July 25, 2024

Mr. David Stroh
North Dakota Department of Environmental Quality
4201 Normandy Street
Bismarck, ND 58503

Re: Permit to Construct Application
Blue Buttes 2 Compressor Station

Dear Mr. Stroh,

Hess North Dakota Pipelines LLC (Hess) owns and operate Blue Buttes 2 compressor station (BBCS2) in McKenzie County, North Dakota. Emission sources at BBCS2 are authorized under Permit to Construct (PTC) 18025, 20029, 18007. The facility operates under Title V permit AOP-28517 v1.

BBCS2 consists of ten 6.5 MMscfd electric-driven compressors, inlet separation, and dehydration facilities with a total nameplate processing capacity of 65 MMscfd.

The current NGL Heater configuration at the compressor station results in large amount of NGLs that drop out in the line heater. These liquids are then carried over to the HP flare KO and then to the slop storage tanks. As these NGLs go through this process they continue to flash off sending hydrocarbons to the facility flare at the HP Flare KO. Once the NGLs get pumped to the slop storage tanks they continue to flash off sending hydrocarbons over to the thermal oxidizer.

Hess is proposing to install a NGL liquids handling skid that will replace the existing line heater configurations. The liquid handling skid is anticipated to capture approximately 182 bpd of the NGL at the site while also reducing the amount of waste gas been sent to the HP Flare and the thermal oxidizer. This project will also reduce throughput to the tank battery which includes two slop tanks, four oil tanks and one water tank.

Hess is submitting this Permit to Construct application to update permit representation associated with the NGL Reinjection Skid Project.

- Update permit representation for slop/condensate storage tanks and rename emission unit name from ST-5 and ST-6 to SLOPST. Update emission unit name to Slop Storage Tanks (TK-791301-791401).
- Update permit representation for slop/condensate storage and rename emission unit name from ST-7 through 10 to OILST. Update emission unit name to Oil Storage Tanks (TK-791302-791602).

- Update permit representation for slop/condensate storage and rename emission unit name from ST-12 to WTRST. Update emission unit name to Water Storage Tanks (TK-791701).
- Update emission factor for the enclosed combustor and rename emission unit name to Thermal Oxidizer (S-795003).
- Update permit representation for TEG dehydration unit and rename emission unit name from GD-2 to STILLVNT.
- Update permit representation for glycol regen heater and rename emission unit name from GH-2 to Glycol Reboiler (E-794090).
- Update permit representation for fugitive components.
- Add emissions associated with truck loading operations.
- Remove emission unit LH-1 Line Heater (1.5 MMBtu/hr) from the permit.

Pursuant to 33.1-15-14-02, Hess is submitting this Permit to Construct application for BBCS2. This project will decrease emissions for each of the criteria pollutant and the facility will no longer be considered a major source under 33.2-15-14-06(q). As part of this application Hess also request to rescind the Title V permit AOP-28517.

Appendix A of the application includes federal rule applicability determination. Appendix B includes Plot plan for the facility. Appendix C includes the applicable air quality permit application forms and Appendix D includes the emissions calculation.

Please contact me at (713) 496-4054 or kashif.malik@hess.com, if you have any questions or need additional information on this permit application.

Sincerely,
HESS Corporation
Kashif Malik
Advisor EHS
Environment & Regulatory

Appendix A

Federal Rule Applicability

Operations at BBCS2 Compressor Station are consistent with the goal of protecting the public health, welfare, and physical property of the people, as outlined below.

NSPS - NDAC § 33-15-12

Subpart Dc - Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

Glycol Reboiler (GLYRBL) commenced construction after June 9, 1989, and have a maximum design heat input less than 10 MMBtu. Therefore, the provision of NSPS Dc does not apply to this heater.

Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels

Slop Storage Tanks (TK-791301 and 791401), Oil Storage Tanks (TK-791302, TK-791402, TK-791502 and TK-791602), Water Storage Tank (TK-791701), Methanol Storage Tank (TK-796004) and Glycol Storage Tank (TK-796003) commenced construction after July 23, 1984, and have storage capacities less than 75 m^3 (19,800 gallons). Therefore, the provision of NSPS Kb does not apply to these storage tanks.

Subpart OOOOa: Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced After September 18, 2015, and on before December 6, 2022

BBCS2 Compressor Station includes ten reciprocating compressors that commence construction after September 18, 2015, and before December 6, 2022. As part of the NGL liquids handling skid project no modification will be made to the ten reciprocating compressors, and they will continue to comply with the applicable requirements of NSPS OOOOa.

Emissions from Slop Storage Tanks (TK-791301 and 791401), Oil Storage Tanks (TK-791302, TK-791402, TK-791502 and TK-791602), Water Storage Tank (TK-791701) are manifolded together and are routed to the thermal oxidizer. These tanks are affected facility under NSPS OOOOa, however the NGL liquids handling skid project will decrease the emissions from the tank battery to less than 6 tpy of VOC.

According to §60.5365a(e)(4), a storage vessel affected facility that subsequently has its potential for VOC emissions decrease to less than 6 tpy shall remain an affected facility under this subpart. Therefore, these tanks will continue to comply with the applicable requirements of NSPS OOOOa.

Subpart OOOOb: Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced After December 6, 2022

The NGL skid project will commence after December 6, 2022, and the storage vessel tank battery at the compressor station will need to be evaluated under NSPS OOOOb.

According to §60.5365b(e)(3)(ii), modification of the tank battery occurs if any of the actions below occurs, and the potential VOC or methane emissions are exceeded.

(A) A storage vessel is added to an existing tank battery.

No additional storage vessels are installed as part of the NGL Skid Project.

(B) One or more storage vessels are replaced such that the cumulative storage capacity of the existing tank battery increases.

No storage vessels are replaced and there is no change in the storage capacity of the existing tank battery.

(C) For tank batteries at well sites or centralized production facilities, an existing tank battery receives additional crude oil, condensate, intermediate hydrocarbons, or produced water throughput from actions, including but not limited to, the addition of operations or a production well, or changes to operations or a production well (including hydraulic fracturing or refracturing of the well).

The tank battery is not located at well site or centralized production facility.

(D) For tank batteries not located at a well site or centralized production facility, including each tank battery at compressor stations or onshore natural gas processing plants, an existing tank battery receives additional fluids which cumulatively exceed the throughput used in the most recent (*i.e.,* prior to an action in paragraphs (e)(3)(ii)(A), (B) or (D) of this section) determination of the potential for VOC or methane emissions.

As a result of NGL skid project the tank battery at the compressor station will receive less fluid which cumulatively decrease the throughput to the tanks and will decrease the potential VOC and methane emissions.

As discussed above the NGL skid project will not trigger modification under NSPS OOOOb for the tank battery. The compressor station will continue to be an affected facility under NSPS OOOOa and will comply with the applicable requirements of NSPS OOOOa.

NESHAP - NDAC § 33-15-13

There are no facilities addressed in this application that are subject to these regulations.

NESHAPS for Source Categories - NDAC § 33-15-22

Subpart HH-National Emissions Standards for Hazardous Air Pollutants for Oil and Natural Gas Production Facilities

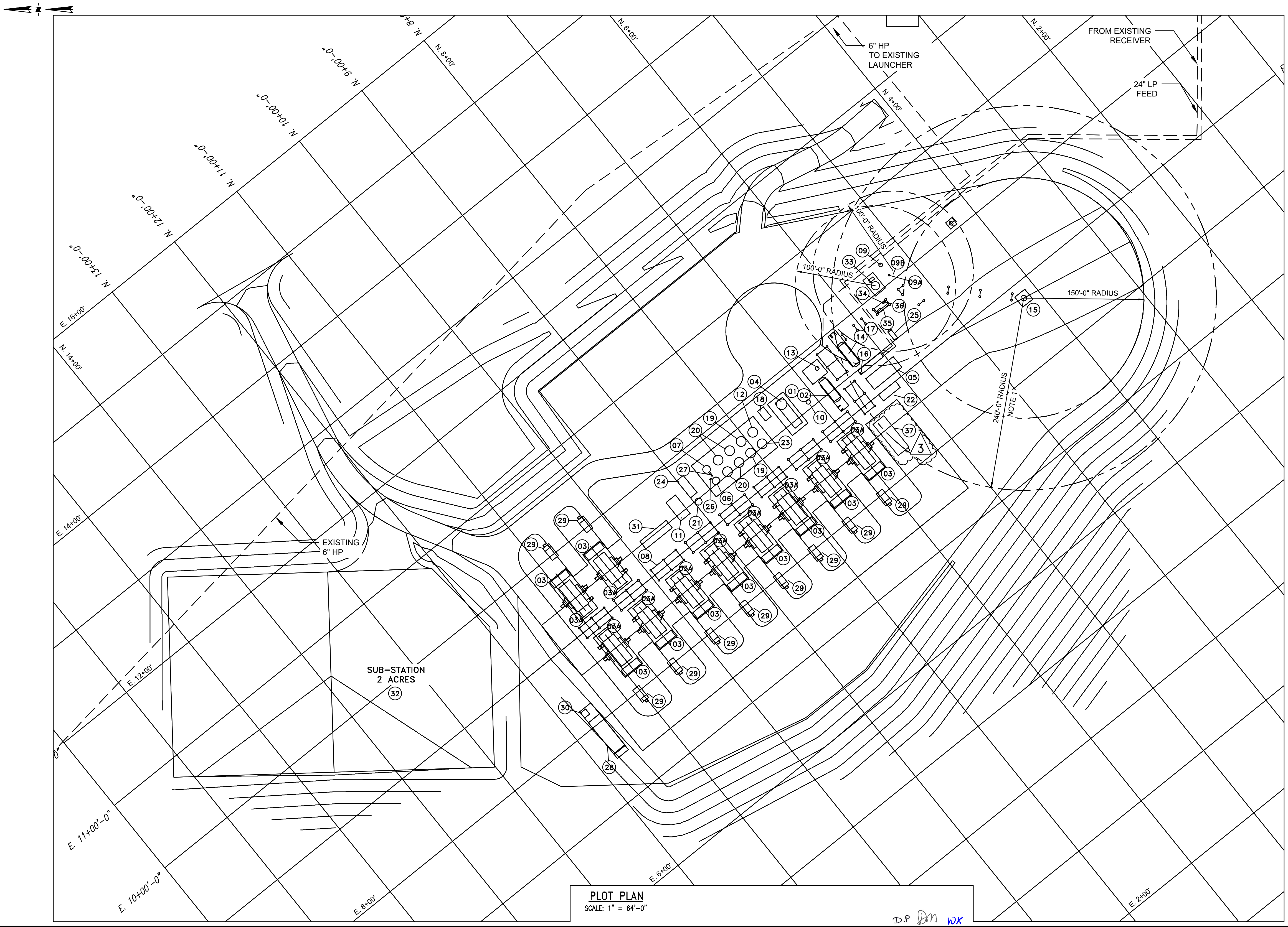
BBCS2 Compressor Station will be an area source of hazardous air pollutants (HAP) and will include a Triethylene Glycol (TEG) Unit. The TEG unit at the compressor station will be subject to MACT HH applicable requirements.

Storage vessels at the compressor station are not an affected source under MACT HH because the compressor station will be an area source sources of HAP.

PSD Review – NDAC § 33-15-15

The changes proposed in this permit application will decrease emissions for pollutant regulated under PSD; therefore, this regulation does not apply.

Appendix B



PLOT PLAN
SCALE: 1" = 64'-0"

MK#	EQP#	EQUIPMENT DESCRIPTION
01	D-790002	LP INLET SEPARATOR
02	P-790102, P-790202	LP INLET SEPARATOR PUMP
03	C-792101, C-792201, C-792301, C-792401, C-792501, C-792601, C-792701, C-792801, C-792901, C-792001	4 STAGE COMPRESSOR PACKAGE (INCLUDES COOLER)
03A	D-795110, D-795210, D-795310, D-795410, D-795510, D-795610, D-795710, D-795810, D-795910, D-795010	COMPRESSOR RELIEF BLOWCASE
04	PK-794110	GAS SWEETENING PACKAGE/SPENT CHEMICAL TANK (200 BBL)
05	PK-794030	GLYCOL DEHYDRATION UNIT
06	TK-796003	GLYCOL STORAGE TANK (150 BBL)
07	TK-796004	METHANOL STORAGE TANK (150 BBL)
08	-	PIPE RACK
09	S-795002	ENCLOSED FLARE
09A	D-795102	ENCLOSED FLARE KO POT
09B	D-795112	ENCLOSED FLARE BLOWCASE
10	D-794000	HP DISCHARGE SCRUBBER
11	PK-796101	INSTRUMENT AIR PACKAGE
12	TK-791701	WATER TANK (400 BBL)
13	FL-790001	INLET GAS STRAINER
14	D-795001	FLARE K.O. DRUM
15	S-795101	FLARE STACK
16	D-796001	FUEL GAS SCRUBBER
17	P-795201, P-795301	FLARE K.O. DRUM LIQUIDS PUMP
18	P-791501, P-791601	WATER TRANSFER PUMPS
19	TK-791301, TK-791401	SLOP TANK (400 BBL)
20	TK-791302, TK-791402, TK-791502, TK-791602	OIL TANK (400 BBL)
21	D-796201	INSTRUMENT AIR RECEIVER
22	PK-791010	LINE HEATER / FLASH VESSEL
23	TK-796002	SCAVENGER MAKE-UP TANK (400 BBL)
24	SK-796005	LUBE OIL SKID
25	TK-794029	GLYCOL POP TANK
26	P-796103	GLYCOL MAKEUP PUMP
27	P-796104, P-796204	METHANOL DISTRIBUTION PUMPS
28	-	STATION PDC BUILDING
29	-	COMPRESSOR ELECTRICAL MCC BUILDING
30	-	4160/480V 2 MVA TRANSFORMER
31	-	STATION MCC BUILDING
32	-	2 ACRE POWER SUB STATION
33	S-XX5003	THERMAL OXIDIZER FLARE
34	D-XX5103	KNOCK OUT POT
35	-	IGNITION RACK
36	D-XX5113	BLOWCASE
37	PK-791002	LIQUIDS HANDLING MODULE 520

3

GRAPHIC SCALE
32 0 32 64 128
(IN FEET)
1 inch = 64 ft.

NOTES:
1. 240 FT RADIUS INDICATES EXTENT WHERE FLARE RADIATION AT OR ABOVE 500 BTU/HR/FT2 MAY OCCUR.

D.P DM WK

NO	DATE	DESCRIPTION	DRAWN BY	CHK'D BY	APPV'D BY
3	3/28/24	ISSUED FOR CONSTRUCTION - PER NDM-BBCS2-MUD-WOP-01006 BY PROPAK SYSTEMS	DP	DM	WK
2	2/9/21	ISUED FOR CONSTRUCTION PER NDM-BBCS2-MUD WOP-01003	JMO	SH	EC
1	12/04/20	ISSUED FOR CONSTRUCTION - NDM-BBCS2-MUD-WOP-01004	JMO	SH	EC
0	08/15/18	ISSUED FOR CONSTRUCTION	DB	JMO	DS
E	05/03/18	ISSUED FOR DESIGN	JMO	DB	DS
D	04/06/18	ISSUED FOR INFORMATION	JMO	DB	DS
C	03/09/18	REISSUED FOR APPROVAL	JMO	DB	DS
B	01/31/18	ISSUED FOR APPROVAL	LRM	JMO	DS
A	12/15/17	ISSUED FOR REVIEW	LRM	JMO	DS

REVISIONS

Worley
energy | chemicals | resources

ISSUED FOR CONSTRUCTION

HESS CORPORATION
EXPLORATION & PRODUCTION

NORTH DAKOTA MIDSTREAM
BLUE BUTTES COMPRESSOR STATION
NDM-BBCS2-MUD-WOP-01000

BLUE BUTTES COMPRESSOR STATION
PLOT PLAN

DRAWN BY: DB	DESGN BY: DB	CHECKED BY: JMO	APPRVD BY: DS	DATE: 12/15/17	SCALE: 1"=64'-0"

SIZE	DRAWING No.	HESS DRAWING No.	REV
D		NDM-BBCS2-PIP-PLA-01000	3

J:\Jobs23\237943\20-Drawings\FIELD\5000-PLOT PLANS\NDM-BBCS2-PIP-PLA-01000-3.dwg 3-28-24 01:50:35 PM dpatel

Appendix C

PERMIT APPLICATION FOR AIR CONTAMINANT SOURCES

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 8516 (9-2021)

SECTION A - FACILITY INFORMATION

Name of Firm or Organization Hess North Dakota Pipelines LLC				
Applicant's Name Charles Leon Tack				
Title Director, Midstream Operations		Telephone Number (701) 664-6221	E-mail Address charles.l.tack@hess.com	
Contact Person for Air Pollution Matters Vicky Sund				
Title Manager Regulatory		Telephone Number (701) 420-7020	E-mail Address vsund@hess.com	
Mailing Address (Street & No.) 3015 16th St. SW, Suite 20				
City Minot		State ND		ZIP Code 58701
Facility Name BBCS2 Compressor Station				
Facility Address (Street & No.) 3107 106th Ave NW				
City Keene		State ND		ZIP Code 58847
County McKenzie	Coordinates NAD 83 in Decimal Degrees (to forth decimal degree) Latitude 475145.00000000		Longitude 103.44840000	
Legal Description of Facility Site				
Quarter SW	Quarter SW	Section 29	Township T151N	Range R96W
Land Area at Facility Site 40 Acres (or) ________ Sq. Ft.		MSL Elevation at Facility 2300		

SECTION B – GENERAL NATURE OF BUSINESS

Describe Nature of Business	North American Industry Classification System Number	Standard Industrial Classification Number (SIC)
Oil and Natural Gas Production	21111	1311

SECTION C – GENERAL PERMIT INFORMATION

Type of Permit? ■ Permit to Construct (PTC) ☐ Permit to Operate (PTO)	
If application is for a Permit to Construct, please provide the following data:	
Planned Start Construction Date 09/2024	Planned End Construction Date 11/2024

SECTION D – SOURCE IDENTIFICATION AND CATEGORY OF EACH SOURCE INCLUDED ON THIS PERMIT APPLICATION

		Permit to Construct				Minor Source Permit to Operate						
Your Source ID Number	Source or Unit (Equipment, Machines, Devices, Boilers, Processes, Incinerators, Etc.)	New Source	Existing Source Modification	Existing Source Expansion	Existing Source Change of Location	New Source	Existing Source Initial Application	Existing Source After Modification	Existing Source After Expansion	Existing Source After Change of Location	Existing Source After Change of Ownership	Other
GLYRBL	Glycol Reboiler (E-794090)	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
STILLVNT	Dehydrator Still Column Vent	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
LOADOIL	Truck Loading-Oil	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
TO-1	Thermal Oxidizer	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
HPFLARE	HP Flare	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
GLYST	Glycol Storage Tank	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
MeOHST	Methanol Storage Tank	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
SLOPST	Slop Storage Tanks	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐
OILST	Oil Storage Tanks	☐	✓	☐	☐	☐	☐	☐	☐	☐	☐	☐

WTRST Water Storage Tank

SECTION D2 – APPLICABLE REGULATIONS

Source ID No.	Applicable Regulations (NSPS/MACT/NESHAP/etc.)
Facility-wide	NSPS OOOOa, MACT HH

SECTION E – TOTAL POTENTIAL EMISSIONS

Pollutant	Amount (Tons Per Year)
NO_x	12.92
CO	8.67
PM	0.02

Pollutant	Amount (Tons Per Year)
PM_{10} (filterable and condensable)	0.02
$PM_{2.5}$ (filterable and condensable)	0.02
SO_2	0.02
VOC	39.42
GHG (as CO_2e)	15220.70
Largest Single HAP	1.07
Total HAPS	2.08

*If performance test results are available for the unit, submit a copy of test with this application. If manufacturer guarantee is used provide spec sheet.

SECTION F1 – ADDITIONAL FORMS

Indicate which of the following forms are attached and made part of the application

■ Air Pollution Control Equipment (SFN 8532)	■ Fuel Burning Equipment Used for Indirect Heating (SFN 8518)
☐ Construct/Operate Incinerators (SFN 8522)	☐ Hazardous Air Pollutant (HAP) Sources (SFN 8329)
☐ Natural Gas Processing Plants (SFN 11408)	☐ Manufacturing or Processing Equipment (SFN 8520)
■ Glycol Dehydration Units (SFN 58923)	■ Volatile Organic Compounds Storage Tank (SFN 8535)
■ Flares (SFN 59652)	☐ Internal Combustion Engines and Turbines (SFN 8891)
☐ Grain, Feed, and Fertilizer Operations (SFN 8524)	☐ Oil/Gas Production Facility Registration (SFN 14334)

SECTION F2 – OTHER ATTACHMENTS INCLUDED AS PART OF THIS APPLICATION

1.	Federal Rule Applicability	4.	Emissions Calcuation
2.	Plot Plan	5.	
3.	NDDEQ Forms	6.	

I, the undersigned applicant, am fully aware that statements made in this application and the attached exhibits and statements constitute the application for Permit(s) to Construct and/or Operate Air Contaminant sources from the North Dakota Department of Environmental Quality and certify that the information in this application is true, correct and complete to the best of my knowledge and belief. Further, I agree to comply with the provisions of Chapter 23.1-06 of the North Dakota Century Code and all rules and regulations of the Department, or revisions thereof. I also understand the permit is nontransferable and, if granted a permit, I will promptly notify the Department upon sale or legal transfer of this permitted establishment.

Signature	Date
[signature]	07/25/2024

PERMIT APPLICATION FOR FUEL BURNING EQUIPMENT FOR INDIRECT HEATING

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 8518 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must include SFN 8516 or SFN 52858

SECTION A - GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station

SECTION B – EQUIPMENT

Source ID No. (From form SFN 8516)	Name of Manufacturer
GLYRBL (E-794090)	PROPAK
Rated Capacity/Maximum Input	**Model Number**
0.5 MMBTU/HR	

Purpose
Space Heat ______%   Power Generation ______%
Process Heat 100 %   Other (Specify % if Multi-Purpose) ______%

SECTION C – TYPE OF COMBUSTION UNIT AND FUEL FEEDING METHOD

Coal (If other solid fuel, specify here)

- ☐ Pulverized
- ☐ General
- ☐ Dry Bottom
- ☐ Wet Bottom with Fly Ash Reinjection
- ☐ Wet Bottom without Fly Ash Reinjection
- ☐ Other – Specify:
- ☐ Spreader Stoker with Fly Ash Reinjection
- ☐ Spreader Stoker without Fly Ash Reinjection
- ☐ Fluidized Bed
- ☐ Cyclone
- ☐ Hand-Fired

Fuel Oil

- ☐ Horizontally Fired
- ☐ Tangentially Fired
- ☐ Other – Specify:

Gas

- ☐ Horizontally Fired
- ☒ Tangentially Fired
- ☐ Other – Specify:

SECTION D – NORMAL SCHEDULE OF OPERATION

Hours Per Day	Days Per Week	Weeks Per Year	Hours Per Year Total	Peak Season (Specify Months)
24	7	52	8760	

SECTION E – FUEL USE EXPECTED IN A CALENDAR YEAR

Year 20

Primary Fuels			Standby Fuels		
Type: Fuel Gas			Type:		
Quantity Per Year: 4199		Units of Measure: MSCF/YR	Quantity Per Year:		Units of Measure:
Percent Ash (Solid Fuels Only)					
Minimum	Maximum	Average	Minimum	Maximum	Average
Percent Sulfur					
Minimum	Maximum	Average	Minimum	Maximum	Average
Btu Per Unit of Measure (e.g. lb, gal, etc. - Specify)					
Minimum	Maximum	Average	Minimum	Maximum	Average

Describe Fuel Transport and Storage Methods:

SECTION F – COMBUSTION AIR

☒ Natural Draft ☐ Induced ☐ Forced ☐ Other – Specify:

SECTION G – STACK DATA

Inside Diameter (ft) 1.34	Height Above Grade (ft) 34
Gas Temperature at Exit (Avg. °F)	Gas Velocity at Exit (Avg. ft/sec)
Are Emission Control Devices in Place? If YES – Complete SFN 8532 ☐ Yes ☒ No	
Stack Exit Gas Flow Rate	
Average (ACFM)	Average (DSCFM)
Maximum (ACFM)	Maximum (DSCFM)
Are sampling ports available? ☒ No ☐ Yes – Describe:	

SECTION H – NEARBY BUILDINGS

Attach drawings which show the plan and elevation views of any nearby buildings including the building that houses the fuel-fired equipment.

SECTION I – AIR CONTAMINANTS EMITTED

Pollutant	Maximum Pounds Per Hour	Amount (Tons Per Year)	Basis of Estimate*
NO_x	0.05	0.21	AP-42 Emission Factor & Design Duty
CO	0.04	0.18	AP-42 Emission Factor & Design Duty
PM	0.004	0.02	AP-42 Emission Factor & Design Duty
PM_{10} (filterable and condensable)	0.004	0.02	AP-42 Emission Factor & Design Duty
$PM_{2.5}$ (filterable and condensable)	0.004	0.02	AP-42 Emission Factor & Design Duty
SO_2	2.94E-04	0.001	AP-42 Emission Factor & Design Duty

Pollutant	Maximum Pounds Per Hour	Amount (Tons Per Year)	Basis of Estimate*
VOC	0.003	0.01	AP-42 Emission Factor & Design Duty
GHG (as CO_2e)	58.82	257.65	
Largest Single HAP			
Total HAPS	0.001	0.004	AP-42 Emission Factor & Design Duty

*If performance test results are available for the unit, submit a copy of test with this application. If manufacturer guarantees are used provide spec sheet.

PERMIT APPLICATION FOR GLYCOL DEHYDRATION UNITS

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 58923 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must include SFN 8516 or SFN 52858

SECTION A – GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station

SECTION B - 40 CFR 63, SUBPART HH APPLICABILITY DETERMINATION

The facility is a (check one): ☐ major, or ■ area source of hazardous air pollutants (HAP) as defined in §63.761. Attach calculations showing expected HAP emissions in accordance with §63.760(a)(1).

The facility (check all that apply):

■ Processes, upgrades or stores hydrocarbon liquids prior to the point of custody transfer.

■ Processes, upgrades or stores natural gas prior to the point at which natural gas enters the transmission and storage source category or is delivered to a final end user.

Identify the 40 CFR 63 Subpart HH (MACT HH) affected source:

☐ Glycol (ethylene, diethylene, or triethylene) dehydration unit & associated equipment (located at a major source), or

■ Tryiethylene glycol (TEG) dehydration unit (located at an area source)

The facility is exempt from MACT HH because it:

☐ Is a qualifying black oil facility, or

☐ Is a major source facility, prior to the point of custody transfer, with a facility-wide actual annual average natural gas throughout less than 18.4 thousand standard cubic meters per day and a facility-wide actual annual average hydrocarbon liquid throughput less than 39,700 liters per day.

■ The facility is not exempt from MACT HH.

SECTION C – EMISSION UNIT INFORMATION

Emission Unit Description	Emission Unit Identifier	Emission Point Number	Pollutant*	Emission Rate		Air Pollution Control Equipment
	(EU)	(EP)		lb/hr	ton/yr	
Dehydrator Still Column Vent	STILLVNT	TO-1	VOC	1.15	5.06	Thermal Oxidizer (S-795003)

* *Includes an estimate of greenhouse gas emissions (CO2e).*

Complete the following for each glycol and triethylene glycol dehydration unit.								
EU	Design Capacity (MMSCFD)	Actual Throughput (MMSCFD)	Gas Pressure (psig)	Gas Temp (°F)	Water Content (lb/MMSCF)		Glycol Recirc. Rate (gal/min)	VOC Emissions (ton/yr)
					Wet Gas	Dry Gas		
STILLVNT	65	65	1230	100	4	0.70	12	5.06

SECTION D – STACK DATA

Inside Diameter (ft) 9.5	Height Above Grade (ft) 55	Gas Volume (scfm) Varies
Gas Temperature at Exit (°F) 215	Gas Velocity at Exit (ft/sec)	
Are Emission Control Devices in Place? If YES – Complete SFN 8532 TO-1	■ Yes	☐ No
Nearest Residence or Building TBD	Distance (ft) TBD	Direction TBD
Nearest Property Line TBD	Distance (ft) TBD	Direction TBD

SEND COMPLETED APPLICATION AND ALL ATTACHMENTS TO:

North Dakota Department of Environmental Quality
Division of Air Quality
4201 Normandy Street, 2nd Floor
Bismarck, ND 58503-1324
(701)328-5188

PERMIT APPLICATION FOR VOLATILE ORGANIC COMPOUNDS STORAGE TANK

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 8535 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must include SFN 8516 or SFN 52858

SECTION A – GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station

SECTION B – TANK DATA

Source ID Number (From SFN 8516)
Slop Storage Tanks (TK-791301 & 1401), Oil Storage Tanks (TK-791302, 402, 502, 602), Water Storage Tank (TK-791701)

Capacity	Barrels: 400		Gallons: 16,800	
Dimensions	Diameter: 12	Height: 20	Length:	Width:
Shape	☒ Cylindrical	☐ Spherical	☐ Other – Specify:	
Materials of Construction	(i.e., steel)			
Construction	☐ Riveted	☒ Welded	☐ Other – Specify:	
Color	Gray/Light			
Condition	☒ Good	☐ Fair	☐ Poor	
Status	☐ New Construction	☐ Alteration	☒ Existing (Give Date Constructed): 08/01/2018	
Type of Tank	☒ Fixed Roof ☐ Variable Vapor Space ☐ Pressure (low or high)		☐ External Floating ☐ Internal Floating ☐ Other – Specify:	
Type of Roof	☐ Pan	☐ Double Deck	☐ Pontoon	☒ Other – Specify: cone

Type of Seal	Metallic Shoe Seal	Liquid Mounted Resilient Seal	Vapor Mounted Resilient Seal
	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Shoe Mounted Secondary Seal	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Weather Shield	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Weather Shield

SECTION C – TANK CONTENTS

Name all liquids, vapors, gases, or mixtures of such materials to be stored in the tank.
Give density (lbs per gal) or A.P.I.

See Promax Tank Emissions Data

SECTION D – VAPOR DISPOSAL

☐ Atmosphere ☐ Vapor Recovery Unit ☐ Flare ☒ Enclosed Combustor ☐ Other – Specify:

SECTION E – VAPOR PRESSURE DATA

psia	
Maximum True Vapor Pressure See Promax Tank Emissions Data	Maximum Reid Vapor Pressure See Promax Tank Emissions Data

SECTION F – OPERATIONAL DATA

Maximum Filling Rate (barrels per hour or gallons per hour) See Promax Tank Emissions Data	Vapor Space Outage (See AP-42, 7.1-92, Equation 1-15) See Promax Tank Emissions Data
Average Throughput (barrels per day or gallons per day) See Promax Tank Emissions Data	Tank Turnovers per Year See Promax Tank Emissions Data

SECTION G – SOLUTION STORAGE

If material stored is a solution, supply the following information:	
Name of Solvent	Name of Material Dissolved
Concentration of Material Dissolved (% by weight or % by volume or lbs/gal)	

SECTION H – AIR CONTAMINANATS EMITTED

Pollutant*	Maximum Pounds Per Hour	Tons Per Year	Basis and Calculations for Quantities (Attach separate sheet if needed)
			See Promax Tank Emissions Data

* Include an estimate of greenhouse gas emissions (CO_2e)

SECTION I – STANDARDS OF PERFORMANCE

Tank subject to: ☐ 40 CFR 60, Subpart K ☐ 40 CFR 60, Subpart Ka ☐ 40 CFR 60, Subpart Kb

☐ 40 CFR 60, Subpart OOOO ☒ 40 CFR 60, Subpart OOOOa

Are the standards of performance for new stationary sources; petroleum liquid storage vessels, 40 CFR Part 60, Subparts K, Ka, and Kb, OOOO, OOOOa being adhered to, where applicable?

☐ Yes ☒ No – Explain:

Slop Storage Tanks (TK-791301 & 1401), Oil Storage Tanks (TK-791302, 402, 502, 602), Water Storage Tank (TK--791701) have storage capacities less than 75 m3 (19,800 gallons). Therefore, the provision of NSPS Kb does not apply to these storage tanks.

<u>SEND COMPLETED APPLICATION AND ALL ATTACHMENTS TO</u>:

North Dakota Department of Environmental Quality
Division of Air Quality
4201 Normandy Street, 2nd Floor
Bismarck, ND 58503-1324
(701) 328-5188

PERMIT APPLICATION FOR VOLATILE ORGANIC COMPOUNDS STORAGE TANK

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 8535 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must include SFN 8516 or SFN 52858

SECTION A – GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station

SECTION B – TANK DATA

Source ID Number (From SFN 8516) Glycol Storage Tank (TK-796003)				
Capacity	Barrels 150		Gallons 6300	
Dimensions	Diameter 9.5	Height 12	Length	Width
Shape	☒ Cylindrical	☐ Spherical	☐ Other – Specify:	
Materials of Construction	(i.e., steel)			
Construction	☐ Riveted	☒ Welded	☐ Other – Specify:	
Color Gray/Light				
Condition	☒ Good	☐ Fair	☐ Poor	
Status	☐ New Construction	☐ Alteration	☒ Existing (Give Date Constructed): 08/01/2018	
Type of Tank	☒ Fixed Roof ☐ Variable Vapor Space ☐ Pressure (low or high)		☐ External Floating ☐ Internal Floating ☐ Other – Specify:	
Type of Roof	☐ Pan	☐ Double Deck	☐ Pontoon	☒ Other – Specify: cone
Type of Seal	Metallic Shoe Seal	Liquid Mounted Resilient Seal	Vapor Mounted Resilient Seal	
	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Shoe Mounted Secondary Seal	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Weather Shield	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Weather Shield	

SECTION C – TANK CONTENTS

Name all liquids, vapors, gases, or mixtures of such materials to be stored in the tank.
Give density (lbs per gal) or A.P.I.

Triethylene glycol
Liquid Density 9.4 lb/gal

SECTION D – VAPOR DISPOSAL

☒ Atmosphere ☐ Vapor Recovery Unit ☐ Flare ☐ Enclosed Combustor ☐ Other – Specify:

SECTION E – VAPOR PRESSURE DATA

psia	
Maximum True Vapor Pressure 0.01	Maximum Reid Vapor Pressure

SECTION F – OPERATIONAL DATA

Maximum Filling Rate (barrels per hour or gallons per hour) 150 bbl/hr	Vapor Space Outage (See AP-42, 7.1-92, Equation 1-15) 1.10
Average Throughput (barrels per day or gallons per day) 1,500 bbl/yr	Tank Turnovers per Year 10

SECTION G – SOLUTION STORAGE

If material stored is a solution, supply the following information:	
Name of Solvent	Name of Material Dissolved
Concentration of Material Dissolved (% by weight or % by volume or lbs/gal)	

SECTION H – AIR CONTAMINANATS EMITTED

Pollutant*	Maximum Pounds Per Hour	Tons Per Year	Basis and Calculations for Quantities (Attach separate sheet if needed)
VOC	0.0003	0.002	See emission calculation

* Include an estimate of greenhouse gas emissions (CO_2e)

SECTION I – STANDARDS OF PERFORMANCE

Tank subject to: ☐ 40 CFR 60, Subpart K ☐ 40 CFR 60, Subpart Ka ☐ 40 CFR 60, Subpart Kb

☐ 40 CFR 60, Subpart OOOO ☐ 40 CFR 60, Subpart OOOOa

Are the standards of performance for new stationary sources; petroleum liquid storage vessels, 40 CFR Part 60, Subparts K, Ka, and Kb, OOOO, OOOOa being adhered to, where applicable?

☐ Yes ■ No – Explain:

Glycol Storage Tank have storage capacity less than 75 m3 (19,800 gallons). Therefore, the provision of NSPS Kb does not apply to this storage tank.

Glycol Storage Tank VOC and methane emissions are less than 6 tpy and 20 tpy, respectively and this tank does not meet the definition of storage vessel under NSPS OOOOa and NSPS OOOOb.

SEND COMPLETED APPLICATION AND ALL ATTACHMENTS TO:

North Dakota Department of Environmental Quality
Division of Air Quality
4201 Normandy Street, 2nd Floor
Bismarck, ND 58503-1324
(701) 328-5188

PERMIT APPLICATION FOR VOLATILE ORGANIC COMPOUNDS STORAGE TANK

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 8535 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must include SFN 8516 or SFN 52858

SECTION A – GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station

SECTION B – TANK DATA

Source ID Number (From SFN 8516)
Methanol Storage Tank (TK-796004)

Capacity	Barrels 150		Gallons 6300	
Dimensions	Diameter 9.5	Height 12	Length	Width

Shape: ☒ Cylindrical ☐ Spherical ☐ Other – Specify:

Materials of Construction (i.e., steel)

Construction: ☐ Riveted ☒ Welded ☐ Other – Specify:

Color
Gray/Light

Condition: ☒ Good ☐ Fair ☐ Poor

Status: ☐ New Construction ☐ Alteration ☒ Existing (Give Date Constructed): 08/01/2018

Type of Tank:
☒ Fixed Roof ☐ External Floating
☐ Variable Vapor Space ☐ Internal Floating
☐ Pressure (low or high) ☐ Other – Specify:

Type of Roof: ☐ Pan ☐ Double Deck ☐ Pontoon ☒ Other – Specify: cone

Type of Seal	Metallic Shoe Seal	Liquid Mounted Resilient Seal	Vapor Mounted Resilient Seal
	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Shoe Mounted Secondary Seal	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Weather Shield	☐ Primary Seal Only ☐ With Rim Mounted Seal ☐ With Weather Shield

SECTION C – TANK CONTENTS

Name all liquids, vapors, gases, or mixtures of such materials to be stored in the tank.
Give density (lbs per gal) or A.P.I.

Methanol
Liquid Density 6.61 lb/gal

SECTION D – VAPOR DISPOSAL

☒ Atmosphere ☐ Vapor Recovery Unit ☐ Flare ☐ Enclosed Combustor ☐ Other – Specify:

SECTION E – VAPOR PRESSURE DATA

psia	
Maximum True Vapor Pressure 4.05	Maximum Reid Vapor Pressure

SECTION F – OPERATIONAL DATA

Maximum Filling Rate (barrels per hour or gallons per hour) 150 bbl/hr	Vapor Space Outage (See AP-42, 7.1-92, Equation 1-15) 1.10
Average Throughput (barrels per day or gallons per day) 1,500 bbl/yr	Tank Turnovers per Year 10

SECTION G – SOLUTION STORAGE

If material stored is a solution, supply the following information:	
Name of Solvent	Name of Material Dissolved
Concentration of Material Dissolved (% by weight or % by volume or lbs/gal)	

SECTION H – AIR CONTAMINANATS EMITTED

Pollutant*	Maximum Pounds Per Hour	Tons Per Year	Basis and Calculations for Quantities (Attach separate sheet if needed)
VOC	0.008	0.03	See emission calculation

* Include an estimate of greenhouse gas emissions (CO_2e)

SECTION I – STANDARDS OF PERFORMANCE

Tank subject to: ☐ 40 CFR 60, Subpart K ☐ 40 CFR 60, Subpart Ka ☐ 40 CFR 60, Subpart Kb

☐ 40 CFR 60, Subpart OOOO ☐ 40 CFR 60, Subpart OOOOa

Are the standards of performance for new stationary sources; petroleum liquid storage vessels, 40 CFR Part 60, Subparts K, Ka, and Kb, OOOO, OOOOa being adhered to, where applicable?

☐ Yes ■ No – Explain:

Methanol Storage Tank have storage capacity less than 75 m3 (19,800 gallons). Therefore, the provision of NSPS Kb does not apply to this storage tank.

Methanol Storage Tank VOC and methane emissions are less than 6 tpy and 20 tpy, respectively and this tank does not meet the definition of storage vessel under NSPS OOOOa and NSPS OOOOb.

<u>SEND COMPLETED APPLICATION AND ALL ATTACHMENTS TO</u>:

North Dakota Department of Environmental Quality
Division of Air Quality
4201 Normandy Street, 2nd Floor
Bismarck, ND 58503-1324
(701) 328-5188

PERMIT APPLICATION FOR FLARES
NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 59652 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must include SFN 8516 or SFN 52858

SECTION A – GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station

SECTION B - FLARE INFORMATION

Use: ☒ Emergency ☐ Process ☐ Both — Subject to NSPS (40 CFR 60.18) ○ Yes ● No

Emission Point ID	Height Above Ground Level (ft.)	Diameter at Top (ft.)
HP Flare (S-795101)	130	24

Flame Monitor: ☒ Thermocouple ☐ Infrared ☐ Ultraviolet ☐ Acoustic ☐ Other:

Ignition: ☐ Automatic ☒ Continuous Burning Pilot ☐ Other:

Average Btu/1000 scf	Percent H_2S	Maximum Hourly Flow Rate to Flare
937 Btu/scf	<0.01	

List source ID numbers controlled by this unit, if any:

SECTION C – AIR CONTAMINANTS EMITTED

Pollutant	Amount (Tons Per Year)	Basis of Estimate*
NO_x	1.15	AP-42 Emission Factor & Process Data
CO	5.26	AP-42 Emission Factor & Process Data
PM		
PM_{10} (filterable and condensable)		
$PM_{2.5}$ (filterable and condensable)		
SO_2	0.02	
VOC	6.31	Process Data
GHG (as CO_2e)	2511.32	
Largest Single HAP		
Total HAPS		

*If performance test results are available for the unit, submit a copy of test with this application. If manufacturer guarantee are used provide spec sheet.

Will flaring of gas comply with applicable Ambient Air Quality Standards?	☒ Yes	☐ No

IS THIS UNIT IN COMPLIANCE WITH ALL APPLICABLE AIR POLLUTION CONTROL RULES AND REGULATIONS? ☒ YES ☐ NO	If "NO" a Compliance Schedule (SFN 61008) must be completed and attached.

Attach and label separate sheet(s) if you need more space to explain any system or answers or to provide complete listings of Emissions, Contaminants or other items.

SEND COMPLETED APPLICATION AND ALL ATTACHMENTS TO:

North Dakota Department of Environmental Quality
Division of Air Quality
4201 Normandy Street, 2nd Floor
Bismarck, ND 58503-1324
(701)328-5188

PERMIT APPLICATION FOR AIR POLLUTION CONTROL EQUIPMENT

NORTH DAKOTA DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF AIR QUALITY
SFN 8532 (9-2021)

NOTE: READ INSTRUCTIONS BEFORE COMPLETING THIS FORM.
- Must also include forms SFN 8516 or SFN 52858

SECTION A – GENERAL INFORMATION

Name of Firm or Organization	Facility Name
Hess North Dakota Pipelines LLC	BBCS2 Compressor Station
Source ID No. of Equipment being Controlled TO-1 (S-795003)	

SECTION B – EQUIPMENT

Type:
- ☐ Cyclone
- ☐ Multiclone
- ☐ Baghouse
- ☐ Electrostatic Precipitator
- ☐ Wet Scrubber
- ☐ Spray Dryer
- ☒ Flare/Combustor
- ☐ Other – Specify:

Name of Manufacturer	Model Number	Date to Be Installed
John Zink	ZTOF	March 2021

Application: ☐ Boiler ☐ Kiln ☐ Engine ☒ Other – Specify: Thermal Oxidizer

Pollutants Removed	VOC	HAP		
Design Efficiency (%)	98	98		
Operating Efficiency (%)	98	98		

Describe method used to determine operating efficiency:

SECTION CD – GAS CONDITIONS

Gas Conditions			Inlet	Outlet
Gas Volume (SCFM; 68°F; 14.7 psia)			118	Varies
Gas Temperature (°F)			163-215	1606
Gas Pressure (in. H_2O)				
Gas Velocity (ft/sec)				
Pollutant Concentration (Specify Pollutant and Unit of Concentration)	Pollutant	Unit of Concentration		
	Refer to Calcs			
Pressure Drop Through Gas Cleaning Device (in. H_2O)				

Appendix D

Hess North Dakota Pipelines LLC
BBCS2 Compressor Station

<table>
<tr><th>Emission Unit</th><th>Emission Unit Description</th><th>Emission Point</th><th>PM (tpy)</th><th>PM10 (tpy)</th><th>PM2.5 (tpy)</th><th>SO2 (tpy)</th><th>NOX (tpy)</th><th>CO (tpy)</th><th>VOC (tpy)</th><th>HAP (tpy)</th><th>GHG [1] (tpy)</th><th>METHANE (tpy)</th></tr>
<tr><td>GLYRBLR</td><td>Glycol Reboiler (E-794090)</td><td>GLYRBLR</td><td>0.02</td><td>0.02</td><td>0.02</td><td>0.001</td><td>0.21</td><td>0.18</td><td>0.01</td><td>0.00</td><td>259.18</td><td>0.00</td></tr>
<tr><td>STILLVNT</td><td>Dehydrator Still Column Vent</td><td>TO-1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>5.06</td><td>0.97</td><td>2104.06</td><td>3.60</td></tr>
<tr><td>SLOPST</td><td>Slop Storage Tanks (TK-791301-791401)</td><td>TO-1</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">0.45</td><td rowspan="3">-</td><td rowspan="3">201.76</td><td rowspan="3">0.74</td></tr>
<tr><td>OILST</td><td>Oil Storage Tanks (TK-791302-1602)</td><td>TO-1</td></tr>
<tr><td>WTRST</td><td>Water Storage Tank (TK-791701)</td><td>TO-1</td></tr>
<tr><td>TO-1</td><td>Thermal Oxidizer (S-795003)</td><td>TO-1</td><td>-</td><td>-</td><td>-</td><td>0.002</td><td>11.55</td><td>3.23</td><td>2.14</td><td>-</td><td>9124.99</td><td>49.60</td></tr>
<tr><td>HPFLARE [2]</td><td>HP Flare (S-795101)</td><td>HPFLARE</td><td>-</td><td>-</td><td>-</td><td>0.02</td><td>1.15</td><td>5.26</td><td>6.31</td><td>-</td><td>2511.32</td><td>6.28</td></tr>
<tr><td>LOADOIL</td><td>Truck Loading Oil</td><td>LOADOIL</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.06</td><td>-</td><td>0.00</td><td>0.00</td></tr>
<tr><td>FUG</td><td>Fugitive</td><td>FUG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>25.36</td><td>1.08</td><td>1019.39</td><td>40.75</td></tr>
<tr><td>GLYST</td><td>Glycol Storage Tank (TK-796003)</td><td>GLYST</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.002</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>MeOHST</td><td>Methanol Storage Tank (TK-796004)</td><td>MeOHST</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.03</td><td>0.03</td><td>-</td><td>-</td></tr>
<tr><td></td><td></td><td>Total:</td><td>0.02</td><td>0.02</td><td>0.02</td><td>0.02</td><td>12.92</td><td>8.67</td><td>39.42</td><td>2.08</td><td>15220.70</td><td>100.98</td></tr>
</table>

Notes:

[1] GHG (as CO2e)

[2] Emergency/maintenance use only;

Glycol Reboiler Emissions
BBCS2 Compressor Station

FACILITY NAME	BBCS2 Compressor Station
Emission Unit	GLYRBLR
EQUIPMENT NUMBER	E-794090
MANUFACTERS NAME	
MODEL NUMBER	
TYPE OF DRIVER	HEATER
RATED INPUT (MMBTU/HR)	0.5
BTU PER CUBIC FOOT	1043
PRIMARY FUEL TYPE	RESIDUE GAS
CALC. MMBTU PER YEAR	4380
CALC. MSCF PER YEAR	4199
SCHEDULE OF OPERATION	
Hours Per Day	24
Days Per Week	7
Weeks Per Year	52
Actual Hours	8760
AIR CONTAMINANTS FROM STACK EMISSIONS	
Particulate (AP-42)	**Table 1.4-2**
EF (lb/MMBtu)	7.45E-03
Pounds Per Hour	0.004
Tons Per Year	0.02
SO2 (AP-42)	**Table 1.4-2**
EF (lb/MMBtu)	5.88E-04
Pounds Per Hour	2.94E-04
Tons Per Year	0.001
NOx (AP-42)	**Table 1.4-1**
EF (lb/MMBtu)	9.80E-02
Pounds Per Hour	0.05
Tons Per Year	0.21
CO (AP-42)	**Table 1.4-1**
EF (lb/MMBtu)	8.24E-02
Pounds Per Hour	0.04
Tons Per Year	0.18
NMVOC (AP-42)	**Table 1.4-2**
EF (lb/MMBtu)	5.39E-03
Pounds Per Hour	0.003
Tons Per Year	0.01
CH4 (AP-42)	**Table 1.4-2**
EF (lb/MMBtu)	2.25E-03
Pounds Per Hour	0.001
Tons Per Year	0.005
N2O (AP-42)	**Table 1.4-2**
EF (lb/MMBtu)	2.16E-03
Pounds Per Hour	0.001
Tons Per Year	0.005

Glycol Reboiler Emissions
BBCS2 Compressor Station

FACILITY NAME	BBCS2 Compressor Station
Emission Unit	GLYRBLR
CO2 (AP-42)	**Table 1.4-2**
EF (lb/MMBtu)	1.18E+02
Pounds Per Hour	58.82
Tons Per Year	257.65
CO2e	
CH4 Global Warming Potential	25
N2O Global Warming Potential	298
CO2e from CH4	0.12
CO2e from N2O	1.41
Total CO2e (tpy)	259.18
Total Criteria Pollutants (TPY)	0.42
HAPs	**Table 1.4-3**
Pounds Per Hour (Avg)	0.001
Tons Per Year	0.004

Thermal Oxidizer (S-795003)
BBCS2 Compressor Station

Waste Stream:	**Purge and Pilot**		
C=	379.3	scf/lb-mole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
NOX	0.15	lb/MMBtu	John Zink ZTOF Vendor Provided Emission Factor
CO	0.042	lb/MMBtu	John Zink ZTOF Vendor Provided Emission Factor
H2S to SO2 conversion	100%		
H2S MW	34.10	lb/lbmol	
SO2 MW	64.066	lb/lbmol	
MW	17.74	lb/lbmol	
Gas Flow (F) =	131,400,000	scf/yr	

		Composition Data		**Flow**			**VOC Emissions**		**Net Heat Release**		
Component	**MW [lb/lb-mol]**	**mi Mole or Vol [%]**	**Wt [%]**	**Fv Volumetric Flow =F*mi [scf/yr]**	**=Fv/C*MW lb/yr**	**D_i Destruction Efficiency [%]**	**VOC Emissions [lb/yr]**	**VOC Emissions [ton/yr]**	**LHV [Btu/scf]**	**$=LHV*m_i$ [BTU/scf]**	**=LHV*Fv Btu/yr**
Nitrogen	28.0	3.37%	5.32%	4428180.00	327045.55	0%	327045.55	163.52	0.0	0.00	0
CO2	44.0	0.27%	0.67%	354780.00	41164.49	0%	41164.49	20.58	0.0	0.00	0
Methane	16.0	89.25%	80.73%	117274500.0	4960126.99	98%	99202.54	49.60	909.4	811.64	106,649,430,300
Ethane	30.1	5.78%	9.80%	7594920.00	602087.13	98%	12041.74	6.02	1619	93.58	12,296,175,480
Propane	44.1	1.13%	2.82%	1490076.00	173229.09	98%	3464.58	1.73	2315	26.25	3,449,525,940
Iso-Butane	58.1	0.06%	0.19%	77394.60	11859.60	98%	237.19	0.12	3000	1.77	232,183,800
n-Butane	58.1	0.14%	0.46%	182777.40	28007.97	98%	560.16	0.28	3011	4.19	550,342,751
Iso-Pentane	72.1	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	3699	0.00	0
n-Pentane	72.1	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	3707	0.00	0
n-Hexane	86.2	0.00%	0.01%	1445.40	328.39	98%	6.57	0.00	4404	0.05	6,365,542
Benzene	78.1	0.00%	0.00%	394.20	81.18	98%	1.62	0.00	3591	0.01	1,415,572
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4180	0.00	0
n-Heptane	100.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5100	0.00	0
Toluene	92.1	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4273	0.00	0
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4971	0.00	0
o-Xylene	106.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4958	0.00	0
n-Octane	114.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5796	0.00	0
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5734	0.00	0
n-Nonane	128.3	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	6493	0.00	0
n-Decane	142.3	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	7190	0.00	0
H2S	34.1	0.00%	0.00%	26.28	2.36	98%	0.05	0.00	586.79	0.00	15,421
		100.00%				VOC	4270.12	2.14		937.48	123,185,454,806
						NOX	18477.82	9.24			
						CO	5173.79	2.59			
						SO2	4.44	0.002			

Sample Calculation:

$$\text{NOx annual emissions (tpy)} = \frac{123185454806\ \text{Btu}}{\text{yr}} \left| \frac{1\ \text{MMBtu}}{10^6\ \text{Btu}} \right| \frac{0.15\ \text{lb}}{\text{MMBtu}} \left| \frac{\text{ton}}{2{,}000\ \text{lb}} \right. = \frac{9.24\ \text{ton}}{\text{yr}}$$

Thermal Oxidizer (S-795003)
BBCS2 Compressor Station

Waste Stream:	**Dehy Regen Vent**		
C=	379.3	scf/lb-mole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
NOX	0.15	lb/MMBtu	John Zink ZTOF Vendor Provided Emission Factor
CO	0.042	lb/MMBtu	John Zink ZTOF Vendor Provided Emission Factor
H2S to SO2 conversion	100%		
H2S MW	34.10	lb/lbmol	
SO2 MW	64.066	lb/lbmol	
MW	18.68	lb/lbmol	
Gas Flow (F) =	62,050,000	scf/yr	

		Composition Data		**Flow**		**Net Heat Release**		
Component	**MW [lb/lb-mol]**	**mi Mole or Vol [%]**	**Wt [%]**	**Fv Volumetric Flow =F*mi [scf/yr]**	**=Fv/C*MW lb/yr**	**LHV [Btu/scf]**	**=LHV*m_i [BTU/scf]**	**=LHV*Fv Btu/yr**
Nitrogen	28.0	1.75%	2.62%	1085875.00	80197.87	0.0	0.00	0
CO2	44.0	0.17%	0.40%	105485.00	12239.24	0.0	0.00	0
Methane	16.0	39.18%	33.65%	24311190.00	1028242.20	909.4	356.30	22,108,596,186
Ethane	30.1	0.94%	1.51%	583270.00	46238.72	1619	15.22	944,314,130
Propane	44.1	0.59%	1.39%	366095.00	42560.45	2315	13.66	847,509,925
Iso-Butane	58.1	0.98%	3.05%	608090.00	93180.93	3000	29.40	1,824,270,000
n-Butane	58.1	0.25%	0.78%	155125.00	23770.65	3011	7.53	467,081,375
Iso-Pentane	72.1	0.65%	2.51%	403325.00	76718.73	3699	24.04	1,491,899,175
n-Pentane	72.1	0.16%	0.62%	99280.00	18884.61	3707	5.93	368,030,960
n-Hexane	86.2	0.00%	0.00%	0.00	0.00	4404	0.00	0
Benzene	78.1	0.02%	0.10%	14271.50	2939.03	3591	0.83	51,248,957
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00	4180	0.00	0
n-Heptane	100.2	0.00%	0.00%	0.00	0.00	5100	0.00	0
Toluene	92.1	0.01%	0.05%	6205.00	1507.30	4273	0.43	26,513,965
Ethylbenzene	106.2	0.01%	0.04%	4343.50	1215.73	4971	0.35	21,591,539
o-Xylene	106.2	0.00%	0.00%	0.00	0.00	4958	0.00	0
n-Octane	114.2	0.00%	0.00%	0.00	0.00	5796	0.00	0
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00	5734	0.00	0
n-Nonane	128.3	0.00%	0.00%	0.00	0.00	6493	0.00	0
n-Decane	142.3	0.00%	0.00%	0.00	0.00	7190	0.00	0
H2O	18.0	55.29%	53.28%	34307445.00	1628088.61	0.00	0.00	0
		100.00%					453.68	28,151,056,211

NOX	4222.66	lb/yr	2.11	tpy
CO	1182.34	lb/yr	0.59	tpy
VOC	Emission data provided under ProMax Dehydration Emissions Report			
HAP	Emission data provided under ProMax Dehydration Emissions Report			

Sample Calculation:

$$\text{CO annual emissions (tpy)} = \frac{28151056211\ \text{Btu}}{\text{yr}} \times \frac{1\ \text{MMBtu}}{10^6\ \text{Btu}} \times \frac{0.042\ \text{lb}}{\text{MMBtu}} \times \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.59\ \text{ton}}{\text{yr}}$$

Thermal Oxidizer (S-795003)
BBCS2 Compressor Station

Waste Stream:	**Storage Tank vapors**		
C=	379.3	scf/lb-mole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
NOX	0.15	lb/MMBtu	John Zink ZTOF Vendor Provided Emission Factor
CO	0.042	lb/MMBtu	John Zink ZTOF Vendor Provided Emission Factor
H2S to SO2 conversion	100%		
H2S MW	34.10	lb/lbmol	
SO2 MW	64.066	lb/lbmol	
MW	22.58	lb/lbmol	
Gas Flow (F) =	2,316,447	scf/yr	

		Composition Data		Flow		Net Heat Release		
Component	**MW [lb/lb-mol]**	**mi Mole or Vol [%]**	**Wt [%]**	**Fv Volumetric Flow =F*mi [scf/yr]**	**=Fv/C*MW lb/yr**	**LHV [Btu/scf]**	**=LHV*m_i [BTU/scf]**	**=LHV*Fv Btu/yr**
Nitrogen	28.0	3.73%	4.63%	86403.48	6381.37	0.0	0.00	0
CO2	44.0	0.00%	0.00%	0.00	0.00	0.0	0.00	0
Methane	16.0	77.67%	55.18%	1799184.55	76096.54	909.4	706.33	1,636,178,434
Ethane	30.1	2.81%	3.74%	65092.17	5160.18	1619	45.49	105,384,218
Propane	44.1	7.15%	13.96%	165625.98	19254.88	2315	165.52	383,424,135
Iso-Butane	58.1	1.49%	3.84%	34515.06	5288.93	3000	44.70	103,545,191
n-Butane	58.1	3.33%	8.57%	77137.69	11820.23	3011	100.27	232,261,592
Iso-Pentane	72.1	0.81%	2.59%	18763.22	3569.06	3699	29.96	69,405,160
n-Pentane	72.1	1.65%	5.27%	38221.38	7270.30	3707	61.17	141,686,652
n-Hexane	86.2	0.00%	0.00%	0.00	0.00	4404	0.00	0
Benzene	78.1	0.00%	0.00%	0.00	0.00	3591	0.00	0
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00	4180	0.00	0
n-Heptane	100.2	0.00%	0.00%	0.00	0.00	5100	0.00	0
Toluene	92.1	0.00%	0.00%	0.00	0.00	4273	0.00	0
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00	4971	0.00	0
o-Xylene	106.2	0.00%	0.00%	0.00	0.00	4958	0.00	0
n-Octane	114.2	0.00%	0.00%	0.00	0.00	5796	0.00	0
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00	5734	0.00	0
n-Nonane	128.3	0.21%	1.19%	4864.54	1644.88	6493	13.64	31,585,453
n-Decane	142.3	0.02%	0.13%	463.29	173.79	7190	1.44	3,331,051
H2O	18.0	1.13%	0.90%	26175.85	1242.20	0.00	0.00	0
		100.00%					1168.51	2,706,801,886

NOX	406.02	lb/yr	0.20	tpy
CO	113.69	lb/yr	0.06	tpy
VOC	Emission data provided under ProMax Tank Emissions Report			

Sample Calculation:

$$\text{NOx annual emissions (tpy)} = \frac{2706801886\ \text{Btu}}{\text{yr}} \cdot \frac{1\ \text{MMBtu}}{10^6\ \text{Btu}} \cdot \frac{0.15\ \text{lb}}{\text{MMBtu}} \cdot \frac{\text{ton}}{2{,}000\ \text{lb}} = \frac{0.20\ \text{ton}}{\text{yr}}$$

Thermal Oxidizer GHG Emissions
BBCS2 Compressor Station

Waste Stream:	**Purge and Pilot**	
Volumetric Gas Flow (F) =	131,400,000	scf/yr

Pilot Gas			HC To TO Calculations				Carbon Content of HC TOd		
Component	**MW [kg/kg-mol]**	**mi Mole or Vol [%]**	**$mi,_{HC\ TO}$ Mole or Vol of HC to TO [%]**	**$MW_{HC\ to\ TO}$ MW of HC to TO [kg/kgmol]**	**$Wt\%_{HC\ to\ TO}$ Wt% of HC to TO [%]**	**$V_{HC\ to\ TO}$ Volumetric HC to TO Flow Rate [Scf/mol]**	**X Stoichiometric Coeff for C**	**Wt%Cj Carbon content by component**	**Wt%Cmix Weighted CC**
Nitrogen	28.0	3.37%							
CO2	44.0	0.27%							
Methane	16.0	89.25%	92.62%	14.86	85.88%	117,274,500	1	0.7	0.64
Ethane	30.1	5.78%	6.00%	1.80	10.42%	7,594,920	2	0.8	0.08
Propane	44.1	1.13%	1.18%	0.52	3.00%	1,490,076	3	0.8	0.02
Iso-Butane	58.1	0.06%	0.06%	0.04	0.21%	77,395	4	0.8	0.00
n-Butane	58.1	0.14%	0.14%	0.08	0.48%	182,777	4	0.8	0.00
Iso-Pentane	72.1	0.00%	0.00%	0.00	0.00%	0	5	0.8	0.00
n-Pentane	72.1	0.00%	0.00%	0.00	0.00%	0	5	0.8	0.00
n-Hexane	86.2	0.00%	0.00%	0.00	0.01%	1,445	6	0.8	0.00
Benzene	78.1	0.00%	0.00%	0.00	0.00%	394	6	0.9	0.00
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00%	0	6	0.9	0.00
n-Heptane	100.2	0.00%	0.00%	0.00	0.00%	0	7	0.8	0.00
Toluene	92.1	0.00%	0.00%	0.00	0.00%	0	6	0.8	0.00
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
o-Xylene	106.2	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
n-Octane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
n-Nonane	128.3	0.00%	0.00%	0.00	0.00%	0	9	0.8	0.00
n-Decane	142.3	0.00%	0.00%	0.00	0.00%	0	10	0.8	0.00
H2S	34.1	0.00%							
			MW of HC to TO:	**17.30**	**HC to TO:**	**126,621,508**		**CF_{HC}:**	**0.76**

Parameter Name & Variable		Value & Units		
1. General Values				
Molar Volume Conversion	MVC	23.685	m3/kgmole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
CH4 Global Warming Potential	GWP_{CH4}	25		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
N2O Global Warming Potential	GWP_{N2O}	298		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
TO Gas Combustion Efficiency	$FE_{TO\ Gas}$	98%		
2.1 CO2 Emission Rate				
Total Flow to TO	$F_{Total\ to\ TO}$	3,720,833.64	m3/yr	Input Converted
HC to TO Gas Flow Rate	$F_{HC\ in\ TO\ Gas}$	3585521.81	m3/yr	Input Converted
TO hydrocarbon mass inlet rate	HC_{in}	2619150.77	kg/yr	= FHC in TO Gas / MVC * MWHC to TO
CO2 Emissions from Combustion of TO Gas	$M_{CO2\ Comb\ TO\ Gas}$	**7113.55**	tonnes/yr	= HC_{in} * CF_{HC} * FE * 44/12 /1000 [kg/tonne]
CO2 Emission from CO2 in TO Gas	$M_{CO2\ in\ TO\ Gas}$	**18.67**	tonnes/yr	= m_{CO2}*MW_{CO2}/MVC/1000 [kg/tonne]
Total CO2 Emitted	E_{CO2}	**7132.21**	**tonnes/yr**	= MCO2 Comb TO Gas + MCO2 in TO Gas
Total CO2 Emitted	E_{CO2}	**7861.91**	**ton/yr**	
3.1 CH4 Emission Rate				
CH4 Emissions	E_{CH4}	**44.99**	**tonnes/yr**	= FTotal to TO*mCH4*(1-FE)/MVC*MWCH4/1000 [kg/tonne]
4.1 N2O Emission Rate				
N2O Emission Factor	$EF_{N2O,\ LP\ Gas}$	0.0006	kg N2O/mmBtu	Emission factor for fuel gas taken from Table C-2 of 40 CFR Part 98 Subpart C.
CO2 Emission Factor	$EF_{CO2,\ LP\ Gas}$	60	kg CO2/mmBTU	Default Emission Factor for CO2 taken from Equation 5-6 of API Compendium 2021.
N2O Emissions	$E_{N2O\ LP\ Gas}$	**0.0711**	**tonnes/yr**	= MCO2 Comb TO Gas * (EFN2O / EFCO2)
5.1 CO2e Calculations				
CO2e from CH4	$CO2e_{CH4}$	**1124.65**	**tonnes/yr**	= E_{CH4}*GWP_{CH4}
CO2e from CH4	$CO2e_{CH4}$	**1239.71**	**ton/yr**	
CO2e from N2O	$CO2e_{N2O}$	**21.20**	**tonnes/yr**	= E_{N2O}*GWP_{N2O}
CO2e from N2O	$CO2e_{N2O}$	**23.37**	**ton/yr**	

Thermal Oxidizer GHG Emissions
BBCS2 Compressor Station

Waste Stream:	**Dehy Regen Vent**	
Volumetric Gas Flow (F) =	62,050,000	scf/yr

Pilot Gas			HC To TO Calculations				Carbon Content of HC TOd		
Component	**MW [kg/kg-mol]**	**mi Mole or Vol [%]**	**$mi,_{HC\ TO}$ Mole or Vol of HC to TO [%]**	**$MW_{HC\ to\ TO}$ MW of HC to TO [kg/kgmol]**	**$Wt\%_{HC\ to\ TO}$ Wt% of HC to TO [%]**	**$V_{HC\ to\ TO}$ Volumetric HC to TO Flow Rate [Scf/mol]**	**X Stoichiometric Coeff for C**	**Wt%Cj Carbon content by component**	**Wt%Cmix Weighted CC**
Nitrogen	2801.34%	1.75%							
CO2	4400.95%	0.17%							
Methane	1604.25%	39.18%	91.56%	14.69	77.01%	24,311,190	1	0.7	0.58
Ethane	3006.90%	0.94%	2.20%	0.66	3.46%	583,270	2	0.8	0.03
Propane	4409.56%	0.59%	1.38%	0.61	3.19%	366,095	3	0.8	0.03
Iso-Butane	5812.22%	0.98%	2.29%	1.33	6.98%	608,090	4	0.8	0.06
n-Butane	5812.22%	0.25%	0.58%	0.34	1.78%	155,125	4	0.8	0.01
Iso-Pentane	7214.88%	0.65%	1.52%	1.10	5.75%	403,325	5	0.8	0.05
n-Pentane	7214.88%	0.16%	0.37%	0.27	1.41%	99,280	5	0.8	0.01
n-Hexane	8617.54%	0.00%	0.00%	0.00	0.00%	0	6	0.8	0.00
Benzene	7811.18%	0.02%	0.05%	0.04	0.22%	14,272	6	0.9	0.00
Cyclohexane	8415.95%	0.00%	0.00%	0.00	0.00%	0	6	0.9	0.00
n-Heptane	10020.19%	0.00%	0.00%	0.00	0.00%	0	7	0.8	0.00
Toluene	9213.84%	0.01%	0.02%	0.02	0.11%	6,205	6	0.8	0.00
Ethylbenzene	10616.50%	0.01%	0.02%	0.02	0.09%	4,344	8	0.9	0.00
o-Xylene	10616.50%	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
n-Octane	11422.85%	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
2,2,4-Trimethylpentane	11422.85%	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
n-Nonane	12825.51%	0.00%	0.00%	0.00	0.00%	0	9	0.8	0.00
n-Decane	14228.17%	0.00%	0.00%	0.00	0.00%	0	10	0.8	0.00
H2O	1800.00%	55.29%							
			MW of HC to TO:	**19.07**	**HC to TO:**	**26,551,195**		**CF_{HC}:**	**0.77**

Parameter Name & Variable		Value & Units		
1. General Values				
Molar Volume Conversion	MVC	23.685	m3/kgmole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
CH4 Global Warming Potential	GWP_{CH4}	25		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
N2O Global Warming Potential	GWP_{N2O}	298		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
TO Gas Combustion Efficiency	$FE_{TO\ Gas}$	98%		
2.1 CO2 Emission Rate				
Total Flow to TO	$F_{Total\ to\ TO}$	1,757,060.33	m3/yr	Input Converted
HC to TO Gas Flow Rate	$F_{HC\ in\ TO\ Gas}$	751,846.12	m3/yr	Input Converted
TO hydrocarbon mass inlet rate	HC_{in}	605,507.66	kg/yr	= FHC in TO Gas / MVC * MWHC to TO
CO2 Emissions from Combustion of TO Gas	$M_{CO2\ Comb\ TO\ Gas}$	**1,665.12**	tonnes/yr	= HC_{in} * CF_{HC} * FE * 44/12 /1000 [kg/tonne]
CO2 Emission from CO2 in TO Gas	$M_{CO2\ in\ TO\ Gas}$	**5.55**	tonnes/yr	= m_{CO2}*MW_{CO2}/MVC/1000 [kg/tonne]
Total CO2 Emitted	E_{CO2}	**1670.67**	**tonnes/yr**	= MCO2 Comb TO Gas + MCO2 in TO Gas
Total CO2 Emitted	E_{CO2}	**1841.60**	**ton/yr**	
3.1 CH4 Emission Rate				
CH4 Emissions	E_{CH4}	**9.33**	**tonnes/yr**	= FTotal to TO*mCH4*(1-FE)/MVC*MWCH4/1000 [kg/tonne]
4.1 N2O Emission Rate				
N2O Emission Factor	$EF_{N2O,\ LP\ Gas}$	0.0006	kg N2O/mmBtu	Emission factor for fuel gas taken from Table C-2 of 40 CFR Part 98 Subpart C.
CO2 Emission Factor	$EF_{CO2,\ LP\ Gas}$	60	kg CO2/mmBTU	Default Emission Factor for CO2 taken from Equation 5-6 of API Compendium 2021.
N2O Emissions	$E_{N2O\ LP\ Gas}$	**0.0167**	**tonnes/yr**	= MCO2 Comb TO Gas * (EFN2O / EFCO2)
5.1 CO2e Calculations				
CO2e from CH4	$CO2e_{CH4}$	**233.14**	**tonnes/yr**	= E_{CH4}*GWP_{CH4}
CO2e from CH4	$CO2e_{CH4}$	**256.99**	**ton/yr**	
CO2e from N2O	$CO2e_{N2O}$	**4.96**	**tonnes/yr**	= E_{N2O}*GWP_{N2O}
CO2e from N2O	$CO2e_{N2O}$	**5.47**	**ton/yr**	

Thermal Oxidizer GHG Emissions
BBCS2 Compressor Station

Waste Stream: **Storage Tank vapors**
Volumetric Gas Flow (F) = 2,316,447 scf/yr

Pilot Gas			HC To TO Calculations				Carbon Content of HC TOd		
Component	**MW [kg/kg-mol]**	**mi** **Mole or Vol [%]**	**mi, HC TO** **Mole or Vol of HC to TO [%]**	**$MW_{HC\ to\ TO}$** **MW of HC to TO [kg/kgmol]**	**$Wt\%_{HC\ to\ TO}$** **Wt% of HC to TO [%]**	**$V_{HC\ to\ TO}$** **Volumetric HC to TO Flow Rate [Scf/mol]**	**X** **Stoichiometric Coeff for C**	**Wt%Cj** **Carbon content by component**	**Wt%Cmix** **Weighted CC**
Nitrogen	28.0	3.73%							
CO2	44.0	0.00%							
Methane	16.0	77.67%	81.64%	13.10	58.41%	1,799,185	1	0.7	0.44
Ethane	30.1	2.81%	2.95%	0.89	3.96%	65,092	2	0.8	0.03
Propane	44.1	7.15%	7.52%	3.31	14.78%	165,626	3	0.8	0.12
Iso-Butane	58.1	1.49%	1.57%	0.91	4.06%	34,515	4	0.8	0.03
n-Butane	58.1	3.33%	3.50%	2.03	9.07%	77,138	4	0.8	0.07
Iso-Pentane	72.1	0.81%	0.85%	0.61	2.74%	18,763	5	0.8	0.02
n-Pentane	72.1	1.65%	1.73%	1.25	5.58%	38,221	5	0.8	0.05
n-Hexane	86.2	0.00%	0.00%	0.00	0.00%	0	6	0.8	0.00
Benzene	78.1	0.00%	0.00%	0.00	0.00%	0	6	0.9	0.00
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00%	0	6	0.9	0.00
n-Heptane	100.2	0.00%	0.00%	0.00	0.00%	0	7	0.8	0.00
Toluene	92.1	0.00%	0.00%	0.00	0.00%	0	6	0.8	0.00
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
o-Xylene	106.2	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
n-Octane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
n-Nonane	128.3	0.21%	0.22%	0.28	1.26%	4,865	9	0.8	0.01
n-Decane	142.3	0.02%	0.02%	0.03	0.13%	463	10	0.8	0.00
H2O	18.0	1.13%							
			MW of HC to TO:	**22.42**	**HC to TO:**	**2,203,868**		**CF_{HC}:**	**0.78**

Parameter Name & Variable		**Value & Units**		
1. General Values				
Molar Volume Conversion	MVC	23.685	m3/kgmole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
CH4 Global Warming Potential	GWP_{CH4}	25		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
N2O Global Warming Potential	GWP_{N2O}	298		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
TO Gas Combustion Efficiency	$FE_{TO\ Gas}$	98%		
2.1 CO2 Emission Rate				
Total Flow to TO	$F_{Total\ to\ TO}$	65,594.48	m3/yr	Input Converted
HC to TO Gas Flow Rate	$F_{HC\ in\ TO\ Gas}$	62,406.59	m3/yr	Input Converted
TO hydrocarbon mass inlet rate	HC_{in}	59,078.31	kg/yr	= FHC in TO Gas / MVC * MWHC to TO
CO2 Emissions from Combustion of TO Gas	$M_{CO2\ Comb\ TO\ Gas}$	**165.29**	tonnes/yr	= HC_{in} * CF_{HC} * FE * 44/12 /1000 [kg/tonne]
CO2 Emission from CO2 in TO Gas	$M_{CO2\ in\ TO\ Gas}$	**0.00**	tonnes/yr	= m_{CO2}*MW_{CO2}/MVC/1000 [kg/tonne]
Total CO2 Emitted	E_{CO2}	**165.29**	**tonnes/yr**	= MCO2 Comb TO Gas + MCO2 in TO Gas
Total CO2 Emitted	E_{CO2}	**182.20**	**ton/yr**	
3.1 CH4 Emission Rate				
CH4 Emissions	E_{CH4}	**0.69**	**tonnes/yr**	= FTotal to TO*mCH4*(1-FE)/MVC*MWCH4/1000 [kg/tonne]
4.1 N2O Emission Rate				
N2O Emission Factor	$EF_{N2O,\ LP\ Gas}$	0.0006	kg N2O/mmBtu	Emission factor for fuel gas taken from Table C-2 of 40 CFR Part 98 Subpart C.
CO2 Emission Factor	$EF_{CO2,\ LP\ Gas}$	60	kg CO2/mmBTU	Default Emission Factor for CO2 taken from Equation 5-6 of API Compendium 2021.
N2O Emissions	$E_{N2O\ LP\ Gas}$	**0.0017**	**tonnes/yr**	= MCO2 Comb TO Gas * (EFN2O / EFCO2)
5.1 CO2e Calculations				
CO2e from CH4	$CO2e_{CH4}$	**17.25**	**tonnes/yr**	= E_{CH4}*GWP_{CH4}
CO2e from CH4	$CO2e_{CH4}$	**19.02**	**ton/yr**	
CO2e from N2O	$CO2e_{N2O}$	**0.49**	**tonnes/yr**	= E_{N2O}*GWP_{N2O}
CO2e from N2O	$CO2e_{N2O}$	**0.54**	**ton/yr**	

HP Flare (S-795101)
BBCS2 Compressor Station

Waste Stream:	**Purge and Pilot**		
C=	379.3	scf/lb-mole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
NOX	0.068	lb/MMBtu	Emissions Factor taken from Table 13.5-1 of AP42.
CO	0.31	lb/MMBtu	Emissions Factor taken from Table 13.5-2 of AP42.
H2S to SO2 conversion	100%		
H2S MW	34.10	lb/lbmol	
SO2 MW	64.066	lb/lbmol	
MW	17.74	lb/lbmol	
Gas Flow (F) =	3,416,400	scf/yr	

		Composition Data		**Flow**			**VOC Emissions**		**Net Heat Release**		
Component	**MW [lb/lb-mol]**	**mi Mole or Vol [%]**	**Wt [%]**	**Fv Volumetric Flow =F*mi [scf/yr]**	**=Fv/C*MW lb/yr**	**D_i Destruction Efficiency [%]**	**VOC Emissions [lb/yr]**	**VOC Emissions [ton/yr]**	**LHV [Btu/scf]**	**=LHV*m_i [BTU/scf]**	**=LHV*Fv Btu/yr**
Nitrogen	28.0	3.37%	5.32%	115132.68	8503.18	0%	8503.18	4.25	0.0	0.00	0
CO2	44.0	0.27%	0.67%	9224.28	1070.28	0%	1070.28	0.54	0.0	0.00	0
Methane	16.0	89.25%	80.73%	3049137.00	128963.30	98%	2579.27	1.29	909.4	811.64	2,772,885,188
Ethane	30.1	5.78%	9.80%	197467.92	15654.27	98%	313.09	0.16	1619	93.58	319,700,562
Propane	44.1	1.13%	2.82%	38741.98	4503.96	98%	90.08	0.05	2315	26.25	89,687,674
Iso-Butane	58.1	0.06%	0.19%	2012.26	308.35	98%	6.17	0.00	3000	1.77	6,036,779
n-Butane	58.1	0.14%	0.46%	4752.21	728.21	98%	14.56	0.01	3011	4.19	14,308,912
Iso-Pentane	72.1	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	3699	0.00	0
n-Pentane	72.1	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	3707	0.00	0
n-Hexane	86.2	0.00%	0.01%	37.58	8.54	98%	0.17	0.00	4404	0.05	165,504
Benzene	78.1	0.00%	0.00%	10.25	2.11	98%	0.04	0.00	3591	0.01	36,805
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4180	0.00	0
n-Heptane	100.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5100	0.00	0
Toluene	92.1	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4273	0.00	0
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4971	0.00	0
o-Xylene	106.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	4958	0.00	0
n-Octane	114.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5796	0.00	0
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5734	0.00	0
n-Nonane	128.3	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	6493	0.00	0
n-Decane	142.3	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	7190	0.00	0
H2S	34.1	0.00%	0.00%	0.68	0.06	98%	0.00	0.00	586.79	0.00	401
		100.00%				VOC	111.02	0.06		937.48	3,202,821,825
						NOX	217.79	0.11			
						CO	992.87	0.50			
						SO2	0.12	0.000			

Sample Calculation:

NOx annual emissions (tpy) =	3202821825 Btu	1 MMBtu	0.068 lb	ton	=	0.11 ton
	yr	10^6 Btu	MMBtu	2,000 lb		yr

HP Flare (S-795101)
BBCS2 Compressor Station

Waste Stream:	**Blowdown**		
C=	379.3	scf/lb-mole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
NOX	0.068	lb/MMBtu	Emissions Factor taken from Table 13.5-1 of AP42.
CO	0.31	lb/MMBtu	Emissions Factor taken from Table 13.5-2 of AP42.
H2S to SO2 conversion	100%		
H2S MW	34.10	lb/lbmol	
SO2 MW	64.066	lb/lbmol	
MW	27.34	lb/lbmol	
Gas Flow (F) =	21,473,333	scf/yr	

		Composition Data		Flow			VOC Emissions		Net Heat Release		
Component	**MW [lb/lb-mol]**	**mi Mole or Vol [%]**	**Wt [%]**	**Fv Volumetric Flow =F*mi [scf/yr]**	**=Fv/C*MW lb/yr**	**D_i Destruction Efficiency [%]**	**VOC Emissions [lb/yr]**	**VOC Emissions [ton/yr]**	**LHV [Btu/scf]**	**=LHV*m_i [BTU/scf]**	**=LHV*Fv Btu/yr**
Nitrogen	28.0	1.93%	1.98%	414435.33	30608.34	0%	30608.34	15.30	0.0	0.00	0
CO2	44.0	0.68%	1.09%	146018.67	16942.28	0%	16942.28	8.47	0.0	0.00	0
Methane	16.0	55.00%	32.28%	11810333.33	499518.25	98%	9990.37	5.00	909.4	500.17	10,740,317,133
Ethane	30.1	22.01%	24.21%	4726280.67	374675.81	98%	7493.52	3.75	1619	356.34	7,651,848,399
Propane	44.1	12.30%	19.84%	2641220.00	307055.58	98%	6141.11	3.07	2315	284.75	6,114,424,300
Iso-Butane	58.1	1.32%	2.81%	283448.00	43434.28	98%	868.69	0.43	3000	39.60	850,344,000
n-Butane	58.1	4.06%	8.63%	871817.33	133593.31	98%	2671.87	1.34	3011	122.25	2,625,041,991
Iso-Pentane	72.1	0.66%	1.74%	141724.00	26958.12	98%	539.16	0.27	3699	24.41	524,237,076
n-Pentane	72.1	1.03%	2.72%	221175.33	42071.01	98%	841.42	0.42	3707	38.18	819,896,961
n-Hexane	86.2	0.01%	0.05%	3143.70	714.23	98%	14.28	0.01	4404	0.64	13,844,837
Benzene	78.1	0.00%	0.00%	197.55	40.68	98%	0.81	0.00	3591	0.03	709,419
Cyclohexane	84.2	0.00%	0.01%	504.62	111.97	98%	2.24	0.00	4180	0.10	2,109,326
n-Heptane	100.2	0.01%	0.03%	1546.08	408.44	98%	8.17	0.00	5100	0.37	7,885,008
Toluene	92.1	0.00%	0.00%	64.42	15.65	98%	0.31	0.00	4273	0.01	275,267
Ethylbenzene	106.2	0.00%	0.00%	2.15	0.60	98%	0.01	0.00	4971	0.00	10,674
o-Xylene	106.2	0.00%	0.00%	42.95	12.02	98%	0.24	0.00	4958	0.01	212,930
n-Octane	114.2	0.00%	0.00%	38.65	11.64	98%	0.23	0.00	5796	0.01	224,031
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00	98%	0.00	0.00	5734	0.00	0
n-Nonane	128.3	0.94%	4.41%	201849.33	68252.59	98%	1365.05	0.68	6493	61.03	1,310,607,721
n-Decane	142.3	0.04%	0.21%	8589.33	3222.00	98%	64.44	0.03	7190	2.88	61,757,307
H2S	34.1	0.00%	0.00%	214.73	19.29	98%	0.39	0.00	586.79	0.01	126,003
		100.00%				VOC	12518.04	6.26		1430.79	30,723,872,382
						NOX	2089.22	1.04			
						CO	9524.40	4.76			
						SO2	36.27	0.02			

Sample Calculation:

NOx annual emissions (tpy) =	30723872382 Btu / yr	1 MMBtu / 10^6 Btu	0.068 lb / MMBtu	ton / 2,000 lb	=	4.76 ton / yr

HP Flare GHG Emissions
BBCS2 Compressor Station

Waste Stream: **Purge and Pilot**
Volumetric Gas Flow (F) = 3,416,400 scf/yr

Pilot Gas			**HC To Flare Calculations**				**Carbon Content of HC Flared**		
Component	**MW [kg/kg-mol]**	**mi** Mole or Vol [%]	**$m_{i, HC Flared}$** Mole or Vol of HC to Flare [%]	**$MW_{HC to Flare}$** MW of HC to Flare [kg/kgmol]	**$Wt\%_{HC to Flare}$** Wt% of HC to Flare [%]	**$V_{HC to Flare}$** Volumetric HC to Flare Flow Rate [Scf/mol]	**X** Stoichiometric Coeff for C	**Wt%Cj** Carbon content by component	**Wt%Cmix** Weighted CC
Nitrogen	28.0	3.37%							
CO2	44.0	0.27%							
Methane	16.0	89.25%	92.62%	14.86	85.88%	3,049,137	1	0.7	0.64
Ethane	30.1	5.78%	6.00%	1.80	10.42%	197,468	2	0.8	0.08
Propane	44.1	1.13%	1.18%	0.52	3.00%	38,742	3	0.8	0.02
Iso-Butane	58.1	0.06%	0.06%	0.04	0.21%	2,012	4	0.8	0.00
n-Butane	58.1	0.14%	0.14%	0.08	0.48%	4,752	4	0.8	0.00
Iso-Pentane	72.1	0.00%	0.00%	0.00	0.00%	0	5	0.8	0.00
n-Pentane	72.1	0.00%	0.00%	0.00	0.00%	0	5	0.8	0.00
n-Hexane	86.2	0.00%	0.00%	0.00	0.01%	38	6	0.8	0.00
Benzene	78.1	0.00%	0.00%	0.00	0.00%	10	6	0.9	0.00
Cyclohexane	84.2	0.00%	0.00%	0.00	0.00%	0	6	0.9	0.00
n-Heptane	100.2	0.00%	0.00%	0.00	0.00%	0	7	0.8	0.00
Toluene	92.1	0.00%	0.00%	0.00	0.00%	0	6	0.8	0.00
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
o-Xylene	106.2	0.00%	0.00%	0.00	0.00%	0	8	0.9	0.00
n-Octane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
n-Nonane	128.3	0.00%	0.00%	0.00	0.00%	0	9	0.8	0.00
n-Decane	142.3	0.00%	0.00%	0.00	0.00%	0	10	0.8	0.00
H2S	34.1	0.00%							
			MW of HC to Flare:	**17.30**	**HC to Flare:**	**3,292,159**		**CF_{HC}:**	**0.76**

Parameter Name & Variable		**Value & Units**		
1. General Values				
Molar Volume Conversion	MVC	23.685	m3/kgmole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
CH4 Global Warming Potential	GWP_{CH4}	25		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
N2O Global Warming Potential	GWP_{N2O}	298		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
Flare Gas Combustion Efficiency	$FE_{Flare Gas}$	98%		
2.1 CO2 Emission Rate				
Total Flow to Flare	$F_{Total to Flare}$	96,741.67	m3/yr	Input Converted
HC to Flare Gas Flow Rate	$F_{HC in Flare Gas}$	93223.57	m3/yr	Input Converted
Flare hydrocarbon mass inlet rate	HC_{in}	68097.92	kg/yr	$= F_{HC in Flare Gas} / MVC * MW_{HC to Flare}$
CO2 Emissions from Combustion of Flare Gas	$M_{CO2 Comb Flare Gas}$	**184.95**	tonnes/yr	$= HC_{in} * CF_{HC} * FE * 44/12 /1000$ [kg/tonne]
CO2 Emission from CO2 in Flare Gas	$M_{CO2 in Flare Gas}$	**0.49**	tonnes/yr	$= m_{CO2} * MW_{CO2} / MVC / 1000$ [kg/tonne]
Total CO2 Emitted	E_{CO2}	**185.44**	**tonnes/yr**	$= M_{CO2 Comb Flare Gas} + M_{CO2 in Flare Gas}$
Total CO2 Emitted	E_{CO2}	**204.41**	**ton/yr**	
3.1 CH4 Emission Rate				
CH4 Emissions	E_{CH4}	**1.17**	**tonnes/yr**	$= F_{Total to Flare} * m_{CH4} * (1-FE) / MVC * MW_{CH4} / 1000$ [kg/tonne]
4.1 N2O Emission Rate				
N2O Emission Factor	$EF_{N2O, HP Gas}$	0.0006	kg N2O/mmBtu	Emission factor for fuel gas taken from Table C-2 of 40 CFR Part 98 Subpart C.
CO2 Emission Factor	$EF_{CO2, HP Gas}$	60	kg CO2/mmBTU	Default Emission Factor for CO2 taken from Equation 5-6 of API Compendium 2021.
N2O Emissions	$E_{N2O HP Gas}$	**0.0018**	**tonnes/yr**	$= M_{CO2 Comb Flare Gas} * (EF_{N2O} / EF_{CO2})$
5.1 CO2e Calculations				
CO2e from CH4	$CO2e_{CH4}$	**29.24**	**tonnes/yr**	$= E_{CH4} * GWP_{CH4}$
CO2e from CH4	$CO2e_{CH4}$	**32.23**	**ton/yr**	
CO2e from N2O	$CO2e_{N2O}$	**0.55**	**tonnes/yr**	$= E_{N2O} * GWP_{N2O}$
CO2e from N2O	$CO2e_{N2O}$	**0.61**	**ton/yr**	

HP Flare GHG Emissions
BBCS2 Compressor Station

Waste Stream: **Blowdown**
Volumetric Gas Flow (F) = 21,473,333 scf/yr

Pilot Gas			HC To Flare Calculations				Carbon Content of HC Flared		
Component	MW [kg/kg-mol]	mi Mole or Vol [%]	$m_{i, HC Flared}$ Mole or Vol of HC to Flare [%]	$MW_{HC\ to\ Flare}$ MW of HC to Flare [kg/kgmol]	$Wt\%_{HC\ to\ Flare}$ Wt% of HC to Flare [%]	$V_{HC\ to\ Flare}$ Volumetric HC to Flare Flow Rate [Scf/mol]	X Stoichiometric Coeff for C	Wt%Cj Carbon content by component	Wt%Cmix Weighted CC
Nitrogen	28.0	1.93%							
CO2	44.0	0.68%							
Methane	16.0	55.00%	56.48%	9.06	33.30%	11,810,333	1	0.7	0.25
Ethane	30.1	22.01%	22.60%	6.80	24.98%	4,726,281	2	0.8	0.20
Propane	44.1	12.30%	12.63%	5.57	20.47%	2,641,220	3	0.8	0.17
Iso-Butane	58.1	1.32%	1.36%	0.79	2.90%	283,448	4	0.8	0.02
n-Butane	58.1	4.06%	4.17%	2.42	8.91%	871,817	4	0.8	0.07
Iso-Pentane	72.1	0.66%	0.68%	0.49	1.80%	141,724	5	0.8	0.01
n-Pentane	72.1	1.03%	1.06%	0.76	2.80%	221,175	5	0.8	0.02
n-Hexane	86.2	0.01%	0.02%	0.01	0.05%	3,144	6	0.8	0.00
Benzene	78.1	0.00%	0.00%	0.00	0.00%	198	6	0.9	0.00
Cyclohexane	84.2	0.00%	0.00%	0.00	0.01%	505	6	0.9	0.00
n-Heptane	100.2	0.01%	0.01%	0.01	0.03%	1,546	7	0.8	0.00
Toluene	92.1	0.00%	0.00%	0.00	0.00%	64	6	0.8	0.00
Ethylbenzene	106.2	0.00%	0.00%	0.00	0.00%	2	8	0.9	0.00
o-Xylene	106.2	0.00%	0.00%	0.00	0.00%	43	8	0.9	0.00
n-Octane	114.2	0.00%	0.00%	0.00	0.00%	39	8	0.8	0.00
2,2,4-Trimethylpentane	114.2	0.00%	0.00%	0.00	0.00%	0	8	0.8	0.00
n-Nonane	128.3	0.94%	0.97%	1.24	4.55%	201,849	9	0.8	0.04
n-Decane	142.3	0.04%	0.04%	0.06	0.21%	8,589	10	0.8	0.00
H2S	34.1	0.00%							
			MW of HC to Flare:	**27.21**	**HC to Flare:**	**20,911,977**		**CF_{HC}:**	**0.79**

Parameter Name & Variable		Value & Units		
1. General Values				
Molar Volume Conversion	MVC	23.685	m3/kgmole	Ideal gas law conversion factor at standard conditions of 60°F and 14.7 psia
CH4 Global Warming Potential	GWP_{CH4}	25		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
N2O Global Warming Potential	GWP_{N2O}	298		GWP taken from Table A-1 of 40 CFR Part 98 Subpart A.
Flare Gas Combustion Efficiency	$FE_{Flare\ Gas}$	98%		
2.1 CO2 Emission Rate				
Total Flow to Flare	$F_{Total\ to\ Flare}$	608,057.09	m3/yr	Input Converted
HC to Flare Gas Flow Rate	$F_{HC\ in\ Flare\ Gas}$	592,161.26	m3/yr	Input Converted
Flare hydrocarbon mass inlet rate	HC_{in}	680,257.67	kg/yr	$= F_{HC\ in\ Flare\ Gas} / MVC * MW_{HC\ to\ Flare}$
CO2 Emissions from Combustion of Flare Gas	$M_{CO2\ Comb\ Flare\ Gas}$	**1,936.29**	tonnes/yr	$= HC_{in} * CF_{HC} * FE * 44/12 /1000$ [kg/tonne]
CO2 Emission from CO2 in Flare Gas	$M_{CO2\ in\ Flare\ Gas}$	**7.68**	tonnes/yr	$= m_{CO2} * MW_{CO2} / MVC / 1000$ [kg/tonne]
Total CO2 Emitted	E_{CO2}	**1943.98**	**tonnes/yr**	$= M_{CO2\ Comb\ Flare\ Gas} + M_{CO2\ in\ Flare\ Gas}$
Total CO2 Emitted	E_{CO2}	**2142.86**	**ton/yr**	
3.1 CH4 Emission Rate				
CH4 Emissions	E_{CH4}	**4.53**	**tonnes/yr**	$= F_{Total\ to\ Flare} * m_{CH4} * (1-FE) / MVC * MW_{CH4} / 1000$ [kg/tonne]
4.1 N2O Emission Rate				
N2O Emission Factor	$EF_{N2O,\ HP\ Gas}$	0.0006	kg N2O/mmBtu	Emission factor for fuel gas taken from Table C-2 of 40 CFR Part 98 Subpart C.
CO2 Emission Factor	$EF_{CO2,\ HP\ Gas}$	60	kg CO2/mmBTU	Default Emission Factor for CO2 taken from Equation 5-6 of API Compendium 2021.
N2O Emissions	$E_{N2O\ HP\ Gas}$	**0.0194**	**tonnes/yr**	$= M_{CO2\ Comb\ Flare\ Gas} * (EF_{N2O} / EF_{CO2})$
5.1 CO2e Calculations				
CO2e from CH4	$CO2e_{CH4}$	**113.26**	**tonnes/yr**	$= E_{CH4} * GWP_{CH4}$
CO2e from CH4	$CO2e_{CH4}$	**124.85**	**ton/yr**	
CO2e from N2O	$CO2e_{N2O}$	**5.77**	**tonnes/yr**	$= E_{N2O} * GWP_{N2O}$
CO2e from N2O	$CO2e_{N2O}$	**6.36**	**ton/yr**	

ProMax Dehydration Emissions Report

Case Name:	BBCS2 Compressor Station	
File Name:	C:\Users\kas09369\OneDrive - Hess Corporation\Desktop\ProMax_Dehydration_Tool\BBCS2 Glycol Dehy Emissions.pmx	
Date:		
Description:		
Dry Gas Flow Rate	59.90	MMSCFD
Dry Gas Water Content	0.70	lb/MMSCF
Glycol Circulation Rate	12.00	sgpm
Glycol Circulation Ratio	69.24	gal/lb
Annual Operating Hours	8760	hrs

INPUT SUMMARY:

Feed Stream Specifications	
Fraction of Water Saturaton (%)	8.64
Water Content (lbm/MMSCF)	4.00
Temperature (°F)	100.00
Pressure (psig)	1230.00
Flow Rate (MMSCFD)	65.00
Lean Glycol Specifications	
Glycol Circulation Rate (sgpm)	12.00
Regenerator Specifications	
Reboiler Temperature (°F)	375.000
Overhead Vapors	To Control Device
Is Reflux Coil Present?	Yes
Flash Tank Specifications	
Is Flash Tank Present?	Flash Tank Present
Temperature (°F)	180.00
Pressure (psig)	45.00
Flash Gas	FALSE
Stripping Gas Specifications	
Nitrogen (scfm)	Not In Use
Dry gas (scfm)	25.69
Kimray Pump Specifications	
Type	Electric/Pneumatic
Gas Injection Volume Ratio (scfm/gpm)	0.000
Methanol Specifications	
Is Methanol Present?	Not Present in Feed
MeOH Feed Mass Fraction (ppm)	0.00
BTEX Condenser Specifications	
Temperature (°F)	Not In Use
Pressure (psig)	Not In Use
BTEX Emissions	To Flare
General Specifications	
Atmospheric Pressure (psia)	14.400
Flash Gas Flare Destruction Efficiency (%)	95.000
Regenerator Flare Destruction Efficiency (%)	98.000

ProMax Dehydration Emissions Report	
Feed Composition Data (mol %)	
Carbon Dioxide	1.27
Hydrogen Sulfide	0.00
Nitrogen	2.48
Methane	60.02
Ethane	18.72
Propane	9.49
i-Butane	1.24
n-Butane	4.17
i-Pentane	0.84
n-Pentane	1.26
Cyclopentane	0.00
n-Hexane	0.38
Cyclohexane	0.04
n-Heptane	0.03
Methylcyclohexane	0.00
2,2,4-Trimethylpentane	0.01
Benzene	0.03
Toluene	0.01
Ethylbenzene	0.00
o-Xylene	0.00
m-Xylene	0.00
p-Xylene	0.00
Triethylene Glycol	0.00
Ethylene Glycol	0.00
Water	0.00
Methanol	0.00
O2	0.00
SO2	0.00
Total	100.00

ProMax Dehydration Emissions Report

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Carbon Dioxide	360.12	8642.87	1577.32
Hydrogen Sulfide	0.00	0.00	0.00
Nitrogen	4087.71	98105.11	17904.18
Methane	0.82	19.70	3.60
Ethane	0.50	11.96	2.18
Propane	0.39	9.46	1.73
i-Butane	0.07	1.60	0.29
n-Butane	0.26	6.33	1.16
i-Pentane	0.07	1.66	0.30
n-Pentane	0.12	2.85	0.52
Cyclopentane	0.00	0.00	0.00
n-Hexane	0.05	1.23	0.22
Cyclohexane	0.02	0.39	0.07
n-Heptane	0.00	0.11	0.02
Methylcyclohexane	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.05	0.01
Benzene	0.13	3.21	0.59
Toluene	0.03	0.70	0.13
Ethylbenzene	0.00	0.10	0.02
o-Xylene	0.00	0.00	0.00
m-Xylene	0.00	0.00	0.00
p-Xylene	0.00	0.00	0.00
Triethylene Glycol	0.00	0.00	0.00
Ethylene Glycol	0.00	0.00	0.00
Water	224.19	5380.55	981.95
Methanol	0.00	0.00	0.00
O2	790.11	18962.70	3460.69
SO2	0.00	0.00	0.00
Total Emissions	5464.61	131150.59	23934.98
Total HC Emissions	2.47	59.37	10.83
Total VOC Emissions	1.15	27.70	5.06
Total HAP Emissions	0.22	5.30	0.97
Total GHG Emissions	360.94	8662.57	1580.92

ProMax Dehydration Emissions Report			
UNCONTROLLED REGENERATOR EMISSIONS			
Component	lbs/hr	lbs/day	tons/yr
Carbon Dioxide	4.45	106.75	19.48
Hydrogen Sulfide	0.00	0.00	0.00
Nitrogen	2.98	71.42	13.03
Methane	41.05	985.21	179.80
Ethane	24.92	598.06	109.15
Propane	19.71	473.13	86.35
i-Butane	3.33	79.89	14.58
n-Butane	13.19	316.45	57.75
i-Pentane	3.46	83.02	15.15
n-Pentane	5.94	142.59	26.02
Cyclopentane	0.00	0.00	0.00
n-Hexane	2.56	61.46	11.22
Cyclohexane	0.82	19.72	3.60
n-Heptane	0.23	5.44	0.99
Methylcyclohexane	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.11	2.66	0.49
Benzene	6.68	160.32	29.26
Toluene	1.47	35.20	6.42
Ethylbenzene	0.21	5.12	0.93
o-Xylene	0.00	0.00	0.00
m-Xylene	0.00	0.00	0.00
p-Xylene	0.00	0.00	0.00
Triethylene Glycol	0.00	0.00	0.00
Ethylene Glycol	0.00	0.00	0.00
Water	8.48	203.42	37.12
Methanol	0.00	0.00	0.00
O2	0.00	0.00	0.00
SO2	0.00	0.00	0.00
Total Emissions	139.58	3349.88	611.35
Total HC Emissions	123.68	2968.28	541.71
Total VOC Emissions	57.71	1385.02	252.77
Total HAP Emissions	11.03	264.77	48.32
Total GHG Emissions	45.50	1091.96	199.28

ProMax Dehydration Emissions Report			
CONTROLLED FLASH TANK EMISSIONS			
Component	lbs/hr	lbs/day	tons/yr
Carbon Dioxide	0.00	0.00	0.00
Hydrogen Sulfide	0.00	0.00	0.00
Nitrogen	0.00	0.00	0.00
Methane	0.00	0.00	0.00
Ethane	0.00	0.00	0.00
Propane	0.00	0.00	0.00
i-Butane	0.00	0.00	0.00
n-Butane	0.00	0.00	0.00
i-Pentane	0.00	0.00	0.00
n-Pentane	0.00	0.00	0.00
Cyclopentane	0.00	0.00	0.00
n-Hexane	0.00	0.00	0.00
Cyclohexane	0.00	0.00	0.00
n-Heptane	0.00	0.00	0.00
Methylcyclohexane	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00	0.00
Benzene	0.00	0.00	0.00
Toluene	0.00	0.00	0.00
Ethylbenzene	0.00	0.00	0.00
o-Xylene	0.00	0.00	0.00
m-Xylene	0.00	0.00	0.00
p-Xylene	0.00	0.00	0.00
Triethylene Glycol	0.00	0.00	0.00
Ethylene Glycol	0.00	0.00	0.00
Water	0.00	0.00	0.00
Methanol	0.00	0.00	0.00
O2	0.00	0.00	0.00
SO2	0.00	0.00	0.00
Total Emissions	0.00	0.00	0.00
Total HC Emissions	0.00	0.00	0.00
Total VOC Emissions	0.00	0.00	0.00
Total HAP Emissions	0.00	0.00	0.00
Total GHG Emissions	0.00	0.00	0.00

ProMax Dehydration Emissions Report

UNCONTROLLED FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Carbon Dioxide	9.04	217.03	39.61
Hydrogen Sulfide	0.00	0.00	0.00
Nitrogen	0.46	10.98	2.00
Methane	20.08	481.97	87.96
Ethane	24.57	589.70	107.62
Propane	21.64	519.37	94.78
i-Butane	3.23	77.60	14.16
n-Butane	13.97	335.19	61.17
i-Pentane	2.90	69.70	12.72
n-Pentane	4.94	118.58	21.64
Cyclopentane	0.00	0.00	0.00
n-Hexane	1.28	30.69	5.60
Cyclohexane	0.22	5.20	0.95
n-Heptane	0.08	2.04	0.37
Methylcyclohexane	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.04	1.03	0.19
Benzene	0.49	11.88	2.17
Toluene	0.07	1.58	0.29
Ethylbenzene	0.01	0.16	0.03
o-Xylene	0.00	0.00	0.00
m-Xylene	0.00	0.00	0.00
p-Xylene	0.00	0.00	0.00
Triethylene Glycol	0.02	0.40	0.07
Ethylene Glycol	0.00	0.00	0.00
Water	0.19	4.45	0.81
Methanol	0.00	0.00	0.00
O2	0.00	0.00	0.00
SO2	0.00	0.00	0.00
Total Emissions	103.23	2477.54	452.15
Total HC Emissions	93.54	2245.08	409.73
Total VOC Emissions	48.89	1173.40	214.15
Total HAP Emissions	1.89	45.33	8.27
Total GHG Emissions	29.13	699.00	127.57

ProMax Dehydration Emissions Report			
COMBINED REGENERATOR VENT/FLASH GAS EMISSIONS			
Component	lbs/hr	lbs/day	tons/yr
Carbon Dioxide	360.12	8642.87	1577.32
Hydrogen Sulfide	0.00	0.00	0.00
Nitrogen	4087.71	98105.11	17904.18
Methane	0.82	19.70	3.60
Ethane	0.50	11.96	2.18
Propane	0.39	9.46	1.73
i-Butane	0.07	1.60	0.29
n-Butane	0.26	6.33	1.16
i-Pentane	0.07	1.66	0.30
n-Pentane	0.12	2.85	0.52
Cyclopentane	0.00	0.00	0.00
n-Hexane	0.05	1.23	0.22
Cyclohexane	0.02	0.39	0.07
n-Heptane	0.00	0.11	0.02
Methylcyclohexane	0.00	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.05	0.01
Benzene	0.13	3.21	0.59
Toluene	0.03	0.70	0.13
Ethylbenzene	0.00	0.10	0.02
o-Xylene	0.00	0.00	0.00
m-Xylene	0.00	0.00	0.00
p-Xylene	0.00	0.00	0.00
Triethylene Glycol	0.00	0.00	0.00
Ethylene Glycol	0.00	0.00	0.00
Water	224.19	5380.55	981.95
Methanol	0.00	0.00	0.00
O2	790.11	18962.70	3460.69
SO2	0.00	0.00	0.00
Total Emissions	5464.61	131150.59	23934.98
Total HC Emissions	2.47	59.37	10.83
Total VOC Emissions	1.15	27.70	5.06
Total HAP Emissions	0.22	5.30	0.97
Total GHG Emissions	360.94	8662.57	1580.92

ProMax Dehydration Emissions Report

EQUIPMENT REPORTS:

BTEX CONDENSER

Condenser Outlet Temperature:	0.00 deg. F
Condenser Pressure:	14.10 psia
Condenser Duty:	0.00 MMBTU/hr
Hydrocarbon Recovery:	0.00 bbls/day
Produced Water:	0.00 bbls/day
VOC Control Efficiency:	0.00 %
HAP Control Efficiency:	0.00 %
BTEX Control Efficiency:	0.00 %
Dissolved Hydrocarbons in Water:	0.00 mg/L

Component	Emitted (wt. %)	Condensed (wt. %)
Carbon Dioxide	0.00	0.00
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.00	0.00
Methane	0.00	0.00
Ethane	0.00	0.00
Propane	0.00	0.00
i-Butane	0.00	0.00
n-Butane	0.00	0.00
i-Pentane	0.00	0.00
n-Pentane	0.00	0.00
Cyclopentane	0.00	0.00
n-Hexane	0.00	0.00
Cyclohexane	0.00	0.00
n-Heptane	0.00	0.00
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00
Benzene	0.00	0.00
Toluene	0.00	0.00
Ethylbenzene	0.00	0.00
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.00
Ethylene Glycol	0.00	0.00
Water	0.00	0.00
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00

ProMax Dehydration Emissions Report

ABSORBER

Absorber Stages:	4.00
Dry Gas Dew Point:	0.70 lb H2O/MMSCF
Temperature:	109.99 deg. F
Pressure:	1249.40 psia
Dry Gas Flow Rate:	59.87 MMSCFD
TEG Losses with Dry Gas:	2.01 lb/hr
Wet Gas Water Content:	4.00 lb H2O/MMSCF
Lean Glycol Recirc. Ratio:	69.29 gal/lb H2O

Component	In Dry Gas (%)	Absorbed in Glycol (%)
Carbon Dioxide	99.70	0.30
Hydrogen Sulfide	-	-
Nitrogen	99.99	0.01
Methane	99.97	0.03
Ethane	99.93	0.07
Propane	99.90	0.10
i-Butane	99.90	0.10
n-Butane	99.86	0.14
i-Pentane	99.85	0.15
n-Pentane	99.81	0.19
Cyclopentane	-	-
n-Hexane	99.77	0.23
Cyclohexane	99.14	0.86
n-Heptane	99.67	0.33
Methylcyclohexane	-	-
2,2,4-Trimethylpentane	99.69	0.31
Benzene	93.25	6.75
Toluene	91.05	8.95
Ethylbenzene	90.66	9.34
o-Xylene	-	-
m-Xylene	-	-
p-Xylene	-	-
Triethylene Glycol	0.03	99.97
Ethylene Glycol	-	-
Water	5.66	94.34
Methanol	-	-
O2	-	-
SO2	-	-

ProMax Dehydration Emissions Report

FLASH TANK

Flash Temperature: 180 deg. F
Flash Pressure: 45 psig

Component	Flashed (wt. %)	Left in Glycol (wt. %)
Carbon Dioxide	80.57	19.43
Hydrogen Sulfide	0.00	0.00
Nitrogen	99.07	0.93
Methane	96.81	3.19
Ethane	90.55	9.45
Propane	83.86	16.14
i-Butane	79.38	20.62
n-Butane	73.18	26.82
i-Pentane	63.70	36.30
n-Pentane	59.69	40.31
Cyclopentane	0.00	0.00
n-Hexane	41.18	58.82
Cyclohexane	22.12	77.88
n-Heptane	31.83	68.17
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	33.41	66.59
Benzene	6.80	93.20
Toluene	3.99	96.01
Ethylbenzene	2.51	97.49
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	100.00
Ethylene Glycol	0.00	0.00
Water	0.64	99.36
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00

ProMax Dehydration Emissions Report

REGENERATOR

Component	Recovered in Glycol (%)	Distilled Overhead (%)
Carbon Dioxide	1.85	98.15
Hydrogen Sulfide	-	-
Nitrogen	164.73	-64.73
Methane	32.39	67.61
Ethane	9.70	90.30
Propane	6.38	93.62
i-Butane	6.51	93.49
n-Butane	4.21	95.79
i-Pentane	4.11	95.89
n-Pentane	3.23	96.77
Cyclopentane	-	-
n-Hexane	3.94	96.06
Cyclohexane	1.38	98.62
n-Heptane	2.30	97.70
Methylcyclohexane	-	-
2,2,4-Trimethylpentane	2.52	97.48
Benzene	2.36	97.64
Toluene	7.78	92.22
Ethylbenzene	19.63	80.37
o-Xylene	-	-
m-Xylene	-	-
p-Xylene	-	-
Triethylene Glycol	100.00	0.00
Ethylene Glycol	-	-
Water	70.69	29.31
Methanol	-	-
O2	-	-
SO2	-	-

ProMax Dehydration Emissions Report

STREAM REPORTS:

WET GAS STREAM

Temperature:	99.99	deg F
Pressure:	1244.40	psia
Flow Rate:	59.91	MMSCFD

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	1.29	3750.00
Hydrogen Sulfide	0.00	0.00
Nitrogen	2.62	4826.74
Methane	62.29	65810.07
Ethane	18.51	36651.97
Propane	8.83	25647.73
i-Butane	1.08	4125.14
n-Butane	3.51	13440.41
i-Pentane	0.64	3038.82
n-Pentane	0.93	4403.80
Cyclopentane	0.00	0.00
n-Hexane	0.23	1309.96
Cyclohexane	0.02	113.41
n-Heptane	0.01	79.94
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.01	44.59
Benzene	0.02	106.98
Toluene	0.00	18.24
Ethylbenzene	0.00	2.51
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.00
Ethylene Glycol	0.00	0.00
Water	0.01	10.40
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	163380.72

ProMax Dehydration Emissions Report

DRY GAS STREAM

Temperature:	100.01	deg F
Pressure:	1239.40	psia
Flow Rate:	59.90	MMSCFD

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	1.29	3736.51
Hydrogen Sulfide	0.00	0.00
Nitrogen	2.62	4823.31
Methane	62.31	65748.94
Ethane	18.51	36602.48
Propane	8.83	25606.38
i-Butane	1.08	4118.58
n-Butane	3.51	13413.26
i-Pentane	0.64	3032.46
n-Pentane	0.93	4392.92
Cyclopentane	0.00	0.00
n-Hexane	0.23	1306.12
Cyclohexane	0.02	112.37
n-Heptane	0.01	79.63
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.01	44.44
Benzene	0.02	99.80
Toluene	0.00	16.70
Ethylbenzene	0.00	2.28
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	2.02
Ethylene Glycol	0.00	0.00
Water	0.00	1.75
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	163139.94

ProMax Dehydration Emissions Report

LEAN GLYCOL STREAM

Temperature:	109.99	deg F
Pressure:	1249.40	psia
Flow Rate:	12.00	sgpm

Component	Conc. (wt%)	Mass Flow (lb/h)
Carbon Dioxide	0.00	0.04
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.00	0.01
Methane	0.00	0.21
Ethane	0.00	0.25
Propane	0.00	0.27
i-Butane	0.00	0.05
n-Butane	0.00	0.21
i-Pentane	0.00	0.07
n-Pentane	0.00	0.11
Cyclopentane	0.00	0.00
n-Hexane	0.00	0.07
Cyclohexane	0.00	0.01
n-Heptane	0.00	0.00
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00
Benzene	0.00	0.16
Toluene	0.00	0.12
Ethylbenzene	0.00	0.04
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	99.67	6753.96
Ethylene Glycol	0.00	0.00
Water	0.30	20.45
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	6776.04

ProMax Dehydration Emissions Report

RICH GLYCOL STREAM

Temperature:	100.06	deg F
Pressure:	1244.40	psia
Flow Rate:	12.58	sgpm

Component	Conc. (wt%)	Mass Flow (lb/h)
Carbon Dioxide	0.16	11.22
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.01	0.46
Methane	0.30	20.74
Ethane	0.39	27.13
Propane	0.37	25.81
i-Butane	0.06	4.07
n-Butane	0.28	19.08
i-Pentane	0.07	4.56
n-Pentane	0.12	8.28
Cyclopentane	0.00	0.00
n-Hexane	0.04	3.10
Cyclohexane	0.01	0.98
n-Heptane	0.00	0.27
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.13
Benzene	0.11	7.27
Toluene	0.02	1.64
Ethylbenzene	0.00	0.27
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	97.63	6751.94
Ethylene Glycol	0.00	0.00
Water	0.42	29.10
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	6916.07

ProMax Dehydration Emissions Report

FLASH TANK OFF GAS STREAM

Temperature:	180.00	deg F
Pressure:	59.40	psia
Flow Rate:	1222.22	scfh

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	6.38	9.04
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.51	0.46
Methane	38.85	20.08
Ethane	25.36	24.57
Propane	15.23	21.64
i-Butane	1.73	3.23
n-Butane	7.46	13.97
i-Pentane	1.25	2.90
n-Pentane	2.13	4.94
Cyclopentane	0.00	0.00
n-Hexane	0.46	1.28
Cyclohexane	0.08	0.22
n-Heptane	0.03	0.08
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.01	0.04
Benzene	0.20	0.49
Toluene	0.02	0.07
Ethylbenzene	0.00	0.01
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.02
Ethylene Glycol	0.00	0.00
Water	0.32	0.19
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	103.23

ProMax Dehydration Emissions Report

FLASH TANK GLYCOL STREAM

Temperature:	180.00	deg F
Pressure:	59.40	psia
Flow Rate:	12.11	sgpm

Component	Conc. (wt%)	Mass Flow (lb/h)
Carbon Dioxide	0.03	2.18
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.00	0.00
Methane	0.01	0.66
Ethane	0.04	2.56
Propane	0.06	4.17
i-Butane	0.01	0.84
n-Butane	0.08	5.12
i-Pentane	0.02	1.65
n-Pentane	0.05	3.34
Cyclopentane	0.00	0.00
n-Hexane	0.03	1.83
Cyclohexane	0.01	0.76
n-Heptane	0.00	0.18
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.09
Benzene	0.10	6.78
Toluene	0.02	1.58
Ethylbenzene	0.00	0.26
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	99.11	6751.93
Ethylene Glycol	0.00	0.00
Water	0.42	28.91
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	6812.84

ProMax Dehydration Emissions Report

REGENERATOR OVERHEADS STREAM

Temperature:	113.59	deg F
Pressure:	14.10	psia
Flow Rate:	1923.93	scfh

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	1.99	4.45
Hydrogen Sulfide	0.00	0.00
Nitrogen	2.09	2.98
Methane	50.44	41.05
Ethane	16.34	24.92
Propane	8.81	19.71
i-Butane	1.13	3.33
n-Butane	4.47	13.19
i-Pentane	0.95	3.46
n-Pentane	1.62	5.94
Cyclopentane	0.00	0.00
n-Hexane	0.59	2.56
Cyclohexane	0.19	0.82
n-Heptane	0.04	0.23
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.02	0.11
Benzene	1.69	6.68
Toluene	0.31	1.47
Ethylbenzene	0.04	0.21
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.00
Ethylene Glycol	0.00	0.00
Water	9.27	8.48
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	100.00	139.58

ProMax Dehydration Emissions Report

BTEX CONDENSER VENT GAS STREAM

Temperature:	0.00	deg F
Pressure:	14.10	psia
Flow Rate:	0.00	scfh

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	0.00	0.00
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.00	0.00
Methane	0.00	0.00
Ethane	0.00	0.00
Propane	0.00	0.00
i-Butane	0.00	0.00
n-Butane	0.00	0.00
i-Pentane	0.00	0.00
n-Pentane	0.00	0.00
Cyclopentane	0.00	0.00
n-Hexane	0.00	0.00
Cyclohexane	0.00	0.00
n-Heptane	0.00	0.00
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00
Benzene	0.00	0.00
Toluene	0.00	0.00
Ethylbenzene	0.00	0.00
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.00
Ethylene Glycol	0.00	0.00
Water	0.00	0.00
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	0.00	0.00

ProMax Dehydration Emissions Report

BTEX CONDENSER RECOVERED OIL STREAM

Temperature:	120.00	deg F
Pressure:	14.10	psia
Flow Rate:	0.00	sgpm

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	0.00	0.00
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.00	0.00
Methane	0.00	0.00
Ethane	0.00	0.00
Propane	0.00	0.00
i-Butane	0.00	0.00
n-Butane	0.00	0.00
i-Pentane	0.00	0.00
n-Pentane	0.00	0.00
Cyclopentane	0.00	0.00
n-Hexane	0.00	0.00
Cyclohexane	0.00	0.00
n-Heptane	0.00	0.00
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00
Benzene	0.00	0.00
Toluene	0.00	0.00
Ethylbenzene	0.00	0.00
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.00
Ethylene Glycol	0.00	0.00
Water	0.00	0.00
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	0.00	0.00

ProMax Dehydration Emissions Report

BTEX CONDENSER PRODUCED WATER STREAM

Temperature:		deg F
Pressure:		psia
Flow Rate:	0.00	sgpm

Component	Conc. (mol%)	Mass Flow (lb/h)
Carbon Dioxide	0.00	0.00
Hydrogen Sulfide	0.00	0.00
Nitrogen	0.00	0.00
Methane	0.00	0.00
Ethane	0.00	0.00
Propane	0.00	0.00
i-Butane	0.00	0.00
n-Butane	0.00	0.00
i-Pentane	0.00	0.00
n-Pentane	0.00	0.00
Cyclopentane	0.00	0.00
n-Hexane	0.00	0.00
Cyclohexane	0.00	0.00
n-Heptane	0.00	0.00
Methylcyclohexane	0.00	0.00
2,2,4-Trimethylpentane	0.00	0.00
Benzene	0.00	0.00
Toluene	0.00	0.00
Ethylbenzene	0.00	0.00
o-Xylene	0.00	0.00
m-Xylene	0.00	0.00
p-Xylene	0.00	0.00
Triethylene Glycol	0.00	0.00
Ethylene Glycol	0.00	0.00
Water	0.00	0.00
Methanol	0.00	0.00
O2	0.00	0.00
SO2	0.00	0.00
Total Components	0.00	0.00

Truck Loading - Oil
BBCS2 Compressor Station

$$L_L = 12.46 \frac{SPM}{T} (1\text{-}eff/100)$$

where:
S = saturation factor
P = true vapor pressure
M = molecular weight of vapors
T = temperature of bulk liquid loaded, °R (°F + 460)

Material loaded = Oil

S =	**0.6**	
P =	**1.34**	**psia at 60 F**
M =	**56.93**	
T =	**504**	

Annual Loading = 97,281 gallons

L_L =	12.46	0.6	1.34 psia	56.93 lb/lb-mole		=	**1.14 lb/1000 gal**
					504 °R		

Total Loading Losses:

Annual =	1.14	lb	97,281	gallons	ton	=	**0.06 ton/yr**
		1000 gal			2000 lb		

Truck Loading - Oil
BBCS2 Compressor Station

Component	Wt [%]	Emissions (tpy)	
Methane	0.00%	0.000	
Ethane	0.00%	0.000	
Propane	20.66%	0.011	
i-Butane	14.36%	0.008	
n-Butane	38.16%	0.021	
i-Pentane	10.99%	0.006	
n-Pentane	15.41%	0.009	
Water	0.32%	0.000	
Nitrogen	0.00%	0.000	
Carbon Dioxide	0.00%	0.000	
H2S	0.00%	0.000	
C6+	0.00%	0.000	
NBP 181	0.10%	0.000	
NBP 300	0.00%	0.000	
NBP 442	0.00%	0.000	
NBP Mix	0.00%	0.000	
TEG	0.00%	0.000	
	100.00%	0.06	tpy
	Total VOC	**0.06**	**tpy**

CVS Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Gas/Vapor	116	0.00992	0	1.15	0.42	5.04
Relief valves	Gas/Vapor	12	0.01940	0	0.23	0.08	1.02
Connectors	Gas/Vapor	598	0.00044	0	0.26	0.10	1.15
Compressors	Gas/Vapor	0	0.01940	0	0.00	0.00	0.00
Pumps	Gas/Vapor	2	0.00529	0	0.01	0.00	0.05
				Total Emission Rate:	**1.66**	**0.61**	**7.26**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Nitrogen	4.63%	0.077	0.028	0.336
CO2	0.00%	0.000	0.000	0.000
Methane	55.18%	0.915	0.334	4.007
Ethane	3.74%	0.062	0.023	0.272
Propane	13.96%	0.231	0.084	1.014
Iso-Butane	3.84%	0.064	0.023	0.278
n-Butane	8.57%	0.142	0.052	0.622
Iso-Pentane	2.59%	0.043	0.016	0.188
n-Pentane	5.27%	0.087	0.032	0.383
n-Nonane	1.19%	0.020	0.007	0.087
n-Decane	0.13%	0.002	0.001	0.009
H2O	0.90%	0.0149	0.00545	0.065
	Total Emission Rate:	**1.66**	**0.61**	**7.26**
	VOC Emission Rate:	**0.59**	**0.22**	**2.58**
	Methane Emission Rate:	**0.91**	**0.33**	**4.01**
	CO2 Emission Rate:	**0.00**	**0.00**	**0.00**
	CO2e Emission Rate:	**22.87**	**8.35**	**100.17**

Gas/Vapor Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Gas/Vapor	236	0.00992	0	2.34	0.85	10.25
Relief valves	Gas/Vapor	17	0.01940	0	0.33	0.12	1.44
Connectors	Gas/Vapor	765	0.00044	0	0.34	0.12	1.48
Compressors	Gas/Vapor	0	0.01940	0	0.00	0.00	0.00
Open-ended Lines	Gas/Vapor	3	0.00441	0	0.01	0.00	0.06
				Total Emission Rate:	**3.02**	**1.10**	**13.23**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Nitrogen	1.98%	0.060	0.022	0.262
CO2	1.09%	0.033	0.012	0.145
Methane	32.28%	0.975	0.356	4.272
Ethane	24.21%	0.732	0.267	3.204
Propane	19.84%	0.599	0.219	2.626
Iso-Butane	2.81%	0.085	0.031	0.371
n-Butane	8.63%	0.261	0.095	1.142
Iso-Pentane	1.74%	0.053	0.019	0.231
n-Pentane	2.72%	0.082	0.030	0.360
n-Hexane	0.05%	0.001	0.001	0.006
Ethylbenzene	0.00%	0.000	0.000	0.000
n-Nonane	4.41%	0.133	0.049	0.584
n-Decane	0.21%	0.006	0.002	0.028
H2S	0.00%	0.00004	0.00001	0.0002
	Total Emission Rate:	**3.02**	**1.10**	**13.23**
	VOC Emission Rate:	**1.22**	**0.45**	**5.35**
	Methane Emission Rate:	**0.98**	**0.36**	**4.27**
	CO2 Emission Rate:	**0.033**	**0.012**	**0.14**
	CO2e Emission Rate:	**24.41**	**8.91**	**106.94**

Light Liquid Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Light Liquid	275	0.00992	0	2.73	1.00	11.95
Relief valves	Light Liquid	6	0.01940	0	0.12	0.04	0.51
Connectors	Light Liquid	924	0.00044	0	0.41	0.15	1.78
Compressors	Light Liquid	0	0.01940	0	0.00	0.00	0.00
Pumps	Light Liquid	10	0.00529	0	0.05	0.02	0.23
				Total Emission Rate:	**3.30**	**1.21**	**14.48**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Nitrogen	0.00%	0.000	0.000	0.000
CO2	0.00%	0.000	0.000	0.000
Methane	0.01%	0.000	0.000	0.001
Ethane	0.04%	0.001	0.000	0.006
Propane	0.08%	0.003	0.001	0.012
Iso-Butane	0.02%	0.001	0.000	0.003
n-Butane	0.11%	0.004	0.001	0.016
Iso-Pentane	0.05%	0.002	0.001	0.007
n-Pentane	0.11%	0.004	0.001	0.016
n-Hexane	0.00%	0.000	0.000	0.000
Benzene	0.00%	0.000	0.000	0.000
Cyclohexane	0.00%	0.000	0.000	0.000
n-Heptane	0.00%	0.000	0.000	0.000
Toluene	0.00%	0.000	0.000	0.000
Ethylbenzene	0.00%	0.000	0.000	0.000
o-Xylene	0.00%	0.000	0.000	0.000
n-Octane	0.00%	0.000	0.000	0.000
2,2,4-Trimethylpentane	0.00%	0.000	0.000	0.000
n-Nonane	0.57%	0.019	0.007	0.083
n-Decane	0.86%	0.028	0.010	0.124
H2O	98.15%	3.244	1.184	14.208
	Total Emission Rate:	**3.31**	**1.21**	**14.48**
	VOC Emission Rate:	**0.06**	**0.02**	**0.26**
	Methane Emission Rate:	**0.00**	**0.00**	**0.00**
	CO2 Emission Rate:	**0.00**	**0.00**	**0.00**
	CO2e Emission Rate:	**0.01**	**0.00**	**0.04**

Level Bridle Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Gas/Vapor	139	0.00992	0	1.38	0.50	6.04
Relief valves	Gas/Vapor	0	0.01940	0	0.00	0.00	0.00
Connectors	Gas/Vapor	355	0.00044	0	0.16	0.06	0.69
Compressors	Gas/Vapor	0	0.01940	0	0.00	0.00	0.00
Open-ended Lines	Gas/Vapor	0	0.00441	0	0.00	0.00	0.00
				Total Emission Rate:	**1.54**	**0.56**	**6.73**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Nitrogen	1.92%	0.029	0.011	0.129
CO2	0.68%	0.010	0.004	0.046
Methane	54.60%	0.838	0.306	3.672
Ethane	22.01%	0.338	0.123	1.480
Propane	12.30%	0.189	0.069	0.827
Iso-Butane	1.32%	0.020	0.007	0.089
n-Butane	4.06%	0.062	0.023	0.273
Iso-Pentane	0.66%	0.010	0.004	0.044
n-Pentane	1.03%	0.016	0.006	0.069
n-Hexane	0.00%	0.000	0.000	0.000
Benzene	0.00%	0.000	0.000	0.000
Cyclohexane	0.00%	0.000	0.000	0.000
n-Heptane	0.00%	0.000	0.000	0.000
Toluene	0.00%	0.000	0.000	0.000
Ethylbenzene	0.00%	0.000	0.000	0.000
o-Xylene	0.00%	0.000	0.000	0.000
n-Octane	0.00%	0.000	0.000	0.000
2,2,4-Trimethylpentane	0.00%	0.000	0.000	0.000
n-Nonane	0.94%	0.014	0.005	0.063
n-Decane	0.04%	0.001	0.000	0.003
H2O	0.44%	0.007	0.002	0.030
	Total Emission Rate:	**1.54**	**0.56**	**6.73**
	VOC Emission Rate:	**0.31**	**0.11**	**1.37**
	Methane Emission Rate:	**0.84**	**0.31**	**3.67**
	CO2 Emission Rate:	**0.01**	**0.00**	**0.05**
	CO2e Emission Rate:	**20.97**	**7.65**	**91.85**

Oil Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Light Oil	112	0.00551	0%	0.62	0.23	2.70
Connectors	Light Oil	412	0.00046	0%	0.19	0.07	0.84
Pumps	Light Oil	2	0.02866	0%	0.06	0.02	0.25
Relief valves	Light Oil	2	0.01653	0%	0.03	0.01	0.14
				Total Emission Rate:	**0.90**	**0.33**	**3.94**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Nitrogen	0.00%	0.000	0.000	0.000
CO2	0.00%	0.000	0.000	0.000
Methane	0.00%	0.000	0.000	0.000
Ethane	0.00%	0.000	0.000	0.000
Propane	20.66%	0.186	0.068	0.813
Iso-Butane	14.36%	0.129	0.047	0.565
n-Butane	38.16%	0.343	0.125	1.501
Iso-Pentane	10.99%	0.099	0.036	0.433
n-Pentane	15.41%	0.138	0.051	0.607
n-Nonane	0.10%	0.001	0.000	0.004
n-Decane	0.00%	0.000	0.000	0.000
H2O	0.32%	0.003	0.001	0.013
	Total Emission Rate:	**0.90**	**0.33**	**3.94**
	VOC Emission Rate:	**0.90**	**0.33**	**3.92**
	Methane Emission Rate:	**0.00**	**0.00**	**0.00**
	CO2 Emission Rate:	**0.00**	**0.00**	**0.00**
	CO2e Emission Rate:	**0.00**	**0.00**	**0.00**

Methanol Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Light Liquid	17	0.00992	0	0.17	0.06	0.74
Relief valves	Light Liquid	1	0.01940	0	0.02	0.01	0.08
Connectors	Light Liquid	105	0.00044	0	0.05	0.02	0.20
Compressors	Light Liquid	0	0.01940	0	0.00	0.00	0.00
Pumps	Light Liquid	2	0.00529	0	0.01	0.00	0.05
				Total Emission Rate:	**0.24**	**0.09**	**1.07**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Methanol	100.00%	0.24	0.09	1.07
	VOC Emission Rate:	**0.24**	**0.09**	**1.07**
	HAP Emission Rate:	**0.24**	**0.09**	**1.07**

Compressor Fugitive Emissions
BBCS2 Compressor Station

Component Name	Stream Type	Number of Components	Oil and Gas Production Operation [1] lb/hr/comp	Control Efficiency %	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Valves	Gas/Vapor	920	0.00992	0	9.13	3.33	39.98
Relief valves	Gas/Vapor	48	0.01940	0	0.93	0.34	4.08
Connectors	Gas/Vapor	3760	0.00044	0	1.66	0.61	7.26
Compressors	Gas/Vapor	8	0.01940	0	0.16	0.06	0.68
Open-ended Lines	Gas/Vapor	48	0.00441	0	0.21	0.08	0.93
				Total Emission Rate:	**12.08**	**4.41**	**52.92**

1. Factors are taken from Table 2-4 of EPA Protocol for Equipment Leak Emission Estimates EPA-453/R-95-017.

Chemical Name	wt% in Stream	Controlled Emission Rate lb/hr	Controlled Emission Rate ton/month	Controlled Emission Rate ton/year
Nitrogen	1.92%	0.232	0.085	1.016
CO2	0.68%	0.082	0.030	0.360
Methane	54.42%	6.576	2.400	28.801
Ethane	21.97%	2.655	0.969	11.627
Propane	12.28%	1.484	0.542	6.499
Iso-Butane	1.32%	0.159	0.058	0.699
n-Butane	4.06%	0.491	0.179	2.149
Iso-Pentane	0.67%	0.081	0.030	0.355
n-Pentane	1.04%	0.126	0.046	0.550
n-Hexane	0.00%	0.000	0.000	0.000
Benzene	0.00%	0.000	0.000	0.000
Cyclohexane	0.00%	0.000	0.000	0.000
n-Heptane	0.00%	0.000	0.000	0.000
Toluene	0.00%	0.000	0.000	0.000
Ethylbenzene	0.00%	0.000	0.000	0.001
o-Xylene	0.00%	0.000	0.000	0.000
n-Octane	0.00%	0.000	0.000	0.000
2,2,4-Trimethylpentane	0.00%	0.000	0.000	0.000
n-Nonane	0.98%	0.118	0.043	0.519
n-Decane	0.07%	0.008	0.003	0.037
H2O	0.59%	0.071	0.026	0.312
	Total Emission Rate:	**12.08**	**4.41**	**52.92**
	VOC Emission Rate:	**2.47**	**0.90**	**10.81**
	Methane Emission Rate:	**6.58**	**2.40**	**28.80**
	CO2 Emission Rate:	**0.08**	**0.03**	**0.36**
	CO2e Emission Rate:	**164.47**	**60.03**	**720.39**

Bryan Research & Engineering, LLC

ProMax 6.0 ®

Simulation Report

Project: BBCS2 Tank Emissions - Rich Case 115 F.pmx

Licensed to Hess Corporation and Affiliates

Client Name: BBCS2 Compressor Station
Location: Mckenzie, ND
Job: Tank and Loading Emissions

ProMax Filename: T:\EHS\Air\Bakken\Blue Buttes Compressor Station 2 (BBCS2)\PTC Applications\PTC July 2024\Promax Runs\Promax Models\BBCS2 Tank Emissions - Rich Case 115 F.pmx
ProMax Version: 6.0.24120.0
Simulation Initiated: 7/18/2024 12:24:21 PM

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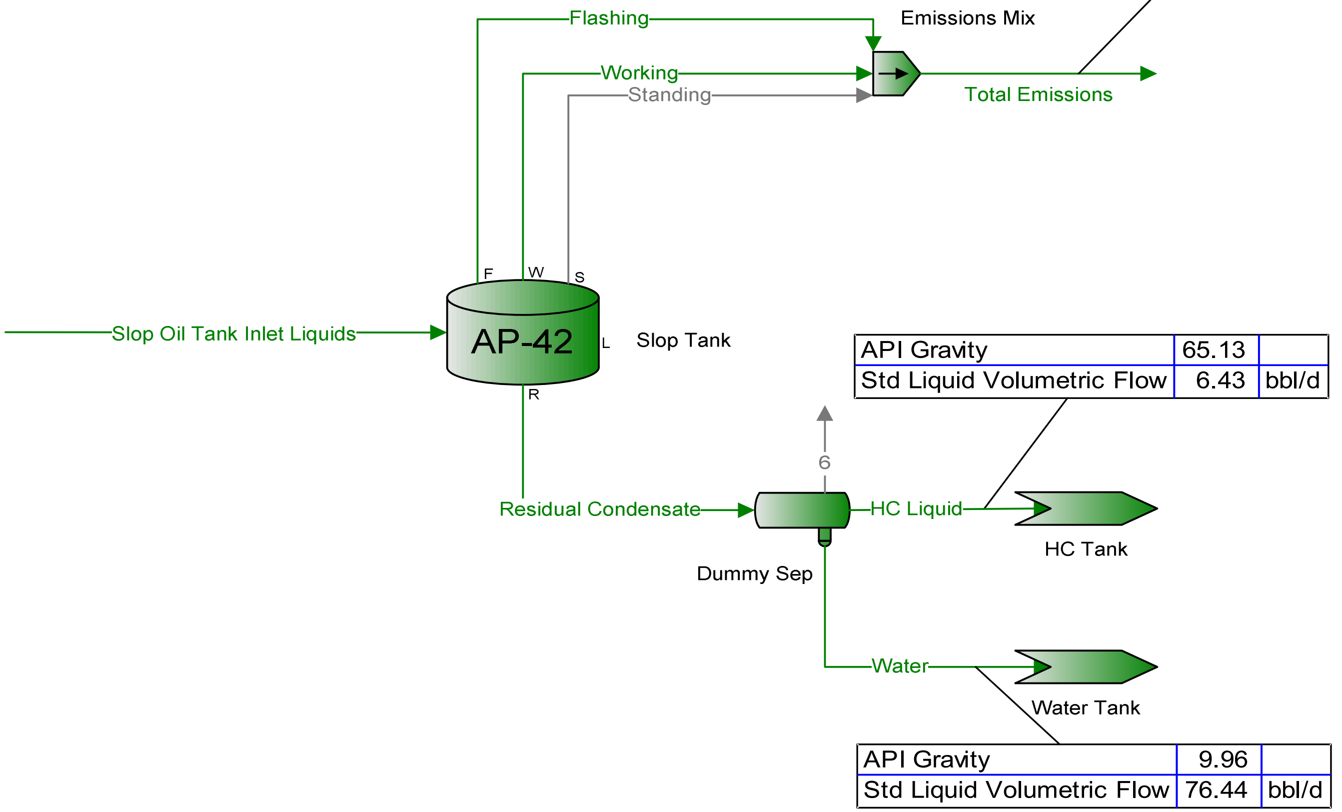
Report Navigator can be activated via the ProMax Navigator Toolbar.
An asterisk (*), throughout the report, denotes a user specified value.
A question mark (?) after a value, throughout the report, denotes an extrapolated or approximate value.

AP 42 Tank Emissions
Slop Tanks

Names	Units	Flashing		Standing		Working	
Methane(Mass Flow)	ton/yr		37		0		0.26
Mass Flow Sum	ton/yr	(VOCs)	21	(VOCs)	0	(VOCs)	1.5

Mass Flow Sum(VOCs)	22.31	ton/yr
Methane(Mass Flow)	37.18	ton/yr



Tank Losses Report
Slop Tank

Client Name:	BBCS2 Compressor Station	**Job:**	Tank and Loading Emissions
Location:	Mckenzie, ND	**Modified:**	4/5/2024 15:09
Flowsheet:	Slop Tanks	**Status:**	Solved 12:21 PM, 7/18/2024

Stream Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
Slop Oil Tank Inlet Liquids	Inlet		Flashing	Flashing Losses Stream	Emissions Mix
Working	Working Losses Stream	Emissions Mix	Standing	Standing Losses Stream	Emissions Mix
Residual Condensate	Residual Liquid Stream	Dummy Sep			

Working and Standing Properties : Scalar Data

Tank Geometry	Vertical Cylinder	Roof Type	Cone
Shell Length	20* ft	Slope of Coned Roof	0.05*
Shell Diameter	12* ft	Breather Vent Pressure	0.03 psi
Number of Storage Tanks	2*	Breather Vacuum Pressure	-0.03 psi
Maximum Fraction Fill of Tank	90 %	Location	Williston, ND*
Average Fraction Fill of Tank	50 %	Time Frame	Year
Minimum Fraction Fill of Tank	10 %	Known Liquid Bulk Temperature?	FALSE
Material Category	Light Organics*	Liquid Bulk Temperature	43.6258 °F
Insulation	Fully Insulated*	Use AP 42 Raoult's Vapor Pressure?	FALSE
Bolted or Riveted Construction?	FALSE	Flashing Temperature	43.6258 °F
Vapor Balanced Tank?	FALSE	Average Daily Maximum Ambient Temperature	53.2 °F
Known Sum of Increases in Liquid Level?	FALSE	Average Daily Minimum Ambient Temperature	29.9 °F
Sum of Increases in Liquid Level	749.046 ft/yr	Atmospheric Pressure at Tank Location	13.72 psia
Shell Color	Light Grey*	Daily Solar Insolation	1193 Btu/(day*ft^2)
Shell Paint Condition	Average	Average Wind Speed	8.9 mph
Roof Color	Light Grey*	Heated Tank?	FALSE
Roof Paint Condition	Average	Include Short Term Emissions	TRUE

Composition Subset Properties : Scalar Data

Component Subset	VOCs*	Species in Results	Selected Species
Atomic Basis	FALSE	Fraction Denominator	Selected Species

Composition Subset Properties : Tabulated Data

Index	Selected Components
Methane	FALSE
Ethane	FALSE
Propane	TRUE
i-Butane	TRUE
n-Butane	TRUE
i-Pentane	TRUE
n-Pentane	TRUE
Water	FALSE
Nitrogen	FALSE
Carbon Dioxide	FALSE
H2S	FALSE
C6+	TRUE
NBP 181	TRUE
NBP 300	TRUE
NBP 442	TRUE
NBP Mix	TRUE
TEG	TRUE

Details Properties : Scalar Data

Vapor Space Volume	1142.28 ft^3	Liquid Height	10 ft
Vapor Density	0.0563817 lb/ft^3	Roof Outage	0.1 ft
Vapor Space Expansion Factor	0 1/day	Tank Roof Height	0.3 ft
Vented Vapor Saturation Factor	0.119842	Tank Shell Radius	6 ft
Vapor Space Outage	10.1 ft	Vapor Molecular Weight	22.1958 lb/lbmol
Average Daily Vapor Temperature Range	0 °R	Average Vapor Temperature	503.296 °R
Average Daily Vapor Pressure Range	0 psi	Average Daily Ambient Temperature	501.22 °R
Breather Vent Pressure Setting Range	0.06 psi	Net Working Loss Throughput	84715.2 ft^3/yr
Vapor Pressure at Average Daily Liquid Surface Temperature	13.7200 psia	Working Loss Turnover (Saturation) Factor	1
Average Daily Liquid Surface Temperature	503.296 °R	Number of Turnovers per Year	46.8154
Average Daily Ambient Temperature Range	23.3 °R	Annual Net Throughput	30180.0 bbl/yr
Tank Roof Surface Solar Absorptance	0.58	Maximum Liquid Height	18 ft
Tank Shell Surface Solar Absorptance	0.58	Minimum Liquid Height	2 ft
Vapor Pressure at Maximum Liquid Surface Temperature	13.7200 psia	Working Loss Product Factor	1
Vapor Pressure at Minimum Liquid Surface Temperature	13.7200 psia	Vent Setting Correction Factor	1
Maximum Liquid Surface Temperature	503.296 °R	Annual Net Throughput Per Tank	15090.0 bbl/yr
Minimum Liquid Surface Temperature	503.296 °R		

Results Properties : Scalar Data

Flashing Losses	20.7754 ton/yr	Standing Losses per Tank	0 ton/yr
Working Losses	1.53801 ton/yr	Flashing Losses per Tank	10.3877 ton/yr
Standing Losses	0 ton/yr	Working and Standing Losses	1.53801 ton/yr
Working Losses per Tank	0.769006 ton/yr	Working and Standing Losses per Tank	0.769006 ton/yr

Results Properties : Tabulated Data

Index	Flashing Losses Mass Flows ton/yr	Working Losses Mass Flows ton/yr	Standing Losses Mass Flows ton/yr	Working and Standing Losses Mass Flows ton/yr
Propane	5.35467	0.396408	0	0.396408
i-Butane	2.33105	0.172568	0	0.172568
n-Butane	6.20125	0.459081	0	0.459081
i-Pentane	2.31436	0.171333	0	0.171333
n-Pentane	3.75934	0.278305	0	0.278305
C6+	0	0	0	0
NBP 181	0.728071	0.0538993	0	0.0538993
NBP 300	0.0855189	0.00633099	0	0.00633099
NBP 442	0.00117720	8.71484E-05	0	8.71484E-05
NBP Mix	0	0	0	0
TEG	6.19742E-10	4.58797E-11	0	4.58797E-11

Short Term Properties : Scalar Data

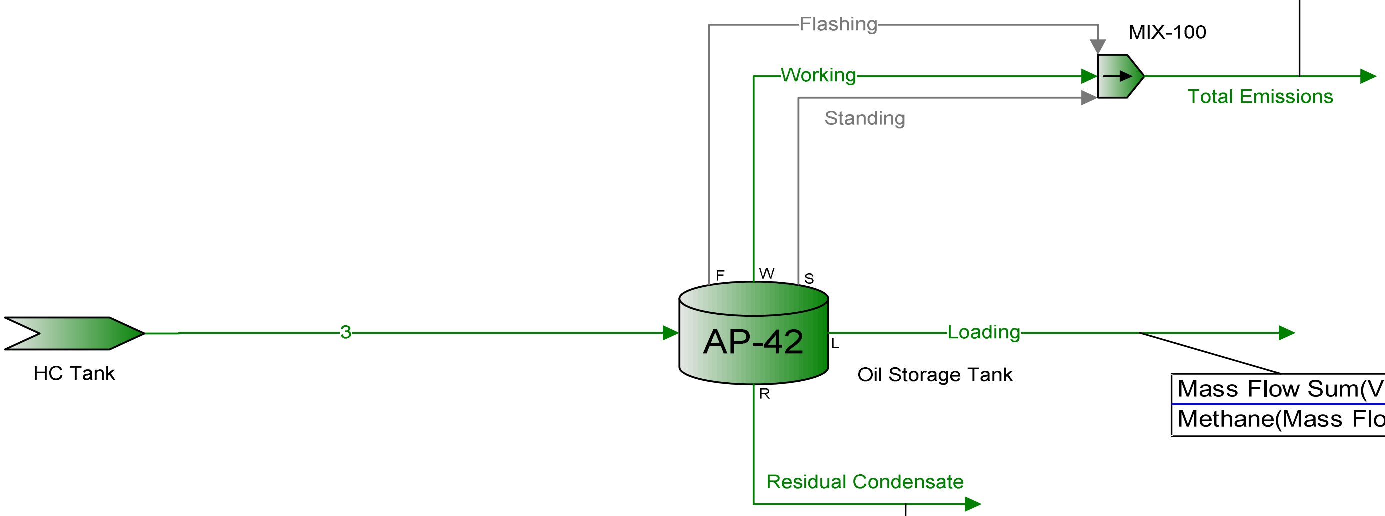
Maximum Battery Filling Rate	15* bbl/hr	Worst-Case Flashing Losses per Tank	15.9192 lb/h
Short-Term Number of Storage Tanks	2	Short-Term Working Losses per Tank	0.983928 lb/h
Worst-Case Liquid Surface Temperature	95 °F	Short-Term Vapor Molecular Weight	24.7270 lb/lbmol
Worst-Case Flashing Losses	31.8384 lb/h	Vapor Pressure at Worst-Case Temperature	13.7200 psia
Short-Term Working Losses	1.96786 lb/h		

Short Term Properties : Tabulated Data

Index	Worst-Case Flashing Losses Mass Flows lb/h	Short-Term Working Losses Mass Flows lb/h
Propane	5.51698	0.322570
i-Butane	2.70543	0.169110
n-Butane	7.74279	0.483983
i-Pentane	3.88461	0.242818
n-Pentane	7.07836	0.442451
C6+	0	0
NBP 181	4.15822	0.259920
NBP 300	0.735376	0.0459666
NBP 442	0.0165982	0.00103751
NBP Mix	0	0
TEG	8.99963E-08	5.62545E-09

AP 42 Tank Emissions
Oil Tanks

Names	Units	Flashing		Standing		Working	
Methane(Mass Flow)	ton/yr		0		0		0
Mass Flow Sum	ton/yr	(VOCs)	0	(VOCs)	0	(VOCs)	0.093



Mass Flow Sum(VOCs)	0.093	ton/yr
Methane(Mass Flow)	0	ton/yr

Mass Flow Sum(VOCs)	0.055	ton/yr
Methane(Mass Flow)	0	ton/yr

API Gravity	65.12	
Std Liquid Volumetric Flow	6.42	bbl/d

Tank Losses Report
Oil Storage Tank

Client Name:	BBCS2 Compressor Station	**Job:**	Tank and Loading Emissions
Location:	Mckenzie, ND	**Modified:**	7/18/2024 12:22
Flowsheet:	Oil Tanks	**Status:**	Solved 12:23 PM, 7/18/2024

Stream Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	HC Tank	Flashing	Flashing Losses Stream	MIX-100
Working	Working Losses Stream	MIX-100	Standing	Standing Losses Stream	MIX-100
Loading	Loading Losses Stream		Residual Condensate	Residual Liquid Stream	

Working and Standing Properties : Scalar Data

Tank Geometry	Vertical Cylinder	Roof Type	Cone
Shell Length	20* ft	Slope of Coned Roof	0.05*
Shell Diameter	12* ft	Breather Vent Pressure	0.03 psi
Number of Storage Tanks	4*	Breather Vacuum Pressure	-0.03 psi
Maximum Fraction Fill of Tank	90 %	Location	Williston, ND*
Average Fraction Fill of Tank	50 %	Time Frame	Year
Minimum Fraction Fill of Tank	10 %	Known Liquid Bulk Temperature?	FALSE
Material Category	Light Organics*	Liquid Bulk Temperature	43.6258 °F
Insulation	Fully Insulated*	Use AP 42 Raoult's Vapor Pressure?	FALSE
Bolted or Riveted Construction?	FALSE	Flashing Temperature	43.6258 °F
Vapor Balanced Tank?	FALSE	Average Daily Maximum Ambient Temperature	53.2 °F
Known Sum of Increases in Liquid Level?	FALSE	Average Daily Minimum Ambient Temperature	29.9 °F
Sum of Increases in Liquid Level	28.7435 ft/yr	Atmospheric Pressure at Tank Location	13.72 psia
Shell Color	Light Grey*	Daily Solar Insolation	1193 Btu/(day*ft^2)
Shell Paint Condition	Average	Average Wind Speed	8.9 mph
Roof Color	Light Grey*	Heated Tank?	FALSE
Roof Paint Condition	Average	Include Short Term Emissions	TRUE

Composition Subset Properties : Scalar Data

Component Subset	VOCs	Species in Results	Selected Species
Atomic Basis	FALSE	Fraction Denominator	Selected Species

Composition Subset Properties : Tabulated Data

Index	Selected Components
Methane	FALSE
Ethane	FALSE
Propane	TRUE
i-Butane	TRUE
n-Butane	TRUE
i-Pentane	TRUE
n-Pentane	TRUE
Water	FALSE
Nitrogen	FALSE
Carbon Dioxide	FALSE
H2S	FALSE
C6+	TRUE
NBP 181	TRUE
NBP 300	TRUE
NBP 442	TRUE
NBP Mix	TRUE
TEG	TRUE

Details Properties : Scalar Data

Vapor Space Volume	1142.28 ft^3	Roof Outage	0.1 ft
Vapor Density	0.0147056 lb/ft^3	Tank Roof Height	0.3 ft
Vapor Space Expansion Factor	0 1/day	Tank Shell Radius	6 ft
Vented Vapor Saturation Factor	0.571535	Vapor Molecular Weight	56.7146 lb/lbmol
Vapor Space Outage	10.1 ft	Average Vapor Temperature	503.296 °R
Average Daily Vapor Temperature Range	0 °R	Average Daily Ambient Temperature	501.22 °R
Average Daily Vapor Pressure Range	0 psi	Net Working Loss Throughput	3250.82 ft^3/yr
Breather Vent Pressure Setting Range	0.06 psi	Working Loss Turnover (Saturation) Factor	1
Vapor Pressure at Average Daily Liquid Surface Temperature	1.40047 psia	Number of Turnovers per Year	1.79647
Average Daily Liquid Surface Temperature	503.296 °R	Annual Net Throughput	2316.22 bbl/yr
Average Daily Ambient Temperature Range	23.3 °R	Maximum Liquid Height	18 ft
Tank Roof Surface Solar Absorptance	0.58	Minimum Liquid Height	2 ft
Tank Shell Surface Solar Absorptance	0.58	Working Loss Product Factor	1
Vapor Pressure at Maximum Liquid Surface Temperature	1.40047 psia	Vent Setting Correction Factor	1
Vapor Pressure at Minimum Liquid Surface Temperature	1.40047 psia	Saturation Factor	0.6
Maximum Liquid Surface Temperature	503.296 °R	Vapor Pressure of Liquid Loaded	1.34426 psia
Minimum Liquid Surface Temperature	503.296 °R	Annual Net Throughput Per Tank	579.056 bbl/yr
Liquid Height	10 ft		

Loading Properties : Scalar Data

Cargo Carrier	Tank Truck or Rail Tank Car	Overall Reduction Efficiency	0* %
Land Based Mode of Operation	Submerged Loading: Dedicated Normal Service*		

Results Properties : Scalar Data

Flashing Losses	0 ton/yr	Standing Losses per Tank	0 ton/yr
Working Losses	0.0925756 ton/yr	Flashing Losses per Tank	0 ton/yr
Standing Losses	0 ton/yr	Working and Standing Losses	0.0925756 ton/yr
Loading Losses	0.0548941 ton/yr	Working and Standing Losses per Tank	0.0231439 ton/yr
Working Losses per Tank	0.0231439 ton/yr	Loading Losses per Tank	0.0137235 ton/yr

Results Properties : Tabulated Data

Index	Flashing Losses Mass Flows ton/yr	Working Losses Mass Flows ton/yr	Standing Losses Mass Flows ton/yr	Loading Losses Mass Flows ton/yr	Working and Standing Losses Mass Flows ton/yr
Propane	0	0.0139333	0	0.00800871	0.0139333
i-Butane	0	0.0106398	0	0.00629291	0.0106398
n-Butane	0	0.0304889	0	0.0181220	0.0304889
i-Pentane	0	0.0124692	0	0.00746193	0.0124692
n-Pentane	0	0.0205201	0	0.0122918	0.0205201
C6+	0	0	0	0	0
NBP 181	0	0.00404640	0	0.00242972	0.00404640
NBP 300	0	0.000471428	0	0.000283072	0.000471428
NBP 442	0	6.41875E-06	0	3.85419E-06	6.41875E-06
NBP Mix	0	0	0	0	0
TEG	0	3.37957E-12	0	2.03024E-12	3.37957E-12

Short Term Properties : Scalar Data

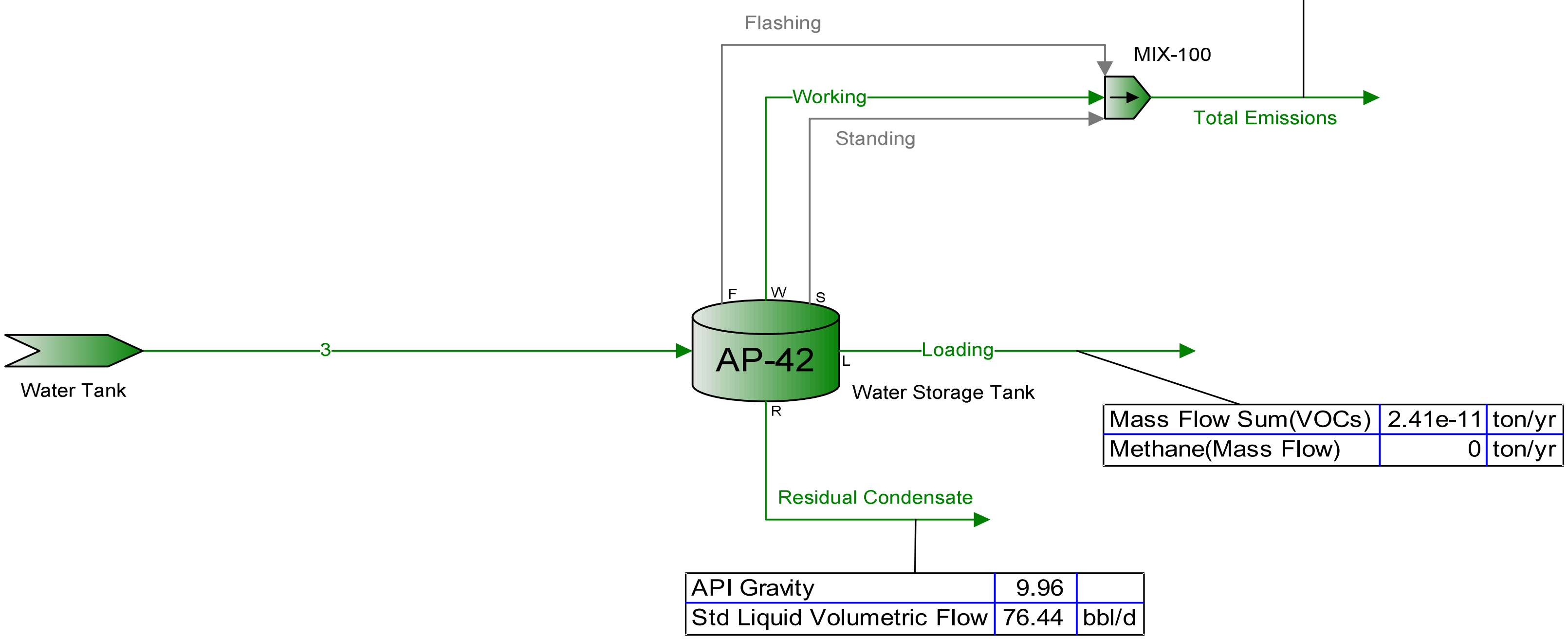
Maximum Battery Filling Rate	15* bbl/hr	Short-Term Working Losses per Tank	0.719845 lb/h
Short-Term Number of Storage Tanks	4	Short-Term Loading Losses per Tank	5.64306 lb/h
Worst-Case Liquid Surface Temperature	95 °F	Short-Term Vapor Molecular Weight	61.1914 lb/lbmol
Maximum Loading Rate	200* bbl/hr	Vapor Pressure at Worst-Case Temperature	3.39096 psia
Worst-Case Flashing Losses	0 lb/h	Short-Term Control Efficiency	0* %
Short-Term Working Losses	2.87938 lb/h	Short-Term Truck Annual Leak Test Passed	None
Short-Term Loading Losses	22.5722 lb/h	Short-Term Overall Reduction Efficiency	0 %
Worst-Case Flashing Losses per Tank	0 lb/h	Short-Term Collection Efficiency	70 %

Short Term Properties : Tabulated Data

Index	Worst-Case Flashing Losses Mass Flows lb/h	Short-Term Working Losses Mass Flows lb/h	Short-Term Loading Losses Mass Flows lb/h
Propane	0	0.320201	2.36781
i-Butane	0	0.285039	2.21123
n-Butane	0	0.860173	6.73542
i-Pentane	0	0.408961	3.24675
n-Pentane	0	0.711987	5.66457
C6+	0	0	0
NBP 181	0	0.249566	1.99850
NBP 300	0	0.0425021	0.340359
NBP 442	0	0.000949934	0.00760613
NBP Mix	0	0	0
TEG	0	3.26696E-10	2.61766E-09

AP 42 Tank Emissions
Water Tank

Names	Units	Flashing	Standing	Working
Methane(Mass Flow)	ton/yr	0	0	0
Mass Flow Sum	ton/yr	(VOCs) 0	(VOCs) 0	(VOCs) 0.04



Mass Flow Sum(VOCs)	0.04	ton/yr
Methane(Mass Flow)	0	ton/yr

Mass Flow Sum(VOCs)	2.41e-11	ton/yr
Methane(Mass Flow)	0	ton/yr

API Gravity	9.96	
Std Liquid Volumetric Flow	76.44	bbl/d

Tank Losses Report
Water Storage Tank

Client Name:	BBCS2 Compressor Station	**Job:**	Tank and Loading Emissions
Location:	Mckenzie, ND	**Modified:**	7/18/2024 10:51
Flowsheet:	Water Tank	**Status:**	Solved 12:21 PM, 7/18/2024

Stream Connections

Stream	Connection Type	Other Block	Stream	Connection Type	Other Block
3	Inlet	Water Tank	Flashing	Flashing Losses Stream	MIX-100
Working	Working Losses Stream	MIX-100	Standing	Standing Losses Stream	MIX-100
Loading	Loading Losses Stream		Residual Condensate	Residual Liquid Stream	

Working and Standing Properties : Scalar Data

Tank Geometry	Vertical Cylinder	Roof Type	Cone
Shell Length	20* ft	Slope of Coned Roof	0.05*
Shell Diameter	12* ft	Breather Vent Pressure	0.03 psi
Number of Storage Tanks	1*	Breather Vacuum Pressure	-0.03 psi
Maximum Fraction Fill of Tank	90 %	Location	Williston, ND*
Average Fraction Fill of Tank	50 %	Time Frame	Year
Minimum Fraction Fill of Tank	10 %	Known Liquid Bulk Temperature?	FALSE
Material Category	Light Organics*	Liquid Bulk Temperature	43.6258 °F
Insulation	Fully Insulated*	Use AP 42 Raoult's Vapor Pressure?	FALSE
Bolted or Riveted Construction?	FALSE	Flashing Temperature	43.6258 °F
Vapor Balanced Tank?	FALSE	Average Daily Maximum Ambient Temperature	53.2 °F
Known Sum of Increases in Liquid Level?	FALSE	Average Daily Minimum Ambient Temperature	29.9 °F
Sum of Increases in Liquid Level	1382.17 ft/yr	Atmospheric Pressure at Tank Location	13.72 psia
Shell Color	Light Grey*	Daily Solar Insolation	1193 Btu/(day*ft^2)
Shell Paint Condition	Average	Average Wind Speed	8.9 mph
Roof Color	Light Grey*	Heated Tank?	FALSE
Roof Paint Condition	Average	Include Short Term Emissions	TRUE

Composition Subset Properties : Scalar Data

Component Subset	VOCs	Species in Results	Selected Species
Atomic Basis	FALSE	Fraction Denominator	Selected Species

Composition Subset Properties : Tabulated Data

Index	Selected Components
Methane	FALSE
Ethane	FALSE
Propane	TRUE
i-Butane	TRUE
n-Butane	TRUE
i-Pentane	TRUE
n-Pentane	TRUE
Water	FALSE
Nitrogen	FALSE
Carbon Dioxide	FALSE
H2S	FALSE
C6+	TRUE
NBP 181	TRUE
NBP 300	TRUE
NBP 442	TRUE
NBP Mix	TRUE
TEG	TRUE

Details Properties : Scalar Data

Vapor Space Volume	1142.28 ft^3	Roof Outage	0.1 ft
Vapor Density	0.0147103 lb/ft^3	Tank Roof Height	0.3 ft
Vapor Space Expansion Factor	0 1/day	Tank Shell Radius	6 ft
Vented Vapor Saturation Factor	0.571446	Vapor Molecular Weight	56.7121 lb/lbmol
Vapor Space Outage	10.1 ft	Average Vapor Temperature	503.296 °R
Average Daily Vapor Temperature Range	0 °R	Average Daily Ambient Temperature	501.22 °R
Average Daily Vapor Pressure Range	0 psi	Net Working Loss Throughput	156320 ft^3/yr
Breather Vent Pressure Setting Range	0.06 psi	Working Loss Turnover (Saturation) Factor	0.513946
Vapor Pressure at Average Daily Liquid Surface Temperature	1.40099 psia	Number of Turnovers per Year	86.3858
Average Daily Liquid Surface Temperature	503.296 °R	Annual Net Throughput	27844.7 bbl/yr
Average Daily Ambient Temperature Range	23.3 °R	Maximum Liquid Height	18 ft
Tank Roof Surface Solar Absorptance	0.58	Minimum Liquid Height	2 ft
Tank Shell Surface Solar Absorptance	0.58	Working Loss Product Factor	1
Vapor Pressure at Maximum Liquid Surface Temperature	1.40099 psia	Vent Setting Correction Factor	1
Vapor Pressure at Minimum Liquid Surface Temperature	1.40099 psia	Saturation Factor	0.6
Maximum Liquid Surface Temperature	503.296 °R	Vapor Pressure of Liquid Loaded	0.140169 psia
Minimum Liquid Surface Temperature	503.296 °R	Annual Net Throughput Per Tank	27844.7 bbl/yr
Liquid Height	10 ft		

Loading Properties : Scalar Data

Cargo Carrier	Tank Truck or Rail Tank Car	Overall Reduction Efficiency	0* %
Land Based Mode of Operation	Submerged Loading: Dedicated Normal Service*		

Results Properties : Scalar Data

Flashing Losses	0 ton/yr	Standing Losses per Tank	0 ton/yr
Working Losses	0.0413287 ton/yr	Flashing Losses per Tank	0 ton/yr
Standing Losses	0 ton/yr	Working and Standing Losses	0.0413287 ton/yr
Loading Losses	2.41261E-11 ton/yr	Working and Standing Losses per Tank	0.0413287 ton/yr
Working Losses per Tank	0.0413287 ton/yr	Loading Losses per Tank	2.41261E-11 ton/yr

Results Properties : Tabulated Data

Index	Flashing Losses Mass Flows ton/yr	Working Losses Mass Flows ton/yr	Standing Losses Mass Flows ton/yr	Loading Losses Mass Flows ton/yr	Working and Standing Losses Mass Flows ton/yr
Propane	0	0.00868374	0	0	0.00868374
i-Butane	0	0.00583778	0	0	0.00583778
n-Butane	0	0.0173923	0	0	0.0173923
i-Pentane	0	0.00596517	0	0	0.00596517
n-Pentane	0	0.00287045	0	0	0.00287045
C6+	0	0	0	0	0
NBP 181	0	0.000392454	0	0	0.000392454
NBP 300	0	0.000169302	0	0	0.000169302
NBP 442	0	1.74273E-05	0	0	1.74273E-05
NBP Mix	0	0	0	0	0
TEG	0	2.08798E-11	0	2.41261E-11	2.08798E-11

Short Term Properties : Scalar Data

Maximum Battery Filling Rate	15* bbl/hr	Short-Term Working Losses per Tank	0.0444373 lb/h
Short-Term Number of Storage Tanks	1	Short-Term Loading Losses per Tank	4.30983E-08 lb/h
Worst-Case Liquid Surface Temperature	95 °F	Short-Term Vapor Molecular Weight	50.9915 lb/lbmol
Maximum Loading Rate	200* bbl/hr	Vapor Pressure at Worst-Case Temperature	3.36763 psia
Worst-Case Flashing Losses	0 lb/h	Short-Term Control Efficiency	0* %
Short-Term Working Losses	0.0444373 lb/h	Short-Term Truck Annual Leak Test Passed	None
Short-Term Loading Losses	4.30983E-08 lb/h	Short-Term Overall Reduction Efficiency	0 %
Worst-Case Flashing Losses per Tank	0 lb/h	Short-Term Collection Efficiency	70 %

Short Term Properties : Tabulated Data

Index	Worst-Case Flashing Losses Mass Flows lb/h	Short-Term Working Losses Mass Flows lb/h	Short-Term Loading Losses Mass Flows lb/h
Propane	0	0.00933691	0
i-Butane	0	0.00627689	0
n-Butane	0	0.0187006	0
i-Pentane	0	0.00641386	0
n-Pentane	0	0.00308636	0
C6+	0	0	0
NBP 181	0	0.000421973	0
NBP 300	0	0.000182037	0
NBP 442	0	1.87382E-05	0
NBP Mix	0	0	0
TEG	0	5.48166E-09	4.30983E-08

Tank ID: TK-796003
Glycol Storage Tank

Emissions Summary:	
3.05	lbs/yr
1.52E-03	tons/yr

Calculation Basis:

Emissions from storage tanks may result from working and standing (W&S) (breathing) losses. Working losses are a result of the change in vapor space during tank filling and emptying and, therefore, vary depending on the quantity of product flowing through the tank. Standing losses are a result of the change in vapor space due to changes in the temperature and pressure of the tank and do not vary depending on the quantity of product flowing through the tank. Annual working and breathing losses were calculated using equations from AP-42, Chapter 7, dated 06/2020..

Tank Information:

Tank Dimensions	Type of Tank:	Vertical Fixed Roof Tank	
	Tank Volume (bbl):	150	
	Tank Height (ft):	12.00	
	Tank Diameter (ft):	9.50	
	Type of Roof:	Cone	
	Average Liquid Height (ft):	11.00	
	Cone roof slope (ft/ft):	0.06	(If cone roof slope is unknown, 0.0625 is the default.)
Paint Characteristics	Shell Color/Shade:	Gray/Light	
	Shell Condition:	New	
	Roof Color/Shade:	Gray/Light	
	Roof Condition:	New	
Breather Vent Settings	Pressure Setting (psig):	0.03	(+0.03 is the default)
	Vacuum Setting (psig):	-0.03	(-0.03 is the default)
Location	Nearest City:	Williston, ND	
Material	Source of Material Data:	Defined Material	
	Select Material:	Triethylene glycol	
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	Category of Product (for working loss product factor determination)	Other Organic Liquid	
Throughput	Annual Throughput (bbl/yr):	3,750	
	January Throughput (bbl/month):	313	
	February Throughput (bbl/month):	313	
	March Throughput (bbl/month):	313	
	April Throughput (bbl/month):	313	
	May Throughput (bbl/month):	313	
	June Throughput (bbl/month):	313	
	July Throughput (bbl/month):	313	
	August Throughput (bbl/month):	313	
	September Throughput (bbl/month):	313	
	October Throughput (bbl/month):	313	
	November Throughput (bbl/month):	313	
	December Throughput (bbl/month):	313	
Annual emissions based on annual average or monthly temperature data?		Annual	(Because vapor pressure is not linearly related to temperature, annual emissions based on annual average temperature data will not equal annual emissions calculated based on monthly temperature data.)

Tank Solar absorptance (α):	0.54
(calculated from Table 7.1-6)	

Defined Material (from Table 7.1-2, 7.1-3, or 7.1-5):	
VP Calculation Method:	Vapor Pressure Interpolation
Vapor Molecular Weight (lb/lb-mole)	150
Liquid Density (lb/gal)	9.39
RVP	--
True Vapor Pressure at 40 ˚F:	0.00326412
True Vapor Pressure at 50 ˚F:	0.004630854
True Vapor Pressure at 60 ˚F:	0.006482019
True Vapor Pressure at 70 ˚F:	0.008958694
True Vapor Pressure at 80 ˚F:	0.012234071
True Vapor Pressure at 90 ˚F:	0.016518604
True Vapor Pressure at 100 ˚F:	0.022065599
Antoine's constant A	--
Antoine's constant B	--
Antoine's constant C	--

Constants		
	˚F to ˚R conversion:	459.67
	mmHg to psia conversion (psia/mmHg):	0.019337
	Ideal Gas Constant (psia ft^3/lb-mole °R):	10.731

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Glycol Storage Tank

Meteorological Data

The daily maximum ambient temperature (T_{AX}), daily minimum ambient temperature (T_{AN}), and daily total solar insolation factor (I) for each month for the specified city were taken from table 7.1-7 in AP-42 Ch. 7.1 (June 2020).

City:	Williston, ND
Annual Average Atmospheric Pressure (psia):	13.81

Month	daily maximum ambient temperature T_{AX} (˚F)	daily minimum ambient temperature T_{AN} (˚F)	daily total solar insolation factor I ($Btu/ft^2 \cdot d$)
Jan.	20.3	0.5	380.00
Feb.	26.9	7.4	628.00
Mar.	39.3	18.4	1069.00
Apr.	55.5	30.9	1537.00
May	66.0	40.9	1781.00
June	74.9	50.6	1928.00
July	82.9	56.6	2042.00
Aug.	82.8	54.9	1735.00
Sept.	71.5	43.8	1249.00
Oct.	55.2	31.3	793.00
Nov.	37.7	18.1	433.00
Dec.	25.0	6.0	299.00
Annual	53.20	29.90	1156.00

Calculated Tank Temperature Data

The daily average ambient temperature (T_{AA}), and bulk liquid temperature (T_B), daily average liquid surface temperature (T_{LA}), daily maximum liquid surface temperature (T_{LX}), daily minimum liquid surface temperature (T_{LN}), average daily ambient temperature range (ΔT_A), average vapor temperature (T_v), and daily vapor temperature range (ΔT_v) were calculated for each month using equations from AP-42, Chapter 7, dated 06/2020.

$T_{AA} = (T_{AX} + T_{AN}) /2$ Equation 1-30

where:

T_{AA} = daily average ambient temperature, ˚R
T_{AX} = daily maximum ambient temperature, ˚R
T_{AN} = daily minimum ambient temperature, ˚R

$\Delta T_v = (1- 0.8/(2.2*(H_s/D) + 1.9))*\Delta T_A + (0.042*\alpha_R*I + 0.026*(H_s/D)*\alpha_S*I)/(2.2*(H_s/D)+1.9)$ Equation 1-6

where:

ΔT_v = average daily vapor temperature range, ˚R
H_s = tank shell height, ft
D = Tank diameter, ft
ΔT_A = average daily ambient temperature range, °R

where:

$\Delta T_A = T_{AX} - T_{AN}$ Equation 1-11
T_{AX} = daily maximum ambient temperature, ˚R
T_{AN} = daily minimum ambient temperature, ˚R

α_R = tank roof surface solar absorptance, dimensionless, see Table 7.1-6
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

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$T_B = T_{AA} + 0.003 * \alpha_s * I$ Equation 1-31

where:
T_B = liquid bulk temperature, ˚R
T_{AA} = daily average ambient temperature, ˚R
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

$T_{LA} = (0.5 - 0.8/(4.4*(H_s/D) + 3.8))*T_{AA} + (0.5+0.8/(4.4*(H_s/D)+3.8))*T_B + (0.021*\alpha_R*I + 0.013 * (H_s/D) * \alpha_s*I)/(4.4*(H_s/D) +3.8)$ Equation 1-27

where:
T_{LA} = daily average liquid surface temperature, °R
H_s = tank shell height, ft
D = Tank diameter, ft
T_{AA} = daily average ambient temperature, ˚R
T_B = liquid bulk temperature, ˚R
α_R = tank roof surface solar absorptance, dimensionless, see Table 7.1-6
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

$T_{LX} = T_{LA} + 0.25*\Delta T_v$ Figure 7.1-17
$T_{LN} = T_{LA} - 0.25*\Delta T_v$
T_{LX} = daily maximum liquid surface temperature, °R
T_{LN} = daily minimum liquid surface temperature, °R
ΔT_v = average daily vapor temperature range, ˚R
T_{LA} = daily average liquid surface temperature, °R

$T_V = ([2.2*(H_s/D)+1.1]*T_{AA} + 0.8*T_B + 0.021*\alpha_R*I + 0.013*(H_s/D)*\alpha_s*I)/(2.2*(H_s/D)+1.9)$ Equation 1-32
T_v= average vapor temperature, ˚R
T_{AA} = daily average ambient temperature, ˚R
H_s = tank shell height, ft
D = Tank diameter, ft
T_B = liquid bulk temperature, ˚R
α_R = tank roof surface solar absorptance, dimensionless, see Table 7.1-6
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

		daily average ambient temperature T_{AA}		average daily ambient temperature range ΔT_A		average vapor temperature T_v		average daily vapor temperature range ΔT_v		liquid bulk temperature T_B		daily average liquid surface temperature T_{LA}		daily maximum liquid surface temperature T_{LX}		daily minimum liquid surface temperature T_{LN}	
Month	Days	°F	°R	°F	°R	°F	°R	°F	°R	°F	°R	°F	°R	°F	°R	°F	°R
Jan.	31	10.40	470.07	19.80	19.80	12.15	471.82	19.70	19.70	11.02	470.69	11.58	471.25	16.51	476.18	6.66	466.33
Feb.	28	17.15	476.82	19.50	19.50	20.04	479.71	21.59	21.59	18.17	477.84	19.10	478.77	24.50	484.17	13.70	473.37
Mar.	31	28.85	488.52	20.90	20.90	33.76	493.43	26.56	26.56	30.58	490.25	32.17	491.84	38.81	498.48	25.53	485.20
Apr.	30	43.20	502.87	24.60	24.60	50.26	509.93	33.67	33.67	45.69	505.36	47.98	507.65	56.39	516.06	39.56	499.23
May	31	53.45	513.12	25.10	25.10	61.64	521.31	36.19	36.19	56.34	516.01	58.99	518.66	68.03	527.70	49.94	509.61
June	30	62.75	522.42	24.30	24.30	71.61	531.28	36.80	36.80	65.87	525.54	68.74	528.41	77.94	537.61	59.54	519.21
July	31	69.75	529.42	26.30	26.30	79.13	538.80	39.44	39.44	73.06	532.73	76.10	535.77	85.96	545.63	66.24	525.91
Aug.	31	68.85	528.52	27.90	27.90	76.82	536.49	38.12	38.12	71.66	531.33	74.24	533.91	83.77	543.44	64.71	524.38
Sept.	30	57.65	517.32	27.70	27.70	63.39	523.06	33.75	33.75	59.67	519.34	61.53	521.20	69.97	529.64	53.09	512.76
Oct.	31	43.25	502.92	23.90	23.90	46.89	506.56	26.66	26.66	44.53	504.20	45.71	505.38	52.38	512.05	39.05	498.72
Nov.	30	27.90	487.57	19.60	19.60	29.89	489.56	19.99	19.99	28.60	488.27	29.25	488.92	34.24	493.91	24.25	483.92
Dec.	31	15.50	475.17	19.00	19.00	16.87	476.54	18.33	18.33	15.98	475.65	16.43	476.10	21.01	480.68	11.85	471.52
	Annual Average	41.55	501.22	23.30	23.30	46.86	506.53	29.30	29.30	43.42	503.09	45.14	504.81	52.47	512.14	37.82	497.49

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Vapor Pressure Calculations

The vapor pressure at the various tank temperatures was calculated according to the method selected above.

Vapor Pressure Calculation Method:		Vapor Pressure Interpolation	
Vapor Molecular Weight (lb/lb-mole)		150	
Liquid Density (lb/gal)		9.39	
	RVP		psia
TVP (psia) at:	40 ˚F	0.00326412	psia
	50 ˚F	0.004630854	psia
	60 ˚F	0.006482019	psia
	70 ˚F	0.008958694	psia
	80 ˚F	0.012234071	psia
	90 ˚F	0.016518604	psia
	100 ˚F	0.022065599	psia
	Antoine's constant A		dimensionless
	Antoine's constant B		˚C
	Antoine's constant C		˚C

RVP Method

When the RVP option is used, the vapor pressure is calculated from the RVP and a given temperature, using the following AP-42 equation from Figure 7.1-14b, page 7.1-82, dated 06/2020. Below the equation is given referencing the bulk liquid temperature in units of ˚R.

$P = \exp\{[0.7553 - (413/(T+459.6))] * S^{0.5} * \log_{10}(RVP) - [1.854 - (1042)/(T+459.6)]*S^{0.5} + [(2416/(T+459.6)-2.013]*\log_{10}(RVP) - (8742/(T+459.6))+15.64\}$

where:

P = Stock True Vapor Pressure, psia

T = temperature, degrees F

S = Slope of the ASTM Distillation Curve at 10 percent evaporated, in degrees Fahrenheit per percent

RVP = Reid Vapor Pressure, psia

Vapor Pressure Interpolation Method

When this option is used, the vapor pressure at a given temperature is interpolated using a table of known vapor pressure and temperature combinations.

Antoine's Equation Method

When Antoine's equation is used, the vapor pressure is calculated based on Antoine's Constants A, B, and C (is using 3-constant formula) at a given temperature, using equations 1-25 or 1-26 as applicable from AP-42, chapter 7, dated 06/2020. This equation can be rearranged to solve for P_{VA}. It can also be converted to use ˚R as the temperature unit and psia as the pressure unit.

Equation 1-25 $P_{VA} = \exp[A-B(T_{LA})]$

where:

exp= exponential function

A= constant in the vapor pressure equation, dimensionless

B= constant in the vapor pressure equation, °R

T_{LA}= average daily liquid surface temperature, °R

P_{VA}= true vapor pressure, psia

Equation 1-26 $\log P_{VA} = A - (B/(T_{LA} + C))$

where:

P_{VA} = vapor pressure at average liquid surface temperature, psia

A = constant in vapor pressure equation, dimensionless

B = constant in vapor pressure equation, °C

C = constant in vapor pressure equation, °C

T_{LA} = average daily liquid surface temperature, °C

log = log 10

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		daily average liquid surface temperature T_{LA}		P_{VA} (psia)			daily maximum liquid surface temperature T_{LX}		P_{VX} (psia)			daily minimum liquid surface temperature T_{LN}		P_{VN} (psia)		
				RVP Method	Vapor Pressure Interpolation Method	Antione's Equation Method			RVP Method	Vapor Pressure Interpolation Method	Antione's Equation Method			RVP Method	Vapor Pressure Interpolation Method	Antione's Equation Method
Month	Days	°F	°R	P_{VA} (psia)	P_{VA} (psia)	P_{VA} (psia)	°F	°R	P_{VX} (psia)	P_{VX} (psia)	P_{VX} (psia)	°F	°R	P_{VN} (psia)	P_{VN} (psia)	P_{VN} (psia)
Jan.	31	11.58	471.25	n/a	0.0014	n/a	16.51	476.18	n/a	0.0016	n/a	6.66	466.33	n/a	0.0012	n/a
Feb.	28	19.10	478.77	n/a	0.0017	n/a	24.50	484.17	n/a	0.0021	n/a	13.70	473.37	n/a	0.0015	n/a
Mar.	31	32.17	491.84	n/a	0.0026	n/a	38.81	498.48	n/a	0.0032	n/a	25.53	485.20	n/a	0.0021	n/a
Apr.	30	47.98	507.65	n/a	0.0044	n/a	56.39	516.06	n/a	0.0058	n/a	39.56	499.23	n/a	0.0033	n/a
May	31	58.99	518.66	n/a	0.0063	n/a	68.03	527.70	n/a	0.0085	n/a	49.94	509.61	n/a	0.0046	n/a
June	30	68.74	528.41	n/a	0.0086	n/a	77.94	537.61	n/a	0.0116	n/a	59.54	519.21	n/a	0.0064	n/a
July	31	76.10	535.77	n/a	0.0110	n/a	85.96	545.63	n/a	0.0148	n/a	66.24	525.91	n/a	0.0080	n/a
Aug.	31	74.24	533.91	n/a	0.0103	n/a	83.77	543.44	n/a	0.0138	n/a	64.71	524.38	n/a	0.0076	n/a
Sept.	30	61.53	521.20	n/a	0.0069	n/a	69.97	529.64	n/a	0.0090	n/a	53.09	512.76	n/a	0.0052	n/a
Oct.	31	45.71	505.38	n/a	0.0040	n/a	52.38	512.05	n/a	0.0051	n/a	39.05	498.72	n/a	0.0033	n/a
Nov.	30	29.25	488.92	n/a	0.0024	n/a	34.24	493.91	n/a	0.0028	n/a	24.25	483.92	n/a	0.0020	n/a
Dec.	31	16.43	476.10	n/a	0.0016	n/a	21.01	480.68	n/a	0.0018	n/a	11.85	471.52	n/a	0.0014	n/a
	Annual Average	45.14	504.81	n/a	0.00	n/a	52.47	512.14	n/a	0.01	n/a	37.82	497.49	n/a	0.00	n/a

Temp (F)	Temp (R)	P (RVP metho	P (VP Inter)	P (Antoine)	**VP (psia)**
95.00	554.67	n/a	0.019292102	n/a	**0.019292102**

		daily average liquid surface temperature T_{LA}		P_{VA} (psia)	daily maximum liquid surface temperature T_{LX}		P_{VX} (psia)	daily minimum liquid surface temperature T_{LN}		P_{VN} (psia)
Month	Days	°F	°R		°F	°R		°F	°R	
Jan.	31	11.58	471.25	0.0014	16.51	476.18	0.0016	6.66	466.33	0.0012
Feb.	28	19.10	478.77	0.0017	24.50	484.17	0.0021	13.70	473.37	0.0015
Mar.	31	32.17	491.84	0.0026	38.81	498.48	0.0032	25.53	485.20	0.0021
Apr.	30	47.98	507.65	0.0044	56.39	516.06	0.0058	39.56	499.23	0.0033
May	31	58.99	518.66	0.0063	68.03	527.70	0.0085	49.94	509.61	0.0046
June	30	68.74	528.41	0.0086	77.94	537.61	0.0116	59.54	519.21	0.0064
July	31	76.10	535.77	0.0110	85.96	545.63	0.0148	66.24	525.91	0.0080
Aug.	31	74.24	533.91	0.0103	83.77	543.44	0.0138	64.71	524.38	0.0076
Sept.	30	61.53	521.20	0.0069	69.97	529.64	0.0090	53.09	512.76	0.0052
Oct.	31	45.71	505.38	0.0040	52.38	512.05	0.0051	39.05	498.72	0.0033
Nov.	30	29.25	488.92	0.0024	34.24	493.91	0.0028	24.25	483.92	0.0020
Dec.	31	16.43	476.10	0.0016	21.01	480.68	0.0018	11.85	471.52	0.0014
	Annual Average	45.14	504.81	0.0040	52.47	512.14	0.0051	37.82	497.49	0.0031

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Total Losses from Fixed Roof Tanks

$L_T = L_S + L_W$ Equation 1-1

where:

L_T = total losses, lb/yr
L_S = standing storage losses, lb/yr
L_W = working losses, lb/yr

Standing Storage Losses

$Ls = 365 * K_E * (\pi/4*D^2) * H_{VO} * K_s * W_v$ Equation 1-4

where:
L_S = standing storage loss, lb/yr
K_E = vapor space expansion factor, dimensionless
D = diameter, ft
H_{VO} = vapor space outage, ft
K_S = vented vapor saturation factor, dimensionless
W_V = stock vapor density, lb/ft^3
365 = constant, the number of daily events in a year, $(year)^{-1}$

K_E - Vapor Space Expansion Factor

If vapor pressure < 0.1 psia and tank breather settings are ± 0.03 psig or less:
$K_E = 0.0018 * \Delta T_v$ Equation 1-12

where:
K_E = vapor space expansion factor, dimensionless
0.0018 = constant, $(°R)^{-1}$
ΔT_v = average daily vapor temperature range, °R

If vapor pressure > 0.1 psia or tank breather settings are more than ±0.03 psig:

$K_E = \Delta T_V/T_{LA} + (\Delta P_v - \Delta P_B)/(P_A - P_{VA})$ Equation 1-5

where:
K_E = vapor space expansion factor, dimensionless
T_{LA} = daily average liquid surface temperature, °R
P_A = atmospheric pressure, psia
P_{VA} = vapor pressure at daily liquid surface temperature, psia
ΔT_v = average daily vapor temperature range, °R
$\Delta Pv = P_{VX} - P_{VN}$
where:
P_{VX} = vapor pressure at the daily maximum liquid surface temperature, psia
P_{VN} = vapor pressure at the daily minimum liquid surface temperature, psia
$\Delta P_B = P_{BP} - P_{BV}$
where:
P_{BP} = breather vent pressure setting, psig
P_{BV} = breather vent vacuum setting, psig

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Month	ΔT_v (°R)	T_{LA} (°R)	P_{VA} (psia)	P_{VX} (psia)	P_{VN} (psia)	ΔP_B (psia)	P_A (psia)	K_E
Jan.	19.7	471.3	0.0014	0.0016	0.0012	0.0600	13.8100	**0.0355**
Feb.	21.6	478.8	0.0017	0.0021	0.0015	0.0600	13.8100	**0.0389**
Mar.	26.6	491.8	0.0026	0.0032	0.0021	0.0600	13.8100	**0.0478**
Apr.	33.7	507.6	0.0044	0.0058	0.0033	0.0600	13.8100	**0.0606**
May	36.2	518.7	0.0063	0.0085	0.0046	0.0600	13.8100	**0.0651**
June	36.8	528.4	0.0086	0.0116	0.0064	0.0600	13.8100	**0.0662**
July	39.4	535.8	0.0110	0.0148	0.0080	0.0600	13.8100	**0.0710**
Aug.	38.1	533.9	0.0103	0.0138	0.0076	0.0600	13.8100	**0.0686**
Sept.	33.8	521.2	0.0069	0.0090	0.0052	0.0600	13.8100	**0.0608**
Oct.	26.7	505.4	0.0040	0.0051	0.0033	0.0600	13.8100	**0.0480**
Nov.	20.0	488.9	0.0024	0.0028	0.0020	0.0600	13.8100	**0.0360**
Dec.	18.3	476.1	0.0016	0.0018	0.0014	0.0600	13.8100	**0.0330**
Annual	29.3	504.8	0.0040	0.0051	0.0031	0.0600	13.8100	**0.0527**

<0.1 psia	>0.1 psia
K_E	K_E
0.03545442	0.037482993
0.03886256	0.040793264
0.047808197	0.049736684
0.060605768	0.062160084
0.065145508	0.065712574
0.066237219	0.065666365
0.070994125	0.069758131
0.068608585	0.067491182
0.060753991	0.060683121
0.047993767	0.048543095
0.035979996	0.036593989
0.033001271	0.034197391
0.052742213	0.053838899

D - Diameter

For vertical tanks, this is the tank diameter. **D = 9.50**

For horizontal tanks, this is the effective diameter calculated by Equation 1-**14.**

$D_E = \text{sqrt}(L * D / (\pi/4))$ Equation 1-14 D_E = n/a ft

where:

D_E = effective tank diameter, ft; use in place of D in Equation 1-4

L = length of horizontal tank, ft L = n/a ft

D = diameter of a vertical cross-section of the horizontal tank, ft D = n/a ft

H_{VO} - Vapor Space Outage

H_{VO} = 1.10

For Vertical Tanks

$H_{VO} = H_S - H_L + H_{RO}$ Equation 1-16 H_{VO} = 1.095

where:

H_{VO} = vapor space outage, ft; use **H_E**/2 from Equation 1-15 for horizontal tanks

H_S = tank shell height, ft H_S = 12

H_L = liquid height, ft H_L = 11

H_{RO} = roof outage, ft H_{RO} = 0.095

Cone Roof

$H_{RO} = (1/3)*H_R$ Equations 1-17 and 1-18 H_{RO} = 0.095

$H_R = S_R * R_S$

where:

H_R = tank roof height, ft

H_{RO} = roof outage (or shell height equivalent to the volume contained under the roof), ft

S_R = tank cone roof slope, ft/ft S_R = 0.06

R_S = tank shell radius, ft R_S = 4.75

Dome Roof

$H_{RO} = H_R * [1/2 + 1/6*[H_R/R_s]^2]$ Equation 1-19 H_{RO} = n/a

$H_R = R_R - (R_R^2 - R_S^2)^{0.5}$ Equation 1-20 H_R = n/a

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where:
H_{RO} = roof outage, ft
H_R = tank roof height, ft
R_S = tank shell radius, ft
R_R = tank dome roof radius, ft

R_S = n/a
R_R = n/a

For Horizontal Tanks

H_{VO} = n/a

$H_E = \pi/4 * D$ Equation 1-15

H_E = n/a

where:
H_E = effective height, ft
D = diameter of a vertical cross-section of the horizontal tank, ft

K_S - Vented Vapor Saturation Factor

$K_S = 1/(1+0.053*P_{VA}*H_{VO})$ Equation 1-21

where:
K_S = vented vapor saturation factor, dimensionless
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
H_{VO} = vapor space outage, ft
0.053 = constant, $(psia\text{-}ft)^{-1}$

Month	P_{VA} (psia)	K_S
Jan.	0.0014	**0.9999**
Feb.	0.0017	**0.9999**
Mar.	0.0026	**0.9998**
Apr.	0.0044	**0.9997**
May	0.0063	**0.9996**
June	0.0086	**0.9995**
July	0.0110	**0.9994**
Aug.	0.0103	**0.9994**
Sept.	0.0069	**0.9996**
Oct.	0.0040	**0.9998**
Nov.	0.0024	**0.9999**
Dec.	0.0016	**0.9999**
Annual	0.0040	**0.9998**

W_V - Stock Vapor Density

where:
W_V = vapor density, lb/ft^3
M_V = vapor molecular weight, lb/lb-mole
R = the ideal gas constant, 10.731 psia ft^3/lb-mole °R
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
T_v = average vapor temperature, °R

Month	T_v (°R)	P_{VA} (psia)	W_V (lb/ft^3)
Jan.	471.82	0.0014	**0.0000**
Feb.	479.71	0.0017	**0.0001**
Mar.	493.43	0.0026	**0.0001**
Apr.	509.93	0.0044	**0.0001**
May	521.31	0.0063	**0.0002**
June	531.28	0.0086	**0.0002**
July	538.80	0.0110	**0.0003**
Aug.	536.49	0.0103	**0.0003**
Sept.	523.06	0.0069	**0.0002**
Oct.	506.56	0.0040	**0.0001**
Nov.	489.56	0.0024	**0.0001**
Dec.	476.54	0.0016	**0.0000**
Annual	506.53	0.0040	**0.0001**

Tank ID: TK-796003
Glycol Storage Tank

Standing Storage Losses*

$L_s = 365 * K_E * (\pi/4*D^2) * H_{VO} * K_s * W_v$ Equation 1-4

*For underground storage tanks or fully insulated storage tanks, $L_S = 0$

Month	Days	K_E	D (ft)	H_{VO} (ft)	K_S	W_V (lb/ft^3)	L_S* (lb)
Jan.	31	0.0355	9.5000	1.0950	0.9999	0.0000	**0.0034**
Feb.	28	0.0389	9.5000	1.0950	0.9999	0.0001	**0.0043**
Mar.	31	0.0478	9.5000	1.0950	0.9998	0.0001	**0.0085**
Apr.	30	0.0606	9.5000	1.0950	0.9997	0.0001	**0.0168**
May	31	0.0651	9.5000	1.0950	0.9996	0.0002	**0.0264**
June	30	0.0662	9.5000	1.0950	0.9995	0.0002	**0.0351**
July	31	0.0710	9.5000	1.0950	0.9994	0.0003	**0.0485**
Aug.	31	0.0686	9.5000	1.0950	0.9994	0.0003	**0.0445**
Sept.	30	0.0608	9.5000	1.0950	0.9996	0.0002	**0.0259**
Oct.	31	0.0480	9.5000	1.0950	0.9998	0.0001	**0.0129**
Nov.	30	0.0360	9.5000	1.0950	0.9999	0.0001	**0.0057**
Dec.	31	0.0330	9.5000	1.0950	0.9999	0.0000	**0.0037**
Annual	365	0.0527	9.5000	1.0950	0.9998	0.0001	**0.1635**

Working Losses

$L_w = V_Q * K_N * K_P * W_v * K_B$ Equation 1-35

where:

L_W = working loss, lb/yr

V_Q = Net working loss throughput, ft^3/yr

where

$V_Q = sum(H_{Qt})*(\pi/4)*D^2$

where:

$sum(H_{Qt})$=value derived from pump throughput records or calculated using following formula:

$sum(H_{Qt}) = (5.614*Q)/((\pi/4)*D^2)$

D = Diameter (effective diameter for horizontal tanks), ft

Q = annual net throughput, bbl/yr

K_N = working loss turnover (saturation) factor, dimensionless

for turnovers >36, $K_N = (180 + N)/6N$

for turnovers ≤36, $K_N = 1$

N = number of turnovers per year, dimensionless

$N = sum(H_{Qt})/(H_{LX}-H_{LN})$

where:

$sum(H_{Qt}) = (5.614*Q)/((\pi/4)*D^2)$

where:

H_{Qt} = annual sum of increases in liquid level, ft/yr

Q = annual net throughput, bbl/yr

D = tank diameter, ft

H_{LX} = maximum liquid height, ft (if unknown, use 1 ft less than shell height for VFR and π/4*D for HFR

H_{LN} = minimum liquid height, ft (if unknown, for VFR use 1 ft, and for HFR use 0)

Wv = vapor density, lb/ft^3

K_B = vent setting correction factor, (only applies if vent pressure settings exceed ±0.03 psig and condition in Equation 1-40 is met)

K_P = working loss product factor, dimensionless

(K_P = 0.75 for crude oils; K_P =1 for all other organic liquids)

Month	Q (bbl)	V_Q (ft^3/month)	K_N (dimensionless)	K_P (dimensionless)	W_V (lb/ft^3)	K_B (dimensionless)
Jan.	313	1,754	1.0000	1.0000	0.0000	1.0000
Feb.	313	1,754	1.0000	1.0000	0.0001	1.0000
Mar.	313	1,754	1.0000	1.0000	0.0001	1.0000
Apr.	313	1,754	1.0000	1.0000	0.0001	1.0000
May	313	1,754	1.0000	1.0000	0.0002	1.0000
June	313	1,754	1.0000	1.0000	0.0002	1.0000
July	313	1,754	1.0000	1.0000	0.0003	1.0000
Aug.	313	1,754	1.0000	1.0000	0.0003	1.0000
Sept.	313	1,754	1.0000	1.0000	0.0002	1.0000
Oct.	313	1,754	1.0000	1.0000	0.0001	1.0000
Nov.	313	1,754	1.0000	1.0000	0.0001	1.0000
Dec.	313	1,754	1.0000	1.0000	0.0000	1.0000
Annual	3,750	21,053				

Tank ID: TK-796003
Glycol Storage Tank

H_{LX} =	11.00	ft
H_{LN} =	1	ft
N =	29.70	number of turnovers
K_N =	1.0000	dimensionless
K_P =	1	dimensionless
K_B =	1	dimensionless

Total Losses

$L_T = L_S + L_W$

Month	L_S (lb)	L_W (lb)	L_T (lb)
Jan.	0.0034	0.0708	**0.0743**
Feb.	0.0043	0.0885	**0.0927**
Mar.	0.0085	0.1304	**0.1389**
Apr.	0.0168	0.2094	**0.2262**
May	0.0264	0.2961	**0.3225**
June	0.0351	0.3991	**0.4342**
July	0.0485	0.4986	**0.5471**
Aug.	0.0445	0.4730	**0.5175**
Sept.	0.0259	0.3217	**0.3476**
Oct.	0.0129	0.1958	**0.2087**
Nov.	0.0057	0.1197	**0.1255**
Dec.	0.0037	0.0818	**0.0855**
Annual	0.1635	2.8850	**3.0485**

Tank ID: TK-796004
Methanol Tank

Emissions Summary:	
67.56	lbs/yr
0.03	tons/yr

Calculation Basis:
Emissions from storage tanks may result from working and standing (W&S) (breathing) losses. Working losses are a result of the change in vapor space during tank filling and emptying and, therefore, vary depending on the quantity of product flowing through the tank. Standing losses are a result of the change in vapor space due to changes in the temperature and pressure of the tank and do not vary depending on the quantity of product flowing through the tank. Annual working and breathing losses were calculated using equations from AP-42, Chapter 7, dated 06/2020..

Tank Information:

Tank Dimensions	Type of Tank:	Vertical Fixed Roof Tank	
	Tank Volume (bbl):	150	
	Tank Height (ft):	12.00	
	Tank Diameter (ft):	9.50	
	Type of Roof:	Cone	
	Average Liquid Height (ft):	11.00	
	Cone roof slope (ft/ft):	0.06	(If cone roof slope is unknown, 0.0625 is the default.)
Paint Characteristics	Shell Color/Shade:	Gray/Light	
	Shell Condition:	New	
	Roof Color/Shade:	Gray/Light	
	Roof Condition:	New	
Breather Vent Settings	Pressure Setting (psig):	0.03	(+0.03 is the default)
	Vacuum Setting (psig):	-0.03	(-0.03 is the default)
Location	Nearest City:	Williston, ND	
Material	Source of Material Data:	Defined Material	
	Select Material:	Methanol	
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	n/a		
	Category of Product (for working loss product factor determination)	Other Organic Liquid	
Throughput	Annual Throughput (bbl/yr):	1,500	
	January Throughput (bbl/month):	125	
	February Throughput (bbl/month):	125	
	March Throughput (bbl/month):	125	
	April Throughput (bbl/month):	125	
	May Throughput (bbl/month):	125	
	June Throughput (bbl/month):	125	
	July Throughput (bbl/month):	125	
	August Throughput (bbl/month):	125	
	September Throughput (bbl/month):	125	
	October Throughput (bbl/month):	125	
	November Throughput (bbl/month):	125	
	December Throughput (bbl/month):	125	
Annual emissions based on annual average or monthly temperature data?		Annual	(Because vapor pressure is not linearly related to temperature, annual emissions based on annual average temperature data will not equal annual emissions calculated based on monthly temperature data.)

Tank Solar absorptance (α):	0.54
(calculated from Table 7.1-6)	

Defined Material (from Table 7.1-2, 7.1-3, or 7.1-5):	
VP Calculation Method:	Constants for Antoine's Equation (using C)
Vapor Molecular Weight (lb/lb-mole)	32.04
Liquid Density (lb/gal)	6.61
RVP	--
True Vapor Pressure at 40 ˚F:	--
True Vapor Pressure at 50 ˚F:	--
True Vapor Pressure at 60 ˚F:	--
True Vapor Pressure at 70 ˚F:	--
True Vapor Pressure at 80 ˚F:	--
True Vapor Pressure at 90 ˚F:	--
True Vapor Pressure at 100 ˚F:	--
Antoine's constant A	8.079
Antoine's constant B	1581.3
Antoine's constant C	239.65

Constants		
	˚F to ˚R conversion:	459.67
	mmHg to psia conversion (psia/mmHg):	0.019337
	Ideal Gas Constant (psia ft^3/lb-mole °R):	10.731

Tank ID: TK-796004
Methanol Tank

Meteorological Data

The daily maximum ambient temperature (T_{AX}), daily minimum ambient temperature (T_{AN}), and daily total solar insolation factor (I) for each month for the specified city were taken from table 7.1-7 in AP-42 Ch. 7.1 (June 2020).

City:	Williston, ND
Annual Average Atmospheric Pressure (psia):	13.81

Month	daily maximum ambient temperature T_{AX} (˚F)	daily minimum ambient temperature T_{AN} (˚F)	daily total solar insolation factor I (Btu/ft²•d)
Jan.	20.3	0.5	380.00
Feb.	26.9	7.4	628.00
Mar.	39.3	18.4	1069.00
Apr.	55.5	30.9	1537.00
May	66.0	40.9	1781.00
June	74.9	50.6	1928.00
July	82.9	56.6	2042.00
Aug.	82.8	54.9	1735.00
Sept.	71.5	43.8	1249.00
Oct.	55.2	31.3	793.00
Nov.	37.7	18.1	433.00
Dec.	25.0	6.0	299.00
Annual	53.20	29.90	1156.00

Calculated Tank Temperature Data

The daily average ambient temperature (T_{AA}), and bulk liquid temperature (T_B), daily average liquid surface temperature (T_{LA}), daily maximum liquid surface temperature (T_{LX}), daily minimum liquid surface temperature (T_{LN}), average daily ambient temperature range (ΔT_A), average vapor temperature (T_v), and daily vapor temperature range (ΔT_v) were calculated for each month using equations from AP-42, Chapter 7, dated 06/2020.

$T_{AA} = (T_{AX} + T_{AN}) /2$ Equation 1-30

where:

T_{AA} = daily average ambient temperature, ˚R

T_{AX} = daily maximum ambient temperature, ˚R

T_{AN} = daily minimum ambient temperature, ˚R

$\Delta T_v = (1- 0.8/(2.2*(H_s/D) + 1.9))*\Delta T_A + (0.042*\alpha_R*I + 0.026*(H_s/D)*\alpha_S*I)/(2.2*(H_s/D)+1.9)$ Equation 1-6

where:

ΔT_v = average daily vapor temperature range, ˚R

H_s = tank shell height, ft

D = Tank diameter, ft

ΔT_A = average daily ambient temperature range, °R

where:

$\Delta T_A = T_{AX} - T_{AN}$ Equation 1-11

T_{AX} = daily maximum ambient temperature, ˚R

T_{AN} = daily minimum ambient temperature, ˚R

α_R = tank roof surface solar absorptance, dimensionless, see Table 7.1-6

α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6

I = average daily total insolation factor, Btu/(ft²-day)

Tank ID: TK-796004
Methanol Tank

$T_B = T_{AA} + 0.003 * \alpha_s * I$ Equation 1-31

where:

T_B = liquid bulk temperature, ˚R
T_{AA} = daily average ambient temperature, ˚R
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

$T_{LA} = (0.5 - 0.8/(4.4*(H_s/D) + 3.8))*T_{AA} + (0.5+0.8/(4.4*(H_s/D)+3.8))*T_B + (0.021*\alpha_R*I + 0.013 * (H_s/D) * \alpha_s*I)/(4.4*(H_s/D) +3.8)$ Equation 1-27

where:

T_{LA} = daily average liquid surface temperature, °R
H_s = tank shell height, ft
D = Tank diameter, ft
T_{AA} = daily average ambient temperature, ˚R
T_B = liquid bulk temperature, ˚R
α_R = tank roof surface solar absorptance, dimensionless, see Table 7.1-6
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

$T_{LX} = T_{LA} + 0.25*\Delta T_v$ Figure 7.1-17
$T_{LN} = T_{LA} - 0.25*\Delta T_v$
T_{LX} = daily maximum liquid surface temperature, °R
T_{LN} = daily minimum liquid surface temperature, °R
ΔT_v = average daily vapor temperature range, ˚R
T_{LA} = daily average liquid surface temperature, °R

$T_V = ([2.2*(H_s/D)+1.1]*T_{AA} + 0.8*T_B + 0.021*\alpha_R*I + 0.013*(H_s/D)*\alpha_s*I)/(2.2*(H_s/D)+1.9)$ Equation 1-32
T_v= average vapor temperature, °R
T_{AA} = daily average ambient temperature, ˚R
H_s = tank shell height, ft
D = Tank diameter, ft
T_B = liquid bulk temperature, ˚R
α_R = tank roof surface solar absorptance, dimensionless, see Table 7.1-6
α_s = tank shell surface solar absorptance, dimensionless, see Table 7.1-6
I = average daily total insolation factor, Btu/(ft^2-day)

		daily average ambient temperature T_{AA}		average daily ambient temperature range ΔT_A		average vapor temperature T_v		average daily vapor temperature range ΔT_v		liquid bulk temperature T_B		daily average liquid surface temperature T_{LA}		daily maximum liquid surface temperature T_{LX}		daily minimum liquid surface temperature T_{LN}	
Month	**Days**	**°F**	**°R**	**°F**	**°R**	**°F**	**°R**	**°F**	**°R**	**°F**	**°R**	**°F**	**°R**	**°F**	**°R**	**°F**	**°R**
Jan.	31	10.40	470.07	19.80	19.80	12.15	471.82	19.70	19.70	11.02	470.69	11.58	471.25	16.51	476.18	6.66	466.33
Feb.	28	17.15	476.82	19.50	19.50	20.04	479.71	21.59	21.59	18.17	477.84	19.10	478.77	24.50	484.17	13.70	473.37
Mar.	31	28.85	488.52	20.90	20.90	33.76	493.43	26.56	26.56	30.58	490.25	32.17	491.84	38.81	498.48	25.53	485.20
Apr.	30	43.20	502.87	24.60	24.60	50.26	509.93	33.67	33.67	45.69	505.36	47.98	507.65	56.39	516.06	39.56	499.23
May	31	53.45	513.12	25.10	25.10	61.64	521.31	36.19	36.19	56.34	516.01	58.99	518.66	68.03	527.70	49.94	509.61
June	30	62.75	522.42	24.30	24.30	71.61	531.28	36.80	36.80	65.87	525.54	68.74	528.41	77.94	537.61	59.54	519.21
July	31	69.75	529.42	26.30	26.30	79.13	538.80	39.44	39.44	73.06	532.73	76.10	535.77	85.96	545.63	66.24	525.91
Aug.	31	68.85	528.52	27.90	27.90	76.82	536.49	38.12	38.12	71.66	531.33	74.24	533.91	83.77	543.44	64.71	524.38
Sept.	30	57.65	517.32	27.70	27.70	63.39	523.06	33.75	33.75	59.67	519.34	61.53	521.20	69.97	529.64	53.09	512.76
Oct.	31	43.25	502.92	23.90	23.90	46.89	506.56	26.66	26.66	44.53	504.20	45.71	505.38	52.38	512.05	39.05	498.72
Nov.	30	27.90	487.57	19.60	19.60	29.89	489.56	19.99	19.99	28.60	488.27	29.25	488.92	34.24	493.91	24.25	483.92
Dec.	31	15.50	475.17	19.00	19.00	16.87	476.54	18.33	18.33	15.98	475.65	16.43	476.10	21.01	480.68	11.85	471.52
Annual Average		41.55	501.22	23.30	23.30	46.86	506.53	29.30	29.30	43.42	503.09	45.14	504.81	52.47	512.14	37.82	497.49

Tank ID: TK-796004
Methanol Tank

Vapor Pressure Calculations

The vapor pressure at the various tank temperatures was calculated according to the method selected above.

Vapor Pressure Calculation Method:		Constants for Antoine's Equation (using C)	
Vapor Molecular Weight (lb/lb-mole)		32.04	
Liquid Density (lb/gal)		6.61	
	RVP		psia
TVP (psia) at:	40 ˚F		psia
	50 ˚F		psia
	60 ˚F		psia
	70 ˚F		psia
	80 ˚F		psia
	90 ˚F		psia
	100 ˚F		psia
Antoine's constant A		8.079	dimensionless
Antoine's constant B		1581.3	˚C
Antoine's constant C		239.65	˚C

RVP Method

When the RVP option is used, the vapor pressure is calculated from the RVP and a given temperature, using the following AP-42 equation from Figure 7.1-14b, page 7.1-82, dated 06/2020. Below the equation is given referencing the bulk liquid temperature in units of ˚R.

$P = \exp\{[0.7553 - (413/(T+459.6))] * S^{0.5} * \log_{10}(RVP) - [1.854 - (1042)/(T+459.6)]*S^{0.5} + [(2416/(T+459.6)-2.013]*\log_{10}(RVP) - (8742/(T+459.6))+15.64\}$

where:

P = Stock True Vapor Pressure, psia

T = temperature, degrees F

S = Slope of the ASTM Distillation Curve at 10 percent evaporated, in degrees Fahrenheit per percent

RVP = Reid Vapor Pressure, psia

Vapor Pressure Interpolation Method

When this option is used, the vapor pressure at a given temperature is interpolated using a table of known vapor pressure and temperature combinations.

Antoine's Equation Method

When Antoine's equation is used, the vapor pressure is calculated based on Antoine's Constants A, B, and C (is using 3-constant formula) at a given temperature, using equations 1-25 or 1-26 as applicable from AP-42, chapter 7, dated 06/2020. This equation can be rearranged to solve for P_{VA}. It can also be converted to use ˚R as the temperature unit and psia as the pressure unit.

Equation 1-25 $P_{VA} = \exp[A-B(T_{LA})]$

where:

exp= exponential function

A= constant in the vapor pressure equation, dimensionless

B= constant in the vapor pressure equation, °R

T_{LA}= average daily liquid surface temperature, °R

P_{VA}= true vapor pressure, psia

Equation 1-26 $\log P_{VA} = A - (B/(T_{LA} + C))$

where:

P_{VA} = vapor pressure at average liquid surface temperature, psia

A = constant in vapor pressure equation, dimensionless

B = constant in vapor pressure equation, °C

C = constant in vapor pressure equation, °C

T_{LA} = average daily liquid surface temperature, °C

log = log 10

Tank ID: TK-796004
Methanol Tank

		daily average liquid surface temperature T_{LA}		P_{VA} (psia)			daily maximum liquid surface temperature T_{LX}		P_{VX} (psia)			daily minimum liquid surface temperature T_{LN}		P_{VN} (psia)		
				RVP Method	Vapor Pressure Interpolation Method	Antione's Equation Method			RVP Method	Vapor Pressure Interpolation Method	Antione's Equation Method			RVP Method	Vapor Pressure Interpolation Method	Antione's Equation Method
Month	Days	°F	°R	P_{VA} (psia)	P_{VA} (psia)	P_{VA} (psia)	°F	°R	P_{VX} (psia)	P_{VX} (psia)	P_{VX} (psia)	°F	°R	P_{VN} (psia)	P_{VN} (psia)	P_{VN} (psia)
Jan.	31	11.58	471.25	n/a	n/a	0.2749	16.51	476.18	n/a	n/a	0.3320	6.66	466.33	n/a	n/a	0.2265
Feb.	28	19.10	478.77	n/a	n/a	0.3661	24.50	484.17	n/a	n/a	0.4469	13.70	473.37	n/a	n/a	0.2984
Mar.	31	32.17	491.84	n/a	n/a	0.5884	38.81	498.48	n/a	n/a	0.7406	25.53	485.20	n/a	n/a	0.4641
Apr.	30	47.98	507.65	n/a	n/a	1.0062	56.39	516.06	n/a	n/a	1.3188	39.56	499.23	n/a	n/a	0.7597
May	31	58.99	518.66	n/a	n/a	1.4305	68.03	527.70	n/a	n/a	1.8867	49.94	509.61	n/a	n/a	1.0726
June	30	68.74	528.41	n/a	n/a	1.9272	77.94	537.61	n/a	n/a	2.5241	59.54	519.21	n/a	n/a	1.4555
July	31	76.10	535.77	n/a	n/a	2.3931	85.96	545.63	n/a	n/a	3.1666	66.24	525.91	n/a	n/a	1.7873
Aug.	31	74.24	533.91	n/a	n/a	2.2674	83.77	543.44	n/a	n/a	2.9789	64.71	524.38	n/a	n/a	1.7066
Sept.	30	61.53	521.20	n/a	n/a	1.5481	69.97	529.64	n/a	n/a	1.9990	53.09	512.76	n/a	n/a	1.1875
Oct.	31	45.71	505.38	n/a	n/a	0.9340	52.38	512.05	n/a	n/a	1.1606	39.05	498.72	n/a	n/a	0.7466
Nov.	30	29.25	488.92	n/a	n/a	0.5304	34.24	493.91	n/a	n/a	0.6326	24.25	483.92	n/a	n/a	0.4429
Dec.	31	16.43	476.10	n/a	n/a	0.3311	21.01	480.68	n/a	n/a	0.3931	11.85	471.52	n/a	n/a	0.2777
	Annual Average	45.14	504.81	n/a	n/a	0.92	52.47	512.14	n/a	n/a	1.16	37.82	497.49	n/a	n/a	0.72

Temp (F)	Temp (R)	P (RVP metho	P (VP Inter)	P (Antoine)	**VP (psia)**
95.00	554.67	n/a	n/a	4.053914181	**4.053914181**

		daily average liquid surface temperature T_{LA}		P_{VA} (psia)	daily maximum liquid surface temperature T_{LX}		P_{VX} (psia)	daily minimum liquid surface temperature T_{LN}		P_{VN} (psia)
Month	Days	°F	°R		°F	°R		°F	°R	
Jan.	31	11.58	471.25	0.2749	16.51	476.18	0.3320	6.66	466.33	0.2265
Feb.	28	19.10	478.77	0.3661	24.50	484.17	0.4469	13.70	473.37	0.2984
Mar.	31	32.17	491.84	0.5884	38.81	498.48	0.7406	25.53	485.20	0.4641
Apr.	30	47.98	507.65	1.0062	56.39	516.06	1.3188	39.56	499.23	0.7597
May	31	58.99	518.66	1.4305	68.03	527.70	1.8867	49.94	509.61	1.0726
June	30	68.74	528.41	1.9272	77.94	537.61	2.5241	59.54	519.21	1.4555
July	31	76.10	535.77	2.3931	85.96	545.63	3.1666	66.24	525.91	1.7873
Aug.	31	74.24	533.91	2.2674	83.77	543.44	2.9789	64.71	524.38	1.7066
Sept.	30	61.53	521.20	1.5481	69.97	529.64	1.9990	53.09	512.76	1.1875
Oct.	31	45.71	505.38	0.9340	52.38	512.05	1.1606	39.05	498.72	0.7466
Nov.	30	29.25	488.92	0.5304	34.24	493.91	0.6326	24.25	483.92	0.4429
Dec.	31	16.43	476.10	0.3311	21.01	480.68	0.3931	11.85	471.52	0.2777
	Annual Average	45.14	504.81	0.9164	52.47	512.14	1.1639	37.82	497.49	0.7158

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Total Losses from Fixed Roof Tanks

$L_T = L_S + L_W$ Equation 1-1

where:

L_T = total losses, lb/yr
L_S = standing storage losses, lb/yr
L_W = working losses, lb/yr

Standing Storage Losses

$Ls = 365 * K_E * (\pi/4*D^2) * H_{VO} * K_s * W_v$ Equation 1-4

where:
L_S = standing storage loss, lb/yr
K_E = vapor space expansion factor, dimensionless
D = diameter, ft
H_{VO} = vapor space outage, ft
K_S = vented vapor saturation factor, dimensionless
W_V = stock vapor density, lb/ft^3
365 = constant, the number of daily events in a year, $(year)^{-1}$

K_E - Vapor Space Expansion Factor

If vapor pressure < 0.1 psia and tank breather settings are ± 0.03 psig or less:

$K_E = 0.0018 * \Delta T_v$ Equation 1-12

where:
K_E = vapor space expansion factor, dimensionless
0.0018 = constant, $(°R)^{-1}$
ΔT_v = average daily vapor temperature range, ˚R

If vapor pressure > 0.1 psia or tank breather settings are more than ±0.03 psig:

$K_E = \Delta T_V/T_{LA} + (\Delta P_v - \Delta P_B)/(P_A-P_{VA})$ Equation 1-5

where:
K_E = vapor space expansion factor, dimensionless
T_{LA} = daily average liquid surface temperature, °R
P_A = atmospheric pressure, psia
P_{VA} = vapor pressure at daily liquid surface temperature, psia
ΔT_v = average daily vapor temperature range, ˚R
$\Delta Pv = P_{VX} - P_{VN}$
where:
P_{VX} = vapor pressure at the daily maximum liquid surface temperature, psia
P_{VN} = vapor pressure at the daily minimum liquid surface temperature, psia
$\Delta P_B = P_{BP} - P_{BV}$
where:
P_{BP} = breather vent pressure setting, psig
P_{BV} = breather vent vacuum setting, psig

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Month	ΔT_v (°R)	T_{LA} (°R)	P_{VA} (psia)	P_{VX} (psia)	P_{VN} (psia)	ΔP_B (psia)	P_A (psia)	K_E
Jan.	19.7	471.3	0.2749	0.3320	0.2265	0.0600	13.8100	**0.0452**
Feb.	21.6	478.8	0.3661	0.4469	0.2984	0.0600	13.8100	**0.0517**
Mar.	26.6	491.8	0.5884	0.7406	0.4641	0.0600	13.8100	**0.0704**
Apr.	33.7	507.6	1.0062	1.3188	0.7597	0.0600	13.8100	**0.1053**
May	36.2	518.7	1.4305	1.8867	1.0726	0.0600	13.8100	**0.1307**
June	36.8	528.4	1.9272	2.5241	1.4555	0.0600	13.8100	**0.1545**
July	39.4	535.8	2.3931	3.1666	1.7873	0.0600	13.8100	**0.1892**
Aug.	38.1	533.9	2.2674	2.9789	1.7066	0.0600	13.8100	**0.1764**
Sept.	33.8	521.2	1.5481	1.9990	1.1875	0.0600	13.8100	**0.1261**
Oct.	26.7	505.4	0.9340	1.1606	0.7466	0.0600	13.8100	**0.0803**
Nov.	20.0	488.9	0.5304	0.6326	0.4429	0.0600	13.8100	**0.0507**
Dec.	18.3	476.1	0.3311	0.3931	0.2777	0.0600	13.8100	**0.0426**
Annual	29.3	504.8	0.9164	1.1639	0.7158	0.0600	13.8100	**0.0881**

<0.1 psia	>0.1 psia
K_E	K_E
0.03545442	0.045156938
0.03886256	0.051683181
0.047808197	0.070380521
0.060605768	0.105305553
0.065145508	0.130694041
0.066237219	0.15451678
0.070994125	0.189174913
0.068608585	0.176422415
0.060753991	0.126051407
0.047993767	0.080251758
0.035979996	0.050655023
0.033001271	0.042620539
0.052742213	0.088141123

D - Diameter

For vertical tanks, this is the tank diameter. **D = 9.50**

For horizontal tanks, this is the effective diameter calculated by Equation 1-**14.**

D_E = sqrt(L * D / (π/4)) Equation 1-14 D_E = n/a ft

where:

D_E = effective tank diameter, ft; use in place of D in Equation 1-4

L = length of horizontal tank, ft L = n/a ft

D = diameter of a vertical cross-section of the horizontal tank, ft D = n/a ft

H_{VO} - Vapor Space Outage

H_{VO} = 1.10

For Vertical Tanks

$H_{VO} = H_S - H_L + H_{RO}$ Equation 1-16 H_{VO} = 1.095

where:

H_{VO} = vapor space outage, ft; use **H_E**/2 from Equation 1-15 for horizontal tanks

H_S = tank shell height, ft H_S = 12

H_L = liquid height, ft H_L = 11

H_{RO} = roof outage, ft H_{RO} = 0.095

Cone Roof

$H_{RO} = (1/3)*H_R$ Equations 1-17 and 1-18 H_{RO} = 0.095

$H_R = S_R * R_S$

where:

H_R = tank roof height, ft

H_{RO} = roof outage (or shell height equivalent to the volume contained under the roof), ft

S_R = tank cone roof slope, ft/ft S_R = 0.06

R_S = tank shell radius, ft R_S = 4.75

Dome Roof

$H_{RO} = H_R * [1/2 + 1/6*[H_R/R_s]^2]$ Equation 1-19 H_{RO} = n/a

$H_R = R_R - (R_R^2 - R_S^2)^{0.5}$ Equation 1-20 H_R = n/a

where:
H_{RO} = roof outage, ft
H_R = tank roof height, ft
R_S = tank shell radius, ft
R_R = tank dome roof radius, ft

R_S =	n/a
R_R =	n/a

For Horizontal Tanks

H_{VO} =	n/a

$H_E = \pi/4 * D$ Equation 1-15

H_E =	n/a

where:
H_E = effective height, ft
D = diameter of a vertical cross-section of the horizontal tank, ft

K_S - Vented Vapor Saturation Factor

$K_S = 1/(1+0.053*P_{VA}*H_{VO})$ Equation 1-21

where:
K_S = vented vapor saturation factor, dimensionless
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
H_{VO} = vapor space outage, ft
0.053 = constant, $(psia\text{-}ft)^{-1}$

Month	P_{VA} (psia)	K_S
Jan.	0.2749	**0.9843**
Feb.	0.3661	**0.9792**
Mar.	0.5884	**0.9670**
Apr.	1.0062	**0.9448**
May	1.4305	**0.9233**
June	1.9272	**0.8994**
July	2.3931	**0.8781**
Aug.	2.2674	**0.8837**
Sept.	1.5481	**0.9176**
Oct.	0.9340	**0.9486**
Nov.	0.5304	**0.9701**
Dec.	0.3311	**0.9811**
Annual	0.9164	**0.9495**

W_V - Stock Vapor Density

where:
W_V = vapor density, lb/ft^3
M_V = vapor molecular weight, lb/lb-mole
R = the ideal gas constant, 10.731 psia ft^3/lb-mole °R
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
T_v = average vapor temperature, °R

Month	T_v (°R)	P_{VA} (psia)	W_V (lb/ft^3)
Jan.	471.82	0.2749	**0.0017**
Feb.	479.71	0.3661	**0.0023**
Mar.	493.43	0.5884	**0.0036**
Apr.	509.93	1.0062	**0.0059**
May	521.31	1.4305	**0.0082**
June	531.28	1.9272	**0.0108**
July	538.80	2.3931	**0.0133**
Aug.	536.49	2.2674	**0.0126**
Sept.	523.06	1.5481	**0.0088**
Oct.	506.56	0.9340	**0.0055**
Nov.	489.56	0.5304	**0.0032**
Dec.	476.54	0.3311	**0.0021**
Annual	506.53	0.9164	**0.0054**

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Standing Storage Losses*

$Ls = 365 * K_E * (\pi/4*D^2) * H_{VO} * K_s * W_v$ Equation 1-4

*For underground storage tanks or fully insulated storage tanks, $L_S = 0$

Month	Days	K_E	D (ft)	H_{VO} (ft)	K_S	W_V (lb/ft^3)	L_S* (lb)
Jan.	31	0.0452	9.5000	1.0950	0.9843	0.0017	**0.1860**
Feb.	28	0.0517	9.5000	1.0950	0.9792	0.0023	**0.2506**
Mar.	31	0.0704	9.5000	1.0950	0.9670	0.0036	**0.5830**
Apr.	30	0.1053	9.5000	1.0950	0.9448	0.0059	**1.3649**
May	31	0.1307	9.5000	1.0950	0.9233	0.0082	**2.3789**
June	30	0.1545	9.5000	1.0950	0.8994	0.0108	**3.5047**
July	31	0.1892	9.5000	1.0950	0.8781	0.0133	**5.3001**
Aug.	31	0.1764	9.5000	1.0950	0.8837	0.0126	**4.7336**
Sept.	30	0.1261	9.5000	1.0950	0.9176	0.0088	**2.3799**
Oct.	31	0.0803	9.5000	1.0950	0.9486	0.0055	**1.0083**
Nov.	30	0.0507	9.5000	1.0950	0.9701	0.0032	**0.3702**
Dec.	31	0.0426	9.5000	1.0950	0.9811	0.0021	**0.2087**
Annual	365	0.0881	9.5000	1.0950	0.9495	0.0054	**12.8075**

Working Losses

$L_w = V_Q * K_N * K_P * W_v * K_B$ Equation 1-35

where:

L_W = working loss, lb/yr

V_Q = Net working loss throughput, ft^3/yr

where

$V_Q = sum(H_{Qt})*(\pi/4)*D^2$

where:

$sum(H_{Qt})$=value derived from pump throughput records or calculated using following formula:

$sum(H_{Qt}) = (5.614*Q)/((\pi/4)*D^2)$

D = Diameter (effective diameter for horizontal tanks), ft

Q = annual net throughput, bbl/yr

K_N = working loss turnover (saturation) factor, dimensionless

for turnovers >36, $K_N = (180 + N)/6N$

for turnovers ≤36, $K_N = 1$

N = number of turnovers per year, dimensionless

$N = sum(H_{Qt})/(H_{LX}-H_{LN})$

where:

$sum(H_{Qt}) = (5.614*Q)/((\pi/4)*D^2)$

where:

H_{Qt} = annual sum of increases in liquid level, ft/yr

Q = annual net throughput, bbl/yr

D = tank diameter, ft

H_{LX} = maximum liquid height, ft (if unknown, use 1 ft less than shell height for VFR and π/4*D for HFR

H_{LN} = minimum liquid height, ft (if unknown, for VFR use 1 ft, and for HFR use 0)

Wv = vapor density, lb/ft^3

K_B = vent setting correction factor, (only applies if vent pressure settings exceed ±0.03 psig and condition in Equation 1-40 is met)

K_P = working loss product factor, dimensionless

(K_P = 0.75 for crude oils; K_P =1 for all other organic liquids)

Month	Q (bbl)	V_Q (ft^3/month)	K_N (dimensionless)	K_P (dimensionless)	W_V (lb/ft^3)	K_B (dimensionless)
Jan.	125	702	1.0000	1.0000	0.0017	1.0000
Feb.	125	702	1.0000	1.0000	0.0023	1.0000
Mar.	125	702	1.0000	1.0000	0.0036	1.0000
Apr.	125	702	1.0000	1.0000	0.0059	1.0000
May	125	702	1.0000	1.0000	0.0082	1.0000
June	125	702	1.0000	1.0000	0.0108	1.0000
July	125	702	1.0000	1.0000	0.0133	1.0000
Aug.	125	702	1.0000	1.0000	0.0126	1.0000
Sept.	125	702	1.0000	1.0000	0.0088	1.0000
Oct.	125	702	1.0000	1.0000	0.0055	1.0000
Nov.	125	702	1.0000	1.0000	0.0032	1.0000
Dec.	125	702	1.0000	1.0000	0.0021	1.0000
Annual	1,500	8,421				

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H_{LX} =	11.00	ft
H_{LN} =	1	ft
N =	11.88	number of turnovers
K_N =	1.0000	dimensionless
K_P =	1	dimensionless
K_B =	1	dimensionless

Total Losses

$L_T = L_S + L_W$

Month	L_S (lb)	L_W (lb)	L_T (lb)
Jan.	0.1860	1.2207	**1.4068**
Feb.	0.2506	1.5992	**1.8498**
Mar.	0.5830	2.4983	**3.0813**
Apr.	1.3649	4.1342	**5.4990**
May	2.3789	5.7494	**8.1283**
June	3.5047	7.6002	**11.1049**
July	5.3001	9.3061	**14.6062**
Aug.	4.7336	8.8552	**13.5889**
Sept.	2.3799	6.2012	**8.5811**
Oct.	1.0083	3.8630	**4.8713**
Nov.	0.3702	2.2701	**2.6402**
Dec.	0.2087	1.4556	**1.6643**
Annual	12.8075	54.7535	**67.5610**