2.78E-05 | 4.00E-04 |
| CH4 | 0.097 | 0.423 | 0.092 | 0.402 | 9.65E-05 | 1.39E-03 |
| HAP | 0.000 | 0.001 | 0.000 | 0.001 | 1.50E-07 | 2.16E-06 |
| CO2 | 0.082 | 0.360 | 0.078 | 0.342 | 8.21E-05 | 0.001 |

¹ - Emissions for Closed Drain vessel taken from ProMax simulation.

² - VRU - 95% Control

³ - Emission calculations for Closed Drain included 5% uncaptured by VRU plus 1000 hours/yr for VRU downtime.

| | |
|-------------------------------------|--------|
| Control Efficiency % | 98 |
| Estimated Loading to flare MMBtu/hr | 492.27 |
| Estimated Loading to flare MMBtu/yr | 10,610 |
| Pilot Gas Rate scf/hr | 506 |
| Pilot Gas Rate MMBtu/hr | 0.51 |
| Pilot Gas Rate MMBtu/yr | 4,467 |
| Purge Gas Rate MMBtu/hr | 0.59 |
| Purge Gas Rate MMBtu/yr | 5,209 |
| Hours of Operation hr/yr | 8,760 |
| Pilot Hours of Operation hr/yr | 8,760 |

See Table 7 for load calculation

See Table 7 for load calculation

Emissions from Pilot

| Pollutant | Emission Factor (kg/MMBtu) | | Post-Control Emissions | | Estimation Basis |
|------------|----------------------------|----------|------------------------|----------|------------------------|
| | | | lb/hr | tpy | |
| CO2 | 53.060 | kg/MMBtu | 59.53 | 260.76 | 40 CFR 98 Tables C-1,2 |
| CH4 | 0.001 | kg/MMBtu | 1.12E-03 | 4.91E-03 | 40 CFR 98 Tables C-1,2 |
| N2O | 0.0001 | kg/MMBtu | 1.12E-04 | 4.91E-04 | 40 CFR 98 Tables C-1,2 |
| GHG (CO2e) | | | 59.53 | 260.76 | |

1 - PM10 and PM2.5 are total values, filterable + condensable.

2 - GHG (CO2e) is carbon dioxide equivalent, which is the summation of CO2 (GWP = 1)+CH4(GWP=25) +N2O (GWP=298).

3 - Emissions of NOx, SOx, CO, PM and GHG pollutants are the result of combustion of the streams in the flare.

Table 6. FLARE-002 Emergency Flare Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: C203; Source ID: FLARE-002

GHG Emissions - Controlled Streams

| Component | Purge Gas | Residue Gas Compressor Blowdowns | Closed Drain Vapors |
|--|------------------|---|----------------------------|
| | mol % | mol % | mol % |
| CO2 | 0.298 | 0.298 | 13.655 |
| Methane | 98.310 | 98.310 | 43.996 |
| Ethane | 0.878 | 0.878 | 34.111 |
| Propane | 0.020 | 0.020 | 3.820 |
| Isobutane | 0.000 | 0.000 | 0.126 |
| n-Butane | 0.000 | 0.000 | 0.409 |
| Isopentane | 0.000 | 0.000 | 0.025 |
| n-Pentane | 0.000 | 0.000 | 0.020 |
| n-Hexane | 0.000 | 0.000 | 0.004 |
| Cyclohexane | 0.000 | 0.000 | 0.000 |
| Heptanes | 0.000 | 0.000 | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | 0.000 | 0.000 |
| Benzene | 0.000 | 0.000 | 0.003 |
| Toluene | 0.000 | 0.000 | 0.001 |
| Ethylbenzene | 0.000 | 0.000 | 0.000 |
| Xylenes | 0.000 | 0.000 | 0.000 |
| C8+ Heavier HC | 0.000 | 0.000 | 0.000 |
| Flow Rate scfh | 651 | 495,000 | 5.190 |
| Flow scf/yr | 5,702,760 | 5,940,000 | 45,464.4 |
| Control Efficiency % | 98% | 98% | 98% |
| Annual Hours of Operation | 8,760 | 12 | 8,760 |
| Density of CO2 kg/ft3 @ 60F & 14.7 psia | 0.053 | 0.0526 | 0.0526 |
| Ea, CO2 (combusted) scf/hr | 639 | 485,727 | |
| Ea, CO2 (combusted) scf/yr | 5,595,926 | 5,828,721 | |
| Mass, CO2 (combusted) - lb/hr | 74 | 56,327 | 0.082 |
| Mass, CO2 (combusted) - tpy | 324 | 338 | 0.359 |

- 1 - Purge gas for operation of flare is based on Promax run at design conditions and facility
- 2 - Closed drain vapors based on Promax run at design conditions and facility operations.

Table 7. FLARE-002 Emergency Flare Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: C203; Source ID: FLARE-002

Heating Value - Controlled Streams

| Component | Purge Gas | Residue Gas Compressor Blowdowns | Closed Drain Vapors | Total Vented to Flare | Lower Heating Value ² |
|---|------------------|---|----------------------------|------------------------------|---|
| | lb/hr | lb/hr | lb/hr | lb/hr | Mj/kg |
| Water | 0 | 0 | 0.0091 | 0.000 | 0.0000 |
| CO2 | 0.225 | 171 | 0.0822 | 171.229 | 0.0000 |
| Nitrogen | 0.237 | 180 | 0.0000 | 180.237 | 0.0000 |
| Methane | 27.15 | 20550 | 0.0965 | 20577.155 | 50.0090 |
| Ethane | 0.453 | 345 | 0.1402 | 345.460 | 47.7940 |
| Propane | 0.014925 | 11.355 | 0.0230 | 11.371 | 46.3570 |
| Isobutane | 2.880E-04 | 0.219 | 0.0010 | 0.219 | 45.6130 |
| n-Butane | 3.945E-04 | 0.3 | 0.0030 | 0.301 | 45.7520 |
| Isopentane | 7.545E-06 | 5.745E-03 | 2.500E-04 | 0.006 | 45.2410 |
| n-Pentane | 1.127E-05 | 8.565E-03 | 2.000E-04 | 0.009 | 45.3570 |
| n-Hexane | 1.038E-06 | 7.890E-04 | 5.000E-05 | 0.001 | 44.7520 |
| Cyclohexane | 4.38E-08 | 3.330E-05 | 0.000E+00 | 0.000 | 43.4500 |
| Heptanes | 4.215E-08 | 3.195E-05 | 2.000E-06 | 0.000 | 44.5660 |
| 2,2,4-Trimethylpentane | 6.735E-08 | 5.130E-05 | 0.000E+00 | 0.000 | 44.3100 |
| Benzene | 1.635E-08 | 1.238E-05 | 3.000E-05 | 0.000 | 40.1700 |
| Toluene | 3.375E-09 | 2.565E-06 | 1.500E-05 | 0.000 | 40.5890 |
| Ethylbenzene | 1.65E-11 | 1.2525E-08 | 2.800E-06 | 0.000 | 40.9380 |
| Xylenes | 2.295E-11 | 1.755E-08 | 5.500E-06 | 0.000 | 40.9610 |
| C8+ Heavier HC | 5.16E-10 | 3.915E-07 | 0.000E+00 | 0.000 | 44.2640 |
| Total | 28.081 | 21,257.89 | 0.356 | 21390.675 | |
| Each Stream | | | | | |
| Gas Flow Rate lb/hr | 28.081 | 21257.889 | 0.356 | 21,285.99 | |
| Higher Heating Value Btu/lb | 21,174 | 21,173 | 15,511 | 21,949.25 | |
| Max Loading to Flare mmBtu/hr | 0.595 | 450.094 | 0.006 | 450.69 | |
| Hours to Flare | 8,760.0 | 12.0 | 2,190.0 | 8,760.00 | |
| Max Loading to Flare mmBtu/yr | 5,208.6 | 5,401.1 | 12.1 | 10,610.35 | |
| Combined | | | | | |
| Gas Flow Rate (lb/hr) | 21,286 | | | | |
| Higher Heating Value (Btu/lb) | 23,127 | | | | |
| Estimated Loading to Flare, Max (mmBtu/hr) | 492.3 | | | | |
| Estimated Loading to Flare, Max (mmBtu/yr) | 10,610 | | | | |

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 engineering toolbox (http://www.engineeringtoolbox.com/gas-density-d_158.html)

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

Table 8. THERM-002 Thermal Oxidizer (Amine+Deethanizer) Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: C204; Source ID: THERM-002

Emissions from Combustion

| Pollutant | Emission Factor (lb/MMBtu) | Units | Post-control emissions | | Estimation Basis |
|------------------|----------------------------|----------|------------------------|----------|-------------------------|
| | | | lb/hr | tpy | |
| NOx | 0.098 | lb/MMBtu | 0.69 | 3.04 | AP42 Table 1.4-1 |
| CO | 0.082 | lb/MMBtu | 0.58 | 2.55 | AP42 Table 1.4-1 |
| VOC ² | 0.005 | lb/MMBtu | 0.04 | 0.17 | AP42 Table 1.4-2 |
| SOx | 0.001 | lb/MMBtu | <0.01 | 0.02 | AP42 Table 1.4-2 |
| PM10 | 0.007 | lb/MMBtu | 0.05 | 0.23 | AP42 Table 1.4-2 |
| PM2.5 | 0.007 | lb/MMBtu | 0.05 | 0.23 | AP42 Table 1.4-2 |
| CO2 | 53.060 | kg/MMBtu | 828.35 | 3,627.35 | 40 CFR 98, Table C-1, 2 |
| GHG (CO2e) | | | 828.35 | 3,628.18 | |

¹ - Emission factors converted by lb/MMscf to lb/MMBtu based on the HHV cited in AP42 (1020 btu/scf).

² - VOCs are accounted for here for pilot emissions only. Additional VOCs are tabulated under their individual sources

| | |
|---|--------|
| Control Efficiency % | 99 |
| Total Heat Release MMBtu/hr | 6.81 |
| Calculated Loading to oxidizer MMBtu/yr | 59,656 |
| Pilot Gas Rate scf/hr | 266 |
| Pilot Gas Rate MMBtu/hr | 0.27 |
| Pilot Gas Rate MMBtu/yr | 2,351 |
| Hours of Operation hr/yr | 8,760 |
| Pilot Hours of Operation hr/yr | 8,760 |

Emissions from Pilot

| Pollutant | Emission Factor | Units | Post-Control Emissions | | Estimation Basis |
|------------|-----------------|----------|------------------------|-----------|-------------------------|
| | | | lb/hr | tpy | |
| HAP | 0.002 | lb/MMBtu | 0.01 | 0.06 | AP42 Table 1.4-3 |
| CO2 | 53.060 | kg/MMBtu | 31.59 | 137.53 | 40 CFR 98, Table C-1, 2 |
| CH4 | 0.001 | kg/MMBtu | 5.954E-04 | 2.592E-03 | AP42 Table 1.4-2 |
| N2O | 0.0001 | kg/MMBtu | 5.954E-05 | 2.592E-04 | AP42 Table 1.4-2 |
| GHG (CO2e) | | | 31.62 | 137.67 | |

1 - PM10 and PM2.5 are total values, filterable + condensable.

2 - GHG (CO2e) is carbon dioxide equivalent, which is the summation of CO2 (GWP = 1)+CH4(GWP=25) +N2O (GWP=298).

3 - Emissions of NOx, SOx, CO, PM and GHG pollutants are the result of combustion of the streams in the oxidizer.

Table 9. THERM-002 Thermal Oxidizer (Amine+Deethanizer) Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: C204; Source ID: THERM-002

GHG Emissions - Controlled Streams

| Component | Amine Vent Stream | | Fuel Stream | | Amine Flash Tank | |
|--|-------------------|------------------|---------------|------------------|------------------|------------------|
| | mol % | Volume scf/hr | mol % | Volume scf/hr | mol % | Volume scf/hr |
| CO2 | 90.9553 | 42667.510 | 0.0149 | 0.557 | 0.61 | 7.76 |
| Methane | 0.0348 | 16.346 | 99.4426 | 3729.098 | 2.56 | 32.46 |
| Ethane | 1.4790 | 693.810 | 0.0810 | 3.038 | 85.37 | 1,080.66 |
| Propane | 0.1233 | 57.842 | 0.0000 | 0.000 | 9.47 | 119.84 |
| Isobutane | 0.0027 | 1.264 | 0.0000 | 0.000 | 0.3257 | 4.12 |
| n-Butane | 0.0103 | 4.827 | 0.0000 | 0.000 | 0.8360 | 10.58 |
| Isopentane | 0.0003 | 0.144 | 0.0000 | 0.000 | 0.0452 | 0.573 |
| n-Pentane | 0.0005 | 0.217 | 0.0000 | 0.000 | 0.0566 | 0.717 |
| n-Hexane | 0.0000 | 0.018 | 0.0000 | 0.000 | 0.0076 | 0.097 |
| Cyclohexane | 0.0000 | 0.000 | 0.0000 | 0.000 | 0.000 | 0.000 |
| Heptanes | 0.0000 | 0.000 | 0.0000 | 0.000 | 0.0002 | 0.002 |
| 2,2,4-Trimethylpentane | 0.0000 | 0.000 | 0.0000 | 0.000 | 0.0000 | 0.000 |
| Benzene | 0.0008 | 0.361 | 0.0000 | 0.000 | 0.0006 | 0.008 |
| Toluene | 0.0002 | 0.096 | 0.0000 | 0.000 | 0.0002 | 0.002 |
| Ethylbenzene | 0.0000 | 0.011 | 0.0000 | 0.000 | 0.0000 | 0.000 |
| Xylenes | 0.0001 | 0.032 | 0.0000 | 0.000 | 0.0000 | 0.001 |
| C8+ Heavier HC | 0.0000 | 0.000 | 0.0000 | 0.000 | 0.0000 | 0.000 |
| Flow Rate scfh | 46,910.42 | 43442.479 | 3,750.00 | 3732.6924 | 1,265.88 | 1256.82 |
| Flow scf/yr | 410,935,250.00 | | 32,850,000.00 | | 11,089,065.00 | |
| Control Efficiency % | 99.000 | | | | | |
| Annual Hours of Operation | 8,760 | | | | | |
| 1 - Based on Promax simulation at design conditions. Uncombusted CO2 shown on the Amine Vent calculations. | | | | | | |

Table 10. THERM-002 Thermal Oxidizer (Amine+Deethanizer) Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: C204; Source ID: THERM-002

Heating Value - Controlled Streams

| Component | Amine Vent Stream | Fuel Gas | Amine Flash Tank | Total Vented to Oxidizer | Lower Heating Value ² | Lower Heating Value ³ | Total Weight Percent | Higher Heating Value |
|------------------------|-------------------|----------------|------------------|--------------------------|----------------------------------|----------------------------------|----------------------|----------------------|
| | lb/hr | lb/hr | lb/hr | lb/hr | Mj/kg | Btu/lb | wt% | Btu/lb |
| Water | 164.632 | | | 164.632 | 0.000 | 0.000 | 0.030 | 0.000 |
| CO2 | 4948.220 | 0.065 | 0.900 | 4949.184 | 0.000 | 0.000 | 0.910 | 0.000 |
| Nitrogen | | 1.278 | 0.000 | 1.278 | 0.000 | 0.000 | 0.000 | 0.000 |
| Methane | 0.691 | 157.645 | 1.372 | 159.708 | 50.009 | 21498.869 | 0.029 | 631.175 |
| Ethane | 54.975 | 0.241 | 85.630 | 140.845 | 47.794 | 20546.641 | 0.026 | 531.973 |
| Propane | 6.721 | 0.000 | 13.926 | 20.647 | 46.357 | 19928.874 | 0.004 | 75.639 |
| Isobutane | 0.194 | 0.000 | 0.632 | 0.825 | 45.613 | 19609.029 | 0.000 | 2.974 |
| n-Butane | 0.739 | 0.000 | 1.621 | 2.360 | 45.752 | 19668.785 | 0.000 | 8.534 |
| Isopentane | 0.027 | | 0.109 | 0.136 | 45.241 | 19449.106 | 0.000 | 0.487 |
| n-Pentane | 0.041 | | 0.136 | 0.177 | 45.357 | 19498.974 | 0.000 | 0.636 |
| n-Hexane | 0.004 | | 0.022 | 0.026 | 44.752 | 19238.885 | 0.000 | 0.092 |
| Cyclohexane | | | 0.000 | 0.000 | 43.450 | 18679.155 | 0.000 | 0.000 |
| Heptanes | 0.000 | | 0.001 | 0.001 | 44.566 | 19158.923 | 0.000 | 0.002 |
| 2,2,4-Trimethylpentane | | | 0.000 | 0.000 | 44.310 | 19048.869 | 0.000 | 0.000 |
| Benzene | 0.074 | | 0.002 | 0.076 | 40.170 | 17269.083 | 0.000 | 0.241 |
| Toluene | 0.023 | | 0.001 | 0.024 | 40.589 | 17449.211 | 0.000 | 0.076 |
| Ethylbenzene | 0.003 | | 0.000 | 0.003 | 40.938 | 17599.246 | 0.000 | 0.010 |
| Xylenes | 0.009 | | 0.000 | 0.009 | 40.961 | 17609.134 | 0.000 | 0.030 |
| C8+ Heavier HC | 0.000 | | 0.000 | 0.000 | 44.264 | 19029.094 | 0.000 | 0.000 |
| Total (lb/hr) | 5176.355 | 159.228 | 104.349 | 5439.932 | | | 1.000 | 1251.869 |

Gas Flow Rate lb/hr 5,439.93
Higher Heating Value (Btu/lb) 1,251.87
Max Loading to Oxidizer mmBtu/hr 6.810
Hours to Oxidizer 8760
Max Loading to Oxidizer mmBtu/yr 59,656.34

1 - Values taken from ProMax Simulation
2 - Published values from https://en.wikipedia.org/wiki/Heat_of_combustion
3 - Conversion from Mj/kg to Btu/lb by using 1 MJ/kg=429.9 Btu/lb.

Table 11. Fugitive Component Leak Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: P703; Source ID: FUG

| Total Fugitive Emissions: Component Leaks + Rod Packing + GHG | | | |
|---|-----------------------|----------|--|
| Pollutant | Atmospheric Emissions | | Emission Estimation Method |
| | lbs/hr | tpy | |
| VOC | 1.76 | 7.69 | EPA Protocol Table 2-4, Site Specific Gas Analysis |
| HAPs | 0.08 | 0.37 | EPA Protocol Table 2-4, Site Specific Gas Analysis |
| CO2 | 0.18 | 0.80 | 40 CFR 98 Table W-1A, Site Specific Gas Analysis |
| CH4 | 21.94 | 96.10 | 41 CFR 98 Table W-1A, Site Specific Gas Analysis |
| GHG (CO2e) | 548.71 | 2,403.33 | GWP: CO2=1, CH4=25 |

| Fugitive Emissions from Component Leaks | | | | | | | | |
|---|---------------|--|--|--------------------------------|---|-----------------------------|--------------------------------|--------------------------------|
| Component - Service | Stream | Estimated Component Count ⁽²⁾ | Gas Leak Emission Factor ⁽³⁾ lb/hr/component | Maximum Gas Leak Rate lb/hr | LDAR Control Efficiency ⁽⁴⁾ % | Actual Gas Leak Rate tpy | Potential VOC Emissions tpy | Potential HAP Emissions tpy |
| Valves - Gas/Vapor | Station Inlet | 3,470 | 9.92E-03 | 34.42 | 97% | 4.52 | 0.89 | 0.06 |
| Valves - Gas/Vapor | Residue | 1,875 | 9.92E-03 | 18.60 | 97% | 2.44 | 0.00 | 0.00 |
| Valves - Heavy Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Valves - Gas/Vapor | Refrigerant | 825 | 9.92E-03 | 8.18 | 97% | 1.08 | 1.08 | 0.00 |
| Valves - Light Oil | Condensate | 4,125 | 5.51E-03 | 22.73 | 97% | 2.99 | 1.45 | 0.10 |
| Valves - Water/Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Pump Seals - Gas | Station Inlet | 0 | 5.29E-03 | 0.00 | 0% | 0.00 | 0.00 | 0.00 |
| Pump Seals - Gas | Residue | 0 | 5.29E-03 | 0.00 | 0% | 0.00 | 0.00 | 0.00 |
| Pump Seals - Heavy Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Pump Seals - Gas | Refrigerant | 6 | 5.29E-03 | 0.03 | 75% | 0.03 | 0.03 | 0.00 |
| Pump Seals - Light Oil | Condensate | 75 | 2.87E-02 | 2.15 | 75% | 2.36 | 1.14 | 0.08 |
| Pump Seals - Water/Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Other ⁽¹⁾ - Gas/Vapor | Station Inlet | 141 | 1.94E-02 | 2.74 | 97% | 0.36 | 0.07 | 0.00 |
| Other - Gas/Vapor | Residue | 75 | 1.94E-02 | 1.46 | 97% | 0.19 | 0.00 | 0.00 |
| Other - Heavy Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Other - Gas/Vapor | Refrigerant | 47 | 1.94E-02 | 0.90 | 75% | 0.99 | 0.99 | 0.00 |
| Other - Light Oil | Condensate | 132 | 1.65E-02 | 2.18 | 75% | 2.38 | 1.16 | 0.08 |
| Other - Water/Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Connectors - Gas | Station Inlet | 1,530 | 4.41E-04 | 0.67 | 97% | 0.09 | 0.02 | 0.00 |
| Connectors - Gas | Residue | 1,530 | 4.41E-04 | 0.67 | 97% | 0.09 | 0.00 | 0.00 |
| Connectors - Heavy Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Connectors - Light Oil | Refrigerant | -- | 4.63E-04 | -- | -- | -- | -- | -- |
| Connectors - Light Oil | Condensate | -- | 4.63E-04 | -- | -- | -- | -- | -- |
| Connectors - Water/Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Flanges - Gas/Vapor | Station Inlet | 12,351 | 8.60E-04 | 10.62 | 97% | 1.40 | 0.28 | 0.02 |
| Flanges - Gas/Vapor | Residue | 6,563 | 8.60E-04 | 5.64 | 97% | 0.74 | 0.00 | 0.00 |
| Flanges - Heavy Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Flanges - Gas/Vapor | Refrigerant | 2,738 | 8.60E-04 | 2.35 | 97% | 0.31 | 0.31 | 0.00 |
| Flanges - Light Oil | Condensate | 15,938 | 2.43E-04 | 3.87 | 97% | 0.51 | 0.25 | 0.02 |
| Flanges - Water/Oil | -- | -- | -- | -- | -- | -- | -- | -- |
| Open-ended Lines - Gas | Station Inlet | 0 | 4.41E-03 | 0.00 | 97% | 0.00 | 0.00 | 0.00 |
| Open-ended Lines - Gas | Residue | 0 | 4.41E-03 | 0.00 | 97% | 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 | -- | -- | -- | -- | -- | 20.48 | 7.67 | 0.37 |

Calculations:

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

| Stream Composition ⁽⁵⁾ | | | | |
|-----------------------------------|---------|---------|---------|----------|
| | Wt% VOC | Wt% HAP | Wt% CO2 | Wt% CH4 |
| Inlet Gas | 19.79% | 1.39% | 103.00% | 5748.00% |
| Residue Gas | 0.06% | 0.00% | 80.00% | 9668.00% |
| Refrigeration | 100.00% | 0.00% | 0.00% | 0.00% |
| Condensate | 48.52% | 3.43% | 137.00% | 62.00% |

(1) Other equipment includes compressor seals, relief valves, diaphragms, drains, meters, etc.

(2) Component count is an estimate based on the proposed design of the facility.

(3) 1995 Protocol for Equipment Leak Emission Estimates Table 2-4, EPA-453/R-95-017.

(4) Control Efficiencies from TCEQ - Control Efficiencies for TCEQ Leak Detection and Repair Programs revised 07/22; accounts for NSPS LDAR and FLIR/AVO programs.

(5) VOC, HAP, CO2, CH4 emissions are based on fractions of these pollutants as shown in the table above.

**Table 12. Fugitive Component Leak Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant**

| Rod Packing Emissions | | | | | | | | |
|------------------------------|------------------|-------------|-----------------------------|-----------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Compressor | # of Compressors | # of Throws | Leak Factor scf/hr/throw | Total Volume NG Emitted scf/yr | Potential VOC Emissions tpy | Potential HAP Emissions tpy | Potential CO2 Emissions tpy | Potential CH4 Emissions tpy |
| Residue (Electric) | 3 | 6.0 | 11.5 | 1,813,320 | 0.02 | 0.00 | 0.31 | 37.72 |
| Stabilizer (Electric) | 0 | 2.0 | 11.5 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| Centrifugal | | | | | | | | |
| Total | | | | | 0.02 | 0.00 | 0.31 | 37.72 |

- Emission factors from http://www.epa.gov/gasstar/documents/ll_rodpack.pdf
- VOC, HAP, CH4, and CO2 emissions are based on fractions of these pollutants as follows:

| Stream Composition ⁽⁴⁾ | | | | | |
|-----------------------------------|---------|---------|---------|---------|-------|
| | Wt% VOC | Wt% HAP | Wt% CO2 | Wt% CH4 | MW |
| Inlet Gas | 19.76% | 1.34% | 1.03% | 57.48% | 21.21 |
| Residue Gas | 0.06% | 0.00% | 0.80% | 96.68% | 16.31 |
| Stabilizer Overhead | 66.01% | 0.22% | 0.01% | 8.67% | 37.34 |

| GHG Fugitive Emissions from Component Leaks | | | | | | |
|--|------------------------------|---|----------------------|----------------------------|----------------------|-------------------|
| Component | Estimated Component Count | GHG Emission Factor scf/hr/source | Factor Source | Total NG Emitted scf/yr | CO2 Emissions tpy | CH4 Emissions tpy |
| Connectors | 4,080 | 0.0030 | 40 CFR 98 Table W-1A | 117,945 | 0.02 | 2.45 |
| Flanges | 25,218 | 0.0030 | 40 CFR 98 Table W-1A | 729,002 | 0.13 | 15.14 |
| Open ended Lines | 0 | 0.0610 | 40 CFR 98 Table W-1A | 0 | 0.00 | 0.00 |
| Valves | 7,125 | 0.0270 | 40 CFR 98 Table W-1A | 1,853,726 | 0.32 | 38.49 |
| Other | 288 | 0.0400 | 40 CFR 98 Table W-1A | 111,007 | 0.02 | 2.30 |
| Total | | | | | 0.49 | 58.38 |

- The component count is a preliminary estimate based on the proposed design of the facility.
- VOC, HAP, CH4, and CO2 emissions are based on fractions of these pollutants as follows:

| | | | | |
|-------------|-----------|-----------|-----------|-------|
| | Vol % VOC | Vol % HAP | Vol % CO2 | Vol % |
| Residue Gas | 0.02 | 0.00 | 0.30 | 98.31 |
| Inlet Gas | 8.02 | 0.31 | 0.50 | 76.10 |
- Emissions are calculated in accordance with Equations W-31, W-35 and W-36 in Subpart W of 40 CFR 98.
- GHG (CO2e) is carbon dioxide equivalent, which is the summation of CO2 (GWP = 1) + CH4 (GWP = 25) + N2O (GWP = 298).
- Pneumatic devices at the facility are plant air; as such, no pneumatic device emissions are estimated.
- Density as follows:

| | |
|---|---|
| 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: 2.40E-05 lb VOC/ft3 of total gas (residue gas) | HAP: 1.73E-09 lb HAP/ft3 of total gas (residue gas) |
| VOC: 1.11E-02 lb VOC/ft3 of total gas (inlet gas) | HAP: 7.52E-04 lb HAP/ft3 of total gas (inlet gas) |

Table 13. Compressor & Misc. Blowdown Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
PA Unit ID: P802

| Total Vented Blowdown Emissions | | | |
|--|-----------------------|----------|--|
| Pollutant | Atmospheric Emissions | | Emission Estimation Method |
| | lb/hr | tpy | |
| VOC | -- | 18.94 | Estimated Gas Volumes & Site Specific Gas Analysis |
| HAPs | -- | 1.28 | |
| CO2 | -- | 0.97 | |
| CH4 | -- | 56.75 | |
| GHG (CO2e) | -- | 1,419.76 | GWP: CO2 1, CH4 25 |

1. Hours/yr (est @ 10 min per event): 22 hr/yr

| Stream Composition ⁽⁴⁾ | | | | | |
|-----------------------------------|---------|---------|---------|---------|-------|
| | Wt% VOC | Wt% HAP | Wt% CO2 | Wt% CH4 | MW |
| Inlet Gas | 19.76% | 1.34% | 1.03% | 57.48% | 21.21 |
| Residue Gas | 0.06% | 0.00% | 0.80% | 96.68% | 16.31 |
| Stabilizer Overhead | 66.01% | 0.22% | 0.01% | 8.67% | 37.34 |

| Vented Blowdown Emissions | | | | | | | | | | |
|----------------------------------|------------|-------------|--------------------------|--------------------------|-----------------------------|--------------------------------|-----------------------------|-------------------|-----------------------------|-----------------------------|
| Blowdown Source | # of Units | # Events/yr | Gas Volume per Event scf | Controlled by Flare? Y/N | Potential NG Emitted scf/yr | NG Emitted Post Control scf/yr | Potential VOC Emissions tpy | Potential HAP tpy | Potential CO2 Emissions tpy | Potential CH4 Emissions tpy |
| Residue Compressor (Electric) | 3 | 72 | 55,000 | Y | 3,960,000 | 79,200 | 0.001 | 0.000 | 0.014 | 1.648 |
| Moisture Analyzer | -- | -- | -- | N | 197,100 | 197,100 | 1.090 | 0.074 | 0.055 | 3.171 |
| Facility Maintenance | -- | -- | -- | N | 450,000 | 450,000 | 2.488 | 0.169 | 0.126 | 7.240 |
| Misc Blowdowns | -- | -- | -- | Y | 138,888,000 | 2,777,760 | 15.359 | 1.042 | 0.777 | 44.692 |
| Total | | | | | | | 18.94 | 1.28 | 0.97 | 56.75 |

1. VOC, HAP, CH4, and CO2 emissions are based on fractions of these pollutants as follows: Wt % VOC Wt % HAP Wt % CO2 Wt % CH4

| | | | | |
|--------------------------------|-------|------|------|-------|
| Residue Gas (MW 16.31) | 0.06 | 0.00 | 0.80 | 96.68 |
| Stabilizer Overhead (MW 37.43) | 66.01 | 0.22 | 0.01 | 8.67 |
| Inlet Gas (MW 21.21) | 19.76 | 1.34 | 1.03 | 57.48 |

2. The gas volumes are estimated based on facility design and standard engineering calculations.

3. Per footnote in Section H10 of GP-5 Application Form and GP-5 Application Instructions (Rev 1/2015), emissions include blowdowns.

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

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:

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: 2.40E-05 lb VOC/ft3 of total gas (residue gas)

VOC: 1.11E-02 lb VOC/ft3 of total gas (inlet gas)

HAP: 1.73E-09 lb HAP/ft3 of total

HAP: 7.52E-04 lb HAP/ft3 of total

Value for 'lb VOC/scf' of total gas = Sum of (vol%/100 * MW (lb/lb-mol) / 379 scf/lb-mol) for each VOC constituent

Table 14. Inlet Gas Mol Sieve Dehydration Regen Heater Emissions

**ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
9.04 MMBtu/hr Regen Heater
PA Unit ID: P402; Source ID: HTR-006**

| Pollutant | Emission Factor | PTE (lb/hr) | PTE (ton/yr) |
|----------------------------------|-----------------------|--------------|--------------|
| Criteria Pollutants | | | |
| PM/PM10/PM2.5 | 1.3E-02 lb/MMBTU (2) | 0.119 (c) | 0.523 (d) |
| SO ₂ | 6.0E-01 lb/MMcf (1) | 0.005 (a) | 0.024 (b) |
| NO _x | 1.2E-02 lb/MMBTU (2) | 0.108 (c) | 0.475 (d) |
| CO | 4.1E-02 lb/MMBTU (2) | 0.368 (c) | 0.178 (d) |
| VOC | 1.9E-02 lb/MMBTU (2) | 0.174 (c) | 0.760 (d) |
| 2 | | | |
| Hazardous Air Pollutants | | | |
| Arsenic | 2.00E-04 lb/MMcf (3) | 1.79E-06 (a) | 7.85E-06 (b) |
| Benzene | 2.10E-03 lb/MMcf (4) | 1.88E-05 (a) | 8.24E-05 (b) |
| Beryllium | 1.20E-05 lb/MMcf (3) | 1.08E-07 (a) | 4.71E-07 (b) |
| Cadmium | 1.10E-03 lb/MMcf (3) | 9.86E-06 (a) | 4.32E-05 (b) |
| Chromium | 1.40E-03 lb/MMcf (3) | 1.25E-05 (a) | 5.49E-05 (b) |
| Cobalt | 8.40E-05 lb/MMcf (3) | 7.53E-07 (a) | 3.30E-06 (b) |
| Dichlorobenzene | 1.20E-03 lb/MMcf (4) | 1.08E-05 (a) | 4.71E-05 (b) |
| Formaldehyde | 7.50E-02 lb/MMcf (4) | 6.72E-04 (a) | 2.94E-03 (b) |
| Hexane | 1.80E+00 lb/MMcf (4) | 1.61E-02 (a) | 7.06E-02 (b) |
| Lead | 5.00E-04 lb/MMcf (3) | 4.48E-06 (a) | 1.96E-05 (b) |
| Manganese | 3.80E-04 lb/MMcf (3) | 3.40E-06 (a) | 1.49E-05 (b) |
| Mercury | 2.60E-04 lb/MMcf (3) | 2.33E-06 (a) | 1.02E-05 (b) |
| Naphthalene | 6.10E-04 lb/MMcf (4) | 5.47E-06 (a) | 2.39E-05 (b) |
| Nickel | 2.10E-03 lb/MMcf (3) | 1.88E-05 (a) | 8.24E-05 (b) |
| PAH/POM | 1.29E-03 lb/MMcf (4) | 1.15E-05 (a) | 5.06E-05 (b) |
| Selenium | 2.40E-05 lb/MMcf (3) | 2.15E-07 (a) | 9.42E-07 (b) |
| Toluene | 3.40E-03 lb/MMcf (4) | 3.05E-05 (a) | 1.33E-04 (b) |
| Total HAPs | | 0.017 | 0.074 |
| Greenhouse Gas Emissions | | | |
| CO ₂ | 116.98 lb/MMBtu (5) | 1057.50 (c) | 4631.85 (d) |
| CH ₄ | 2.2E-03 lb/MMBtu (5) | 0.02 (c) | 0.09 (d) |
| N ₂ O | 2.20E-04 lb/MMBtu (5) | 0.00 (c) | 0.01 (d) |
| CO ₂ e ^(e) | - | 1058.59 | 4636.63 |

Calculations:

LB/MMCF

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

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

LB/MMBTU

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

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

| EMISSION INPUTS TABLE | |
|--|--------|
| Fuel Use (MMBtu/hr) = | 9.040 |
| Number of Burners = | 1 |
| Hours of Operation (hr/yr) = | 8,760 |
| MMBtu/MMcf = | 1,009 |
| PTE Fuel Use (MMft ³ /yr) = | 78.484 |

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

| | | |
|------------------|-----|-----|
| CO ₂ | 1 | (6) |
| CH ₄ | 25 | (6) |
| N ₂ O | 298 | (6) |

Notes:

(1) AP-42, Chapter 1.4, Table 1.4-2. Emission Factors For Criteria Pollutants and Greenhouse Gases From Natural Gas Combustion, July 1998.

(2) Manufacturer Guarantee. Emission Factors For, NO_x, CO, VOC, and PM/PM10/PM2.5

(3) AP-42, Chapter 1.4, Table 1.4-4. Emission Factors For Metals From Natural Gas Combustion, July 1998.

(4) AP-42, Chapter 1.4, Table 1.4-3. Emission Factors for Speciated Organic Compounds from Natural Gas Combustion, July 1998.

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

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

Table 15. NGL Dehy Regen Heater Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
6.64 MMBtu/hr Reboiler Burner
PA Unit ID: P403; Source ID: HTR-007

| Pollutant | Emission Factor | PTE (lb/hr) | PTE (ton/yr) |
|----------------------------------|-----------------------|-------------|--------------|
| Criteria Pollutants | | | |
| PM/PM10/PM2.5 | 1.3E-02 lb/MMBTU (2) | 0.088 (a) | 0.384 (b) |
| SO ₂ | 6.0E-01 lb/MMcf (1) | 0.004 (a) | 0.017 (b) |
| NO _x | 1.2E-02 lb/MMBTU (2) | 0.080 (a) | 0.349 (b) |
| CO | 4.1E-02 lb/MMBTU (2) | 0.270 (a) | 1.184 (b) |
| VOC | 1.9E-02 lb/MMBTU (2) | 0.127 (a) | 0.558 (b) |
| Hazardous Air Pollutants | | | |
| Arsenic | 2.00E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Benzene | 2.10E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Beryllium | 1.20E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Cadmium | 1.10E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Chromium | 1.40E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Cobalt | 8.40E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Dichlorobenzene | 1.20E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Formaldehyde | 7.50E-02 lb/MMcf (4) | 0.000 (a) | 0.002 (b) |
| Hexane | 1.80E+00 lb/MMcf (4) | 0.012 (a) | 0.052 (b) |
| Lead | 5.00E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Manganese | 3.80E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Mercury | 2.60E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Naphthalene | 6.10E-04 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Nickel | 2.10E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| PAH/POM | 1.29E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Selenium | 2.40E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Toluene | 3.40E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Total HAPs | | 0.012 | 0.054 |
| Greenhouse Gas Emissions | | | |
| CO ₂ | 116.98 lb/MMBtu (5) | 776.75 (c) | 3402.15 (d) |
| CH ₄ | 2.2E-03 lb/MMBtu (5) | 0.01 (c) | 0.06 (d) |
| N ₂ O | 2.20E-04 lb/MMBtu (5) | 0.00 (c) | 0.01 (d) |
| CO ₂ e ^(e) | - | 777.55 | 3405.67 |

Calculations:

LB/MMCF

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

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

LB/MMBTU

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

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

| EMISSION INPUTS TABLE | |
|------------------------------|--------|
| Fuel Use (MMBtu/hr) = | 6.640 |
| Number of Burners = | 1 |
| Hours of Operation (hr/yr) = | 8,760 |
| MMBtu/MMcf = | 1,009 |
| PTE Fuel Use (MMcf/yr) = | 57.648 |

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

| | | |
|------------------|-----|-----|
| CO ₂ | 1 | (6) |
| CH ₄ | 25 | (6) |
| N ₂ O | 298 | (6) |

Notes:

(1) AP-42, Chapter 1.4, Table 1.4-2. Emission Factors For Criteria Pollutants and Greenhouse Gases From Natural Gas Combustion, July 1998.

(2) Manufacturer Guarantee. Emission Factors for NO_x, CO, VOC, and PM/PM10/PM2.5

(3) AP-42, Chapter 1.4, Table 1.4-4. Emission Factors For Metals From Natural Gas Combustion, July 1998.

(4) AP-42, Chapter 1.4, Table 1.4-3. Emission Factors for Speciated Organic Compounds from Natural Gas Combustion, July 1998.

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

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

Table 16. HMO Heaters (3)

ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
 PA Unit ID: P034, P035, P036; Source ID: HTR-008, HTR-009, HTR-010
 Three - 34.65 MMBtu/hr Units

| Pollutant | Emission Factor | 1 Unit | | 3 Units Total | |
|----------------------------------|---|--------------|---------------|------------------------------|------------------------------|
| | | PTE (lb/hr) | PTE (ton/yr) | PTE (lb/hr) | PTE (ton/yr) |
| Criteria Pollutants | | | | | |
| SO ₂ ⁽¹⁾ | 6.0E-01 lb/MMcf AP-42, Chapter 1.4, Table 1.4-2 | 0.021 (a) | 0.090 (b) | 0.062 AP-42 | 0.271 AP-42 |
| VOC ⁽²⁾ | 1.9E-02 lb/MMBTU | 0.665 (a) | 2.914 (d) | 1.996 | 8.742 |
| PM/PM10/PM2.5 ⁽²⁾ | 1.3E-02 lb/MMBTU Manufacturer Guarantee | 0.457 (c) | 0.231 (d) | 1.372 Manufacturer Guarantee | 0.692 Manufacturer Guarantee |
| Nox ⁽²⁾ | 1.2E-02 lb/MMBTU | 0.416 (c) | 1.821 (d) | 1.247 | 5.464 |
| CO ⁽²⁾ | 4.1E-02 lb/MMBTU | 1.410 (c) | 6.177 (d) | 4.231 | 18.531 |
| Hazardous Air Pollutants | | | | | |
| Arsenic | 2.00E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 2.060E-05 | 9.025E-05 |
| Benzene | 2.10E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) | 2.163E-04 | 9.476E-04 |
| Beryllium | 1.20E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 1.236E-06 | 5.415E-06 |
| Cadmium | 1.10E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 1.133E-04 | 4.964E-04 |
| Chromium | 1.40E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 1.442E-04 | 6.317E-04 |
| Cobalt | 8.40E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 8.654E-06 | 3.790E-05 |
| Dichlorobenzene | 1.20E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) | 1.236E-04 | 5.415E-04 |
| Formaldehyde | 7.50E-02 lb/MMcf (4) | 0.003 (a) | 0.011 (b) | 7.727E-03 | 3.384E-02 |
| Hexane | 1.80E+00 lb/MMcf (4) | 0.062 (a) | 0.271 (b) | 1.854E-01 | 8.122E-01 |
| Lead | 5.00E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 5.151E-05 | 2.256E-04 |
| Manganese | 3.80E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 3.915E-05 | 1.715E-04 |
| Mercury | 2.60E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 2.679E-05 | 1.173E-04 |
| Naphthalene | 6.10E-04 lb/MMcf (4) | 0.000 (a) | 0.000 (b) | 6.284E-05 | 2.753E-04 |
| Nickel | 2.10E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 2.163E-04 | 9.476E-04 |
| PAH/POM | 1.29E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) | 1.327E-04 | 5.813E-04 |
| Selenium | 2.40E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) | 2.473E-06 | 1.083E-05 |
| Toluene | 3.40E-03 lb/MMcf (4) | 0.000 (a) | 0.001 (b) | 3.503E-04 | 1.534E-03 |
| Total HAPs | | 0.065 | 0.284 | 0.195 | 0.853 |
| Greenhouse Gas Emissions | | | | | |
| CO ₂ | 116.98 lb/MMBTU (5) | 4,053.36 (c) | 17,753.70 (d) | 12,160.07 | 53,261.11 |
| CH ₄ | 2.2E-03 lb/MMBTU (5) | 0.08 (c) | 0.33 (d) | 0.23 | 1.00 |
| N ₂ O | 2.20E-04 lb/MMBTU (5) | 0.01 (c) | 0.03 (d) | 0.02 | 0.10 |
| CO ₂ e ^(e) | - | 4,057.54 | 17,772.04 | 12,172.63 | 53,316.12 |

Calculations:

LB/MMCF

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

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

LB/MMBTU

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

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

| EMISSION INPUTS TABLE | |
|------------------------------|---------|
| Heat Input (MMBTU/hr) = | 34.65 |
| Number of Burners = | 3 |
| Hours of Operation (hr/yr) = | 8,760 |
| MMBTU/MMcf = | 1,009 |
| Heat Input (MMBTU/hr) = | 34.65 |
| Heat Input (MMBTU/yr) = | 303,534 |
| PTE Fuel Use (MMcf3/yr) = | 300.83 |

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

Global Warming Potential (GWP)

| | | |
|------------------|-----|-----|
| CO ₂ | 1 | (6) |
| CH ₄ | 25 | (6) |
| N ₂ O | 298 | (6) |

Notes:

(1) AP-42, Chapter 1.4, Table 1.4-2. Emission Factors For SO₂ and Greenhouse Gases From Natural Gas Combustion, July 1998.

(2) Manufacturer Guarantee. Emission Factors for NOx, CO, VOC, and PM/PM10/PM2.5

(3) AP-42, Chapter 1.4, Table 1.4-4. Emission Factors For Metals From Natural Gas Combustion, July 1998.

(4) AP-42, Chapter 1.4, Table 1.4-3. Emission Factors for Speciated Organic Compounds from Natural Gas Combustion, July 1998.

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

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

Table 17. Catalytic Heater Emissions
ETC Northeast Pipeline, LLC - Revolution Cryogenic Plant
0.06 MMBtu/hr Catalytic Heater
PA Unit ID: P038

| Total Emissions for 15 Units | lb/hr | TPY |
|----------------------------------|--------|--------|
| PM/PM10/PM2.5 | 0.01 | 0.06 |
| SO ₂ | 0.00 | 0.00 |
| NOx | 0.04 | 0.16 |
| CO | 0.04 | 0.16 |
| VOC | 0.01 | 0.02 |
| Total HAPs | 0.003 | 0.01 |
| CO ₂ e ^(e) | 105.35 | 465.22 |

| Pollutant | Emission Factor | PTE (lb/hr) | PTE (ton/yr) |
|---|-----------------------|---------------|---------------|
| Criteria Pollutants | | | |
| PM/PM10/PM2.5 | 1.4E-02 lb/MMBtu (1) | 0.001 (a) | 0.004 (b) |
| SO ₂ | 6.0E-01 lb/MMcf (1) | 0.000 (a) | 0.000 (b) |
| NOx | 4.0E-02 lb/MMBtu (2) | 0.002 (a) | 0.011 (b) |
| CO | 4.0E-02 lb/MMBtu (2) | 0.002 (a) | 0.011 (b) |
| VOC | 5.5E+00 lb/MMcf (1) | 0.001 (a) | 0.001 (b) |
| Hazardous Air Pollutants | | | |
| Arsenic | 2.00E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Benzene | 2.10E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Beryllium | 1.20E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Cadmium | 1.10E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Chromium | 1.40E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Cobalt | 8.40E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Dichlorobenzene | 1.20E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Formaldehyde | 8.00E-02 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Hexane | 1.80E+00 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Lead | 5.00E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Manganese | 3.80E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Mercury | 2.60E-04 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Naphthalene | 6.10E-04 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Nickel | 2.10E-03 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| PAH/POM | 1.29E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Selenium | 2.40E-05 lb/MMcf (3) | 0.000 (a) | 0.000 (b) |
| Toluene | 3.40E-03 lb/MMcf (4) | 0.000 (a) | 0.000 (b) |
| Total HAPs (per unit) | 1.892 | 0.000 | 0.000 |
| Total HAPs (15 units) | | 0.003 | 0.007 |
| Greenhouse Gas Emissions | | | |
| CO ₂ | 53.06 kg/MMBtu (6) | 7.02 (c) | 31.00 (d) |
| CH ₄ | 1.0E-03 kg/MMBtu (6) | 0.00 (c) | 0.00 (d) |
| N ₂ O | 1.00E-04 kg/MMBtu (6) | 0.00 (c) | 0.00 (d) |
| CO ₂ e ^(e) (per unit) | - | 7.02 | 31.01 |
| CO ₂ e ^(e) (15 units) | | 105.35 | 465.22 |

Calculations:

LB/MMCF

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

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

LB/MMBTU

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

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

| EMISSION INPUTS TABLE | |
|-------------------------------|---------|
| Fuel Use (MMScf/hr) = | 0.0001 |
| Fuel Use (MMScf/yr) = | 0.5000 |
| Number of Burners = | 1 |
| Hours of Operation (hr/yr) = | 8,760 |
| MMBtu/MMcf = | 1,009 |
| Number of Units = | 15 |
| HHV (Btu/scf) = | 1,009 |
| Heat Input each(MMBtu/hr) = | 0.06 |
| PTE Fuel Use each(MMBtu/yr) = | 526.000 |

$$(e) \text{ CO}_2 \text{ equivalent} = [(\text{CO}_2 \text{ emissions}) * (\text{GWP}_{\text{CO}_2})] + [(\text{CH}_4 \text{ emissions}) * (\text{GWP}_{\text{CH}_4})] + [(\text{N}_2\text{O emissions}) * (\text{GWP}_{\text{N}_2\text{O}})]$$

Global Warming Potential (GWP)

| | | |
|------------------|-----|-----|
| CO ₂ | 1 | (7) |
| CH ₄ | 25 | (7) |
| N ₂ O | 298 | (7) |

Notes:

- (1) AP-42, Chapter 1.4, Table 1.4-2. Emission Factors For Criteria Pollutants and Greenhouse Gases From Natural Gas Combustion, July 1998.
- (2) AP-42, Chapter 1.4, Table 1.4-1. Emission Factors For Nitrogen Oxides (NOx) and Carbon Monoxide(CO) From Natural Gas Combustion, July 1998.
- (3) AP-42, Chapter 1.4, Table 1.4-4. Emission Factors For Metals From Natural Gas Combustion, July 1998.
- (4) AP-42, Chapter 1.4, Table 1.4-3. Emission Factors for Speciated Organic Compounds from Natural Gas Combustion, July 1998.
- (5) AP-42, Chapter 5.3, Section 5.3.1
- (6) Emission factors are from 40 CFR 98, Subpart C, Table C-1 and C-2.
- (7) Global Warming Potentials obtained from 40 CFR 98, Subpart A, Table A-1



Bryan Research & Engineering, LLC

ProMax[®] 6.0

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Simulation Report

Project: Revolution 2 - RSV Recovery - Summer (JJC 2023-0605) - (SLR).pmx

Licensed to SLR International Corporation and Affiliates

Client Name: Energy Transfer
Location: Revolution Extraction Plant
Job: Cryo 2 Permitting

ProMax Filename: N:\West Virginia\Energy Transfer Partners\Projects\PA Permitting\Revolution 2 Train\Updated ProMax and Equipment Summer 2023\Revolution 2 - RSV Recovery - Summer (JJC 2023-0605) - (SLR).pmx
ProMax Version: 6.0.22251.0
Simulation Initiated: 8/8/2023 4:01:53 PM

Bryan Research & Engineering, LLC

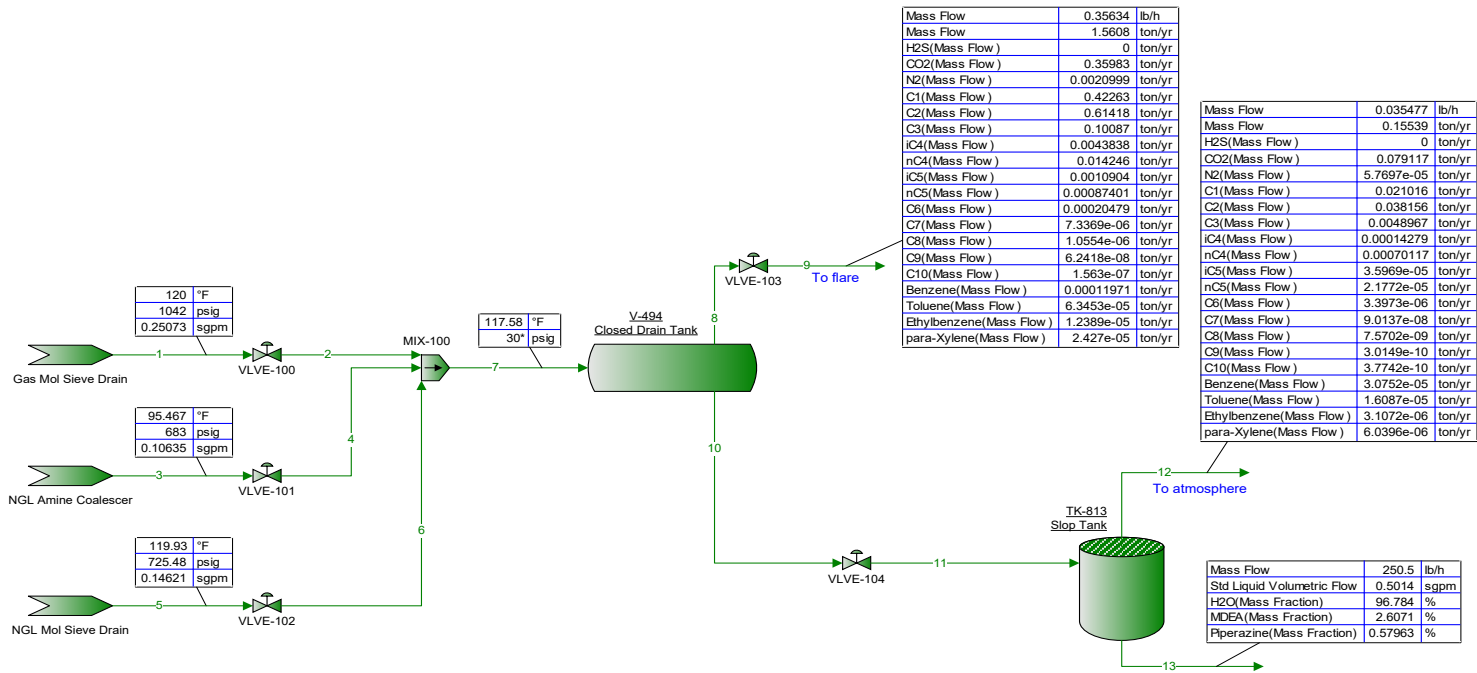
Chemical Engineering Consultants
P.O. Box 4747 Bryan, Texas 77805
Office: (979) 776-5220
FAX: (979) 776-4818
<mailto:sales@bre.com>
<http://www.bre.com/>

Report Navigator can be activated via the ProMax Navigator Toolbar.

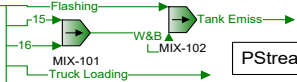
An asterisk (*), throughout the report, denotes a user specified value.

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

Closed Drain



Annual tank loss calculations for "11".
 Total working and breathing losses are 5.437E-05 ton/yr.
 Flashing losses are 0.003971 ton/yr.
 Loading losses are 1.146E-05 ton/yr of loaded liquid.
 * Only Non-Exempt VOCs are reported.



PStreams "Tank Emiss"/"13" VOCs EF= 0.001283 lb/bbl

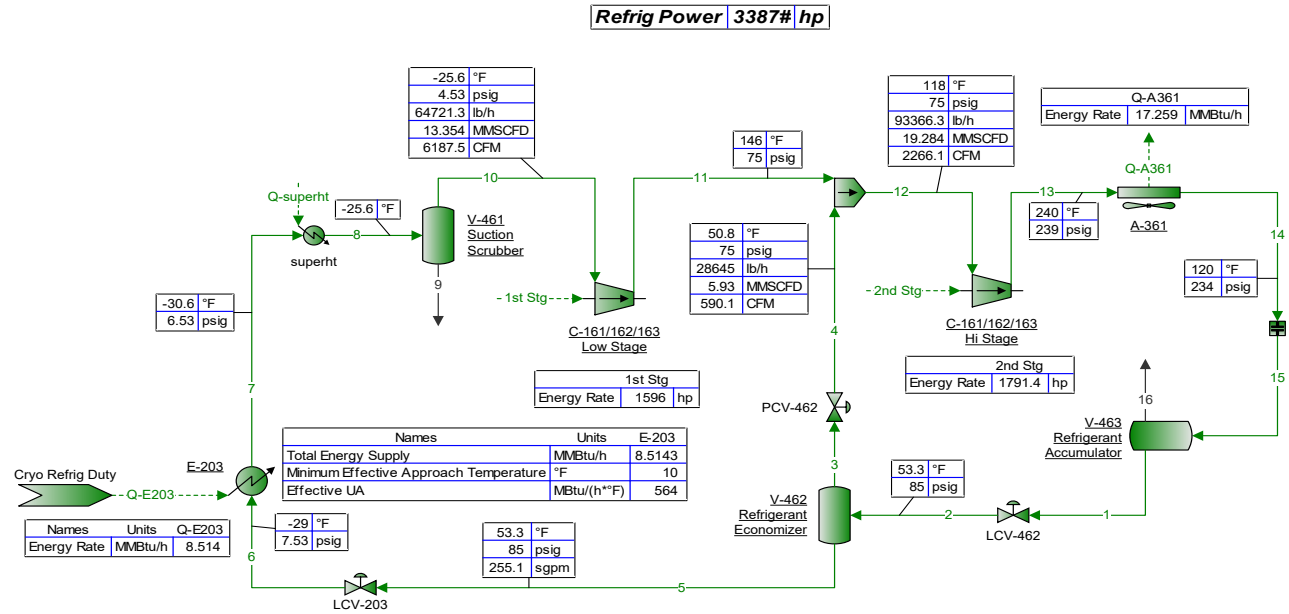
PStreams "Truck Loading"/"13" VOCs EF= 3.653E-06 lb/bbl

Tank-1

| | | | | | | | | | | | | | | | | | | | |
|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| C10 | 5.46051E-07 | 2.77901E-07 | 1.53316E-14 | 1.53316E-14 | 2.73359E-08 | 2.73359E-08 | 1.94014E-09 | 1.94014E-09 | 7.46082E-10 | 7.46082E-10 | 1.42577E-08 | 1.00140E-05 | 1.00140E-05 | 3.47201E-11 | 3.47201E-11 | 2.42883E-07 | 3.26227E-13 | 1.53316E-14 | 1.53316E-14 |
| Benzene | 0.00740674 | 0.00384384 | 0.000151392 | 0.000151392 | 0.000111959 | 0.000111959 | 4.34505E-05 | 4.34505E-05 | 4.36125E-05 | 4.36125E-05 | 7.76630E-05 | 0.00767011 | 0.00767011 | 6.68639E-05 | 6.68639E-05 | 0.0197903 | 6.40706E-05 | 0.000151392 | 0.000151392 |
| Toluene | 0.00388628 | 0.00198779 | 2.02768E-05 | 2.02768E-05 | 6.30918E-05 | 6.30918E-05 | 1.29181E-05 | 1.29181E-05 | 1.22053E-05 | 1.22053E-05 | 3.77325E-05 | 0.00406544 | 0.00406544 | 3.20037E-05 | 3.20037E-05 | 0.0103528 | 3.05420E-05 | 2.02768E-05 | 2.02768E-05 |
| Ethylbenzene | 0.000646908 | 0.000329814 | 1.19060E-06 | 1.19060E-06 | 1.28692E-05 | 1.28692E-05 | 1.58019E-06 | 1.58019E-06 | 1.46855E-06 | 1.46855E-06 | 7.17759E-06 | 0.000793739 | 0.000793739 | 6.05883E-06 | 6.05883E-06 | 0.00199961 | 5.77649E-06 | 1.19060E-06 | 1.19060E-06 |
| para-Xylene | 0.00140060 | 0.000713721 | 1.87098E-06 | 1.87098E-06 | 2.14700E-05 | 2.14700E-05 | 4.74871E-06 | 4.74871E-06 | 2.22211E-06 | 2.22211E-06 | 1.23525E-05 | 0.00155499 | 0.00155499 | 1.01584E-05 | 1.01584E-05 | 0.00388672 | 9.60936E-06 | 1.87098E-06 | 1.87098E-06 |
| MDEA | 0.00306907 | 0.00166900 | 0.000218033 | 0.000218033 | 0 | 0 | 12.3758 | 12.3758 | 0 | 0 | 2.60306 | 0.0143932 | 0.0143932 | 2.60674 | 2.60674 | 0.0379994 | 2.60710 | 0.000218033 | 0.000218033 |
| Piperazine | 3.88338E-06 | 0.0130718 | 0.0266148 | 0.0266148 | 0 | 0 | 2.75145 | 2.75145 | 0 | 0 | 0.578724 | 5.62969E-05 | 5.62969E-05 | 0.579547 | 0.579547 | 0.000152246 | 0.579629 | 0.0266148 | 0.0266148 |

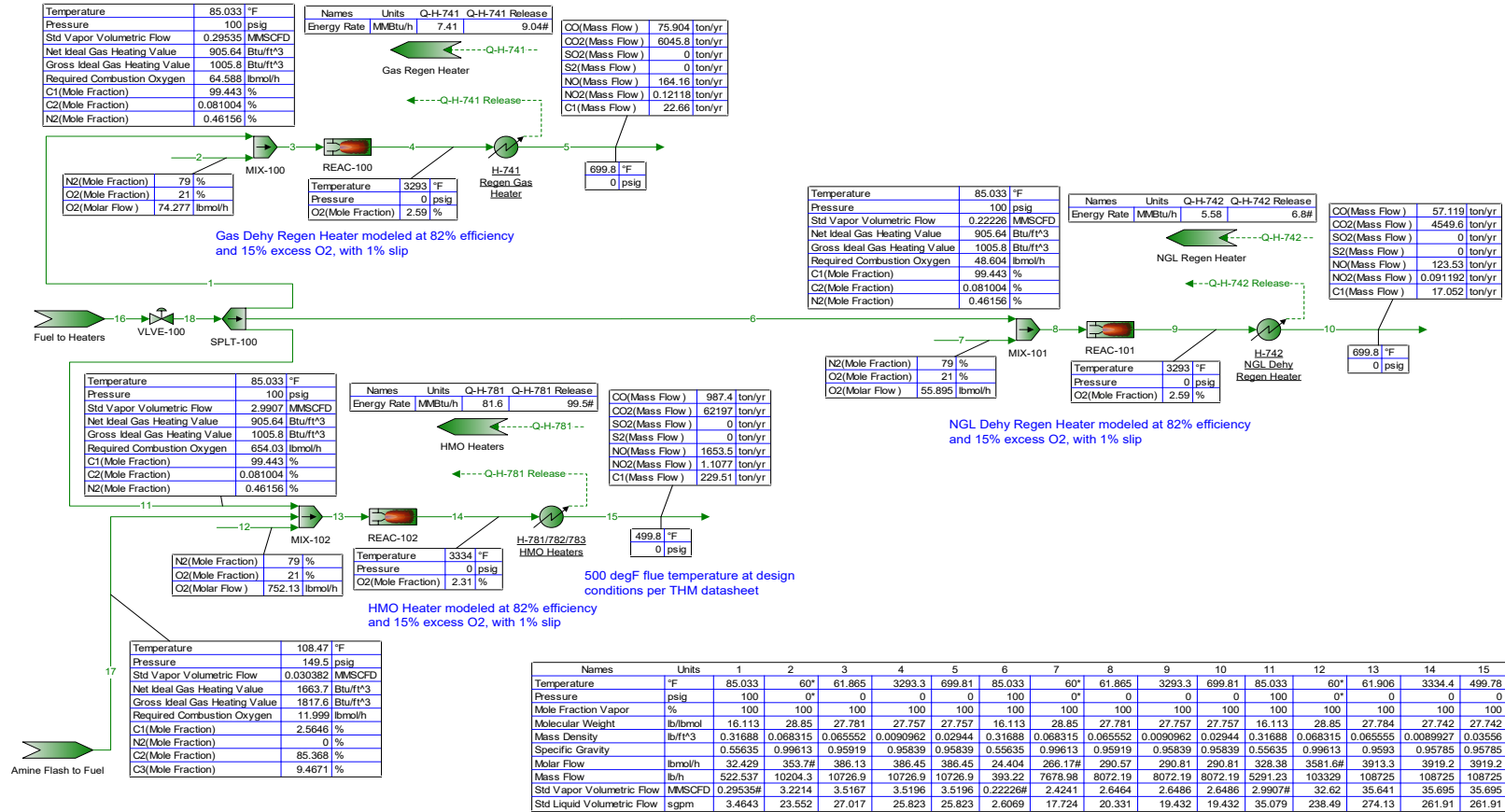
| Process Streams | | Flashing | Tank Emiss | ruck Loadin | W&B | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 15 | 16 | |
|-------------------|-------------|-------------|-------------|-------------|-------------|-----------|----------------|-----------|-------------|-----------|-----------------|------------|-------------|--------------|---------------|--------------|-------------|----------------|---------------|-------------|----|
| Properties | Status: | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | |
| Phase: | Total | From Bloc | -- | MIX-102 | -- | MIX-101 | s Mol Sieve Dr | VLVE-100 | Amine Coale | VLVE-101 | iL Mol Sieve Dr | VLVE-102 | MIX-100 | Closed Drain | VLVE-103 | Closed Drain | VLVE-104 | K-813 Slop Tar | K-813 Slop Ta | -- | -- |
| To Block | MIX-102 | -- | -- | MIX-102 | VLVE-100 | MIX-100 | VLVE-101 | MIX-100 | VLVE-102 | MIX-100 | Closed Drain | VLVE-103 | -- | VLVE-104 | C-813 Slop Ta | -- | -- | MIX-101 | MIX-101 | | |
| Property | Units | | | | | | | | | | | | | | | | | | | | |
| Temperature | °F | 62.6258 | 61.8071 | 62.6258 | 62.6258 | 120 | 122.609 | 95.4671 | 99.0818 | 119.931 | 121.691 | 117.575 | 117.575 | 114.947 | 117.575 | 117.631 | 117.631 | 117.631 | 62.6258 | 62.6258 | |
| Pressure | psig | 0.960000 | -12.8148 | -12.8148 | -12.8148 | 1042 | 30* | 683 | 30* | 725.475 | 30 | 30* | 30 | 0* | 30 | 0 | 0 | 0 | -12.8148 | -12.8148 | |
| Molecular Weig | lb/lbmol | 27.9222 | 26.7748 | 25.6811 | 25.6811 | 18.0165 | 18.0165 | 20.6869 | 20.6869 | 18.0238 | 18.0238 | 18.5216 | 26.0655 | 26.0655 | 18.5139 | 18.5139 | 30.3263 | 18.5129 | 25.6811 | 25.6811 | |
| Std Vapor Volu | MMSCFD | 5.08409E-06 | 1.04179E-05 | 1.12432E-06 | 5.33382E-06 | 0.0632500 | 0.0632500 | 0.0232329 | 0.0232329 | 0.0368876 | 0.0368876 | 0.123371 | 0.000124511 | 0.000124511 | 0.123246 | 0.123246 | 1.06546E-05 | 0.123235 | 2.24461E-06 | 3.08921E-06 | |
| Std Liquid Volu | sgpm | 7.16100E-05 | 0.000107115 | 7.48407E-06 | 3.55047E-05 | 0.250727 | 0.250727 | 0.106354 | 0.106354 | 0.146209 | 0.146209 | 0.503290 | 0.00175768 | 0.00175768 | 0.501532 | 0.501532 | 0.000135337 | 0.501397 | 1.49413E-05 | 2.05634E-05 | |
| Compressibility | | 0.994991 | 0.999824 | 0.999705 | 0.999705 | 0.0495713 | 0.00309498 | 0.0383884 | 0.00366666 | 0.0347070 | 0.00261958 | 0.00308498 | 0.988823 | 0.996536 | 0.00208912 | 0.000724343 | 0.996303 | 0.000638268 | 0.999705 | 0.999705 | |
| Specific Gravity | | 0.964082 | 0.924465 | 0.886703 | 0.886703 | 0.988470 | 1.00971 | 0.988834 | 0.988834 | 0.899974 | 0.899974 | 0.899974 | 0.899974 | 0.990895 | 1.04709 | 0.990862 | 1.04709 | 0.990862 | 0.886703 | 0.886703 | |
| Mass Flow | lb/h | 0.0155869 | 0.0306269 | 0.00317030 | 0.0150400 | 125.120 | 125.120 | 52.7708 | 52.7708 | 72.9998 | 72.9998 | 250.890 | 0.356344 | 0.356344 | 250.534 | 250.534 | 0.0354774 | 250.499 | 0.00632922 | 0.00871078 | |
| Mass Cp | Btu/(lb*°F) | 0.3635227 | 0.3433187 | 0.3244307 | 0.3244307 | 0.976064 | 0.976985 | 0.907496 | 0.921485 | 0.976258 | 0.976921 | 0.965946 | 0.417279 | 0.413326 | 0.966727 | 0.966696 | 0.336365 | 0.966786 | 0.3244307 | 0.3244307 | |
| Mass Density | lb/ft^3 | 0.0708947 | 0.00184309 | 0.00176524 | 0.00176524 | 61.6496 | 40.2441 | 62.9745 | 40.6467 | 61.6723 | 47.6418 | 41.8683 | 0.183826 | 0.0559893 | 61.8009 | 54.4581 | 0.0648539 | 61.7988 | 0.00176524 | 0.00176524 | |
| Gross Ideal Ga | Btu/ft^3 | 1070.42 | 568.104 | 89.3040 | 89.3040 | 51.5208 | 51.5208 | 156.743 | 156.743 | 51.4608 | 51.4608 | 71.3181 | 1165.78 | 1165.78 | 70.2124 | 70.2124 | 767.894 | 70.1521 | 89.3040 | 89.3040 | |

Cryo Refrigeration Unit



| Names | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|----------------------------|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| Temperature | °F | 120 | 53.27 | 53.27 | 50.819 | 53.27 | -29# | -30.554 | -25.554 | -25.554 | -25.554 | 145.8 | 117.71 | 240.23 | 120 | 120* | 120 |
| Pressure | psig | 233.93 | 85* | 85 | 75 | 85 | 7.5328 | 6.5328 | 4.5328 | 4.5328 | 4.5328 | 75# | 75 | 238.93 | 233.93 | 233.93 | 233.93 |
| Mole Fraction Vapor | % | 0 | 30.752 | 100 | 100 | 0 | 27.258 | 100* | 100 | | 100 | 100 | 100 | 100 | 0 | 0* | 100 |
| Molecular Weight | lb/lbmol | 44.096 | 44.096 | 43.992 | 43.992 | 44.142 | 44.142 | 44.142 | 44.142 | | 44.142 | 44.142 | 44.096 | 44.096 | 44.096 | 44.096 | 43.967 |
| Mass Density | lb/ft³ | 28.172 | 2.7898 | 0.91093 | 0.80906 | 32.013 | 0.74776 | 0.19738 | 0.17433 | | 0.17433 | 0.64745 | 0.68669 | 1.7262 | 28.172 | 28.172 | 2.4097 |
| Specific Gravity | | 0.45169 | | 1.5189 | 1.5189 | 0.51329 | | 1.5241 | 1.5241 | | 1.5241 | 1.5241 | 1.5225 | 1.5225 | 0.45169 | 0.45169 | 1.5181 |
| Molar Flow | lbmol/h | 2117.4 | 2117.4 | 651.14 | 651.14 | 1466.2 | 1466.2 | 1466.2 | 1466.2 | 0 | 1466.2 | 1466.2 | 2117.4 | 2117.4 | 2117.4 | 2117.4 | 0 |
| Mass Flow | lb/h | 93366.3 | 93366.3 | 28644.9 | 28644.9 | 64721.3 | 64721.3 | 64721.3 | 64721.3 | 0 | 64721.3 | 64721.3 | 93366.3 | 93366.3 | 93366.3 | 93366.3 | 0 |
| Std Vapor Volumetric Flow | MMSCFD | 19.284 | 19.284 | 5.9303 | 5.9303 | 13.354 | 13.354 | 13.354 | 13.354 | 0 | 13.354 | 13.354 | 19.284 | 19.284 | 19.284 | 19.284 | 0 |
| Std Liquid Volumetric Flow | sgpm | 368.3 | 368.3 | 113.19 | 113.19 | 255.1 | 255.1 | 255.1 | 255.1 | 0 | 255.1 | 255.1 | 368.3 | 368.3 | 368.3 | 368.3 | 0 |

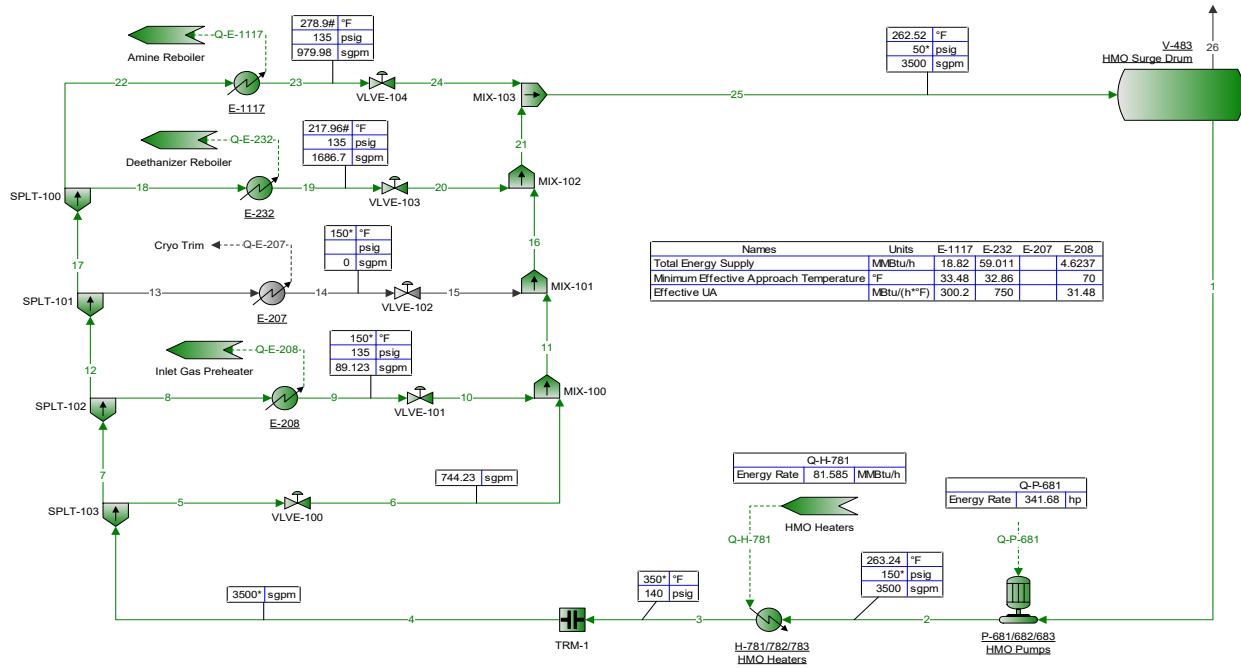
Fired Heaters



| Process Streams | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|-----------------|-----------|--------------|--------|-------------|-------------|---------------|---------------|---------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------|
| Composition | Status: | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved | Solved |
| | From | Inlet Gas to | V-401 | V-401 Inlet | E-208 Inlet | MIX-101 | V-442/443/444 | V- | TRM-1 | SPLT-100 | SPLT-100 | FCV-141A | C-141 Regen | H-741 Regen | MIX-100 | Bed Q | A-341 Regen | V-447 Regen | V-447 Regen | RCYL-1 |
| Phase: Total | To Block: | V-401 Inlet | -- | E-208 Inlet | MIX-101 | V-442/443/444 | TRM-1 | MIX-100 | SPLT-100 | SPLT-100 | FCV-141A | C-141 Regen | H-741 Regen | MIX-100 | Bed Q | A-341 Regen | V-447 Regen | V-447 Regen | RCYL-1 | RCYL-1 |
| Mole Fraction | | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| H2O | | 0.0210601 | | 0.0210601 | 0.0210601 | 0.0286481 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0.675208 | 0.675208 | 0.675208 | 99.8904 | 0.200754 | 0.200756 |
| H2S | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO2 | | 0.0441907 | | 0.0441907 | 0.0441907 | 0.0441873 | 0 | 0 | 0.0442000 | 0.0442000 | 0.0442000 | 0.0442000 | 0.0442000 | 0.0442000 | 0.0439015 | 0.0439015 | 0.0439015 | 0.000737014 | 0.0441079 | 0.0441104 |
| N2 | | 0.357825 | | 0.357825 | 0.357825 | 0.357800 | 0 | 0 | 0.357902 | 0.357902 | 0.357902 | 0.357902 | 0.357902 | 0.357902 | 0.355486 | 0.355486 | 0.355486 | 0.000253945 | 0.357185 | 0.357239 |
| C1 | | 77.2390 | | 77.2390 | 77.2335 | 77.2335 | 0 | 0 | 77.2557 | 77.2557 | 77.2557 | 77.2557 | 77.2557 | 77.2557 | 76.7340 | 76.7340 | 76.7340 | 0.0901928 | 77.1005 | 77.1089 |
| C2 | | 15.0103 | | 15.0103 | 15.0103 | 15.0091 | 0 | 0 | 15.0134 | 15.0134 | 15.0134 | 15.0134 | 15.0134 | 15.0134 | 14.9121 | 14.9121 | 14.9121 | 0.0151215 | 14.9833 | 14.9820 |
| C3 | | 5.04244 | | 5.04244 | 5.04244 | 5.04195 | 0 | 0 | 5.04340 | 5.04340 | 5.04340 | 5.04340 | 5.04340 | 5.00934 | 5.00934 | 5.00934 | 0.00261932 | 5.03329 | 5.03096 | |
| IC4 | | 0.508193 | | 0.508193 | 0.508193 | 0.508132 | 0 | 0 | 0.508277 | 0.508277 | 0.508277 | 0.508277 | 0.508277 | 0.504845 | 0.504845 | 0.504845 | 0.000113173 | 0.507259 | 0.506743 | |
| nC4 | | 1.16286 | | 1.16286 | 1.16286 | 1.16270 | 0 | 0 | 1.16303 | 1.16303 | 1.16303 | 1.16303 | 1.16303 | 1.15518 | 1.15518 | 1.15518 | 0.000417213 | 1.16070 | 1.15911 | |
| IC5 | | 0.197558 | | 0.197558 | 0.197558 | 0.197521 | 0 | 0 | 0.197578 | 0.197578 | 0.197578 | 0.197578 | 0.197578 | 0.196244 | 0.196244 | 0.196244 | 3.05394E-05 | 0.197182 | 0.196680 | |
| nC5 | | 0.253247 | | 0.253247 | 0.253247 | 0.253193 | 0 | 0 | 0.253266 | 0.253266 | 0.253266 | 0.253266 | 0.253266 | 0.251556 | 0.251556 | 0.251556 | 2.25906E-05 | 0.252759 | 0.251987 | |
| C6 | | 0.141270 | | 0.141270 | 0.141270 | 0.141215 | 0 | 0 | 0.141256 | 0.141256 | 0.141256 | 0.141256 | 0.141256 | 0.140302 | 0.140302 | 0.140302 | 5.78703E-06 | 0.140973 | 0.139972 | |
| C7 | | 0.0102978 | | 0.0102978 | 0.0102978 | 0.0102916 | 0 | 0 | 0.0102945 | 0.0102945 | 0.0102945 | 0.0102945 | 0.0102945 | 0.0102250 | 0.0102250 | 0.0102250 | 2.00554E-07 | 0.0102739 | 0.010491 | |
| C8 | | 0.00369922 | | 0.00369922 | 0.00369922 | 0.00369576 | 0 | 0 | 0.00369682 | 0.00369682 | 0.00369682 | 0.00369682 | 0.00369682 | 0.00367186 | 0.00367186 | 0.00367186 | 2.64675E-08 | 0.00368942 | 0.00361729 | |
| C9 | | 0.000499895 | | 0.000499895 | 0.000499895 | 0.000499227 | 0 | 0 | 0.000499370 | 0.000499370 | 0.000499370 | 0.000499370 | 0.000499370 | 0.000495998 | 0.000495998 | 0.000495998 | 1.52148E-09 | 0.000498370 | 0.000484079 | |
| C10 | | 0.00459903 | | 0.00459903 | 0.00459903 | 0.00459196 | 0 | 0 | 0.00459327 | 0.00459327 | 0.00459327 | 0.00459327 | 0.00459327 | 0.00456226 | 0.00456226 | 0.00456226 | 3.46143E-09 | 0.00458408 | 0.00443151 | |
| Benzene | | 0.00109977 | | 0.00109977 | 0.00109977 | 0.00109938 | 0 | 0 | 0.00109970 | 0.00109970 | 0.00109970 | 0.00109970 | 0.00109970 | 0.00109227 | 0.00109227 | 0.00109227 | 2.58233E-05 | 0.00109737 | 0.00109058 | |
| Toluene | | 0.000899810 | | 0.000899810 | 0.000899810 | 0.000899257 | 0 | 0 | 0.000899514 | 0.000899514 | 0.000899514 | 0.000899514 | 0.000899514 | 0.000893441 | 0.000893441 | 0.000893441 | 1.23368E-05 | 0.000897654 | 0.000886697 | |
| Ethylbenzene | | 0.000299937 | | 0.000299937 | 0.000299937 | 0.000299650 | 0 | 0 | 0.000299736 | 0.000299736 | 0.000299736 | 0.000299736 | 0.000299736 | 0.000297712 | 0.000297712 | 0.000297712 | 2.18395E-06 | 0.000299125 | 0.000293137 | |
| para-Xylene | | 0.000599874 | | 0.000599874 | 0.000599874 | 0.000599287 | 0 | 0 | 0.000599459 | 0.000599459 | 0.000599459 | 0.000599459 | 0.000599459 | 0.000595411 | 0.000595411 | 0.000595411 | 3.64352E-06 | 0.000598241 | 0.000585987 | |
| Mass Flow | | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h | lb/h |
| H2O | | 124.974 | 0 | 124.974 | 124.974 | 177.497 | 177.497 | 177.497 | 0 | 0 | 0 | 0 | 0 | 0 | 177.497 | 177.497 | 177.497 | 124.974 | 52.5224 | 52.5229 |
| H2S | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO2 | | 640.610 | 0 | 640.610 | 640.610 | 668.802 | 668.802 | 668.802 | 640.609 | 640.609 | 28.1928 | 28.1928 | 28.1928 | 28.1928 | 28.1928 | 28.1928 | 28.1928 | 0.00225257 | 28.1905 | 28.1921 |
| N2 | | 3301.81 | 0 | 3301.81 | 3301.81 | 3447.15 | 3447.15 | 3447.15 | 3301.84 | 3301.84 | 145.311 | 145.311 | 145.311 | 145.311 | 145.311 | 145.311 | 145.311 | 0.000494039 | 145.311 | 145.333 |
| C1 | | 4081.54 | 0 | 4081.54 | 4081.54 | 4261.19 | 4261.19 | 4261.19 | 4081.56 | 4081.56 | 17962.7 | 17962.7 | 17962.7 | 17962.7 | 17962.7 | 17962.7 | 17962.7 | 0.100484 | 17962.6 | 17964.5 |
| C2 | | 14867.1 | 0 | 14867.1 | 14867.1 | 15521.3 | 15521.3 | 15521.3 | 14867.0 | 14867.0 | 6542.88 | 6542.88 | 6542.88 | 6542.88 | 6542.88 | 6542.88 | 6542.88 | 0.0315770 | 6542.85 | 6542.28 |
| C3 | | 73240.7 | 0 | 73240.7 | 73240.7 | 76462.4 | 76462.4 | 76462.4 | 73239.2 | 73239.2 | 3223.20 | 3223.20 | 3223.20 | 3223.20 | 3223.20 | 3223.20 | 3223.20 | 0.00802120 | 3223.20 | 3221.71 |
| IC4 | | 9729.42 | 0 | 9729.42 | 9729.42 | 10157.2 | 10157.2 | 10157.2 | 9728.99 | 9728.99 | 428.166 | 428.166 | 428.166 | 428.166 | 428.166 | 428.166 | 428.166 | 0.000456813 | 428.165 | 427.730 |
| nC4 | | 22263.0 | 0 | 22263.0 | 22263.0 | 23241.4 | 23241.4 | 23241.4 | 22261.7 | 22261.7 | 979.720 | 979.720 | 979.720 | 979.720 | 979.720 | 979.720 | 979.720 | 0.00168405 | 979.719 | 978.381 |
| IC5 | | 4695.06 | 0 | 4695.06 | 4695.06 | 4901.13 | 4901.13 | 4901.13 | 4695.03 | 4695.03 | 206.603 | 206.603 | 206.603 | 206.603 | 206.603 | 206.603 | 206.603 | 0.000153019 | 206.603 | 206.076 |
| nC5 | | 6018.51 | 0 | 6018.51 | 6018.51 | 6282.54 | 6282.54 | 6282.54 | 6017.70 | 6017.70 | 264.835 | 264.835 | 264.835 | 264.835 | 264.835 | 264.835 | 264.835 | 0.00013191 | 264.835 | 264.026 |
| C6 | | 4010.05 | 0 | 4010.05 | 4010.05 | 4185.23 | 4185.23 | 4185.23 | 4008.80 | 4008.80 | 176.424 | 176.424 | 176.424 | 176.424 | 176.424 | 176.424 | 176.424 | 3.46333E-05 | 176.424 | 175.172 |
| C7 | | 339.890 | 0 | 339.890 | 339.890 | 354.659 | 354.659 | 354.659 | 339.708 | 339.708 | 14.9503 | 14.9503 | 14.9503 | 14.9503 | 14.9503 | 14.9503 | 14.9503 | 1.39561E-06 | 14.9503 | 14.7688 |
| C8 | | 139.188 | 0 | 139.188 | 139.188 | 145.188 | 145.188 | 145.188 | 139.068 | 139.068 | 6.12029 | 6.12029 | 6.12029 | 6.12029 | 6.12029 | 6.12029 | 6.12029 | 2.09963E-07 | 6.12029 | 6.00064 |
| C9 | | 21.1188 | 0 | 21.1188 | 21.1188 | 22.0205 | 22.0205 | 22.0205 | 21.0922 | 21.0922 | 0.928253 | 0.928253 | 0.928253 | 0.928253 | 0.928253 | 0.928253 | 0.928253 | 1.35518E-08 | 0.928253 | 0.901636 |
| C10 | | 215.542 | 0 | 215.542 | 215.542 | 224.699 | 224.699 | 224.699 | 215.227 | 215.227 | 9.47197 | 9.47197 | 9.47197 | 9.47197 | 9.47197 | 9.47197 | 9.47197 | 3.42027E-08 | 9.47197 | 9.15675 |
| Benzene | | 28.2966 | 0 | 28.2966 | 28.2966 | 29.5337 | 29.5337 | 29.5337 | 28.2888 | 28.2888 | 1.24497 | 1.24497 | 1.24497 | 1.24497 | 1.24497 | 1.24497 | 1.24497 | 0.000140083 | 1.24483 | 1.23713 |
| Toluene | | 27.3092 | 0 | 27.3092 | 27.3092 | 28.4956 | 28.4956 | 28.4956 | 27.2944 | 27.2944 | 1.20121 | 1.20121 | 1.20121 | 1.20121 | 1.20121 | 1.20121 | 1.20121 | 7.89403E-05 | 1.20113 | 1.18647 |
| Ethylbenzene | | 10.4888 | 0 | 10.4888 | 10.4888 | 10.9408 | 10.9408 | 10.9408 | 10.4796 | 10.4796 | 0.461199 | 0.461199 | 0.461199 | 0.461199 | 0.461199 | 0.461199 | 0.461199 | 1.61020E-05 | 0.461183 | 0.451951 |
| para-Xylene | | 20.9777 | 0 | 20.9777 | 20.9777 | 21.8811 | 21.8811 | 21.8811 | 20.9588 | 20.9588 | 0.922380 | 0.922380 | 0.922380 | 0.922380 | 0.922380 | 0.922380 | 0.922380 | 2.68632E-05 | 0.922353 | 0.903461 |
| Mass Fraction | | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % | % |
| H2O | | 0.0183339 | | 0.0183339 | 0.0183339 | 0.0249401 | 100 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0.588306 | 0.588306 | 0.588306 | 99.8837 | 0.174809 | 0.174840 |
| H2S | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO2 | | 0.0939790 | | 0.0939790 | 0.0939790 | 0.0939734 | 0 | 0 | 0.0939969 | 0.0939969 | 0.0939969 | 0.0939969 | 0.0939969 | 0.0939969 | 0.0934439 | 0.0934439 | 0.0934439 | 0.00180033 | 0.0938255 | 0.0938468 |
| N2 | | 0.484384 | | 0.484384 | 0.484384 | 0.484359 | 0 | 0 | 0.484480 | 0.4844 | | | | | | | | | | |

| Phase: Total | From Block: | Inlet Gas to Dehy V-401 Inlet | V-401 Inlet Separat | V-401 Inlet Separator E-208 Inlet | E-208 Inlet Gas Preheater | MIX-101 V-442/443/444 | V-442/443/444 4 Mol TRM-1 | V-442/443/444 Mol Sieve | SPLT-100 Dry Gas to Cryo | SPLT-100 FCV-141A | FCV-141A C-141 Regen Gas | Compressor H-741 Regen Gas Heater | H-741 Regen Gas Heater | MIX-100 Bed Q | Bed Q A-341 Regen Gas Cooler | A-341 Regen Gas Cooler | V-447 Regen Gas Scrubber | V-447 Regen Gas Scrubber | V-447 Regen Gas Scrubber | RCYL-1 |
|-------------------|-------------|-------------------------------|---------------------|-----------------------------------|---------------------------|-----------------------|---------------------------|-------------------------|--------------------------|-------------------|--------------------------|-----------------------------------|------------------------|---------------|------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------|
| Property | Units | To Block: Separator | -- | Gas | MIX-101 | Mol Sieve | TRM-1 | MIX-100 | SPLT-100 | FCV-141A | C-141 Regen Gas | Compressor H-741 Regen Gas Heater | MIX-100 | Bed Q | A-341 Regen Gas Cooler | V-447 Regen Gas Scrubber | V-447 Regen Gas Scrubber | V-447 Regen Gas Scrubber | RCYL-1 | MIX-101 |
| Temperature | °F | 80 | 80 | 80 | 90* | 90.6735 | 90.6735 | 90.2197 | 90.3834 | 90.3834 | 88.1957 | 111.265 | 485* | 475.062 | 350* | 120* | 120 | 120 | 120 | 120 |
| Pressure | psig | 950 | 950 | 950 | 947 | 942 | 942 | 1100* | 932 | 932 | 900* | 1050* | 1047 | 1047 | 1045 | 1042 | 1042 | 1042 | 1042 | 1042 |
| Molecular Weight | lb/lbmol | 20.6941 | | 20.6941 | 20.6941 | 20.6937 | 18.0153 | 18.0153 | 20.6945 | 20.6945 | 20.6945 | 20.6945 | 20.6945 | 20.6764 | 20.6764 | 20.6764 | 18.0165 | 20.6891 | 20.6856 | 20.6856 |
| Std Vapor Volume | MMSCFD | 300 | 0 | 300 | 300 | 313.227 | 0.0897333 | 0.0897333 | 313.137 | 299.937 | 13.2* | 13.2 | 13.2 | 13.2897 | 13.2897 | 13.2897 | 0.0632500 | 13.2265 | 13.2265 | 13.2265 |
| Std Liquid Volume | sgpm | 4013.01 | 0 | 4013.01 | 4013.01 | 4189.70 | 0.354829 | 0.354829 | 4189.35 | 4012.75 | 176.598 | 176.598 | 176.598 | 176.953 | 176.953 | 176.953 | 0.250727 | 176.702 | 176.690 | 176.690 |
| Compressibility | | 0.781833 | | 0.781833 | 0.797808 | 0.799680 | 0.0469051 | 0.0546963 | 0.801025 | 0.801025 | 0.801025 | 0.803694 | 0.811495 | 0.993643 | 0.991970 | 0.965373 | 0.820122 | 0.0495713 | 0.823806 | 0.823878 |
| Specific Gravity | | 0.714513 | | 0.714513 | 0.714513 | 0.714501 | 0.995981 | 0.996208 | 0.714527 | 0.714527 | 0.714527 | 0.714527 | 0.714527 | 0.713903 | 0.713903 | 0.713903 | 0.988470 | 0.714342 | 0.714219 | 0.714219 |
| Mass Flow | lb/h | 681652 | 0 | 681652 | 681652 | 711693 | 177.497 | 177.497 | 711515 | 681522 | 29993.3 | 29993.3 | 29993.3 | 30170.8 | 30170.8 | 30170.8 | 125.120 | 30045.7 | 30040.6 | 30040.6 |
| Mass Cp | Btu/(lb*°F) | 0.671191 | | 0.671191 | 0.658528 | 0.656413 | 0.975507 | 0.975230 | 0.654356 | 0.654356 | 0.648699 | 0.659780 | 0.717256 | 0.711950 | 0.665845 | 0.652971 | 0.976064 | 0.651625 | 0.651599 | 0.651599 |
| Mass Density | lb/ft^3 | 4.40207 | | 4.40207 | 4.22225 | 4.18523 | 62.1180 | 62.1323 | 4.13680 | 4.13680 | 4.13680 | 3.99938 | 4.42521 | 2.17805 | 2.20300 | 2.60841 | 4.27649 | 61.6496 | 4.25998 | 4.25888 |
| Gross Ideal Gas | lb-Btu/ft^3 | 1253.19 | | 1253.19 | 1253.19 | 1253.09 | 50.3100 | 50.3100 | 1253.43 | 1253.43 | 1253.43 | 1253.43 | 1253.43 | 1245.31 | 1245.31 | 1245.31 | 51.5208 | 1251.02 | 1250.83 | 1250.83 |

HMO System

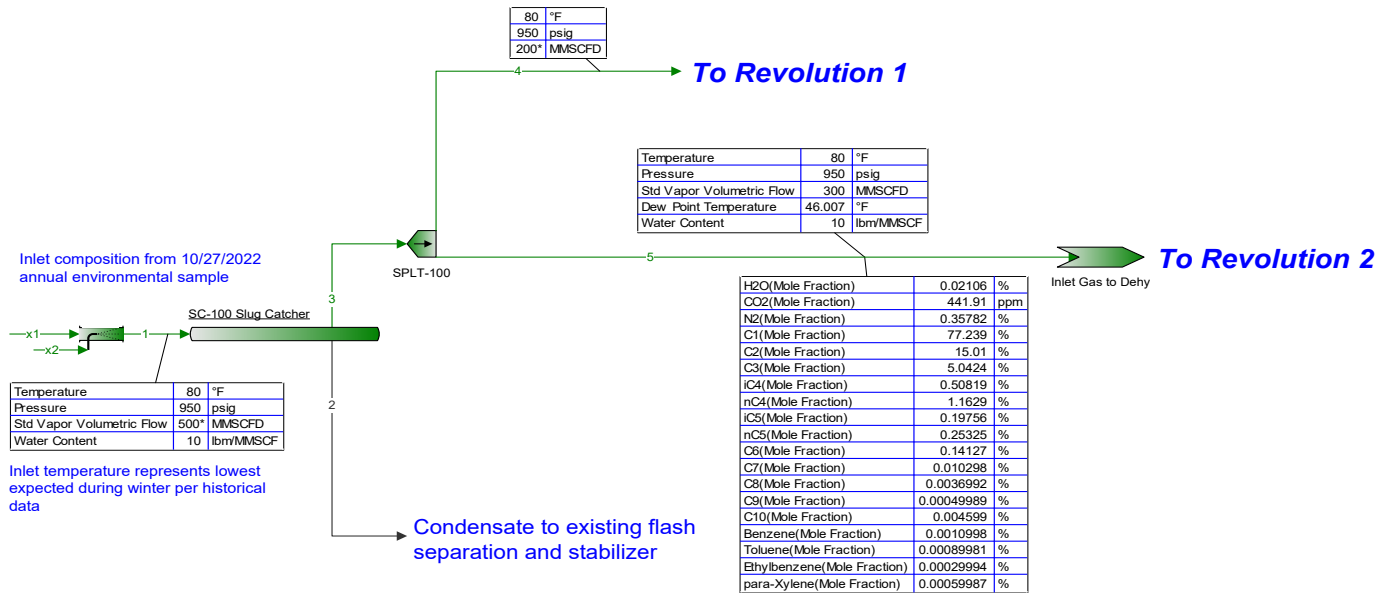


| Names | Units | E-1117 | E-232 | E-207 | E-208 |
|--|--------------|--------|--------|-------|--------|
| Total Energy Supply | MMBtu/h | 18.82 | 59.011 | | 4.6237 |
| Minimum Effective Approach Temperature | °F | 33.48 | 32.86 | | 70 |
| Effective UA | MMBtu/(h*°F) | 300.2 | 750 | | 31.48 |

| Q-H-781 | Energy Rate | 81.585 | MMBtu/h |
|---------|-------------|--------|---------|
| Q-P-681 | Energy Rate | 341.68 | hp |

| Names | Units | 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 | 26 |
|----------------------------|----------|---------|---------|---------|---------|----------|----------|---------|----------|----------|----------|----------|---------|--------|---------|--------|----------|---------|----------|----------|----------|---------|----------|----------|----------|---------|--------|
| Temperature | °F | 262.52 | 263.24 | 350* | 350 | 350 | 350.19 | 350 | 350 | 150* | 150.23 | 329.98 | 350 | 140 | 140 | 150* | 329.98 | 350 | 350 | 217.96# | 218.17 | 256.03 | 350 | 278.9# | 279.09 | 262.52 | |
| Pressure | psig | 50 | 150* | 140 | 140 | 140 | 50* | 140 | 140 | 135 | 50 | 50 | 140 | 140 | 50* | 50 | 50 | 140 | 140 | 135 | 50* | 50 | 140 | 135 | 50* | 50* | 50 |
| Mole Fraction Vapor | % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Molecular Weight | lb/lbmol | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 | 289.8 |
| Mass Density | lb/ft³ | 56.001 | 56.004 | 53.422 | 53.422 | 53.422 | 53.392 | 53.422 | 53.422 | 59.289 | 59.265 | 53.999 | 53.422 | 53.422 | 53.422 | 53.422 | 53.999 | 53.422 | 53.422 | 57.325 | 57.299 | 56.192 | 53.422 | 55.539 | 55.512 | 56.001 | 56.001 |
| Specific Gravity | | 0.8979 | 0.89795 | 0.85655 | 0.85655 | 0.85655 | 0.85606 | 0.85655 | 0.85655 | 0.95062 | 0.95023 | 0.8658 | 0.85655 | 0.8658 | 0.85655 | 0.8658 | 0.85655 | 0.85655 | 0.85655 | 0.91912 | 0.91871 | 0.90096 | 0.85655 | 0.8905 | 0.89007 | 0.8979 | 0.8979 |
| Molar Flow | lbmol/h | 5447.3 | 5447.3 | 5447.3 | 5447.3 | 1158.3 | 1158.3 | 4289 | 138.71 | 138.71 | 138.71 | 1297 | 4150.3 | 0 | 0 | 0 | 1297 | 4150.3 | 2625.1 | 2625.1 | 2625.1 | 3922.1 | 1525.2 | 1525.2 | 1525.2 | 5447.3 | 0 |
| Mass Flow | lb/h | 1578625 | 1578625 | 1578625 | 1578625 | 335675.2 | 335675.2 | 1242950 | 40197.87 | 40197.87 | 40197.87 | 375873.1 | 1202752 | 0 | 0 | 0 | 375873.1 | 1202752 | 760747.8 | 760747.8 | 760747.8 | 1136621 | 442004.5 | 442004.5 | 442004.5 | 1578625 | 0 |
| Std Vapor Volumetric Flow | MMSCFD | 49.612 | 49.612 | 49.612 | 49.612 | 10.549 | 10.549 | 39.063 | 1.2633 | 1.2633 | 1.2633 | 11.813 | 37.799 | 0 | 0 | 0 | 11.813 | 37.799 | 23.908 | 23.908 | 23.908 | 35.721 | 13.891 | 13.891 | 13.891 | 49.612 | 0 |
| Std Liquid Volumetric Flow | sgpm | 3500 | 3500 | 3500 | 3500* | 744.23 | 744.23 | 2755.8 | 89.123 | 89.123 | 89.123 | 833.36 | 2666.6 | 0 | 0 | 0 | 833.36 | 2666.6 | 1686.7 | 1686.7 | 1686.7 | 2520 | 979.98 | 979.98 | 979.98 | 3500 | 0 |

Inlet Separation



| Names | Units | 1 | 3 | 4 | 5 |
|----------------------------|----------|------------|------------|------------|------------|
| Temperature | °F | 80 | 80 | 80 | 80 |
| Pressure | psig | 950 | 950 | 950 | 950 |
| Mole Fraction Vapor | % | 100 | 100 | 100 | 100 |
| Molecular Weight | lb/lbmol | 20.694 | 20.694 | 20.694 | 20.694 |
| Mass Density | lb/ft³ | 4.4021 | 4.4021 | 4.4021 | 4.4021 |
| Specific Gravity | | 0.71451 | 0.71451 | 0.71451 | 0.71451 |
| Molar Flow | lbmol/h | 54899 | 54899 | 21960 | 32939 |
| Mass Flow | lb/h | 1.1361e+06 | 1.1361e+06 | 4.5443e+05 | 6.8165e+05 |
| Std Vapor Volumetric Flow | MMSCFD | 500* | 500 | 200* | 300 |
| Std Liquid Volumetric Flow | sgpm | 6688.3 | 6688.3 | 2675.3 | 4013 |

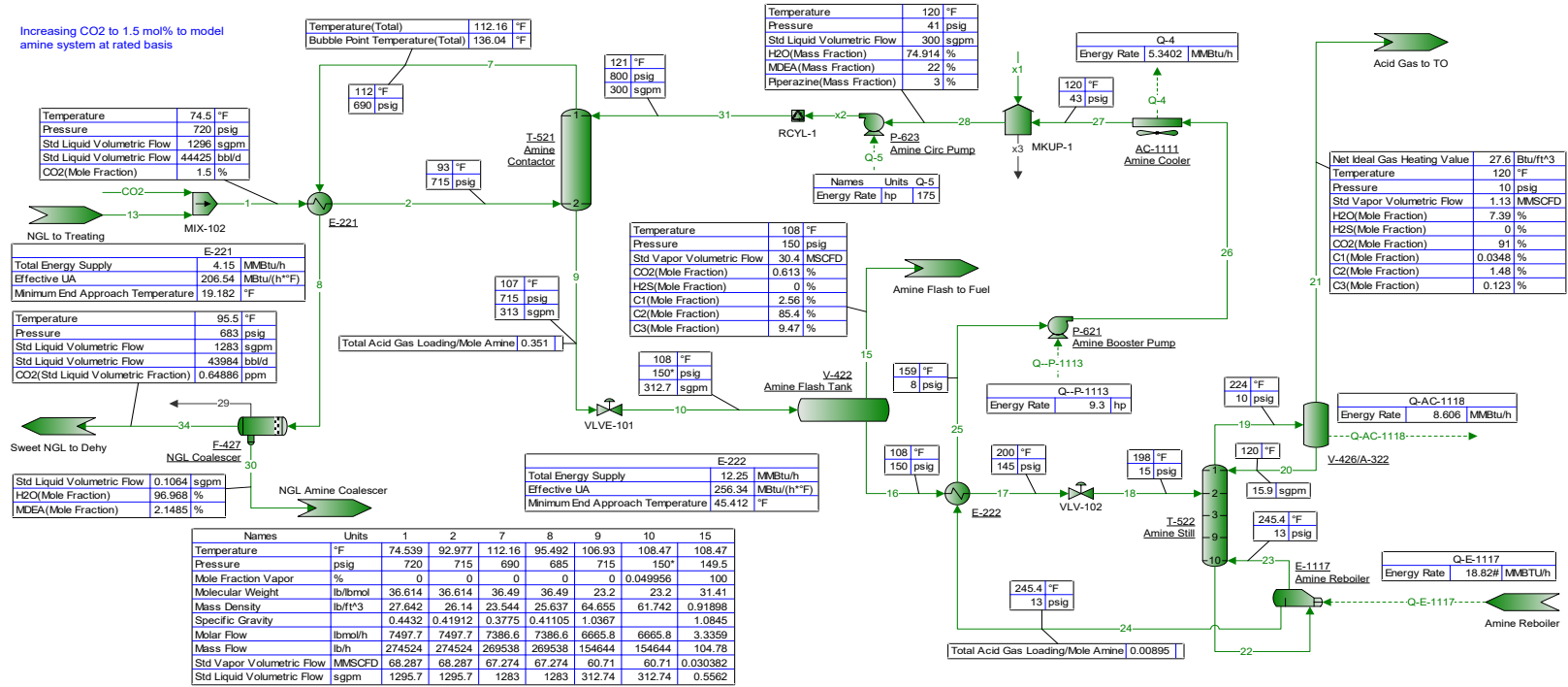
| Process Streams | | x1 | x2 | 1 | 2 | 3 | 4 | 5 |
|----------------------|--|-----------------------|----------|---------------------|---------------------|---------------------|-------------|-------------------|
| Composition | | Status: Solved Solved | | Solved | Solved | Solved | Solved | Solved |
| Phase: Total | | From Block: -- -- | | SAT-1 | SC-100 Slug Catcher | SC-100 Slug Catcher | SPLT-100 | SPLT-100 |
| To Block: | | SAT-1 | SAT-1 | SC-100 Slug Catcher | -- | SPLT-100 | -- | Inlet Gas to Dehy |
| Mole Fraction | | % | | % | % | % | % | % |
| H2O | | 0* | 100* | 0.0210601 | | 0.0210601 | 0.0210601 | 0.0210601 |
| H2S | | 0* | 0* | 0 | | 0 | 0 | 0 |
| CO2 | | 0.0442* | 0* | 0.0441907 | | 0.0441907 | 0.0441907 | 0.0441907 |
| N2 | | 0.3579* | 0* | 0.357825 | | 0.357825 | 0.357825 | 0.357825 |
| C1 | | 77.2553* | 0* | 77.2390 | | 77.2390 | 77.2390 | 77.2390 |
| C2 | | 15.0135* | 0* | 15.0103 | | 15.0103 | 15.0103 | 15.0103 |
| C3 | | 5.0435* | 0* | 5.04244 | | 5.04244 | 5.04244 | 5.04244 |
| iC4 | | 0.5083* | 0* | 0.508193 | | 0.508193 | 0.508193 | 0.508193 |
| nC4 | | 1.1631* | 0* | 1.16286 | | 1.16286 | 1.16286 | 1.16286 |
| iC5 | | 0.1976* | 0* | 0.197558 | | 0.197558 | 0.197558 | 0.197558 |
| nC5 | | 0.2533* | 0* | 0.253247 | | 0.253247 | 0.253247 | 0.253247 |
| C6 | | 0.1413* | 0* | 0.141270 | | 0.141270 | 0.141270 | 0.141270 |
| C7 | | 0.0103* | 0* | 0.0102978 | | 0.0102978 | 0.0102978 | 0.0102978 |
| C8 | | 0.0037* | 0* | 0.00369922 | | 0.00369922 | 0.00369922 | 0.00369922 |
| C9 | | 0.0005* | 0* | 0.000499895 | | 0.000499895 | 0.000499895 | 0.000499895 |
| C10 | | 0.0046* | 0* | 0.00459903 | | 0.00459903 | 0.00459903 | 0.00459903 |
| Benzene | | 0.0011* | 0* | 0.00109977 | | 0.00109977 | 0.00109977 | 0.00109977 |
| Toluene | | 0.0009* | 0* | 0.000899810 | | 0.000899810 | 0.000899810 | 0.000899810 |
| Ethylbenzene | | 0.0003* | 0* | 0.000299937 | | 0.000299937 | 0.000299937 | 0.000299937 |
| para-Xylene | | 0.0006* | 0* | 0.000599874 | | 0.000599874 | 0.000599874 | 0.000599874 |
| Mass Flow | | lb/h lb/h | | lb/h | lb/h | lb/h | lb/h | lb/h |
| H2O | | 0* | 208.289* | 208.289 | 0 | 208.289 | 83.3158 | 124.974 |
| H2S | | 0* | 0* | 0 | 0 | 0 | 0 | 0 |
| CO2 | | 1067.68* | 0* | 1067.68 | 0 | 1067.68 | 427.073 | 640.610 |
| N2 | | 5503.02* | 0* | 5503.02 | 0 | 5503.02 | 2201.21 | 3301.81 |
| C1 | | 680257* | 0* | 680257 | 0 | 680257 | 272103 | 408154 |
| C2 | | 247785* | 0* | 247785 | 0 | 247785 | 99114.1 | 148671 |
| C3 | | 122068* | 0* | 122068 | 0 | 122068 | 48827.1 | 73240.7 |
| iC4 | | 16215.7* | 0* | 16215.7 | 0 | 16215.7 | 6486.28 | 9729.42 |
| nC4 | | 37105.0* | 0* | 37105.0 | 0 | 37105.0 | 14842.0 | 22263.0 |
| iC5 | | 7825.10* | 0* | 7825.10 | 0 | 7825.10 | 3130.04 | 4695.06 |
| nC5 | | 10030.9* | 0* | 10030.9 | 0 | 10030.9 | 4012.34 | 6018.51 |
| C6 | | 6683.42* | 0* | 6683.42 | 0 | 6683.42 | 2673.37 | 4010.05 |
| C7 | | 566.483* | 0* | 566.483 | 0 | 566.483 | 226.593 | 339.890 |
| C8 | | 231.980* | 0* | 231.980 | 0 | 231.980 | 92.7919 | 139.188 |
| C9 | | 35.1980* | 0* | 35.1980 | 0 | 35.1980 | 14.0792 | 21.1188 |
| C10 | | 359.237* | 0* | 359.237 | 0 | 359.237 | 143.695 | 215.542 |
| Benzene | | 47.1610* | 0* | 47.1610 | 0 | 47.1610 | 18.8644 | 28.2966 |
| Toluene | | 45.5153* | 0* | 45.5153 | 0 | 45.5153 | 18.2061 | 27.3092 |
| Ethylbenzene | | 17.4814* | 0* | 17.4814 | 0 | 17.4814 | 6.99256 | 10.4888 |
| para-Xylene | | 34.9628* | 0* | 34.9628 | 0 | 34.9628 | 13.9851 | 20.9777 |
| Mass Fraction | | % | | % | % | % | % | % |
| H2O | | 0* | 100* | 0.0183339 | | 0.0183339 | 0.0183339 | 0.0183339 |
| H2S | | 0* | 0* | 0 | | 0 | 0 | 0 |
| CO2 | | 0.0939962* | 0* | 0.0939790 | | 0.0939790 | 0.0939790 | 0.0939790 |
| N2 | | 0.484473* | 0* | 0.484384 | | 0.484384 | 0.484384 | 0.484384 |
| C1 | | 59.8882* | 0* | 59.8772 | | 59.8772 | 59.8772 | 59.8772 |
| C2 | | 21.8144* | 0* | 21.8104 | | 21.8104 | 21.8104 | 21.8104 |
| C3 | | 10.7466* | 0* | 10.7446 | | 10.7446 | 10.7446 | 10.7446 |
| iC4 | | 1.42759* | 0* | 1.42733 | | 1.42733 | 1.42733 | 1.42733 |
| nC4 | | 3.26664* | 0* | 3.26604 | | 3.26604 | 3.26604 | 3.26604 |
| iC5 | | 0.688902* | 0* | 0.688776 | | 0.688776 | 0.688776 | 0.688776 |
| nC5 | | 0.883092* | 0* | 0.882930 | | 0.882930 | 0.882930 | 0.882930 |
| C6 | | 0.588392* | 0* | 0.588284 | | 0.588284 | 0.588284 | 0.588284 |
| C7 | | 0.0498718* | 0* | 0.0498627 | | 0.0498627 | 0.0498627 | 0.0498627 |
| C8 | | 0.0204229* | 0* | 0.0204192 | | 0.0204192 | 0.0204192 | 0.0204192 |
| C9 | | 0.00309875* | 0* | 0.00309818 | | 0.00309818 | 0.00309818 | 0.00309818 |
| C10 | | 0.0316263* | 0* | 0.0316205 | | 0.0316205 | 0.0316205 | 0.0316205 |
| Benzene | | 0.00415194* | 0* | 0.00415118 | | 0.00415118 | 0.00415118 | 0.00415118 |
| Toluene | | 0.00400705* | 0* | 0.00400632 | | 0.00400632 | 0.00400632 | 0.00400632 |
| Ethylbenzene | | 0.00153902* | 0* | 0.00153874 | | 0.00153874 | 0.00153874 | 0.00153874 |
| para-Xylene | | 0.00307804* | 0* | 0.00307748 | | 0.00307748 | 0.00307748 | 0.00307748 |

| Process Streams | | x1 | x2 | 1 | 2 | 3 | 4 | 5 |
|-------------------|--|-----------------------|-------|---------------------|---------------------|---------------------|----------|-------------------|
| Properties | | Status: Solved Solved | | Solved | Solved | Solved | Solved | Solved |
| Phase: Total | | From Block: -- -- | | SAT-1 | SC-100 Slug Catcher | SC-100 Slug Catcher | SPLT-100 | SPLT-100 |
| To Block: | | SAT-1 | SAT-1 | SC-100 Slug Catcher | -- | SPLT-100 | -- | Inlet Gas to Dehy |

| Property | Units | | | | | | | | |
|-------------------------------|-------------|-------------|----------|-------------|-----|-------------|----------|---------|----------|
| Temperature | °F | 80* | 539.783 | 80 | 80 | 80 | 80 | 80 | 80 |
| Pressure | psig | 950* | 950 | 950 | 950 | 950 | 950 | 950 | 950 |
| Molecular Weight | lb/lbmol | 20.6947 | 18.0153 | 20.6941 | | 20.6941 | 20.6941 | 20.6941 | 20.6941 |
| Std Vapor Volumetric Flow | MMSCFD | 499.895 | 0.105301 | 500* | 0 | 500 | 200* | | 300 |
| Std Liquid Volumetric Flow | sgpm | 6687.93 | 0.416386 | 6688.35 | 0 | 6688.35 | 2675.34 | | 4013.01 |
| Compressibility | | 0.781827 | 0.598788 | 0.781833 | | 0.781833 | 0.781833 | | 0.781833 |
| Specific Gravity | | 0.714533 | | 0.714513 | | 0.714513 | 0.714513 | | 0.714513 |
| Mass Flow | lb/h | 1.13588E+06 | 208.289 | 1.13609E+06 | 0 | 1.13609E+06 | 454435 | | 681652 |
| Mass Cp | Btu/(lb*°F) | 0.671214 | 0.868860 | 0.671191 | | 0.671191 | 0.671191 | | 0.671191 |
| Mass Density | lb/ft^3 | 4.40223 | 2.70183 | 4.40207 | | 4.40207 | 4.40207 | | 4.40207 |
| Gross Ideal Gas Heating Value | Btu/ft^3 | 1253.44 | 50.3100 | 1253.19 | | 1253.19 | 1253.19 | | 1253.19 |

NGL Amine Treating

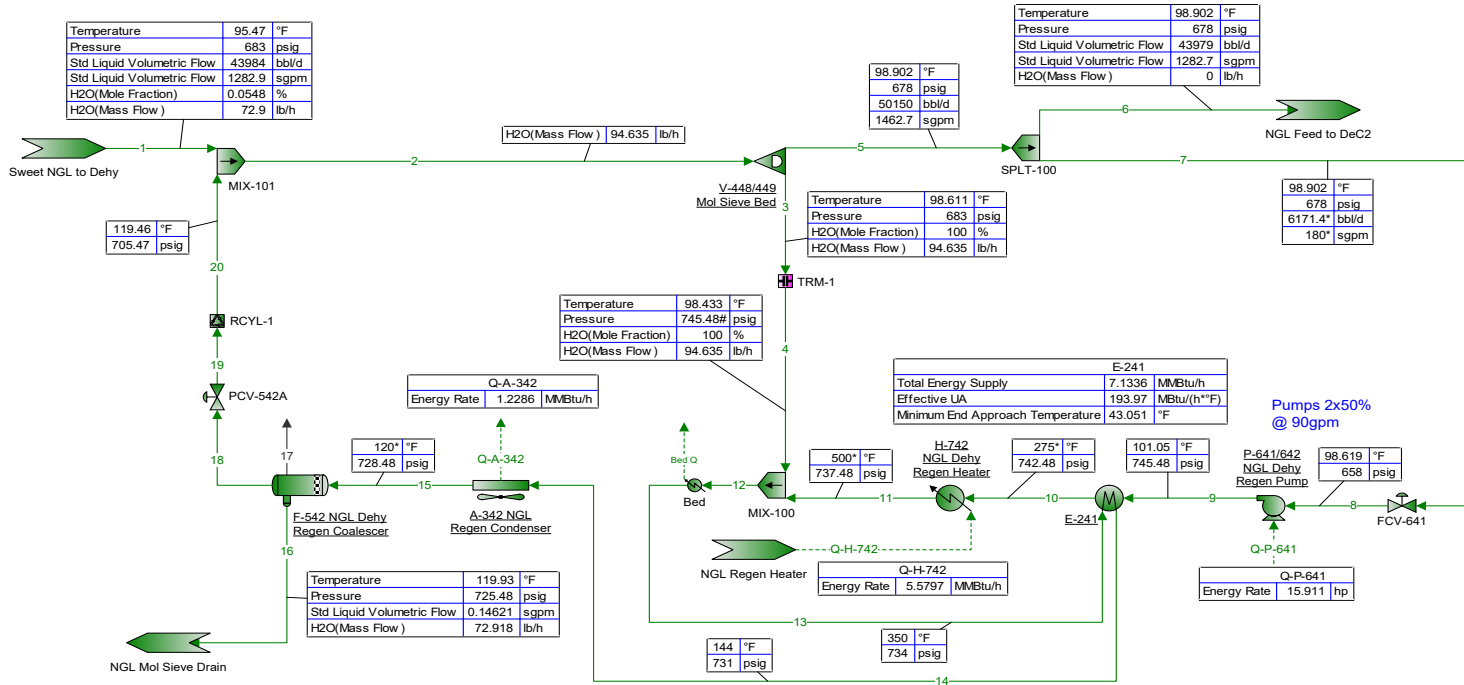
Increasing CO2 to 1.5 mol% to model amine system at rated basis



| Names | Units | 1 | 2 | 7 | 8 | 9 | 10 | 15 |
|----------------------------|--------------------|--------|---------|--------|---------|--------|----------|----------|
| Temperature | °F | 74.539 | 92.977 | 112.16 | 95.492 | 106.93 | 108.47 | 108.47 |
| Pressure | psig | 720 | 715 | 690 | 685 | 715 | 150* | 149.5 |
| Mole Fraction Vapor | % | 0 | 0 | 0 | 0 | 0 | 0.049956 | 100 |
| Molecular Weight | lb/lbmol | 36.614 | 36.614 | 36.49 | 36.49 | 23.2 | 23.2 | 31.41 |
| Mass Density | lb/ft ³ | 27.842 | 26.14 | 23.544 | 25.637 | 64.655 | 61.742 | 0.91898 |
| Specific Gravity | | 0.4432 | 0.41912 | 0.3775 | 0.41105 | 1.0367 | 1.0845 | 1.0845 |
| Molar Flow | lbmol/h | 7497.7 | 7497.7 | 7386.6 | 7386.6 | 6665.8 | 6665.8 | 3.3359 |
| Mass Flow | lb/h | 274524 | 274524 | 269538 | 269538 | 154644 | 154644 | 104.78 |
| Std Vapor Volumetric Flow | MMSCFD | 68.287 | 68.287 | 67.274 | 67.274 | 60.71 | 60.71 | 0.030382 |
| Std Liquid Volumetric Flow | sgpm | 1295.7 | 1295.7 | 1283 | 1283 | 312.74 | 312.74 | 0.5562 |

| Names | Units | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 31 |
|----------------------------|--------------------|--------|----------|---------|----------|---------|---------|---------|----------|---------|---------|---------|--------|--------|--------|
| Temperature | °F | 108.47 | 200* | 197.53 | 223.76 | 120 | 120 | 244.93 | 245.41 | 245.41 | 158.84 | 158.91 | 120* | 120.01 | 121.23 |
| Pressure | psig | 149.5 | 144.5 | 15* | 10 | 10 | 10 | 13 | 13 | 13 | 8 | 48 | 43 | 41 | 800 |
| Mole Fraction Vapor | % | 0 | 0.015264 | 0.26419 | 100 | 0 | 100 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| Molecular Weight | lb/lbmol | 23.195 | 23.195 | 23.195 | 23.241 | 18.029 | 41.875 | 22.171 | 18.149 | 22.842 | 22.842 | 22.842 | 22.842 | 22.832 | 22.832 |
| Mass Density | lb/ft ³ | 64.627 | 61.772 | 22.666 | 0.074278 | 61.69 | 0.15732 | 59.991 | 0.063706 | 60.05 | 62.316 | 62.318 | 63.083 | 63.08 | 63.117 |
| Specific Gravity | | 1.0362 | | | 0.80246 | 0.98911 | 1.4458 | 0.96188 | 0.62662 | 0.96281 | 0.99915 | 0.99918 | 1.0115 | 1.0114 | 1.012 |
| Molar Flow | lbmol/h | 6662.5 | 6662.5 | 6662.5 | 565.51 | 441.89 | 123.62 | 7629.7 | 1090.8 | 6538.8 | 6538.8 | 6538.8 | 6538.8 | 6554.6 | 6554.6 |
| Mass Flow | lb/h | 154539 | 154539 | 154539 | 13143.1 | 7966.73 | 5176.35 | 169159 | 19796.8 | 149363 | 149363 | 149363 | 149363 | 149658 | 149658 |
| Std Vapor Volumetric Flow | MMSCFD | 60.679 | 60.679 | 60.679 | 5.1504 | 4.0246 | 1.1258 | 69.488 | 9.9347 | 59.553 | 59.553 | 59.553 | 59.553 | 59.697 | 59.697 |
| Std Liquid Volumetric Flow | sgpm | 312.19 | 312.19 | 312.19 | 28.708 | 15.931 | 12.777 | 339.08 | 39.674 | 299.41 | 299.41 | 299.41 | 299.41 | 300* | 300 |

NGL Mol Sieve Dehydration

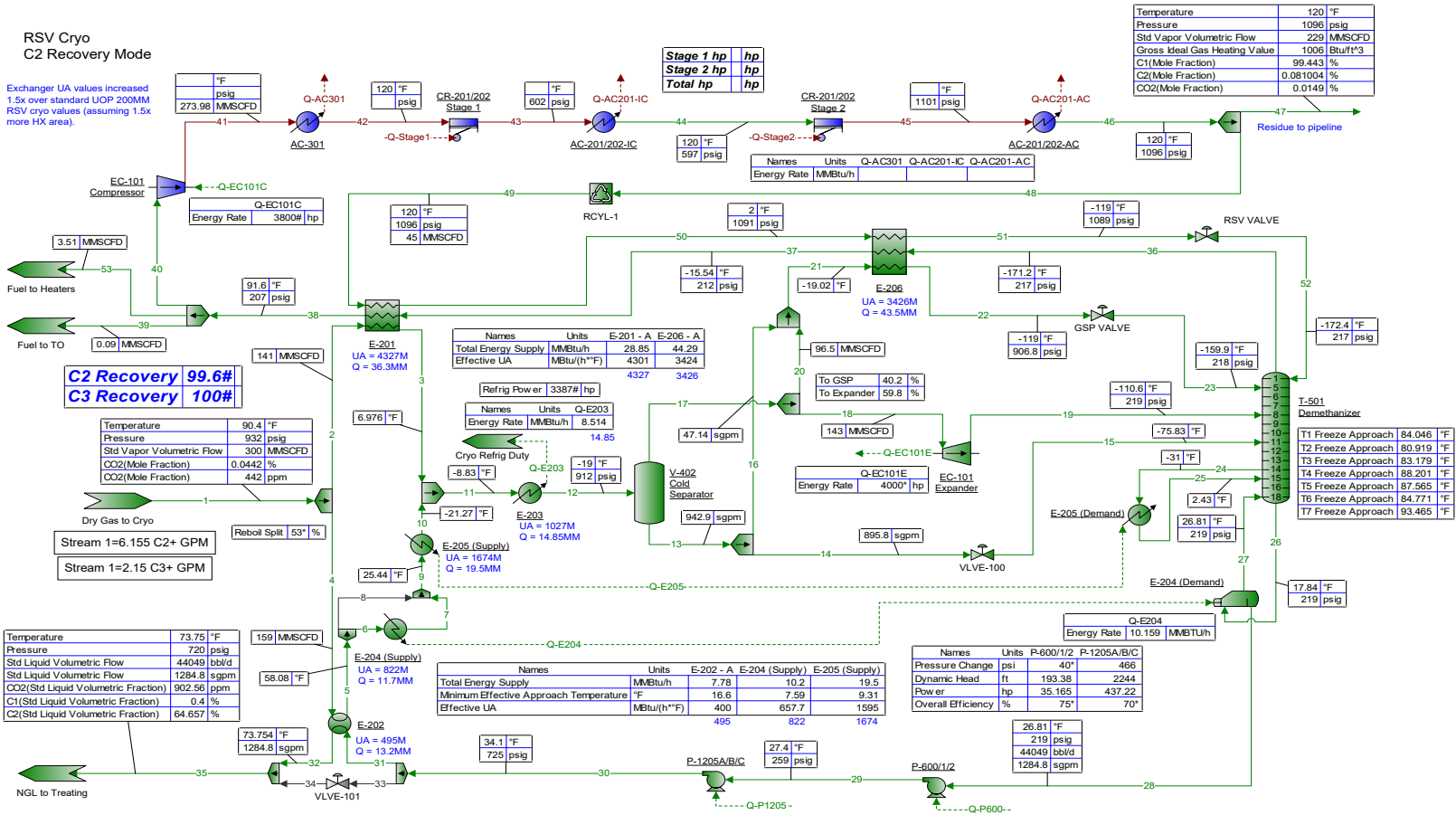


| Names | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|----------------------------|----------|---------|---------|----------|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|---------|---------|---------|---------|
| Temperature | °F | 95.472 | 98.611 | 98.611 | 98.433 | 98.902 | 98.902 | 98.902 | 98.619 | 101.05 | 275* | 500* | 495.54 | 350 | 144.1 | 120* | 119.93 | 119.93 | 119.46 | 119.46 | 119.46 |
| Pressure | psig | 683 | 683 | 683 | 745.48# | 678 | 678 | 678 | 658 | 745.48 | 742.48 | 737.48 | 737.48 | 734.48 | 731.48 | 728.48 | 725.48 | 725.48 | 705.48 | 705.48 | 705.47 |
| Mole Fraction Vapor | % | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 100 | 100 | 1.3375 | 0 | 0 | 0 | 0 | 0 | 0 |
| Molecular Weight | lb/lbmol | 36.495 | 36.493 | 18.015 | 18.015 | 36.505 | 36.505 | 36.505 | 36.505 | 36.505 | 36.505 | 36.505 | 36.412 | 36.412 | 36.412 | 36.412 | 18.024 | 36.483 | 36.483 | 36.481 | 36.481 |
| Mass Density | lb/ft³ | 25.629 | 25.308 | 62.008 | 62.014 | 25.24 | 25.24 | 25.193 | 25.257 | 4.6135 | 2.8905 | 2.9006 | 3.7326 | 17.45 | 22.64 | 61.672 | | 22.596 | 22.473 | 22.468 | 22.468 |
| Specific Gravity | | 0.41093 | 0.40578 | 0.99421 | 0.99431 | 0.40469 | 0.40469 | 0.40394 | 0.40496 | 1.2604 | 1.2604 | 1.2572 | 1.2572 | | 0.36301 | 0.98883 | | 0.36229 | 0.36032 | 0.36025 | 0.36025 |
| Molar Flow | lbmol/h | 7384 | 8420.8 | 5.2531 | 5.2531 | 8415.6 | 7380 | 1035.6 | 1035.6 | 1035.6 | 1035.6 | 1035.6 | 1040.9 | 1040.9 | 1040.9 | 1040.9 | 4.0502 | 0 | 1036.8 | 1036.8 | 1036.8 |
| Mass Flow | lb/h | 269480 | 307305 | 94.6355 | 94.6355 | 307210 | 269405 | 37804.8 | 37804.8 | 37804.8 | 37804.8 | 37804.8 | 37899.4 | 37899.4 | 37899.4 | 37899.4 | 72.9998 | 0 | 37826.4 | 37826.4 | 37824.5 |
| Std Vapor Volumetric Flow | MMSCFD | 67.251 | 76.694 | 0.047843 | 0.047843 | 76.646 | 67.214 | 9.4319 | 9.4319 | 9.4319 | 9.4319 | 9.4319 | 9.4798 | 9.4798 | 9.4798 | 9.4798 | 0.036888 | 0 | 9.4429 | 9.4429 | 9.4431 |
| Std Liquid Volumetric Flow | sgpm | 1282.9 | 1462.9 | 0.18918 | 0.18918 | 1462.7 | 1282.7 | 180* | 180 | 180 | 180 | 180 | 180.19 | 180.19 | 180.19 | 180.19 | 0.14621 | 0 | 180.04 | 180.04 | 180.04 |

| Process Streams | | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | | 17 | | 18 | | 19 | | 20 | | |
|-----------------|--|-------------------------------|--|-------------|--|-------------------------|--|-----------------------|--|---------------------------|--|------------------|--|-------------|--|-------------|--|-------------------------|--|-----------------------|--|----------------------|--|------------------------|--|-------------|--|--|--|--|--|-------------------------------|--|-------------|--|-------------|--|-------------|--|-------------|--|-------------|
| Composition | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | Solved | | | | |
| Phase: Total | | From Block: Sweet NGL to Dehy | | MX-101 | | V-448/449 Mol Sieve Bed | | 8/449 Mol Sieve TRM-1 | | 8/449 Mol Sieve SPLIT-100 | | NGL Feed to Dec2 | | SPLIT-100 | | FCV-641 | | 42 NGL Dehy Reg FCV-641 | | 42 NGL Dehy Reg E-241 | | 2 NGL Dehy Reg E-241 | | NGL Dehy Regen MIX-100 | | Bed E-241 | | NGL Regen Con3L Dehy Regen C NGL Mol Sieve Drain | | NGL Regen Con3L Dehy Regen C NGL Mol Sieve Drain | | Co. Dehy Regen3L Dehy Regen3L | | PCV-542A | | PCV-542A | | RCYL-1 | | | | |
| Mole Fraction | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | % | | |
| H2O | | 0.0548140 | | 0.0623818 | | 100 | | 100 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0.504685 | | 0.504685 | | 0.504685 | | 0.504685 | | 99.9352 | | 0.116270 | | 0.116270 | | 0.116277 | | |
| H2S | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| CO2 | | 0.000104709 | | 0.000104521 | | 0 | | 0 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 | | 0.000104586 |
| N2 | | 1.10754E-08 | | 1.10760E-08 | | 0 | | 0 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 | | 1.10829E-08 |
| C1 | | 0.649011 | | 0.649858 | | 0 | | 0 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 | | 0.649363 |
| C2 | | 66.6170 | | 66.6128 | | 0 | | 0 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 | | 66.6543 |
| C3 | | 22.4871 | | 22.4854 | | 0 | | 0 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 | | 22.4994 |
| C4 | | 2.26672 | | 2.26648 | | 0 | | 0 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 | | 2.26790 |
| nC4 | | 5.18655 | | 5.18592 | | 0 | | 0 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 | | 5.18916 |
| iC5 | | 0.881169 | | 0.881014 | | 0 | | 0 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 | | 0.881564 |
| nC5 | | 1.12953 | | 1.12930 | | 0 | | 0 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 | | 1.13001 |
| C6 | | 0.629995 | | 0.629741 | | 0 | | 0 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 | | 0.630141 |
| C7 | | 0.0459132 | | 0.0459130 | | 0 | | 0 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 | | 0.0459130 |
| C8 | | 0.0164878 | | 0.0164716 | | 0 | | 0 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 | | 0.0164819 |
| C9 | | 0.00222718 | | 0.00222405 | | 0 | | 0 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 | | 0.00222544 |
| C10 | | 0.0204859 | | 0.0204528 | | 0 | | 0 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 | | 0.0204656 |
| Benzene | | 0.0048916 | | 0.00488975 | | 0 | | 0 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 | | 0.00489280 |
| Toluene | | 0.00400831 | | 0.00400577 | | 0 | | 0 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 | | 0.00400827 |
| Ethylbenzene | | 0.00133641 | | 0.00133507 | | 0 | | 0 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 | | 0.00133591 |
| para-Xylene | | 0.00267241 | | 0.00266968 | | 0 | | 0 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 | | 0.00267134 |
| Mass Flow | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | lb/h | | | | |
| H2O | | 72.9162 | | 94.6355 | | 94.6355 | | 94.6355 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 94.6355 | | 94.6355 | | 94.6355 | | 94.6355 | | 94.6355 | | 72.9161 | | 21.7173 | | 21.7173 | | 21.7192 |
| H2S | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | |
| CO2 | | 0.340288 | | 0.387350 | | 0 | | 0 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 | | 0.387350 |
| N2 | | 2.29095E-05 | | 2.61278E-05 | | 0 | | 0 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 | | 2.61278E-05 |
| C1 | | 768.802 | | 876.683 | | 0 | | 0 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 | | 876.683 |
| C2 | | 147909 | | 186668 | | 0 | | 0 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 | | 186668 |
| C3 | | 73218.2 | | 83493.2 | | 0 | | 0 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 | | 83493.2 |
| iC4 | | 9728.16 | | 11093.0 | | 0 | | 0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 | | 11093.0 |
| nC4 | | 22259.3 | | 25381.8 | | 0 | | 0 | | 253 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

RSV Cryo
C2 Recovery Mode

Exchanger UA values increased 1.5x over standard UOP 200MM RSV cryo values (assuming 1.5x more HX area).



| | |
|---------------------------|------------|
| Temperature | 90.4 °F |
| Pressure | 932 psig |
| Std Vapor Volumetric Flow | 300 MMSCFD |
| CO2(Mole Fraction) | 0.0442 % |
| CO2(ppm) | 442 |

| | |
|-------------------------------------|-------------|
| Temperature | 73.75 °F |
| Pressure | 720 psig |
| Std Liquid Volumetric Flow | 44049 bbl/d |
| Std Liquid Volumetric Flow | 1284.8 sgm |
| CO2(Std Liquid Volumetric Fraction) | 0.4 % |
| C2(Std Liquid Volumetric Fraction) | 64.657 % |

| Names | Units | E-201 - A | E-206 - A |
|---------------------|------------|-----------|-----------|
| Total Energy Supply | MMBtu/h | 28.85 | 44.29 |
| Effective UA | MBtu/(h°F) | 4301 | 3424 |

| Names | Units | Q-E203 |
|--------------------|---------|--------|
| Energy Rate | MMBtu/h | 8.514 |
| Refrigerator Power | hp | 3387# |

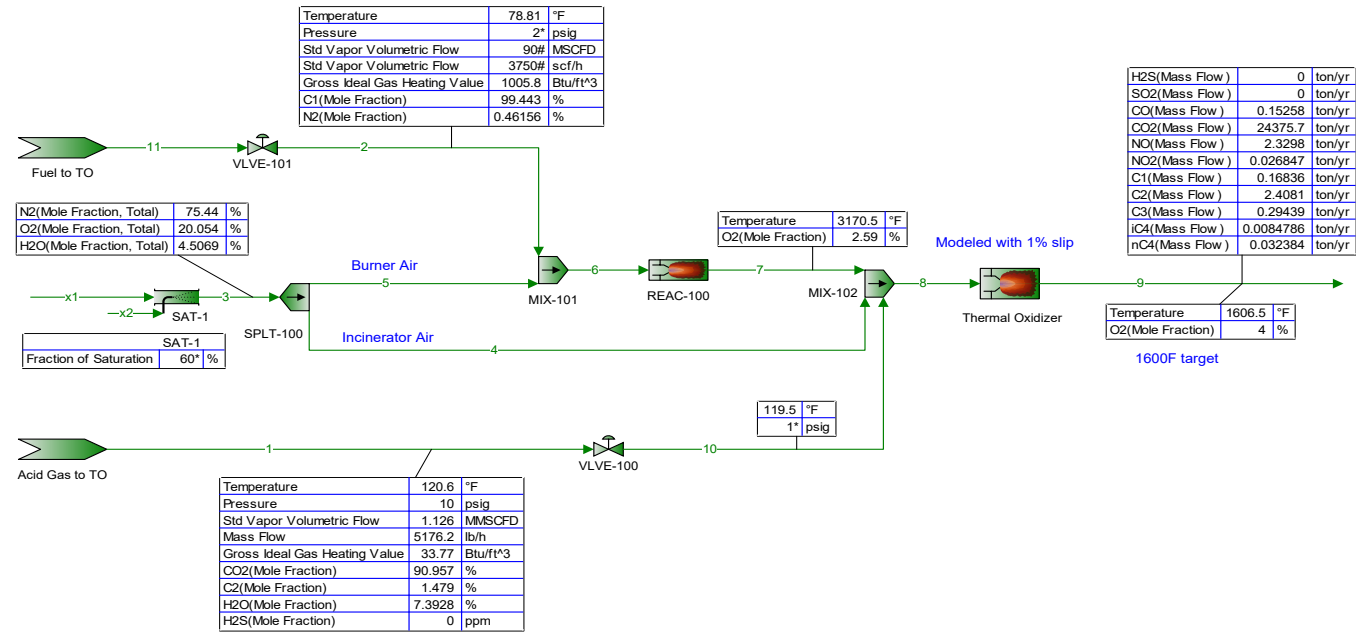
| Names | Units | E-202 - A | E-204 (Supply) | E-205 (Supply) |
|--|------------|-----------|----------------|----------------|
| Total Energy Supply | MMBtu/h | 7.78 | 10.2 | 19.5 |
| Minimum Effective Approach Temperature | °F | 16.6 | 7.59 | 9.31 |
| Effective UA | MBtu/(h°F) | 400 | 657.7 | 1595 |

| | |
|-------------------------------|--------------|
| Temperature | 120 °F |
| Pressure | 1096 psig |
| Std Vapor Volumetric Flow | 229 MMSCFD |
| Gross Ideal Gas Heating Value | 1006 Btu/ft³ |
| C1(Mole Fraction) | 99.443 % |
| C2(Mole Fraction) | 0.081004 % |
| CO2(Mole Fraction) | 0.0149 % |

| | |
|--------------------|-----------|
| T1 Freeze Approach | 84.046 °F |
| T2 Freeze Approach | 80.919 °F |
| T3 Freeze Approach | 83.179 °F |
| T4 Freeze Approach | 88.201 °F |
| T5 Freeze Approach | 87.565 °F |
| T6 Freeze Approach | 84.771 °F |
| T7 Freeze Approach | 93.465 °F |

| Names | Units | P-600/1/2 | P-1205A/B/C |
|--------------------|-------|-----------|-------------|
| Pressure Change | psi | 40* | 466 |
| Dynamic Head | ft | 193.38 | 2244 |
| Power | hp | 35.165 | 437.22 |
| Overall Efficiency | % | 75* | 70* |

Thermal Oxidizer



| Names | Units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----------------------------|----------|---------|----------|----------|----------|----------|----------|-----------|----------|---------|
| Temperature | °F | 120.6 | 78.81 | 105 | 105 | 105 | 102.44 | 3170.5 | 1203.5 | 1606.5 |
| Pressure | psig | 10 | 2* | 2 | 2 | 2 | 2 | 1 | 1 | 0* |
| Mole Fraction Vapor | % | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Molecular Weight | lb/lbmol | 41.874 | 16.113 | 28.362 | 28.362 | 28.362 | 27.373 | 27.358 | 32.98 | 32.88 |
| Mass Density | lb/ft³ | 0.15715 | 0.042475 | 0.071169 | 0.071169 | 0.071169 | 0.069005 | 0.0099707 | 0.026232 | 0.01957 |
| Specific Gravity | | 1.4458 | 0.55635 | 0.97927 | 0.97927 | 0.97927 | 0.94511 | 0.9446 | 1.1387 | 1.1353 |
| Molar Flow | lbmol/h | 123.61 | 9.8818 | 201.49 | 89.029# | 112.47# | 122.35 | 122.41 | 335.06 | 336.07 |
| Mass Flow | lb/h | 5176.2 | 159.23 | 5714.8 | 2525 | 3189.8 | 3349 | 3349 | 11050 | 11050 |
| Std Vapor Volumetric Flow | MMSCFD | 1.1258 | 0.09# | 1.8351 | 0.81084 | 1.0243 | 1.1143 | 1.1149 | 3.0516 | 3.0608 |
| Std Liquid Volumetric Flow | sgpm | 12.777 | 1.0556 | 13.14 | 5.8056 | 7.334 | 8.3897 | 8.0273 | 26.61 | 26.513 |

**ProMax 6.0 EOS Report
for Methanol Tank
&
Oil Tanks**



Bryan Research & Engineering, LLC

ProMax[®] 6.0

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Simulation Report

Client Name: ETC
Location: Rev Cryo
Job:

ProMax Filename: 2023-0331 Rev Cryo Misc Tanks v0.1

ProMax Version: 6.0.22251.0

Property Stencil Name: Lube Oil Tank

Property Stencil Flowsheet: Tanks

Emission Summary [Total]

| Component Subset | Tank Losses | Flashing Losses | Working Losses | Standing Losses | Loading Losses |
|------------------|-------------|-----------------|----------------|-----------------|----------------|
| | [ton/yr] | [ton/yr] | [ton/yr] | [ton/yr] | [ton/yr] |
| VOCs | 0.000 | 0.000 | 0.000 | 0.000 | - |
| HAPs | 0.000 | 0.000 | 0.000 | 0.000 | - |
| BTEX | 0.000 | 0.000 | 0.000 | 0.000 | - |
| H2S | 0.000 | - | - | - | - |
| Methane | 0.000 | 0.000 | 0.000 | 0.000 | - |

Bryan Research & Engineering, LLC

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<http://www.bre.com/>

Report Navigator can be activated via the ProMax Navigator Toolbar.



Bryan Research & Engineering, LLC

ProMax[®] 6.0

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Simulation Report

Client Name: ETC
Location: Rev Cryo
Job:

ProMax Filename: 2023-0331 Rev Cryo Misc Tanks v0.1

ProMax Version: 6.0.22251.0

Property Stencil Name: Methanol Tank

Property Stencil Flowsheet: Tanks

Emission Summary [Total]

| Component Subset | Tank Losses | Flashing Losses | Working Losses | Standing Losses | Loading Losses |
|------------------|-------------|-----------------|----------------|-----------------|----------------|
| | [ton/yr] | [ton/yr] | [ton/yr] | [ton/yr] | [ton/yr] |
| VOCs | 0.015 | 0.000 | 0.003 | 0.012 | - |
| HAPs | 0.015 | 0.000 | 0.003 | 0.012 | - |
| BTEX | 0.000 | 0.000 | 0.000 | 0.000 | - |
| H2S | 0.000 | - | - | - | - |
| Methane | 0.000 | 0.000 | 0.000 | 0.000 | - |

Bryan Research & Engineering, LLC

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P.O. Box 4747 Bryan, Texas 77805

Office: (979) 776-5220

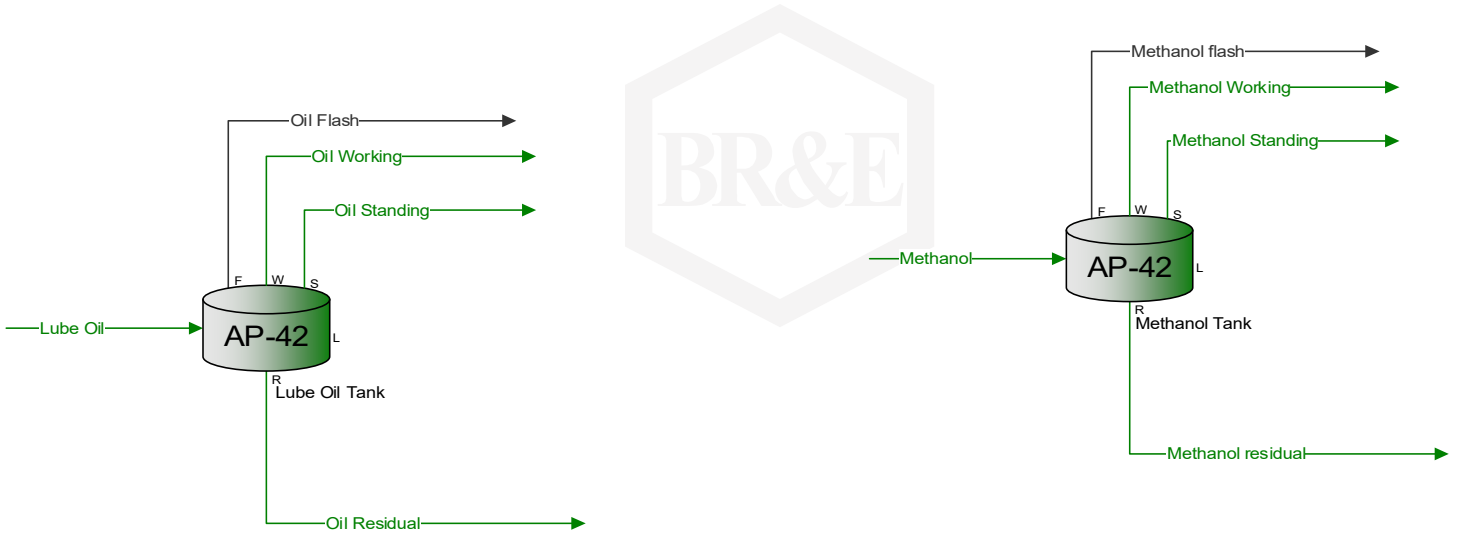
FAX: (979) 776-4818

mailto:sales@bre.com

<http://www.bre.com/>

Report Navigator can be activated via the ProMax Navigator Toolbar.

Tanks



Inlet Stream Summary

| Stream Name | | Lube Oil | Methanol |
|---------------------------------|--------|----------|----------|
| Stream Flowsheet | | Tanks | Tanks |
| Temperature | °F | 60.000 | 60.000 |
| Pressure | psig | 0.000 | 0.000 |
| Standard Vapor Volumetric Flow | MSCFD | 10.749 | 1.292 |
| Standard Liquid Volumetric Flow | bbbl/d | 17.874 | 0.391 |
| Vapor Fraction | (%) | 0.000 | 0.000 |
| Component | | [Mol%] | [Mol%] |
| Carbon Dioxide | | 0.000 | 0.000 |
| Nitrogen | | 0.000 | 0.000 |
| Methane | | 0.000 | 0.000 |
| Ethane | | 0.000 | 0.000 |
| Propane | | 0.000 | 0.000 |
| i-Butane | | 0.000 | 0.000 |
| n-Butane | | 0.000 | 0.000 |
| i-Pentane | | 0.000 | 0.000 |
| n-Pentane | | 0.000 | 0.000 |
| i-Hexane | | 0.000 | 0.000 |
| Heptane | | 0.000 | 0.000 |
| Octane | | 0.000 | 0.000 |
| Nonane | | 0.000 | 0.000 |
| Benzene | | 0.000 | 0.000 |
| Toluene | | 0.000 | 0.000 |
| Ethylbenzene | | 0.000 | 0.000 |
| m-Xylene | | 0.000 | 0.000 |
| n-Hexane | | 0.000 | 0.000 |
| 2,2,4-Trimethylpentane | | 0.000 | 0.000 |
| Neopentane | | 0.000 | 0.000 |
| Decanes Plus | | 0.000 | 0.000 |
| Water | | 0.000 | 0.000 |
| Helium | | 0.000 | 0.000 |
| Hydrogen | | 0.000 | 0.000 |
| Oxygen | | 0.000 | 0.000 |
| Lube Oil | | 100.000 | 0.000 |
| Propylene Glycol | | 0.000 | 0.000 |
| Methanol | | 0.000 | 100.000 |
| TEG | | 0.000 | 0.000 |
| Ethanol | | 0.000 | 0.000 |
| DEG | | 0.000 | 0.000 |
| MEG | | 0.000 | 0.000 |
| Methyl Mercaptan | | 0.000 | 0.000 |
| Diesel | | 0.000 | 0.000 |
| Gasoline | | 0.000 | 0.000 |

Flowsheet Information

| | |
|--------------------------------|---------------|
| Tank Losses Block Name | Lube Oil Tank |
| Tank Losses Block Inlet Stream | Lube Oil |

Tank Characteristics

| | | | |
|--|-------------------|--------|--|
| Tank Type | Vertical Cylinder | | |
| Time Frame | Year | | |
| Material Category | Light Organics | | |
| Number of Tanks | 1 | | |
| Shell Height [ft] | 10.000 | | |
| Diameter [ft] | 5.000 | | |
| Maximum Liquid Height [%] [ft] | 90.000 | 9.000 | |
| Average Liquid Height [%] [ft] | 50.000 | 5.000 | |
| Minimum Liquid Height [%] [ft] | 10.000 | 1.000 | |
| Sum of Increases in Liquid Level [ft/yr] | 1862.746 | | |
| Tank Volume [gal] [bbl] | 1468.797 | 34.971 | |
| Insulation | Uninsulated | | |
| Bolted or Riveted Construction | False | | |
| Vapor Balanced Tank | False | | |

Paint Characteristics

| | |
|-----------------------|------------|
| Shell Color | Dark Green |
| Shell Paint Condition | Average |
| Roof Color | Dark Green |
| Roof Paint Condition | Average |

Roof Characteristics

| | |
|---------------|-------|
| Type | Cone |
| Diameter [ft] | - |
| Slope [ft/ft] | 0.063 |

Breather Vent Settings

| | |
|---------------------------------|--------|
| Breather Vacuum Pressure [psig] | -0.030 |
| Breather Vent Pressure [psig] | 0.030 |

Loading Loss Parameters

| | |
|----------------------------------|---|
| Cargo Carrier | - |
| Land Based Mode of Operation | - |
| Marine Based Mode of Operation | - |
| Control Efficiency [%] | - |
| Truck Annual Leak Test Passed | - |
| Overall Reduction Efficiency [%] | - |

Meteorological Data

| | | | |
|---|----------------|--|--|
| Location | Pittsburgh, PA | | |
| Average Atmospheric Pressure [psia] | 14.100 | | |
| Maximum Average Temperature [°F] | 60.400 | | |
| Minimum Average Temperature [°F] | 42.800 | | |
| Solar Insolation [BTU/ft ² *day] | 1170.000 | | |
| Average Wind Speed [mph] | 7.800 | | |

Tank Conditions

| | | | |
|--|---------|----------|--|
| Flashing Temperature [°F] | 65.077 | | |
| Maximum Liquid Surface Temperature [°F] | 65.077 | | |
| Average Liquid Surface Temperature [°F] | 57.308 | | |
| Known Liquid Bulk Temperature? | False | | |
| Bulk Liquid Temperature [°F] | 54.759 | | |
| Net Throughput [bbl/day] [bbl/yr] | 17.849 | 6514.950 | |
| Net Throughput Per Tank [bbl/day] [bbl/yr] | 17.849 | 6514.950 | |
| Annual Turnovers Per Tank | 232.843 | | |
| Residual Liquid [bbl/day] | 17.874 | | |
| Residual Liquid Per Tank [bbl/day] | 17.874 | | |
| Raoult's Law Used for Vapor Pressure Calc? | False | | |
| Vapor Pressure @ Minimum Liquid Surface Temperature [psia] | 0.000 | | |
| Vapor Pressure @ Maximum Liquid Surface Temperature [psia] | 0.000 | | |
| Vapor Pressure @ Average Daily Liquid Surface Temperature [psia] | 0.000 | | |

Tank Conditions

| | |
|--------------|---|
| Heated Tank? | - |
|--------------|---|

Flowsheet Information

| | |
|--------------------------------|---------------|
| Tank Losses Block Name | Methanol Tank |
| Tank Losses Block Inlet Stream | Methanol |

Tank Characteristics

| | | | |
|--|-------------------|--------|--|
| Tank Type | Vertical Cylinder | | |
| Time Frame | Year | | |
| Material Category | Light Organics | | |
| Number of Tanks | 1 | | |
| Shell Height [ft] | 10.000 | | |
| Diameter [ft] | 5.000 | | |
| Maximum Liquid Height [%] [ft] | 90.000 | 9.000 | |
| Average Liquid Height [%] [ft] | 50.000 | 5.000 | |
| Minimum Liquid Height [%] [ft] | 10.000 | 1.000 | |
| Sum of Increases in Liquid Level [ft/yr] | 39.786 | | |
| Tank Volume [gal] [bbl] | 1468.797 | 34.971 | |
| Insulation | Uninsulated | | |
| Bolted or Riveted Construction | False | | |
| Vapor Balanced Tank | False | | |

Paint Characteristics

| | |
|-----------------------|------------|
| Shell Color | Dark Green |
| Shell Paint Condition | Average |
| Roof Color | Dark Green |
| Roof Paint Condition | Average |

Roof Characteristics

| | |
|---------------|-------|
| Type | Cone |
| Diameter [ft] | - |
| Slope [ft/ft] | 0.063 |

Breather Vent Settings

| | |
|---------------------------------|--------|
| Breather Vacuum Pressure [psig] | -0.030 |
| Breather Vent Pressure [psig] | 0.030 |

Loading Loss Parameters

| | |
|----------------------------------|---|
| Cargo Carrier | - |
| Land Based Mode of Operation | - |
| Marine Based Mode of Operation | - |
| Control Efficiency [%] | - |
| Truck Annual Leak Test Passed | - |
| Overall Reduction Efficiency [%] | - |

Meteorological Data

| | |
|---|----------------|
| Location | Pittsburgh, PA |
| Average Atmospheric Pressure [psia] | 14.100 |
| Maximum Average Temperature [°F] | 60.400 |
| Minimum Average Temperature [°F] | 42.800 |
| Solar Insolation [BTU/ft ² *day] | 1170.000 |
| Average Wind Speed [mph] | 7.800 |

Tank Conditions

| | |
|--|-----------------|
| Flashing Temperature [°F] | 65.077 |
| Maximum Liquid Surface Temperature [°F] | 65.077 |
| Average Liquid Surface Temperature [°F] | 57.308 |
| Known Liquid Bulk Temperature? | False |
| Bulk Liquid Temperature [°F] | 54.759 |
| Net Throughput [bbl/day] [bbl/yr] | 0.381 139.153 |
| Net Throughput Per Tank [bbl/day] [bbl/yr] | 0.381 139.153 |
| Annual Turnovers Per Tank | 4.973 |
| Residual Liquid [bbl/day] | 0.391 |
| Residual Liquid Per Tank [bbl/day] | 0.391 |
| Raoult's Law Used for Vapor Pressure Calc? | False |
| Vapor Pressure @ Minimum Liquid Surface Temperature [psia] | 1.101 |
| Vapor Pressure @ Maximum Liquid Surface Temperature [psia] | 1.789 |
| Vapor Pressure @ Average Daily Liquid Surface Temperature [psia] | 1.410 |

Tank Conditions

| | |
|--------------|---|
| Heated Tank? | - |
|--------------|---|

| Emission Summary [Total] | | | | | |
|--------------------------|-------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|
| Component Subset | Tank Losses [ton/yr] | Flashing Losses [ton/yr] | Working Losses [ton/yr] | Standing Losses [ton/yr] | Loading Losses [ton/yr] |
| VOCs | 0.000 | 0.000 | 0.000 | 0.000 | - |
| HAPs | 0.000 | 0.000 | 0.000 | 0.000 | - |
| BTEX | 0.000 | 0.000 | 0.000 | 0.000 | - |
| H2S | 0.000 | - | - | - | - |

| Emission Summary [Per Tank] | | | | | |
|-----------------------------|-------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|
| Component Subset | Tank Losses [ton/yr] | Flashing Losses [ton/yr] | Working Losses [ton/yr] | Standing Losses [ton/yr] | Loading Losses [ton/yr] |
| VOCs (C3+) | 0.000 | 0.000 | 0.000 | 0.000 | - |
| HAPs | 0.000 | 0.000 | 0.000 | 0.000 | - |
| BTEX | 0.000 | 0.000 | 0.000 | 0.000 | - |
| H2S | 0.000 | - | - | - | - |

| Stream Properties | | | | | | |
|--|------------|-----------------|----------------|-----------------|----------------|----------|
| | Tank Inlet | Flashing Losses | Working Losses | Standing Losses | Loading Losses | Residual |
| Molecular Weight [lb/lbmol] | 188.000 | - | 188.000 | 188.000 | - | 188.000 |
| Net Ideal Gas Heating Value [BTU/scf] | - | - | 9169.963 | 9169.963 | - | - |
| Standard Vapor Volumetric Flow [scf/d] | - | 0.000 | 0.000 | 0.000 | - | - |
| Specific Gravity | 0.851 | - | - | - | - | 0.849 |
| Real Vapor Pressure [psi] | 0.209 | - | - | - | - | 0.209 |
| API Gravity | 34.804 | - | - | - | - | 34.805 |
| Standard Liquid Volumetric Flow [bbbl/d] | 17.874 | - | - | - | - | 17.874 |

| Stream Mass Flow [Total] | | | | | | | |
|--------------------------|------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|----------------------|-----------------------------|
| Component | Tank Inlet [ton/yr] | Flashing Losses [ton/yr] | Working Losses [ton/yr] | Standing Losses [ton/yr] | Loading Losses [ton/yr] | Residual [ton/yr] | Total Emissions [ton/yr] |
| Carbon Dioxide | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Nitrogen | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Methane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Ethane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Propane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| i-Butane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Butane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| i-Pentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Pentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| i-Hexane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Hexane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Heptane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Octane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Nonane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Benzene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Toluene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Ethylbenzene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| m-Xylene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Hexane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Neopentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Decanes Plus | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Water | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Helium | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Hydrogen | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Oxygen | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Lube Oil | 971.805 | 0.000 | 0.000 | 0.000 | - | 971.805 | 0.000 |
| Propylene Glycol | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Methanol | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| TEG | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Ethanol | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| DEG | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| MEG | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Methyl Mercaptan | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Diesel | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Gasoline | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |

| Stream Composition | | | | | | |
|------------------------|---------------------|--------------------------|-------------------------|--------------------------|-------------------------|-------------------|
| Component | Tank Inlet [MoL% | Flashing Losses [MoL% | Working Losses [MoL% | Standing Losses [MoL% | Loading Losses [MoL% | Residual [MoL% |
| Carbon Dioxide | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nitrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Propane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Heptane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Octane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nonane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Benzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Toluene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethylbenzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| m-Xylene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Neopentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Decanes Plus | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Water | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Helium | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Hydrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Oxygen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Lube Oil | 100.000 | - | 100.000 | 100.000 | - | 100.000 |
| Propylene Glycol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methanol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| TEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethanol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| DEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| MEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methyl Mercaptan | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Diesel | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Gasoline | 0.000 | - | 0.000 | 0.000 | - | 0.000 |

| Component | Tank Inlet [Mass% | Flashing Losses [Mass% | Working Losses [Mass% | Standing Losses [Mass% | Loading Losses [Mass% | Residual [Mass% |
|------------------------|----------------------|---------------------------|--------------------------|---------------------------|--------------------------|--------------------|
| Carbon Dioxide | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nitrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Propane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Heptane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Octane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nonane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Benzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Toluene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethylbenzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| m-Xylene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Neopentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Decanes Plus | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Water | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Helium | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Hydrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Oxygen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Lube Oil | 100.000 | - | 100.000 | 100.000 | - | 100.000 |
| Propylene Glycol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methanol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| TEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethanol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| DEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| MEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methyl Mercaptan | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Diesel | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Gasoline | 0.000 | - | 0.000 | 0.000 | - | 0.000 |

| Emission Summary [Total] | | | | | |
|--------------------------|-------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|
| Component Subset | Tank Losses [ton/yr] | Flashing Losses [ton/yr] | Working Losses [ton/yr] | Standing Losses [ton/yr] | Loading Losses [ton/yr] |
| VOCs | 0.012 | 0.000 | 0.000 | 0.012 | - |
| HAPs | 0.015 | 0.000 | 0.003 | 0.012 | - |
| BTEX | 0.000 | 0.000 | 0.000 | 0.000 | - |
| H2S | 0.000 | - | - | - | - |

| Emission Summary [Per Tank] | | | | | |
|-----------------------------|-------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|
| Component Subset | Tank Losses [ton/yr] | Flashing Losses [ton/yr] | Working Losses [ton/yr] | Standing Losses [ton/yr] | Loading Losses [ton/yr] |
| VOCs (C3+) | 0.012 | 0.000 | 0.000 | 0.012 | - |
| HAPs | 0.015 | 0.000 | 0.003 | 0.012 | - |
| BTEX | 0.000 | 0.000 | 0.000 | 0.000 | - |
| H2S | 0.000 | - | - | - | - |

| Stream Properties | | | | | | |
|--|------------|-----------------|----------------|-----------------|----------------|----------|
| | Tank Inlet | Flashing Losses | Working Losses | Standing Losses | Loading Losses | Residual |
| Molecular Weight [lb/lbmol] | 32.042 | - | 32.042 | 32.042 | - | 32.042 |
| Net Ideal Gas Heating Value [BTU/scf] | - | - | 766.100 | 766.100 | - | - |
| Standard Vapor Volumetric Flow [scf/d] | - | 0.000 | 0.205 | 0.757 | - | - |
| Specific Gravity | 0.815 | - | - | - | - | 0.812 |
| Real Vapor Pressure [psi] | 4.884 | - | - | - | - | 4.884 |
| API Gravity | 42.036 | - | - | - | - | 42.037 |
| Standard Liquid Volumetric Flow [bb/d] | 0.391 | - | - | - | - | 0.391 |

| Stream Mass Flow [Total] | | | | | | | |
|--------------------------|------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|----------------------|-----------------------------|
| Component | Tank Inlet [ton/yr] | Flashing Losses [ton/yr] | Working Losses [ton/yr] | Standing Losses [ton/yr] | Loading Losses [ton/yr] | Residual [ton/yr] | Total Emissions [ton/yr] |
| Carbon Dioxide | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Nitrogen | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Methane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Ethane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Propane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| i-Butane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Butane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| i-Pentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Pentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| i-Hexane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Hexane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Heptane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Octane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Nonane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Benzene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Toluene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Ethylbenzene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| m-Xylene | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| n-Hexane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Neopentane | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Decanes Plus | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Water | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Helium | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Hydrogen | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Oxygen | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Lube Oil | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Propylene Glycol | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Methanol | 19.509 | 0.000 | 0.003 | 0.012 | - | 19.894 | 0.015 |
| TEG | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Ethanol | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| DEG | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| MEG | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Methyl Mercaptan | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Diesel | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |
| Gasoline | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 |

| Stream Composition | | | | | | |
|------------------------|----------------------|---------------------------|--------------------------|---------------------------|--------------------------|--------------------|
| Component | Tank Inlet [MoHx] | Flashing Losses [MoHx] | Working Losses [MoHx] | Standing Losses [MoHx] | Loading Losses [MoHx] | Residual [MoHx] |
| Carbon Dioxide | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nitrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Propane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Heptane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Octane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nonane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Benzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Toluene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethylbenzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| m-Xylene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Neopentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Decanes Plus | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Water | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Helium | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Hydrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Oxygen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Lube Oil | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Propylene Glycol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methanol | 100.000 | - | 100.000 | 100.000 | - | 100.000 |
| TEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethanol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| DEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| MEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methyl Mercaptan | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Diesel | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Gasoline | 0.000 | - | 0.000 | 0.000 | - | 0.000 |

| Stream Composition | | | | | | |
|------------------------|-----------------------|----------------------------|---------------------------|----------------------------|---------------------------|---------------------|
| Component | Tank Inlet [Mass%] | Flashing Losses [Mass%] | Working Losses [Mass%] | Standing Losses [Mass%] | Loading Losses [Mass%] | Residual [Mass%] |
| Carbon Dioxide | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nitrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Propane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Butane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Pentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| i-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Heptane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Octane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Nonane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Benzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Toluene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethylbenzene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| m-Xylene | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| n-Hexane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| 2,2,4-Trimethylpentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Neopentane | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Decanes Plus | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Water | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Helium | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Hydrogen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Oxygen | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Lube Oil | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Propylene Glycol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methanol | 100.000 | - | 100.000 | 100.000 | - | 100.000 |
| TEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Ethanol | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| DEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| MEG | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Methyl Mercaptan | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Diesel | 0.000 | - | 0.000 | 0.000 | - | 0.000 |
| Gasoline | 0.000 | - | 0.000 | 0.000 | - | 0.000 |

**Site Specific Gas Analyses
Sampled at Revolution
Cryogenic Plant**

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

Site-Specific Gas Analysis

Location: Cryo Plant Residue/Fuel Gas
 HHV (Btu/scf): 1,009

| Constituent | Natural Gas Stream Speciation (Vol. %) | Natural Gas Stream Speciation (Wt. %) | MW g/mol |
|------------------------|--|---|-------------|
| N2 | 0.4915 | 0.8440 | 28.0100 |
| METHANE | 98.3123 | 96.6776 | 16.0400 |
| CO2 | 0.2983 | 0.8050 | 44.0100 |
| ETHANE | 0.8775 | 1.6177 | 30.0700 |
| PROPANE | 0.0197 | 0.0533 | 44.1000 |
| I-BUTANE | 0.0003 | 0.0010 | 58.1200 |
| N-BUTANE | 0.0004 | 0.0014 | 58.1200 |
| I-PENTANE | 6.09E-06 | 0.0000 | 72.1500 |
| N-PENTANE | 9.09E-06 | 0.0000 | 72.1500 |
| I-HEXANES | 0.00E+00 | 0.0000 | 86.1800 |
| N-HEXANE | 7.01E-07 | 0.0000 | 86.1800 |
| BENZENE | 1.21E-08 | 0.0000 | 78.1100 |
| CYCLOHEXANE | 3.03E-08 | 0.0000 | 84.1600 |
| HEPTANES | 2.44E-08 | 0.0000 | 100.2100 |
| TOLUENE | 2.13E-09 | 0.0000 | 92.1400 |
| 2,2,4 Trimethylpentane | 3.44E-08 | 0.0000 | 114.2300 |
| N-OCTANE | 2.31E-10 | 0.0000 | 114.2400 |
| *E-BENZENE | 9.03E-12 | 0.0000 | 106.1700 |
| *m,o,&p-XYLENE | 1.26E-11 | 0.0000 | 106.1600 |
| I-NONANES | 2.50E-11 | 0.0000 | 128.2000 |
| N-NONANE | 2.63E-12 | 0.0000 | 128.2000 |
| I-DECANES | 0.00E+00 | 0.0000 | 142.2900 |
| N-DECANE | 2.66E-13 | 0.0000 | 142.2900 |
| I-UNDECANES + | 0.00E+00 | 0.0000 | 142.2900 |
| Totals | 100.000 | 100.000 | |

| | | | |
|-------------|--------|--------|--|
| TOC (Total) | 99.210 | 98.351 | |
| VOC (Total) | 0.020 | 0.056 | |
| HAP (Total) | 0.000 | 0.000 | |

C8+ 0.000 0.000

Molecular Weight 16.311

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

Site-Specific Gas Analysis

Location: Cryo Plant Inlet Gas
 HHV (Btu/scf): 1,152

| Constituent | Natural Gas Stream Speciation (Vol. %) | Natural Gas Stream Speciation (Wt. %) | MW g/mol |
|------------------------|--|---|-------------|
| N2 | 0.3787 | 0.4996 | 28.01 |
| METHANE | 76.0979 | 57.4840 | 16.04 |
| CO2 | 0.4983 | 1.0327 | 44.01 |
| ETHANE | 14.9106 | 21.1114 | 30.07 |
| PROPANE | 5.0034 | 10.3888 | 44.1 |
| I-BUTANE | 0.5582 | 1.5276 | 58.12 |
| N-BUTANE | 1.3655 | 3.7371 | 58.12 |
| I-PENTANE | 0.2890 | 0.9820 | 72.15 |
| N-PENTANE | 0.3787 | 1.2867 | 72.15 |
| I-HEXANES | | | 86.18 |
| N-HEXANE | 0.2591 | 1.0515 | 86.18 |
| BENZENE | 0.0022 | 0.0081 | 78.11 |
| CYCLOHEXANE | 0.0130 | 0.0513 | 84.16 |
| HEPTANES | 0.0857 | 0.4044 | 100.21 |
| TOLUENE | 0.0030 | 0.0130 | 92.14 |
| 2,2,4 Trimethylpentane | 0.0498 | 0.2680 | 114.23 |
| N-OCTANE | 0.0054 | 0.0289 | 114.24 |
| *E-BENZENE | 0.0002 | 0.0010 | 106.17 |
| *m,o,&p-XYLENE | | | 106.16 |
| I-NONANES | 0.0007 | 0.0042 | 128.2 |
| N-NONANE | | | 128.2 |
| I-DECANES | 0.0011 | 0.0073 | 142.29 |
| N-DECANE | | | 142.29 |
| I-UNDECANES + | | | 142.29 |
| Totals | 99.901 | 99.888 | |

| | Vol % | Wt% | |
|-------------|--------|--------|--|
| TOC (Total) | 99.024 | 98.355 | |
| VOC (Total) | 8.015 | 19.760 | |
| HAP (Total) | 0.314 | 1.342 | |

C8+ 0.007 0.041

Molecular Weight 21.212

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. $CO_2[\text{lb}/10^6 \text{ scf}] = (3.67) (\text{CON}) (\text{C})(\text{D})$, where CON = fractional conversion of fuel carbon to CO₂, C = carbon content of fuel by weight (0.76), and D = density of fuel, $4.2 \times 10^4 \text{ lb}/10^6 \text{ scf}$.

^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 | Phenanathrene ^{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 lb/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 (H₂S) is present in amounts greater than 5.7 milligrams per normal cubic meters (mg/Nm³) (0.25 grains per 100 standard cubic feet [gr/100 scf]). The H₂S must be removed (called "sweetening" the gas) before the gas can be utilized. If H₂S is present, the gas is usually sweetened by absorption of the H₂S 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 (SO₂).

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 SO₂ 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 H₂S 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 H₂S 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 H₂S is oxidized to SO₂ and is then passed to the atmosphere out a stack. For more details, the reader should consult Reference 8.

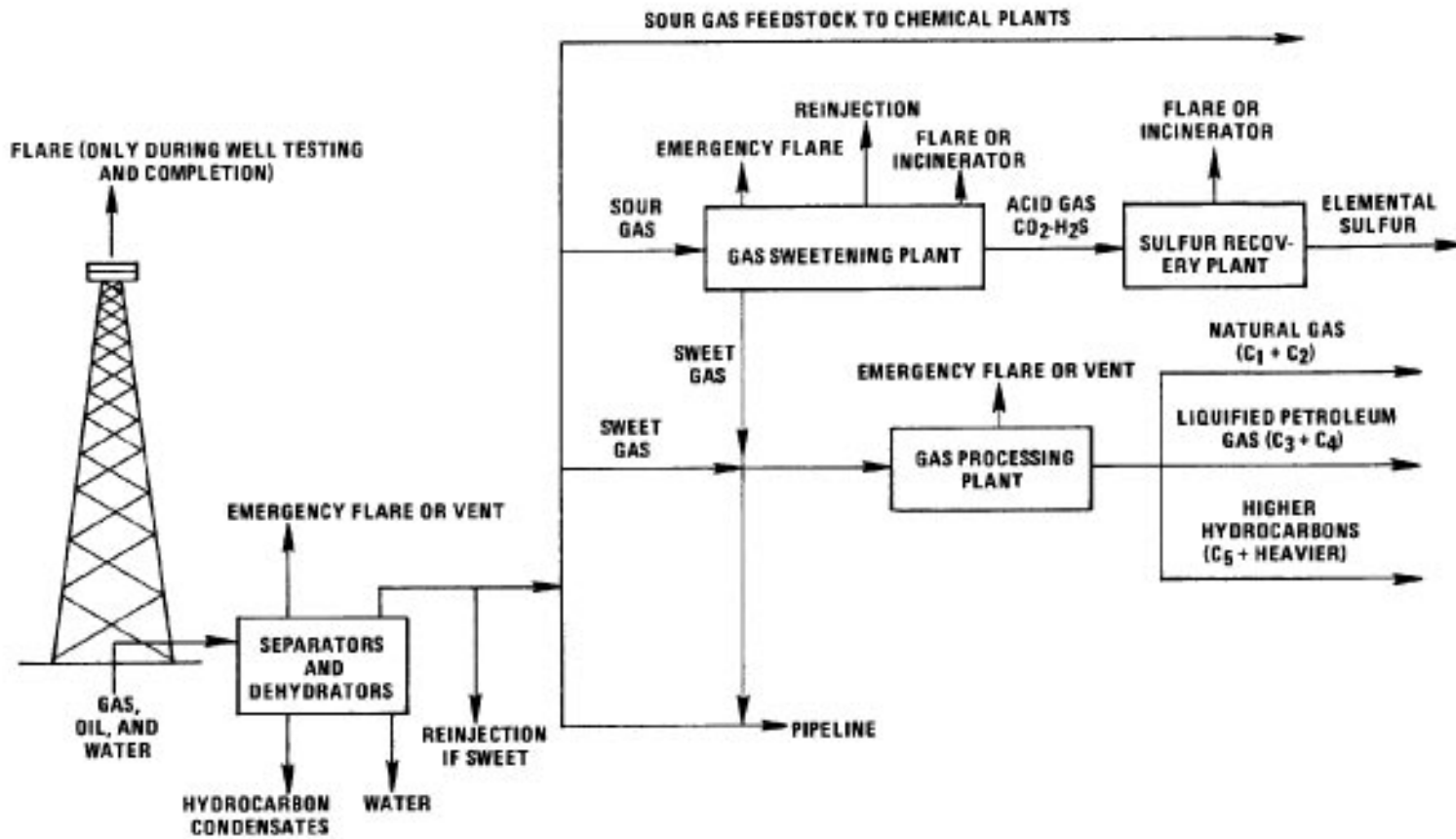


Figure 5.3-1. General flow diagram of the natural gas industry.

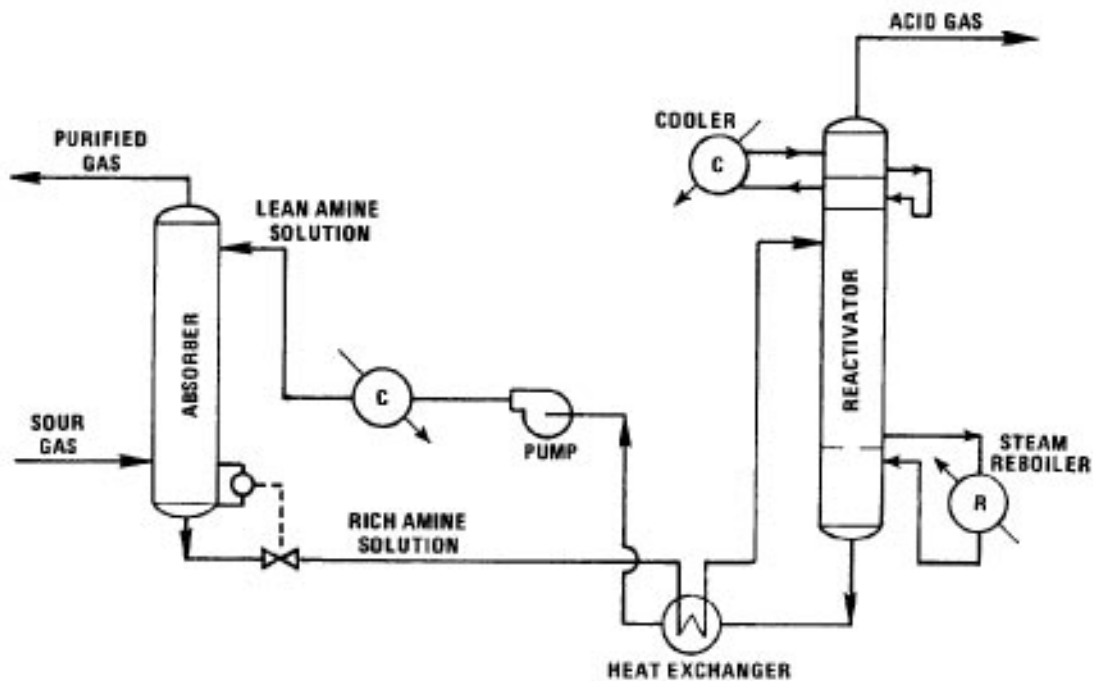


Figure 5.3-2. Flow diagram of the amine process for gas sweetening.

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 |
| | Utah | Four Corners (AZ, CO, NM) | 14 |
| 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 %.

References For Section 5.3

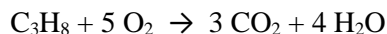
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13.5 Industrial Flares

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).

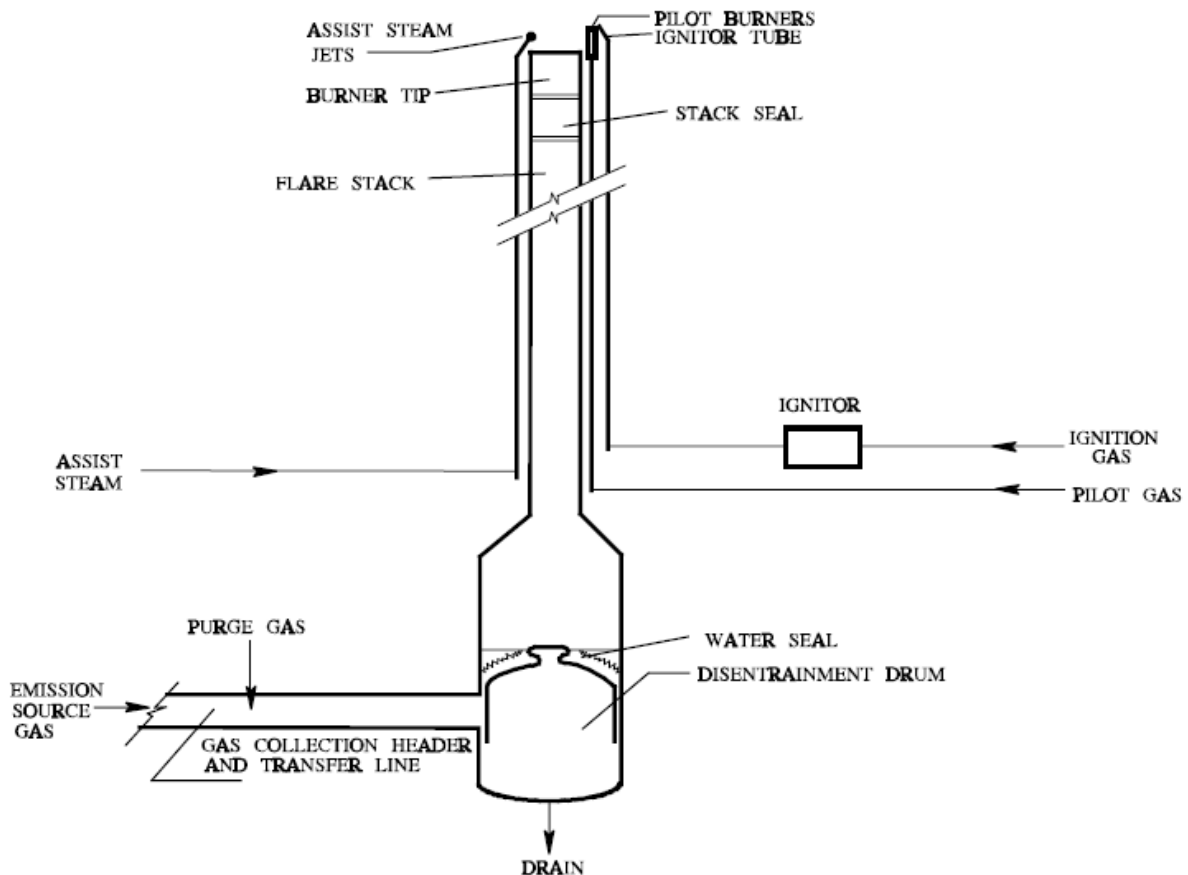


Figure 13.5-1. Diagram of a typical steam-assisted smokeless elevated flare.

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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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

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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Your item has been delivered and is available at a PO Box at 12:47 pm on June 22, 2024 in SLOVAN, PA 15078.

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SLOVAN, PA 15078

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Your item was delivered in or at the mailbox at 8:29 am on June 22, 2024 in WASHINGTON, PA 15301.

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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.

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 | <input type="checkbox"/> | New Source Review, Subchapter E | \$7,500 | |
| 3 | <input type="checkbox"/> | 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 | <input type="checkbox"/> | Case-by-Case MACT | \$9,500 | |
| 5 | <input type="checkbox"/> | Prevention of Significant Deterioration (PSD) requirements. Subchapter D | \$32,500 | |
| 6 | <input type="checkbox"/> | Plantwide Applicability Limit (PAL) for NSR regulated pollutants or PAL for PSD regulated pollutants or both | \$7,500 | |
| 7 | <input type="checkbox"/> | Risk Assessment Analysis – Inhalation only | \$10,000 | |
| 8 | <input type="checkbox"/> | 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 | <input type="checkbox"/> | Minor Modification | \$1,500 | |
| 2 | <input type="checkbox"/> | Extension | \$750 | |
| 3 | <input type="checkbox"/> | Transfer of Ownership | \$750 | |
| 4 | <input type="checkbox"/> | Significant Modification, Ambient Impact Analysis | \$9,000 | |
| 5 | <input type="checkbox"/> | 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).



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 | <input type="checkbox"/> | New Application, Subchapter F | \$2,500 | |
| 2 | <input type="checkbox"/> | Renewal | \$2,100 | |
| 3 | <input type="checkbox"/> | Minor Modification | \$1,500 | |
| 4 | <input type="checkbox"/> | Significant Modification | \$2,000 | |
| 5 | <input type="checkbox"/> | 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).



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 | <input type="checkbox"/> | New Application, Subchapter G | \$5,000 | |
| 2 | <input type="checkbox"/> | Renewal | \$4,000 | |
| 3 | <input type="checkbox"/> | Minor Modification | \$1,500 | |
| 4 | <input type="checkbox"/> | Significant Modification | \$4,000 | |
| 5 | <input type="checkbox"/> | Administrative Amendment / Change of Ownership | \$1,500 | |
| 6 | <input type="checkbox"/> | 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 become a major stationary source of VOC under the Title V program (i.e. greater than 50 tons per year of VOC). The site will not become a major stationary source of NO_x (i.e. sitewide potential to emit is, and will continue to be, less than 100 tons per year of NO_x). 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 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 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%.

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.

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 |
| Good Operating Practices | Varies | 3 |

Step 4: Evaluate Most Effective Controls and Document Results

Both routing the flash tank and regenerator vents to the thermal oxidizer and using a VRU for the flash gas vent are technically feasible. ETC is proposing to control these streams with a thermal oxidizer, therefore, no further economic or environmental analysis is required.

Step 5: Select BAT

ETC will use the thermal oxidizer for control of the amine process streams at 99% to satisfy the BAT requirements. ETC will operate the thermal oxidizer 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).

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.

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**. For emission sources such as compressor rod packing, the technology is technically infeasible, as there are engineering design concerns with routing the vapors to a control device. In instances of this nature, a nitrogen sweeping system would need to be installed to ensure those vapors get combusted by the facility flare.

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**. Note that this option is limited to consistent venting sources as intermittent venting episodes (e.g., blowdowns) are not handled well by VRUs, which operate best with consistent flow.

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 |
|-----------------------------|---------------------------|----------------|
| Flare | 95 - 98% | 1 |
| VRU | 95% | 2 |
| Good Operating Practices | Varies | 3 |

Step 4: Evaluate Most Effective Controls and Document Results

While both routing the gas vented from blowdowns to a flare and utilizing a VRU to compress the gas back to the pipeline are technically feasible, routing the gas to the flare results in a higher control efficiency and therefore, is selected as BAT. ETC will implement based management practices to minimize maintenance blowdown emissions. For the reciprocating compressor rod packing vents, vapors will not be sent to the facility flare. There are operational concerns regarding back pressure issues. A VRU is utilized to control the closed drain vapors; the vapors will be sent to the facility flare for control while the VRU is down.

Step 5: Select BAT

ETC will utilize good operating practices to limit blowdown emissions with 98% control. ETC will develop and implement a blowdown best management practice that will result in the minimization of blowdown emissions. ETC will send the gas vented from the various sources to the flare to satisfy BAT.

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 80¹ 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.

¹ 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 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 0000b to satisfy BAT. Note that EPA recently completed an evaluation of emission reductions and determined the LDAR program finalized under NSPS 0000b 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.

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

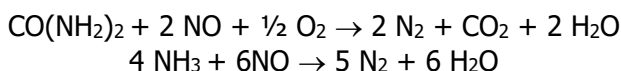
temperatures are reduced, and the flame structure reduces oxygen supply to the hottest part of the flame, thus resulting in less NO_x formation.

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:

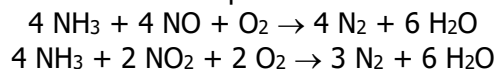


Temperatures underneath the optimal range result in unreacted ammonia passing through the SNCR and is emitted from the stack, this is otherwise known as ammonia slip. If the temperatures rise above the optimal range, the ammonia may combust and generate additional NO_x emissions. SNCR operation is generally 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 percent² 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 percent³ depending on the source conditions.

² [snrcostmanualchapter7thedition20162017revisions.pdf \(epa.gov\)](#)

³ [snrcostmanualchapter7thedition_2016revisions2017.pdf \(epa.gov\)](#)

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.

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 ppmdv 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

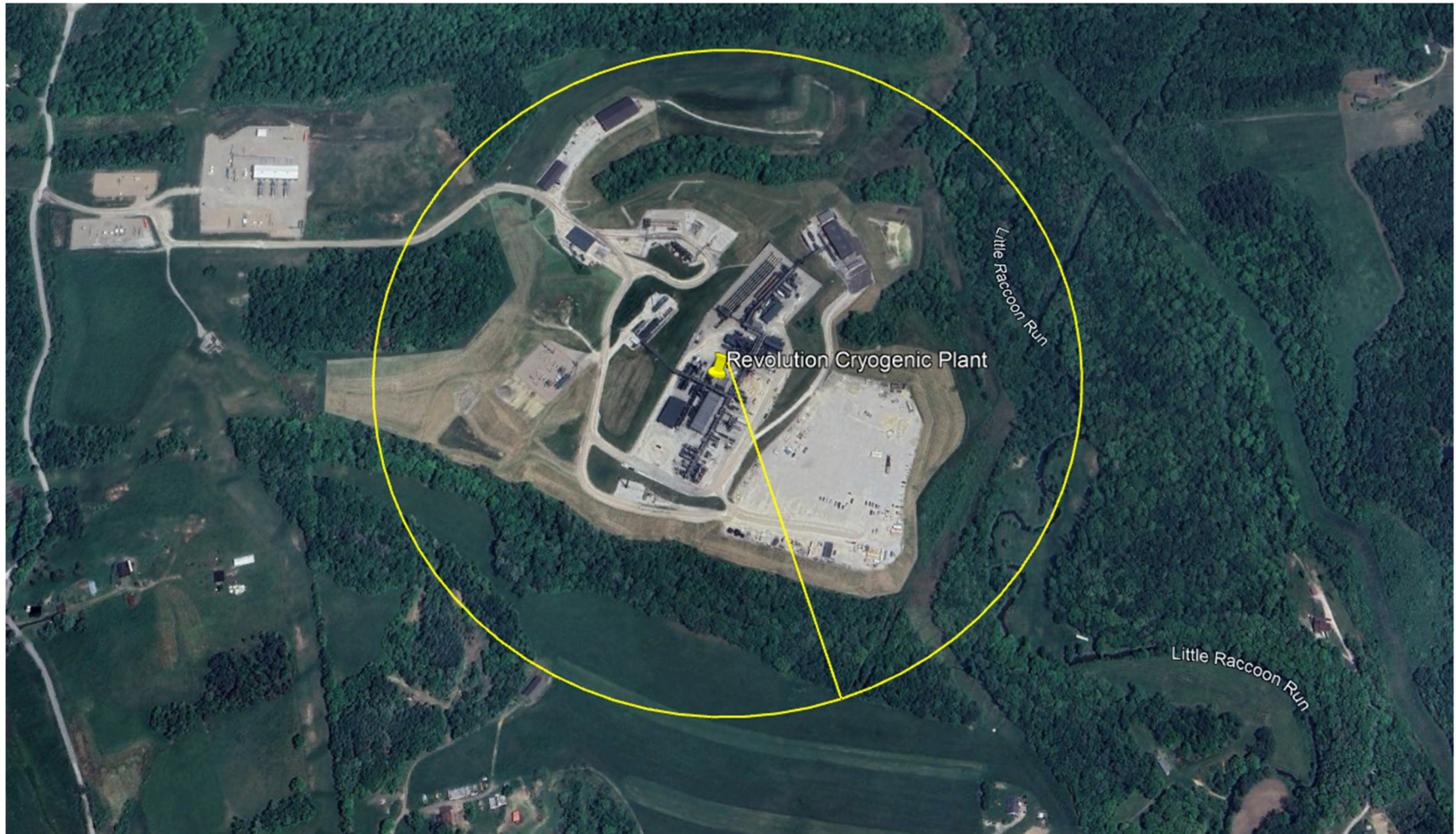


Figure 1 - 0.25 mi Radius of the Revolution Cryogenic Plant