From:	Robinson, Jeffrey
To:	Wilson, Aimee
Subject:	FW: Mt. Belvieu Train 5 drafts
Date:	Thursday, October 17, 2013 1:24:20 PM
Attachments:	Train 5 GHG Summary Tables.pdf TEG Dehy_Flare_Startup.pdf Train 5 Startup Flare Emission Tables.pdf Train 5 Pilot Emissions.pdf

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From: Roberts, Melanie [mailto:MRoberts@targaresources.com]
Sent: Wednesday, September 18, 2013 2:53 PM
To: Cox, Kyndall; Keiser, Jessica
Cc: Robinson, Jeffrey
Subject: RE: Mt. Belvieu Train 5 drafts

Attached please find revised emission rate calculations for Mont Belvieu Train 5. I've included the summary pages along with the revised TEG-2 emission rates (these will only occur during startup now), GLYCalc output file, Pilot and Supplemental Fuel calculations to remove supplemental fuel, and Startup Emissions to Flare calculations to add TEG-2.

Here is a more detailed explanation of the changes made to the different calculations:

- TEG-2 calculation tables have been removed. The TEG-2 emissions will now only occur during startup and are added to the startup calculations
- New GLYCalc Output file with revised emission rates showing uncontrolled emission rates to the flare.
- Revised Startup to Flare calculation tables to add TEG-2 vents since emissions will only occur during startup with the VRU capturing 100% of the emissions during normal operation.
- Revised Flare pilot fuel & supplemental fuel calculations to remove supplemental fuel calculations. Pilot gas will be the only source of normal emissions from the flare. There will be no process streams routed to the flare from Train 5.

Please let me know if you need any additional information.

Thank you,
Melanie Roberts

From: Cox, Kyndall [mailto:Cox.Kyndall@epa.gov]
Sent: Friday, September 13, 2013 4:14 PM
To: Roberts, Melanie; Keiser, Jessica
Cc: Robinson, Jeffrey
Subject: RE: Mt. Belvieu Train 5 drafts

This email is confirmation that we received the comments.

Thank you,

Kyndall Barry Cox
Air Permits Section (6PD-R)
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202
Phone: 214.665.8567
Fax: 214.665.7263
E-mail: cox.kyndall@epa.gov

From: Roberts, Melanie <MRoberts@targaresources.com>
Sent: Friday, September 13, 2013 3:27 PM
To: Cox, Kyndall; Keiser, Jessica
Cc: Robinson, Jeffrey
Subject: RE: Mt. Belvieu Train 5 drafts

Targa would like to provide the following comments on the draft permit you sent on September 9, 2013. We will provide the revised emission rate calculations for items 10 and 11 early next week.

1. ***Permit Cover Letter.***

   The last paragraph appears to come from the Longhorn permit delaying the permit effective date to 30 days after issuance. Targa requests revising this or somehow noting that if no comments are given this would be changed to say the permit is effective immediately.

2. ***Permit Section III.A.1.a.***

   The heaters will not be ducted to a common stack but will operate independently with separate SCR systems. Please revise the second sentence to read as follows: "Both process heaters ~~will~~shall be ~~ducted to a common stack that will be~~ equipped with Selective Catalytic Reduction (SCR) technology using aqueous NH_3 and the heaters shall be equipped with low NO_X burners."

3. ***Permit Section III.A.1.f.***

   Targa intends to install coriolis meters, which we already have on existing equipment, which cannot be calibrated unless removed and sent off to a third party vendor. These meters do not have moving parts and the precision of these meters is far better than a meter that needs calibrating (i.e. orifice meter). Coriolis meters can only have diagnostic tests done via software.

   The coriolis meters have a 0.5% vapor uncertainty and a 0.01% liquid uncertainty versus the 5% uncertainty for a meter that could be calibrated annually onsite. Therefore, Targa requests this condition be removed from our permit.

4. Permit Section III.B.1.b.

The RTO is only designed to meet a destruction efficiency of 99.0%. This is what was represented in the emission rate calculations provided to EPA and is the minimum destruction efficiency required by TCEQ Permit 101616. Please revise this condition to require a destruction efficiency of 99.0%.

5. Permit Section III.B.1.i.

The RTO-5 exhaust temperature monitoring data is required to be reduced to 6 minute averages in TCEQ Permit 101616 while this requirement is to reduce data to 15 minute averages. Targa requests this condition be changed to have the same averaging period as the TCEQ permit so we do not have to keep 2 sets of averaged records of the exhaust temperature in order to comply with both permits.

6. Permit Section III.B.1.j, k, l.

Targa would like to request removal of the RTO oxygen monitoring requirements. Targa is willing to include a requirement for continuous oxygen monitoring during stack testing to verify that the oxygen content is sufficient during the test but a continuous oxygen monitor does not give any useful information about the destruction efficiency or energy efficiency of the unit. The unit is designed to have 6-8% excess oxygen. A statement from our vendor is attached.

In addition, the BACT write-up in the SOB lists monitoring and analysis of the waste gas flow rate, monitoring temperature in the combustion chamber, and periodic maintenance as ways to determine proper operation and good combustion practices. Therefore, Targa requests removal of oxygen monitoring from the requirements of the permit. If this information is not sufficient to remove this condition from the permit, we would like to setup a meeting to discuss this further.

7. Permit Section V.A.

The first sentence has an error on the EPNs. It lists EPN F5A1 but should just be F5A.

8. Statement of Basis Section II.

Please revise the Targa contact to be:

Melanie Roberts

Environmental Manager-Air

Targa Midstream Services LLC

(713) 584-1422

9. Statement of Basis Section IX. Step 4

The subsection “Proper Operation and Good Combustion Practice” does not seem to be correct. It repeats the paragraph in the next section “Heat Integration”. The write-up appears to explain heat integration rather than proper operation and good combustion practices for heaters.

10. TEG Dehydrator Flash Gas Vent

The TEG flash tank was incorrectly represented in the permit as going to flare continuously. The flash tank will actually be routed to fuel (primary) and flare (secondary). Flare routing is for startup, upsets, or issues with the unit (such as high flash tank liquid level) that would preclude using the TEG flash tank vapors as fuel. Under normal operations the flash tank vapors will be routed to the fuel system. Therefore, Targa will provide revised emission rate calculations revising the emission rates for this vent stream.

11. TEG Dehydrator Regeneration Still Vent

The original energy evaluation Targa did for recovering the TEG still vent vapors was incorrect. The recovered stream would have more fuel value than the energy required to produce it. Therefore, Targa proposes to install 2 electric vapor recovery unit (VRU) compressors on the exhaust vent to compress and route the vapors to the fuel system. The vent will still be routed to flare but only during upset conditions. There will be no maintenance downtime due to the redundancy of installing 2 VRUs. Targa will provide revised calculations for this change next week.

The sections of the Statement of Basis that will require revision as a result of this change include Sections VI (last paragraph), Section XI, and Table 1. The sections of the permit that will require change include Table 1, C.1.b, C.1.e, C.2.b, and C.2.c.

From: Cox, Kyndall [mailto:Cox.Kyndall@epa.gov]
Sent: Monday, September 09, 2013 12:17 PM
To: Keiser, Jessica; Roberts, Melanie
Cc: Robinson, Jeffrey
Subject: Mt. Belvieu Train 5 drafts

Hello and good day;

Attached please find the draft statement of basis and draft permit for the Targa Mont Belvieu Train 5. These drafts are being provided for your courtesy review. Please let me know if you have any technical comments.

Thanking you in advance,

Kyndall Barry Cox
Air Permits Section (6PD-R)
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202
Phone: 214.665.8567
Fax: 214.665.7263
E-mail: cox.kyndall@epa.gov

Targa Midstream Services LLC - Mont Belvieu Plant Train 5
GHG Summary Table

Summary of GHG Hourly Emissions

Hourly Emissions (lb/hr)													
GHG Pollutants	**RTO-5 Regenerative Thermal Oxidizer Emissions (RTO-5)**	**RTO Startup Emissions (RTO5-MSS)**	**Amine Still Vent Emissions During RTO Downtime Emissions (AU-4)**	**Hot Oil Heater (F5A)**	**Hot Oil Heater (F5B)**	**Fugitives (FUG-FRAC5)**	**Flare Pilot (FLR-5)**	**Controlled Maintenance Emissions (FLR-5)**	**Maintenance Emissions to Atmosphere (Maintenance)**	**Controlled Startup Emissions (FLR-5)**	**Controlled Shutdown Emissions (FLR-5)**	**Shutdown Emissions to Atmosphere (Shutdown)**	**Total [1]**
CO_2	2,686.29	233.78	2,482.57	16,884.46	16,884.46	2.35E-03	23.73	20,279.46	-	41,017.87	41,465.66	-	59,474.75
CH_4	0.02	4.40E-03	0.91	0.32	0.32	0.03	4.47E-04	1.57	3.17	3.33	3.26	7.42	7.42
N_2O	6.56E-03	4.40E-04	--	0.03	0.03	-	4.47E-05	2.72E-04	-	6.48E-04	1.37E-03	-	0.07
CO_2e	2,688.70	234.01	2,501.66	16,901.02	16,901.02	0.53	23.75	20,312.49	66.66	41,088.09	41,534.48	155.85	59,563.18
lb CO_2/bbl [2]			--	4.06	4.06	--	--	--	--	--	--	--	8.11

[1] The total hourly emissions are calculated based on the maximum emissions rate between maintenance and normal operations, startup, and shutdown (controlled and to atmosphere). Maintenance emissions occur at the same time as normal operation. Maintenance emissions to the flare do not occur at the same time as maintenance emissions to the atmosphere. Startup emissions do not occur during normal operation or maintenance. Shutdown emissions do not occur during normal operation or maintenance. Startup and shutdown emissions do not occur at the same time. Controlled shutdown of liquid releases, controlled shutdown of vapor releases, and uncontrolled shutdown emissions do not occur at the same time.

Maximum hourly emissions are taken from the following operating scenarios:

(1) TEG-2 to FLR-5, AU-4 to FLR-5, F5A, F5B, Frac5, Pilot & Supplemental Fuel to FLR-5, Maintenance to FLR-5
(2) TEG-2 to FLR-5, AU-4 to FLR-5, F5A, F5B, Frac5, Pilot & Supplemental Fuel to FLR-5, Maintenance to Atmosphere
(3) Startup to FLR-5
(4) Shutdown to FLR-5
(5) Shutdown to Atmosphere

[2] Greenhouse Gas Limit (lb CO_2/ bbl) is based on the CO_2 Hourly Emissions Rate and the proposed plant throughput. The proposed fractionation train is designed to handle 100,000 bbl/day of inlet liquid. An example calculation is provided below.

Greenhouse Gas Limit	16,884.46 lb	day	24 hrs	=	4.06 lb CO2
	hr	100,000 bbl	day		bbl

Summary of GHG Annual Emissions

Annual Emissions (tpy)													
GHG Pollutants	**RTO-5 Regenerative Thermal Oxidizer Emissions (RTO-5)**	**RTO Startup Emissions (RTO5-MSS)**	**Amine Still Vent Emissions During RTO Downtime Emissions (AU-4)**	**Hot Oil Heater (F5A)**	**Hot Oil Heater (F5B)**	**Fugitives (FUG-FRAC5)**	**Flare Pilot (FLR-5)**	**Controlled Maintenance Emissions (FLR-5)**	**Maintenance Emissions to Atmosphere (Maintenance)**	**Controlled Startup Emissions (FLR-5)**	**Controlled Shutdown Emissions (FLR-5)**	**Shutdown Emissions to Atmosphere (Shutdown)**	**Total [1]**
CO_2	11,765.94	0.94	188.68	73,953.92	73,953.92	0.01	103.93	302.95	-	280.68	400.59	-	160,951.55
CH_4	0.08	1.76E-05	0.01	1.39	1.39	0.11	1.96E-03	0.02	0.03	0.02	0.03	0.05	3.14
N_2O	0.03	1.76E-06	-	0.14	0.14	-	1.96E-04	6.17E-06	-	1.93E-05	1.88E-05	-	0.31
CO_2e	11,776.52	0.94	190.13	74,026.45	74,026.45	2.33	104.03	303.36	0.65	281.20	401.13	1.04	161,114.22

[1] The total annual emissions is calculated based on the emissions rate of annual maintenance and normal operations, startup, and shutdown (controlled and to atmosphere).

GRI-GLYCalc VERSION 4.0 - AGGREGATE CALCULATIONS REPORT

Case Name: Targa Midstream Services, L.P. - Mont Belvieu Plant - TEG-1
File Name: \\Targa\targafiles\CorpData\Engineering & Operations\ES&H\Air\Permits\Texas\NSR and PBR Permits\Mont Belvieu Frac\2012-03 NSR Train 5\EPA Additional Questions\Aug 2013 Response\TEG Dehy_Flare_Startup.ddf
Date: September 18, 2013

DESCRIPTION:

Description: TEG-1 Potential Emissions

Annual Hours of Operation: 3.0 hours/yr

EMISSIONS REPORTS:

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0354	0.849	0.0001
Ethane	28.2371	677.689	0.0424
Propane	1.3997	33.593	0.0021
Total Emissions	29.6722	712.132	0.0445
Total Hydrocarbon Emissions	29.6722	712.132	0.0445
Total VOC Emissions	1.3997	33.593	0.0021

UNCONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.0354	0.850	0.0001
Ethane	28.2520	678.047	0.0424
Propane	1.4005	33.611	0.0021
Total Emissions	29.6879	712.509	0.0445
Total Hydrocarbon Emissions	29.6879	712.509	0.0445
Total VOC Emissions	1.4005	33.611	0.0021

FLASH TANK OFF GAS

Component	lbs/hr	lbs/day	tons/yr
Methane	0.5174	12.417	0.0008
Ethane	113.0598	2713.435	0.1696
Propane	2.3874	57.297	0.0036
Total Emissions	115.9646	2783.149	0.1739
Total Hydrocarbon Emissions	115.9646	2783.149	0.1739
Total VOC Emissions	2.3874	57.297	0.0036

EQUIPMENT REPORTS:

CONDENSER

Condenser Outlet Temperature:	120.00 deg. F
Condenser Pressure:	14.70 psia
Condenser Duty:	3.94e-001 MM BTU/hr
Produced Water:	35.24 bbls/day
VOC Control Efficiency:	0.05 %
HAP Control Efficiency:	0.00 %
BTEX Control Efficiency:	0.00 %
Dissolved Hydrocarbons in Water:	30.51 mg/L

Component	Emitted	Condensed
Water	0.45%	99.55%
Carbon Dioxide	99.08%	0.92%
Methane	99.95%	0.05%
Ethane	99.95%	0.05%
Propane	99.95%	0.05%

ABSORBER

Calculated Absorber Stages:	1.39
Specified Dry Gas Dew Point:	5.50 lbs. H2O/MMSCF
Temperature:	100.0 deg. F
Pressure:	393.0 psig
Dry Gas Flow Rate:	110.0000 MMSCF/day
Glycol Losses with Dry Gas:	1.1417 lb/hr
Wet Gas Water Content:	Saturated
Calculated Wet Gas Water Content:	117.92 lbs. H2O/MMSCF
Calculated Lean Glycol Recirc. Ratio:	3.26 gal/lb H2O

Component	Remaining in Dry Gas	Absorbed in Glycol
Water	4.65%	95.35%
Carbon Dioxide	99.83%	0.17%
Methane	99.99%	0.01%
Ethane	99.96%	0.04%
Propane	99.93%	0.07%

FLASH TANK

Flash Control:	Vented to atmosphere
Flash Temperature:	107.0 deg. F
Flash Pressure:	60.0 psig

Component	Left in Glycol	Removed in Flash Gas
Water	99.98%	0.02%
Carbon Dioxide	49.04%	50.96%
Methane	6.41%	93.59%
Ethane	19.99%	80.01%
Propane	36.97%	63.03%

REGENERATOR

No Stripping Gas used in regenerator.

Component	Remaining in Glycol	Distilled Overhead
Water	23.39%	76.61%
Carbon Dioxide	0.00%	100.00%
Methane	0.00%	100.00%
Ethane	0.00%	100.00%
Propane	0.00%	100.00%

STREAM REPORTS:

WET GAS STREAM

Temperature: 100.00 deg. F
Pressure: 407.70 psia
Flow Rate: 4.60e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	2.48e-001	5.42e+002
Carbon Dioxide	3.39e-002	1.81e+002
Methane	2.31e+000	4.49e+003
Ethane	9.64e+001	3.51e+005
Propane	9.60e-001	5.13e+003
Total Components	100.00	3.62e+005

DRY GAS STREAM

Temperature: 100.00 deg. F
Pressure: 407.70 psia
Flow Rate: 4.58e+006 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.16e-002	2.52e+001
Carbon Dioxide	3.40e-002	1.81e+002
Methane	2.32e+000	4.49e+003
Ethane	9.67e+001	3.51e+005
Propane	9.62e-001	5.12e+003
Total Components	100.00	3.61e+005

LEAN GLYCOL STREAM

Temperature: 100.00 deg. F
Flow Rate: 2.80e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.90e+001	1.56e+004
Water	1.00e+000	1.58e+002
Carbon Dioxide	1.99e-013	3.14e-011
Methane	1.18e-019	1.86e-017
Ethane	4.23e-007	6.67e-005
Propane	9.77e-010	1.54e-007

Total Components	100.00	1.58e+004

RICH GLYCOL STREAM

Temperature: 100.00 deg. F
Pressure: 407.70 psia
Flow Rate: 2.93e+001 gpm
NOTE: Stream has more than one phase.

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.50e+001	1.56e+004
Water	4.11e+000	6.75e+002
Carbon Dioxide	1.91e-003	3.14e-001
Methane	3.37e-003	5.53e-001
Ethane	8.60e-001	1.41e+002
Propane	2.31e-002	3.79e+000
Total Components	100.00	1.64e+004

FLASH TANK OFF GAS STREAM

Temperature: 107.00 deg. F
Pressure: 74.70 psia
Flow Rate: 1.46e+003 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.52e-001	1.05e-001
Carbon Dioxide	9.43e-002	1.60e-001
Methane	8.37e-001	5.17e-001
Ethane	9.75e+001	1.13e+002
Propane	1.40e+000	2.39e+000
Total Components	100.00	1.16e+002

FLASH TANK GLYCOL STREAM

Temperature: 107.00 deg. F
Flow Rate: 2.91e+001 gpm

Component	Conc. (wt%)	Loading (lb/hr)
TEG	9.57e+001	1.56e+004
Water	4.14e+000	6.74e+002
Carbon Dioxide	9.44e-004	1.54e-001
Methane	2.17e-004	3.54e-002
Ethane	1.73e-001	2.83e+001
Propane	8.59e-003	1.40e+000
Total Components	100.00	1.63e+004

REGENERATOR OVERHEADS STREAM

Temperature: 212.00 deg. F
Pressure: 14.70 psia

Flow Rate: 1.13e+004 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	9.67e+001	5.17e+002
Carbon Dioxide	1.18e-002	1.54e-001
Methane	7.44e-003	3.54e-002
Ethane	3.17e+000	2.83e+001
Propane	1.07e-001	1.40e+000
Total Components	100.00	5.47e+002

CONDENSER VENT GAS STREAM

Temperature: 120.00 deg. F
Pressure: 14.70 psia
Flow Rate: 4.19e+002 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	1.16e+001	2.31e+000
Carbon Dioxide	3.14e-001	1.53e-001
Methane	2.00e-001	3.54e-002
Ethane	8.50e+001	2.82e+001
Propane	2.87e+000	1.40e+000
Total Components	100.00	3.21e+001

CONDENSER PRODUCED WATER STREAM

Temperature: 120.00 deg. F
Flow Rate: 1.03e+000 gpm

Component	Conc. (wt%)	Loading (lb/hr)	(ppm)
Water	1.00e+002	5.14e+002	999967.
Carbon Dioxide	2.74e-004	1.41e-003	3.
Methane	3.19e-006	1.64e-005	0.
Ethane	2.90e-003	1.49e-002	29.
Propane	1.48e-004	7.59e-004	1.
Total Components	100.00	5.14e+002	1000000.

CONDENSER RECOVERED OIL STREAM

Temperature: 120.00 deg. F

The calculated flow rate is less than 0.000001 #mol/hr.
The stream flow rate and composition are not reported.

FLR-5 Emission Factors [1]

Units	CO	NO_x	C1, C2, and C3 Flare Destruction Efficiency	C4+ Flare Destruction Efficiency
lb/MMBtu	0.2755	0.138	-	-
%	-	-	99%	98%

[1] Flare Emissions factors are from TCEQ Air Permits Division, *Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers,* RG-109 (Draft), October 2000, Table 4 (other, high Btu).

Start-up Emissions Summary

FIN	EPN	Source Name	Hourly Emissions (lb/hr) VOC [1]	Hourly Emissions (lb/hr) NO_x [2]	Hourly Emissions (lb/hr) CO [2]	Annual Emissions (tpy) VOC [1]	Annual Emissions (tpy) NO_x [3]	Annual Emissions (tpy) CO [3]
Startup	FLR-5	Startup Emissions to FLR-5	48.01	3.31	6.60	0.51	0.03	0.05

[1] VOC emissions calculated below.
[2] Hourly emissions of NO_x and CO based on the maximum hourly heating rate among all events.
Hourly Emissions of NO_x or CO (lb/hr) = Emission Factor (lb/MMBtu) x Gas Heating Rate (MMBtu/hr)

$$\text{Hourly Emissions of } NO_x \text{ (lb/hr)} = \frac{0.138 \text{ lb}}{\text{MMBtu}} \Big| \frac{8.89 \text{ MMBtu}}{\text{hr}} = 3.31 \text{ lb/hr}$$

[3] Annual Emissions (tpy) = Emission Factor (lb/MMBtu) x Σ (Hours per Event [hr/event] x Frequency per Year [event/yr] x Gas Heating Rate [MMBtu/hr])

Gas Heating Rates [1]

Speciated Gas	Higher Heating Value (Btu/ft^3)
C1	912
C2	1,699
C3	2,385
iC4	3105
C4	3,123
iC5	3,705
C5	3,714
C6	4,415
C7	4,415

[1] Per Table 5-7 of *Combined Heating, Cooling & Power Handbook: Technologies & Applications,* by Neil Petchers (2003)

Targa Midstream Services LLC - Mont Belvieu Plant
Startup Emissions Sent to Flare Calculations

Startup Parameters for Emissions to FLR-5

Unit ID	Description	Hours Per Event (hr/event)	Frequency per Year (event/yr)	ID (ft)	Height (ft)	Total Volume[1] (ft^3/event)	Total Volume Rate[2] (ft^3/hr)	Vapor Density (lb/ft^3)	Vapor Mass Fraction[3] C1	C2	C3	iC4	C4	iC5	C5	C6	C7+	Gas Heating Rate[4] (MMBtu/hr)
TEG Dehydration Unit[5]																		
TEG-2	TEG Flash Gas Vent and Still Vent	3	1			5,637	1,879											3.26
Pressure Vessels																		
31-358-1 Deeth	DC2	12	1	16	126	28,551	2,379	3.35	0.0323	0.7766	0.1329	0.0269	0.0199	0.0053	0.0033	0.0004	0.0025	4.42
30-358-1	DC2 Reflux Accum	12	1	10	50	4,712	393	7.72	0.0203	0.9699	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.66
30-358-4	C2 Comp suct scrub	6	1	7	10	548	91	7.72	0.0203	0.9699	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.15
30-358-6	Refrig comp suct scrub	6	1	8	10	905	151	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	0.35
30-358-7	Refrig Accumulator	12	1	8	24	1,608	134	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	0.31
31-358-4	DC3	12	1	13	114	16,857	1,405	0.83	0.0000	0.1079	0.6462	0.0800	0.1290	0.0183	0.0122	0.0009	0.0055	3.54
30-358-9	DC3 Reflux Accum	12	1	10	40	3,927	327	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	0.75
30-358-401A/B	C3 COS Reactors	6	1	6	30	1,018	170	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	0.39
30-358-402A/B	C3 H2S Reactors	6	1	7	34	1,578	263	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	0.61
31-358-5	DC4	12	1	10	98	7,620	635	0.33	0.0000	0.0000	0.0069	0.3097	0.5389	0.0728	0.0480	0.0034	0.0203	2.04
30-358-10	DC4 Reflux accum	12	1	9	30	2,185	182	0.46	0.0000	0.0000	0.0079	0.3612	0.6294	0.0014	0.0000	0.0000	0.0000	0.57
31-358-6	C4 Splitter	12	1	12	212	25,334	2,111	0.46	0.0000	0.0000	0.0079	0.3612	0.6294	0.0014	0.0000	0.0000	0.0000	6.57
30-358-11	C4 Splitter comp K.O.	12	1	7	16	747	62	0.59	0.0000	0.0000	0.0225	0.9647	0.0128	0.0000	0.0000	0.0000	0.0000	0.19
30-358-12	C4 Splitter Reflux accum	12	1	9	40	2,752	229	0.46	0.0000	0.0000	0.0225	0.9647	0.0128	0.0000	0.0000	0.0000	0.0000	0.71
30-358-501A/B/C	Gasoline treaters	6	1	8	16	3,619	603	0.12	0.0000	0.0000	0.0000	0.0003	0.0230	0.4936	0.3272	0.0221	0.1338	2.30
30-358-502A/B/C	Caustic separators	6	1	6	20	2,205	368	0.12	0.0000	0.0000	0.0000	0.0003	0.0230	0.4936	0.3272	0.0221	0.1338	1.40
30-358-601A/B	Caustic Contactors	6	1	12	50	14,024	2,337	0.12	0.0000	0.0000	0.0000	0.0003	0.0230	0.4936	0.3272	0.0221	0.1338	8.89
30-358-602A/B	Caustic Settlers	6	1	6	30	2,036	339	0.12	0.0000	0.0000	0.0000	0.0003	0.0230	0.4936	0.3272	0.0221	0.1338	1.29
Pipelines																		
	RP	6	1	1	3,800	2,487	415	3.35	0.0323	0.7766	0.1329	0.0269	0.0199	0.0053	0.0033	0.0004	0.0025	0.77
	C2	6	1	1	3,800	2,487	415	7.72	0.0203	0.9699	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.70
	C3	6	1	1	3,800	1,990	332	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	0.76
	iC4	6	1	1	3,800	1,492	249	0.59	0.0000	0.0000	0.0225	0.9647	0.0128	0.0000	0.0000	0.0000	0.0000	0.77
	nC4	6	1	1	3,800	1,492	249	0.40	0.0000	0.0000	0.0000	0.0401	0.9576	0.0021	0.0001	0.0000	0.0000	0.78
	C5+	6	1	1	3,800	1,492	249	0.12	0.0000	0.0000	0.0000	0.0003	0.0230	0.4936	0.3272	0.0221	0.1338	0.95
Compressors																		
11-358-1A/B	Ethane	1	1	-	-	2,000	2,000	7.72	0.0203	0.9699	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.38
11-358-2A/B	Refrigeration	2	1	-	-	1,200	600	1.50	0.0000	0.1297	0.8584	0.0109	0.0010	0.0000	0.0000	0.0000	0.0000	1.38
11-358-3	C4 Splitter	2	1	-	-	1,000	500	0.59	0.0000	0.0000	0.0225	0.9647	0.0128	0.0000	0.0000	0.0000	0.0000	1.54

[1] Total Volume (ft^3/event) = Pi * (ID (ft) / 2)^2 x Height (ft)

Pressure Vessel 31-358-1 Deeth C3 Total Volume (ft^3/event) = π | (16 ft / 2)^2 | 126 ft = 28,551 ft^3/event

[2] Total Volume Rate (ft^3/hr) = Total Volume (ft^3/event) / Hours Per Event (hr/event)

Pressure Vessel 31-358-1 Deeth C3 Total Volume Rate (ft^3/hr) = (28,551 ft3 / event) | (event / 12 hr) = 2,379 ft3/hr

[3] The mass fraction ratio of n-hexane to n-hexane and higher is 14.2 %

[4] Speciated Gas Heating Rate (MMBtu/hr) = Gas Volume Flow Rate (ft^3/hr) x Component Mass Fraction x Higher Heating Value (Btu/ft^3) x 1 MMBtu / 1,000,000 Btu

[5] TEG-2 data taken from GRI-GLYCalc 4.0

Targa Midstream Services LLC - Mont Belvieu Plant
Startup Emissions Sent to Flare Calculations

Startup Emissions to FLR-5

Unit ID	Description	Emission Groups	Controlled Weight Per Hour (lb/hr) [1] C1	C2	C3	iC4	C4	iC5	C5	C6	C7	Controlled Weight Per Year (lb/yr) [2] C1	C2	C3	iC4	C4	iC5	C5	C6	C7
TEG Dehydration Unit[5]																				
TEG-2	TEG Flash Gas Vent and Still Vent	A	5.53E-03	1.41	0.04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.02	4.24	0.11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pressure Vessels																				
31-358-1 Deeth	DC2	A	2.57	61.80	10.58	4.29	3.16	0.84	0.52	0.07	0.40	30.83	741.64	126.92	51.47	37.92	10.05	6.23	0.79	4.80
30-358-1	DC2 Reflux Accum	A	0.62	29.40	0.30	1.60E-05	3.68E-07	3.68E-07	3.68E-07	5.22E-08	3.16E-07	7.39	352.79	3.57	1.92E-04	4.41E-06	4.41E-06	4.41E-06	6.27E-07	3.79E-06
30-358-4	C2 Comp suct scrub	A	0.14	6.83	0.07	3.71E-06	8.55E-08	8.55E-08	8.55E-08	1.21E-08	7.33E-08	0.86	40.99	0.41	2.23E-05	5.13E-07	5.13E-07	5.13E-07	7.28E-08	4.40E-07
30-358-6	Refrig comp suct scrub	B	1.61E-08	0.29	1.94	0.05	4.51E-03	7.45E-08	7.45E-08	1.06E-08	6.40E-08	9.65E-08	1.75	11.61	0.29	0.03	4.47E-07	4.47E-07	6.35E-08	3.84E-07
30-358-7	Refrig Accumulator	B	1.43E-08	0.26	1.72	0.04	4.01E-03	6.63E-08	6.63E-08	9.41E-09	5.68E-08	1.72E-07	3.12	20.64	0.52	0.05	7.95E-07	7.95E-07	1.13E-07	6.82E-07
31-358-4	DC3	C	7.97E-08	1.26	7.55	1.87	3.02	0.43	0.29	0.02	0.13	9.57E-07	15.13	90.65	22.44	36.20	5.12	3.43	0.26	1.55
30-358-9	DC3 Reflux Accum	C	3.49E-08	0.63	4.20	0.11	9.80E-03	1.62E-07	1.62E-07	2.30E-08	1.39E-07	4.19E-07	7.61	50.40	1.28	0.12	1.94E-06	1.94E-06	2.76E-07	1.67E-06
30-358-401A/B	C3 COS Reactors	D	1.81E-08	0.33	2.18	0.06	5.08E-03	8.39E-08	8.39E-08	1.19E-08	7.19E-08	1.09E-07	1.97	13.06	0.33	0.03	5.03E-07	5.03E-07	7.14E-08	4.32E-07
30-358-402A/B	C3 H2S Reactors	D	2.80E-08	0.51	3.37	0.09	7.87E-03	1.30E-07	1.30E-07	1.85E-08	1.12E-07	1.68E-07	3.06	20.25	0.51	0.05	7.80E-07	7.80E-07	1.11E-07	6.69E-07
31-358-5	DC4	E	6.94E-25	1.62E-09	0.01	1.28	2.23	0.30	0.20	0.01	0.08	8.33E-24	1.95E-08	0.17	15.34	26.70	3.61	2.38	0.17	1.00
30-358-10	DC4 Reflux accum	E	3.02E-25	3.02E-25	6.56E-03	0.60	1.04	2.32E-03	7.66E-05	5.84E-12	3.53E-11	3.62E-24	3.62E-24	0.08	7.19	12.53	0.03	9.19E-04	7.00E-11	4.23E-10
31-358-6	C4 Splitter	E	3.50E-24	3.50E-24	0.08	6.95	12.11	0.03	8.88E-04	6.77E-11	4.09E-10	4.20E-23	4.20E-23	0.91	83.38	145.30	0.32	0.01	8.12E-10	4.91E-09
30-358-11	C4 Splitter comp K.O.	E	1.35E-25	1.35E-25	8.31E-03	0.71	9.46E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E-24	1.61E-24	0.10	8.55	0.11	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30-358-12	C4 Splitter Reflux accum	E	3.81E-25	3.81E-25	0.02	2.02	0.03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.57E-24	4.57E-24	0.28	24.19	0.32	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30-358-501A/B/C	Gasoline treaters	E	0.00E+00	1.98E-24	6.14E-11	3.78E-04	0.03	0.71	0.47	0.03	0.19	0.00E+00	1.19E-23	3.68E-10	2.27E-03	0.20	4.24	2.81	0.19	1.15
30-358-502A/B/C	Caustic separators	E	0.00E+00	1.21E-24	3.74E-11	2.30E-04	0.02	0.43	0.29	0.02	0.12	0.00E+00	7.24E-24	2.24E-10	1.38E-03	0.12	2.58	1.71	0.12	0.70
30-358-601A/B	Caustic Contactors	E	0.00E+00	7.68E-24	2.38E-10	1.46E-03	0.13	2.74	1.82	0.12	0.74	0.00E+00	4.61E-23	1.43E-09	8.79E-03	0.76	16.43	10.89	0.74	4.45
30-358-602A/B	Caustic Settlers	E	0.00E+00	1.11E-24	3.45E-11	2.13E-04	0.02	0.40	0.26	0.02	0.11	0.00E+00	6.69E-24	2.07E-10	1.28E-03	0.11	2.39	1.58	0.11	0.65
Pipelines																				
	RP	-	0.45	10.77	1.84	0.75	0.55	0.15	0.09	0.01	0.07	2.69	64.60	11.06	4.48	3.30	0.88	0.54	0.07	0.42
	C2	-	0.65	31.03	0.31	1.69E-05	3.88E-07	3.88E-07	3.88E-07	5.51E-08	3.33E-07	3.90	186.19	1.88	1.01E-04	2.33E-06	2.33E-06	2.33E-06	3.31E-07	2.00E-06
	C3	-	3.54E-08	0.64	4.26	0.11	9.93E-03	1.64E-07	1.64E-07	2.33E-08	1.41E-07	2.12E-07	3.86	25.53	0.65	0.06	9.83E-07	9.83E-07	1.40E-07	8.44E-07
	iC4	-	5.38E-25	5.38E-25	0.03	2.85	0.04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.23E-24	3.23E-24	0.20	17.10	0.23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	nC4	-	0.00E+00	0.00E+00	0.00E+00	0.08	1.92	4.22E-03	2.01E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.48	11.55	0.03	1.21E-03	0.00E+00	0.00E+00
	C5+	-	0.00E+00	8.17E-25	2.53E-11	1.56E-04	0.01	0.29	0.19	0.01	0.08	0.00E+00	4.90E-24	1.52E-10	9.35E-04	0.08	1.75	1.16	0.08	0.47
Compressors																				
11-358-1A/B	Ethane	-	3.14	149.73	1.52	8.14E-05	1.87E-06	1.87E-06	1.87E-06	2.66E-07	1.61E-06	3.14	149.73	1.52	8.14E-05	1.87E-06	1.87E-06	1.87E-06	2.66E-07	1.61E-06
11-358-2A/B	Refrigeration	-	6.40E-08	1.16	7.70	0.20	0.02	2.97E-07	2.97E-07	4.21E-08	2.54E-07	1.28E-07	2.33	15.40	0.39	0.04	5.93E-07	5.93E-07	8.42E-08	5.09E-07
11-358-3	C4 Splitter	-	1.08E-24	1.08E-24	0.07	5.73	0.08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E-24	2.16E-24	0.13	11.46	0.15	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Emissions[3]			3.33	149.73	11.75	11.56	15.61	4.60	3.03	0.21	1.24	48.83	1,579.01	394.90	250.10	275.96	47.42	30.75	2.51	15.19

[1] Controlled Weight Per Hour (lb/hr) = Total Volume Rate (ft3/hr) x Vapor Density (lb/ft3) x Component Vapor Mass Fraction x (100-(Flare Destruction Factor (%))/100

$$\text{Pressure Vessel 31-358-1 Deeth C3 Weight Per Hour (lb/hr)} = \frac{2{,}379\ \text{ft3}}{\text{hr}} \times \frac{3.35\ \text{lb}}{\text{ft}^3} \times 0.13 \times \frac{100-99\%}{100} = 10.58\ \text{lb/hr}$$

[2] Controlled Weight Per Year (lb/yr) = Total Volume (ft3) x Vapor Density (lb/ft3) x Component Vapor Mass Fraction x Frequency/Year x (100-(Flare Destruction Factor (%))/100

$$\text{Pressure Vessel 31-358-1 Deeth C3 Weight Per Year (lb/yr)} = 28{,}551\ \text{ft3} \times \frac{3.35\ \text{lb}}{\text{ft}^3} \times 0.13 \times \frac{1\ \text{event}}{\text{yr}} \times \frac{100-99\%}{100} = 126.92\ \text{lb/yr}$$

[3] Each of the pipelines, compressors, and pressure vessels groups occur at separate instances. Therefore, hourly emissions are based on the maximum emissions for the sum of the emissions of Group A, B, C, D, E and each of the remaining units. The annual emissions (lb/yr) are the sum of the speciated emissions of all units.

GHG Emissions

Input Data		
Maximum Hourly Release to Flare [1] =	2,379.23	scf/hr
Annual Releases to Flare [1] =	141,502.64	scf/yr
Higher Heating Value for N_2O [2] =	1.235E-03	MMBtu/scf

[1] Hourly inlet to flare based on the maximum hourly releases among all events. Annual inlet to flare based on the sum of the releases from all events.
[2] Per 40 CFR Part 98, Subpart W, Equation W-40

Global Warming Potentials [1]

CO_2	CH_4	N_2O
1	21	310

[1] Global warming potentials (GWP) obtained from 40 CFR 98 Subpart A Table A-1.

N_2O Emissions

Emission Factor[1,2]		N_2O Emissions[3,4]	
(kg/MMBtu)	(lb/MMBtu)	(lb/hr)	(tpy)
1.00E-04	2.20E-04	6.48E-04	1.93E-05

[1] Per 40 CFR 98 Subpart W, Equation W-40.
[2] Emission factors converted from kg/MMBtu to lb/MMBtu using the following conversion: GHG Emission Factor (lb/MMBtu) = GHG Emission Factor (kg/MMBtu) x 2.2046 (lb/kg)
[3] Hourly Emission Rate for N_2O (lb/hr) = Gas Flowrate (scf/hr) x Subpart W Process Gas HHV (MMBtu/scf) x Emission Factor (lb/MMBtu)

Example N_2O Hourly Emissions (lb/hr) = 2,379.23 scf / hr | 1.235E-03 MMBtu / scf | 2.20E-04 lb / MMBtu = 6.48E-04 lb/hr

[4] Annual Emission Rate for N_2O (tpy) = Gas Flowrate (scf/yr) x Subpart W Process Gas HHV (MMBtu/scf) x Emission Factor (lb/MMBtu) / 2,000 (lb/ton)

Example N_2O Annual Emission Rate (tpy) = 141,502.64 scf / yr | 1.235E-03 MMBtu / scf | 2.20E-04 lb / MMBtu | 1 ton / 2,000 lb = 1.93E-05 tpy

Speciated GHG Emissions - FLR-5

Gas Stream	Compound	Number of Carbon Atoms	DRE [1] (%)	Inlet to Flare [2] (lb/hr)	Inlet to Flare [2] (tpy)	Controlled GHG Emissions[3,4] (lb/hr)	Controlled GHG Emissions[3,4] (tpy)	Converted to CO_2 [5,6] (lb/hr)	Converted to CO_2 [5,6] (tpy)
Emissions to FLR-5	Methane	1	99%	333.43	2.44	3.33	0.02	330.09	2.42
	Ethane	2	99%	14,972.69	78.95	--	--	29,645.93	156.32
	Propane	3	99%	1,175.37	19.74	--	--	3,490.85	58.64
	Butanes	4	98%	1,358.50	13.15	--	--	5,325.33	51.55
	Pentanes +	5	98%	454.22	2.40	--	--	2,225.67	11.75

FLR-5 GHG Emissions [7]	(lb/hr)	(tpy)
CO_2	41,017.87	280.68
CH_4	3.33	0.02
N_2O	6.48E-04	1.93E-05
CO_2e	41,088.09	281.20

[1] TCEQ Air Permits Division, Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers, RG-109 (Draft), October 2000.
[2] Inlet to flare based on the maximum uncontrolled hourly and annual releases.
[3] Controlled GHG Emission (lb/hr) = Inlet to Flare (lb/hr) x (100 - Flare DRE (%))/100

Example Controlled Methane Hourly Emission Rate (lb/hr) = 333.43 lb / hr | (100 - 99%) / 100 = 3.33 lb/hr

[4] Controlled GHG Annual Rate (tpy) = Inlet to Flare (tpy) x (100 - Flare DRE (%))/100

Example Controlled Methane Annual Emission Rate (tpy) = 2.44 ton / yr | (100 - 99%) / 100 = 0.02 tpy

[5] Per 40 CFR Part 98.233(z) (Subpart W), for fuel combustion units that combust process vent gas, the following equation is used to estimate the GHG emissions from additional carbon compounds in the fuel.
Hourly Emission Rate for Compounds Converted to CO_2 (lb/hr) = Inlet to Flare (lb/hr) x DRE (%)/100 x Carbon Count (#)

Example Converted Methane Hourly Emission Rate (lb/hr) = 333.43 lb / hr | 99 % / 100 | 1 = 330.09 lb/hr

[6] Annual Emission Rate for Compounds Converted to CO_2 (tpy) = Inlet to Flare (tpy) x DRE (%)/100 x Carbon Count (#)

Example Converted Methane Annual Emission Rate (tpy) = 2.44 ton / yr | 99 % / 100 | 1 = 2.42 tpy

[7] CO_2e Hourly Emission Rate (lb/hr) = CO_2 Emission Rate (lb/hr) x CO_2 GWP + CH_4 Emission Rate (lb/hr) x CH_4 GWP + N_2O Emission Rate (lb/hr) x N_2O GWP

Example CO_2e Hourly Emission Rate (lb/hr) = 41,017.87 lb / hr | 1 + 3.33 lb / hr | 21 + 6.48E-04 lb / hr | 310 = 41,088.09 lb/hr

Targa Midstream Services LLC - Mont Belvieu Plant
Pilot Gas Flare Calculations

Input Data - Pilot Gas

Gas Stream Heat Value =	1,015	Btu/scf
Number of Pilots =	4	
Average Flowrate =	50	scf/hr-pilot
Maximum Flowrate =	0.833	scfm/pilot
Hourly Flowrate [1] =	200	scf/hr
Hours of Operation =	8,760	hrs/yr
Annual Flowrate [2] =	1.752	MMscf/yr
Gas Stream Heat Input [3] =	0.20	MMBtu/hr
Gas Stream Heat Input [4] =	1,778	MMBtu/yr

Compound	Flare Emission Factors [5] (lb/MMBtu)	Pilot Emissions [6, 7]	
		(lb/hr)	(tpy)
NO_x	0.138	0.03	0.12
CO	0.2755	0.06	0.24

[1] Hourly Flowrate (scf/hr) = Average Flowrate (scf/hr-pilot) x Number of Pilots

$$\text{Hourly Flowrate (scf/hr)} = \frac{50.0\text{ scf}}{\text{hr-pilot}} \times 4 = \frac{200\text{ scf}}{\text{hr}}$$

[2] Annual Flowrate (MMscf/yr) = Hourly Flowrate (scf/hr) x Annual Operation (hr/yr) x (1 MMscf /10^6 scf)

$$\text{Annual Flowrate (MMscf/yr)} = \frac{200\text{ scf}}{\text{hr}} \times \frac{8{,}760\text{ hr}}{\text{yr}} \times \frac{1\text{ MMscf}}{10^6\text{ scf}} = \frac{1.752\text{ MMscf}}{\text{yr}}$$

[3] Hourly Gas Stream Heat Input (MMBtu/hr) = Hourly Flowrate (scf/hr) x Gas Stream Heat Value (Btu/scf) x (1 MMscf /10^6 scf)

$$\text{Example Hourly Gas Stream Heat Input (MMBtu/hr)} = \frac{200\text{ scf}}{\text{hr}} \times \frac{1{,}015\text{ Btu}}{\text{scf}} \times \frac{1\text{ MMBtu}}{10^6\text{ Btu}} \quad \frac{0.20\text{ MMBtu}}{\text{hr}}$$

[4] Annual Gas Stream Heat Input (MMBtu/yr) = Hourly Gas Stream Heat Input (MMBtu/hr) x Hours of Operation (hrs/yr)

$$\text{Example Annual Gas Stream Heat Input (MMBtu/yr)} = \frac{0.20\text{ MMBtu}}{\text{hr}} \times \frac{8{,}760\text{ hrs}}{\text{yr}} = \frac{1{,}778\text{ MMBtu}}{\text{yr}}$$

[5] Pilot gas emissions from TCEQ "Air Permit Guidance For Chemical Sources, Flare And Vapor Oxidizers" (Draft Oct. 2000) Table 4, emission factors for industrial flares combusting high-Btu vapors.

[6] Maximum Potential Hourly Emission Rate (lb/hr) = Flare Emission Factor (lb/MMBtu) x Gas Stream Heat Input (MMBtu/hr)

$$\text{Example } NO_x \text{ Hourly Emission Rate (lb/hr)} = \frac{0.138\text{ lb}}{\text{MMBtu}} \times \frac{0.20\text{ MMBtu}}{\text{hr}} = \frac{0.03\text{ lb}}{\text{hr}}$$

[7] Maximum Potential Annual Emission Rate (tpy) = Flare Emission Factor (lb/MMBtu) x Gas Stream Heat Input (MMBtu/yr) x (1 ton / 2,000 lb)

$$\text{Example } NO_x \text{ Annual Emission Rate (tpy)} = \frac{0.138\text{ lb}}{\text{MMBtu}} \times \frac{1{,}778\text{ MMBtu}}{\text{yr}} \times \frac{1\text{ ton}}{2{,}000\text{ lb}} = \frac{0.12\text{ ton}}{\text{yr}}$$

Targa Midstream Services LLC - Mont Belvieu Plant
Pilot Gas Flare Calculations

Flare Emissions - Pilot Gas - VOC

Input Data

Gas Stream Heat Value =	1,015	Btu/scf
Number of Pilots =	4	
Average Flowrate =	50	scf/hr-pilot
Maximum Flowrate =	0.833	scfm/pilot
Hourly Flowrate [1] =	200	scf/hr
Hours of Operation =	8,760	hrs/yr
Annual Flowrate [2] =	1.752	MMscf/yr

Compound	Composition [3] (wt %)	MW (lb/lb-mole)	DRE [4] (%)	Gas Vented to Flare [5] (lb/hr)	Gas Vented to Flare [5] (tpy)	Controlled Emissions [6,7] (lb/hr)	Controlled Emissions [6,7] (tpy)
Methane	88.85	16.04	99%	--	--	--	--
Ethane	3.60	30.07	99%	--	--	--	--
Propane	0.71	44.10	99%	0.16	0.72	1.65E-03	7.22E-03
i-Butane	0.23	58.12	98%	0.07	0.30	1.39E-03	6.09E-03
n-Butane	0.21	58.12	98%	0.06	0.28	1.27E-03	5.54E-03
i-Pentane	0.15	72.15	98%	0.06	0.25	1.15E-03	5.04E-03
n-Pentane	0.08	72.15	98%	0.03	0.13	5.76E-04	2.52E-03
n-Hexane	0.43	86.18	98%	0.19	0.85	3.88E-03	0.02
VOC [8]	1.80	-	0.98	0.58	2.53	9.91E-03	0.04

[1] Hourly Flowrate (scf/hr) = Average Flowrate (scf/hr-pilot) x Number of Pilots

Hourly Flowrate (scf/hr) = 50.0 scf / hr-pilot | 4 = 200 scf / hr

[2] Annual Flowrate (MMscf/yr) = Hourly Flowrate (scf/hr) x Annual Operation (hr/yr) x (1 MMscf /10^6 scf)

Annual Flowrate (MMscf/yr) = 200 scf / hr | 8,760 hr / yr | 1 MMscf / 10^6 scf = 1.752 MMscf / yr

[3] Composition of the gas stream is based on similar operations at the facility.

[4] Per TCEQ Air Permits Division, *Air Permit Technical Guidance for Chemical Sources: Flares and Vapor Oxidizers* , RG-109 (Draft), October 2000.

[5] Gas Vented to Flare (lb/hr) = (Pilot Gas Hourly Flowrate (scf/hr) + Supplemental Fuel Hourly Flowrate (scf/hr)) x Mole Percent / 100 x MW (lb/lb-mole) / 379.5 (scf/lb-mole)

Example Propane Hourly Emission Rate (lb/hr) = 200 scf / hr + #REF! / hr | 0.71 % / 100 | 44.10 lb / lb-mole | lb-mole / 379.5 scf = 0.16 lb / hr

[6] Annual Emissions (tpy) = Hourly Emissions (lb/yr) x Hours of Operation (hrs/yr) x (1 ton / 2,000 lb)

Example Propane Vented to Flare Annual Emission Rate (tpy) = 0.16 lb / hr | 8,760 hrs / yr | 1 ton / 2,000 lb = 0.72 ton / yr

[7] Controlled Maximum Potential Hourly Emission Rate (lb/hr) = Gas Vented to Flare (lb/hr) x (100 - DRE(%))/100

Example Controlled Propane Hourly Emission Rate (lb/hr) = 0.16 lb / hr | (100 - 99%) / 100 = 0.00 lb / hr

[8] Total VOC taken as the sum of NMNEHC. Methane and ethane are not VOCs. Therfore, their emissions are not counted toward the total VOC emissions.

Flare Emissions - Pilot Gas - Greenhouse Gases

Input Data
Pilot Gas = 0.203 MMBtu/hr
Hours of Operation = 8,760 hr/yr

Natural Gas External Combustion Greenhouse Gas Emission Factors [1]

Units [2]	CO_2	CH_4	N_2O
kg/MMBtu	53.02	1.00E-03	1.00E-04
GWP [3]	1	21	310
lb/MMBtu [4]	116.89	2.20E-03	2.20E-04

[1] Per 40 CFR Part 98.233(z)(1) (Subpart W), if the fuel combusted in the stationary or portable equipment is listed in Table C-1 of Subpart C, then emissions are calculated per Subpart C.
[2] Emission factors obtained from 40 CFR 98 Subpart C Tables C-1 and C-2 for natural gas.
[3] Global warming potentials (GWP) obtained from 40 CFR 98 Subpart A Table A-1.
[4] Emission factors converted from kg/MMBtu to lb/MMBtu using the following conversion:
Greenhouse Gas Emission Factor (lb/MMBtu) = Greenhouse Gas Emission Factor (kg/MMBtu) x 2.2046 (lb/kg)

Example CO_2 Emission Factor (lb/MMBtu) = $\frac{53.02\ \text{kg}}{\text{MMBtu}} \times \frac{2.2046\ \text{lb}}{\text{kg}} = \frac{116.89\ \text{lb}}{\text{MMBtu}}$

Compound	Flare Emissions [1, 2, 3] (lb/hr)	(tpy)
CO_2	23.73	103.93
CH_4	4.47E-04	1.96E-03
N_2O	4.47E-05	1.96E-04
CO_2e	23.75	104.03

[1] Maximum Potential Hourly Emission Rate (lb/hr) = Pilot Gas (MMBtu/hr) x Emission Factor (lb/MMBtu)

Example CO_2 Hourly Emission Rate (lb/hr) = $\frac{0.20\ \text{MMBtu}}{\text{hr}} \times \frac{53.02\ \text{lb}}{\text{MMBtu}} = \frac{23.73\ \text{lb}}{\text{hr}}$

[2] Maximum Potential Annual Emission Rate (tpy) = Hourly Emission Rate (lb/hr) x Hours of Operation (hr/yr) x (1 ton / 2,000 lb)

Example CO_2 Annual Emission Rate (tpy) = $\frac{23.73\ \text{lb}}{\text{hr}} \times \frac{8{,}760\ \text{hr}}{\text{yr}} \times \frac{1\ \text{ton}}{2{,}000\ \text{lb}} = \frac{0{,}104\ \text{ton}}{\text{yr}}$

[3] CO_2e emissions based on GWPs for each greenhouse gas pollutant.
CO_2e Hourly Emission Rate (lb/hr) = CO_2 Emission Rate (lb/hr) x CO_2 GWP + CH_4 Emission Rate (lb/hr) x CH_4 GWP + N_2O Emission Rate (lb/hr) x N_2O GWP

Example CO_2e Hourly Emission Rate (lb/hr) = $\frac{23.73\ \text{lb}}{\text{hr}} \times 1 + \frac{0.00\ \text{lb}}{\text{hr}} \times 21 + \frac{4.47\text{E-}05\ \text{lb}}{\text{hr}} \times 310 = \frac{23.75\ \text{lb}}{\text{hr}}$