

US EPA ARCHIVE DOCUMENT



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May 9, 2013

Ms. Aimee Wilson
Air Permits Section (6PD-R)
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, TX 75202

**Re: Corpus Christi Liquefaction, LLC
GHG Permit Application
Updates to Permit Application**

Dear Ms. Wilson:

Corpus Christi Liquefaction, LLC (CCL) proposes to construct and operate natural gas liquefaction and export plant and import facilities with regasification capabilities (collectively referred to as the "LNG Terminal") in San Patricio and Nueces Counties, Texas. An Environmental Protection Agency (EPA) Air Quality Permit Application was submitted by CCL in August. At this time, CCL is submitting updated process and emissions information for the Wet/Dry Flares and the Marine Flare. In addition, CCL is updating the emissions information for the fugitives and adding emissions from maintenance of the BOG compressors.

Wet/Dry Flares Updates

Based on additional engineering and the refinement of operations and maintenance plans, CCL has identified additional continuous and intermittent gas flows to the Wet/Dry Flares (Emission Point Number [EPN]s WTDYFLR1 and WTDYFLR2). The additional continuous flow results from refrigerant compressor seal leakage. Refrigerant (methane, propane and ethylene) leakage will occur during normal operation of the compressor dry gas seals. Primary and secondary recovery systems will capture most of the refrigerant seal leakage; however, relatively small quantities of refrigerants will pass through the recovery systems (at pressures that are lower than practically feasible to recover). These gases will be routed to the wet/dry flare header for control in the flares. The estimated leak rates are based on the compressor manufacturer's guarantee.

The additional intermittent flows occur due to additional planned inspection and maintenance activities designed to ensure safety, reliability and performance of the refrigerant compressors and gas turbine drivers. These activities will require the intermittent depressurization and purging of refrigerant systems, which will result in additional gas flows routed to the wet/dry flares. In addition to the complete "major overhaul" of two refrigeration trains per year described in the initial application submittal, more frequent maintenance activities have been identified, due primarily to wear of turbine components attributable to

the injection of water for control of emission of oxides of nitrogen (NO_x). These additional activities range from routine bore-scope inspection of compressor and turbine components every 6 months to complete gas generator change-out every 36 months.

Control of continuous and intermittent gas flows to the wet/dry flares will be consistent with BACT destruction efficiencies represented in the initial application submittal. Hourly and annual emissions for normal operation of the wet/dry gas flares based on pilot and continuous flows are proposed. Proposed changes in total annual emissions for planned MSS are based on the projected "worst case" scenario for additional annual inspection and maintenance activities. Maximum hourly emissions for planned MSS are based on the projected "worst case" for the "major overhaul" scenario.

Marine Flare Updates

The Marine Flare is represented as having 2,800 hours of pilot flame operation in the original application submittal. Revised scheduling simulations indicate that LNG carriers may be berthed at one or both of the facility's two docks for longer periods than originally anticipated, with each vessel potentially docked several days per call. As a result, LNG vapors from those vessels will be routed to the Marine Flare for more than 2,800 hours per year, during which periods the pilot must remain in operation. To accommodate the duration of anticipated LNG vessels calls, CCL has updated the pilot flame calculations to allow for 8,760 hours of operation per year. LNG vapors will be controlled once sufficient methane in the vent stream is introduced from the LNG carriers in accordance with prior representations regarding minimum btu, destruction efficiencies and compliance with operating practices in 40 CFR 60.18. Prior to introduction of sufficient methane, inert noncombustible gases from LNG carriers must be vented through the flare.

Additional Representation Changes

In addition to the changes noted above for the flares, CCL is updating the following items in the permit application. The first update is to add a representation of maintenance on the BOG Compressors. These compressors are scheduled to be overhauled every two years. Purge gas and startup emissions from the compressors will be vented to the atmosphere. Methane emissions from BOG Compressor maintenance has been added to Table 1(a).

The second update is for the fugitive emissions. Emissions estimates have been updated based on the control methodologies presented in the Response to Completeness Determination submitted in March 2013. Components in greater than 10% VOC service will be monitored using the 28LAER program. Components in methane service will be monitored using a modified 28M program.

Updated emission calculations for the Wet/Dry Flares, Marine Flare, BOG Compressor, and Fugitives are attached. An updated Table 1(a) (with changes in bold) is also attached.

Should you have any questions about this filing, please feel free to contact the undersigned at (713) 375-5000.

Respectfully Submitted,



David F. Ayers
Corpus Christi Liquefaction, LLC



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	Rev. 5/9/2013	Permit No:	Regulated Entity No:	104401716
Area Name:	Corpus Christi Liquefaction, LLC		Customer Reference No.:	603391640

Review of applications and issuance of permits will be expedited by supplying all necessary information requested on this Table.

AIR CONTAMINANT DATA				
1. Emission Point				
(A) EPN	(B) FIN	(C) NAME	2. Component or Air Contaminant Name	3. Air Contaminant Emission Rate (A) MTCE/yr (B) TPY
TRB1	TRB1	Turbine 1	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28
TRB2	TRB2	Turbine 2	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28
TRB3	TRB3	Turbine 3	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28
TRB4	TRB4	Turbine 4	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28
TRB5	TRB5	Turbine 5	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28
TRB6	TRB6	Turbine 6	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28
TRB7	TRB7	Turbine 7	CO2	133,031.31 146,600.51
			CH4	2.51 2.77
			N2O	0.25 0.28



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AIR CONTAMINANT DATA				
I. Emission Point			2. Component or Air Contaminant Name	
(A) EPN	(B) FIN	(C) NAME	(A) MTCE/yr	(B) TTPV
TRB8	TRB8	Turbine 8	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28
TRB9	TRB9	Turbine 9	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28
TRB10	TRB10	Turbine 10	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28
TRB11	TRB11	Turbine 11	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28
TRB12	TRB12	Turbine 12	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28
TRB13	TRB13	Turbine 13	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28
TRB14	TRB14	Turbine 14	133,031.31	146,600.51
			2.51	2.77
			0.25	0.28



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AIR CONTAMINANT DATA				
1. Emission Point				
(A) EPN	(B) FIN	(C) NAME	2. Component or Air Contaminant Name	3. Air Contaminant Emission Rate
			(A) MTCE/yr	(B) TTPY
TRB15	TRB15	Turbine 15	CO2	133,031.31
			CH4	2.51
			N2O	0.25
TRB16	TRB16	Turbine 16	CO2	133,031.31
			CH4	2.51
			N2O	0.25
TRB17	TRB17	Turbine 17	CO2	133,031.31
			CH4	2.51
			N2O	0.25
TRB18	TRB18	Turbine 18	CO2	133,031.31
			CH4	2.51
			N2O	0.25
TO-1	TO-1	Thermal Oxidizer 1	CO2	178,255.96
			CH4	0.50
			N2O	0.02
TO-2	TO-2	Thermal Oxidizer 2	CO2	178,255.96
			CH4	0.50
			N2O	0.02
TO-3	TO-3	Thermal Oxidizer 3	CO2	178,255.96
			CH4	0.50
			N2O	0.02



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	Rev. 5/9/2013	Permit No:	Regulated Entity No:	104401716
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AIR CONTAMINANT DATA				
1. Emission Point				
(A) EPN	(B) FIN	(C) NAME	2. Component or Air Contaminant Name	3. Air Contaminant Emission Rate (A) MTCE/yr (B) TTPY
WTDYFLR1	WTDYFLR1	Wet/Dry Gas Flare 1 (continuous)	CO2	10,590.18 11,670.38
			CH4	11.52 12.70
			N2O	0.02 0.02
WTDYFLR2	WTDYFLR2	Wet/Dry Gas Flare 1 (MSS)	CO2	49,230.44 54,251.94
			CH4	155.31 171.15
			N2O	0.08 0.09
WTDYFLR2	WTDYFLR2	Wet/Dry Gas Flare 2 (continuous)	CO2	10,590.18 11,670.38
			CH4	11.52 12.70
			N2O	0.02 0.02
MRNFLR	MRNFLR	Wet/Dry Gas Flare 2 (MSS)	CO2	49,230.44 54,251.94
			CH4	155.31 171.15
			N2O	0.08 0.09
BOG	BOG	Marine Flare	CO2	23,532.02 25,932.28
			CH4	96.72 106.59
			N2O	0.01 0.01
GEN1	GEN1	BOG Compressor Venting (MSS)	CH4	0.68 0.75
			CO2	31.55 34.77
			CH4	< 0.01 < 0.01
GEN2	GEN2	Standby Generator 1	N2O	< 0.01 < 0.01
			CO2	31.55 34.77
			CH4	< 0.01 < 0.01
GEN2	GEN2	Standby Generator 2	CO2	31.55 34.77
			CH4	< 0.01 < 0.01
			N2O	< 0.01 < 0.01



TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Table 1(a) Emission Point Summary

Date:	Rev. 5/9/2013	Permit No:	Regulated Entity No: 104401716
Area Name:	Corpus Christi Liquefaction, LLC	Customer Reference No.: 603391640	

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AIR CONTAMINANT DATA				
1. Emission Point				
(A) EPN	(B) FIN	(C) NAME	2. Component or Air Contaminant Name	3. Air Contaminant Emission Rate (A) MTCE/yr (B) TTPY
GEN3	GEN3	Standby Generator 3	CO2	31.55 34.77
			CH4	< 0.01 < 0.01
			N2O	< 0.01 < 0.01
GEN4	GEN4	Standby Generator 4	CO2	31.55 34.77
			CH4	< 0.01 < 0.01
			N2O	< 0.01 < 0.01
FWPUMP1	FWPUMP1	Diesel Firewater Pump 1	CO2	11.37 12.53
			CH4	< 0.01 < 0.01
			N2O	< 0.01 < 0.01
FWPUMP2	FWPUMP2	Diesel Firewater Pump 2	CO2	11.37 12.53
			CH4	< 0.01 < 0.01
			N2O	< 0.01 < 0.01
FWPUMP3	FWPUMP3	Diesel Firewater Pump 3	CO2	11.37 12.53
			CH4	< 0.01 < 0.01
			N2O	< 0.01 < 0.01
FUG	FUG	Fugitive Emissions	CO2	0.20 0.22
			CH4	392.90 432.98

EPN = Emission Point Number

FIN = Facility Identification Number

Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
Summary of Updated GHG Emission Rates

WET/DRY FLARE PILOTS

Pollutant	Hourly Emissions		Annual Emissions	
	Wet/Dry Flare 1 (lb/hr)	Wet/Dry Flare 2 (lb/hr)	Wet/Dry Flare 1 (tpy)	Wet/Dry Flare 2 (tpy)
CO ₂	3.33E+01	3.33E+01	1.46E+02	1.46E+02
CH ₄	1.19E-01	1.19E-01	2.72E-02	2.72E-02
N ₂ O	5.73E-05	5.73E-05	1.86E-09	1.86E-09
CO ₂ e	3.58E+01	3.58E+01	1.46E+02	1.46E+02

WET/DRY FLARE CONTINUOUS FLOWS

Pollutant	Hourly Emissions		Annual Emissions	
	Wet/Dry Flare 1 (lb/hr)	Wet/Dry Flare 2 (lb/hr)	Wet/Dry Flare 1 (tpy)	Wet/Dry Flare 2 (tpy)
CO ₂	2.71E+03	1.32E+03	1.15E+04	5.76E+03
CH ₄	3.18E+00	1.45E+00	1.27E+01	6.33E+00
N ₂ O	4.16E-03	2.01E-03	1.76E-02	8.82E-03
CO ₂ e	2.78E+03	1.35E+03	1.18E+04	5.90E+03

WET/DRY FLARE MAINTENANCE AND TURNAROUND

Pollutant	Hourly Emissions		Annual Emissions	
	Wet/Dry Flare 1 (lb/hr)	Wet/Dry Flare 2 (lb/hr)	Wet/Dry Flare 1 (tpy)	Wet/Dry Flare 2 (tpy)
CO ₂	2.60E+05	2.60E+05	1.49E+03	7.47E+02
CH ₄	6.64E+01	6.64E+01	6.01E-01	3.00E-01
N ₂ O	3.79E-01	3.79E-01	3.31E-03	1.66E-03
CO ₂ e	2.60E+05	2.60E+05	1.51E+03	7.54E+02

WET/DRY FLARE MAJOR OVERHAUL

Pollutant	Hourly Emissions		Annual Emissions
	Wet/Dry Flare 1 (lb/hr)	Wet/Dry Flare 2 (lb/hr)	Wet/Dry Flare 1 and 2 combined (tpy)
CO ₂	7.50E+05	7.50E+05	5.28E+04
CH ₄	2.53E+03	2.53E+03	1.71E+02
N ₂ O	1.27E+00	1.27E+00	8.89E-02
CO ₂ e	8.03E+05	8.03E+05	5.64E+04

MARINE FLARE PILOTS

Pollutant	Marine Flare (lb/hr)	Marine Flare (tpy)
CO ₂	3.33E+01	1.46E+02
CH ₄	1.19E-01	2.72E-02
N ₂ O	5.73E-05	1.86E-09
CO ₂ e	3.58E+01	1.46E+02

MARINE FLARE INERT SHIP GAS-UP VENTING

Pollutant	Inert Ship Venting (lb/hr)	Inert Ship Venting (tpy)
CO ₂	1.97E+05	2.58E+04
CH ₄	1.27E+03	1.07E+02
N ₂ O	8.11E-02	9.73E-03
CO ₂ e	2.23E+05	2.80E+04

BOG COMPRESSOR OVERHAUL

Pollutant	BOG Compressor (lb/hr)	BOG Compressor (tpy)
CO ₂	--	--
CH ₄	2.88E+02	7.54E-01
N ₂ O	--	--
CO ₂ e	6.05E+03	1.58E+01

FUGITIVES

Pollutant	Fugitives (lb/hr)	Fugitives (tpy)
CO ₂	5.07E-02	2.22E-01
CH ₄	9.89E+01	4.33E+02
N ₂ O	--	--
CO ₂ e	2.08E+03	9.09E+03

Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
Wet/Dry Flare and Marine Flare Pilot Emissions

Pilot Gas Emissions

Number of Pilots = 4 [1]
 Flare Pilot Heat Input = 0.065 MMBtu/hr [1]
 Heating Value of Fuel = 850.24 Btu/scf
 Pilot Gas Molar Flowrate = 0.20 lb-mol/hr
 Annual Operating Time = 8,760 hr/yr [1]

Emissions From Pilot Gas Combustion

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[2]	3.33E+01	1.46E+02
CH ₄			[3]	1.19E-01	2.72E-02
N ₂ O	1.0E-04	kg/MMBtu	[4]	5.73E-05	1.86E-09
CO ₂ e	--	--	[5]	3.58E+01	1.46E+02

[1] Data provided by Cheniere.

[2] Based on mass balance of carbon in pilot gas.

[3] Emission rate estimated at a DRE of 99%

[4] Based on EPA default factors in U.S. EPA, 40 CFR 98 Subpart C, Tables C-1 and C-2 for natural gas.

[5] CH₄, CO₂, and N₂O are included in the emissions of CO₂ equivalent (CO₂e), weighted according to their global warming potentials (GWP). The GWP of CH₄ is 21, of CO₂ is 1, and of N₂O is 310.

Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
Marine Flare Flows

Emissions from Inert Ship Gas-Up Venting

First Volume Change (emissions routed through flare stack but not combusted)

Vent Flow = 3.77E+04 lb/hr
Annual Operating Time= 300 hr/yr

Constituents	Mol %	Molecular Weight (lb/lb-mol)	NHV Btu/lb	Molar mass	Weight Fraction	Net Heat Release Btu/lb	Emissions	
							Hourly (lb/hr)	Annual (tpy)
Nitrogen	8.50E+01	28.01		2.38E+01	1.28E+00	0.00E+00	4.83E+04	7.25E+03
Carbon Dioxide	1.40E+01	44.01		6.16E+00	3.32E-01	0.00E+00	1.25E+04	1.88E+03
Methane	1.00E+00	16.04	2.15E+04	1.60E-01	8.64E-03	1.86E+02	3.26E+02	4.88E+01

First 20% of Second Volume Change (emissions routed through flare stack but not combusted)

Vent Flow = 3.68E+04 lb/hr
Annual Operating Time= 60 hr/yr

Constituents	Mol %	Molecular Weight (lb/lb-mol)	NHV Btu/lb	Molar mass	Weight Fraction	Net Heat Release Btu/lb	Emissions	
							Hourly (lb/hr)	Annual (tpy)
Nitrogen	8.40E+01	28.01		2.35E+01	1.27E+00	0.00E+00	4.67E+04	1.40E+03
Carbon Dioxide	1.20E+01	44.01		5.28E+00	2.85E-01	0.00E+00	1.05E+04	3.14E+02
Methane	4.00E+00	16.04	2.15E+04	6.42E-01	3.46E-02	7.44E+02	1.27E+03	3.82E+01

Last 80% of Second Volume Change (flare is lit and combusting emissions)

Flare Fuel Flow = 2.27E+04 lb/hr
Heating Value of inert ship gas = 16,192 Btu/lb
Operating Rate = 3.68E+02 MMBtu/hr
Annual Operating Time= 240 hr/yr

Constituents	Mol %	Molecular Weight (lb/lb-mol)	NHV Btu/lb	Molar mass	Weight Fraction	Net Heat Release Btu/lb	Flow to Flare	
							Hourly (lb/hr)	Annual (tpy)
Nitrogen	1.30E+01	28.01		3.65E+00	1.97E-01	0.00E+00	4.47E+03	5.36E+02
Hydrogen Sulfide	2.62E-04	34.08	2.89E+01	8.93E-05	4.82E-06	1.39E-04	1.09E-01	1.31E-02
Water	6.00E-02	18.02		1.08E-02	5.83E-04	0.00E+00	1.32E+01	1.59E+00
Carbon Dioxide	2.01E+00	44.01		8.84E-01	4.76E-02	0.00E+00	1.08E+03	1.30E+02
Methane	8.28E+01	16.04	2.15E+04	1.33E+01	7.16E-01	1.54E+04	1.63E+04	1.95E+03
Ethane	1.75E+00	30.069	2.04E+04	5.27E-01	2.84E-02	5.80E+02	6.45E+02	7.73E+01
Propane	2.30E-01	44.096	1.99E+04	1.01E-01	5.45E-03	1.09E+02	1.24E+02	1.49E+01
Isobutane	5.95E-02	58.122	1.96E+04	3.46E-02	1.86E-03	3.65E+01	4.23E+01	5.08E+00
n-Butane	4.25E-02	58.122	1.96E+04	2.47E-02	1.33E-03	2.62E+01	3.02E+01	3.63E+00
Isopentane	1.70E-02	72.149	1.93E+04	1.23E-02	6.61E-04	1.28E+01	1.50E+01	1.80E+00
n-Pentane	8.50E-03	72.149	1.93E+04	6.13E-03	3.31E-04	6.39E+00	7.51E+00	9.01E-01
n-Hexane	1.70E-02	86.175	1.92E+04	1.46E-02	7.90E-04	1.52E+01	1.79E+01	2.15E+00
n-Heptane	8.50E-03	100.2	1.92E+04	8.52E-03	4.59E-04	8.80E+00	1.04E+01	1.25E+00
						18.56	16,192.0	

Emissions From Inert Ship Gas-Up Venting

Pollutant	Emission Factor		References	Emission Rate	
				Hourly (lb/hr)	Annual (tpy)
CO ₂			[1]	1.97E+05	2.58E+04
CH ₄			[2]	1.27E+03	1.07E+02
N ₂ O	1.0E-04	kg/MMBtu	[3]	8.11E-02	9.73E-03
CO ₂ e	--	--	[4]	2.23E+05	2.80E+04

[1] Based on mass balance of carbon in purge gas.

[2] Emission rate estimated at a DRE of 99% (during last 80% of second volume when emissions are combusted).

[3] Based on EPA default factors in U.S. EPA, 40 CFR 98 Subpart C, Tables C-1 and C-2 for natural gas.

[4] CH₄, CO₂, and N₂O are included in the emissions of CO₂ equivalent (CO₂e), weighted according to their global warming potentials (GWP). The GWP of CH₄ is 21, of CO₂ is 1, and of N₂O is 310.

**Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
Wet/Dry Flare Continuous Flows**

Continuous Flow to Flare 1

Continuous Flow Gas Heat Input = 18.89 MMBtu/hr
160,000.99 MMBtu/yr

Emissions From Continuous Flow Gas Combustion

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	2.71E+03	1.15E+04
CH ₄			[2]	3.18E+00	1.27E+01
N ₂ O	1.0E-04	kg/MMBtu	[3]	4.16E-03	1.76E-02
CO ₂ e	--	--	[4]	2.78E+03	1.18E+04

Continuous Flow to Flare 2

Continuous Flow Gas Heat Input = 9.13 MMBtu/hr
79,996.76 MMBtu/yr

Emissions From Continuous Flow Gas Combustion

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	1.32E+03	5.76E+03
CH ₄			[2]	1.45E+00	6.33E+00
N ₂ O	1.0E-04	kg/MMBtu	[3]	2.01E-03	8.82E-03
CO ₂ e	--	--	[4]	1.35E+03	5.90E+03

[1] Based on mass balance of carbon in purge gas.

[2] Emission rate estimated at a DRE of 99%

[3] Based on EPA default factors in U.S. EPA, 40 CFR 98 Subpart C, Tables C-1 and C-2 for natural gas.

[4] CH₄, CO₂, and N₂O are included in the emissions of CO₂ equivalent (CO₂e), weighted according to their global warming potentials (GWP). The GWP of CH₄ is 21, of CO₂ is 1, and of N₂O is 310.

Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
Wet/Dry Flare Maintenance and Turnaround Emissions

LNG Train Planned Maintenance Emissions

Borescope Purges

Purge Gas Heat Input = 1096.23 MMBtu/hr
19732.17 MMBtu/yr

Emissions From Borescope Purges

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	1.62E+05	9.75E+02
CH ₄			[2]	6.64E+01	5.98E-01
N ₂ O	1.0E-04	kg/MMBtu	[3]	2.42E-01	2.18E-03
CO ₂ e	--	--	[4]	1.64E+05	9.88E+02

Combustor Changeout/Hot Section Purges

Purge Gas Heat Input = 1096.23 MMBtu/hr
9866.09 MMBtu/yr

Emissions From Combustor Changeout/Hot Section Purges

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	1.62E+05	4.87E+02
CH ₄			[2]	6.64E+01	2.99E-01
N ₂ O	1.0E-04	kg/MMBtu	[3]	2.42E-01	1.09E-03
CO ₂ e	--	--	[4]	1.64E+05	4.94E+02

Combustor Changeout/Hot Section Startup

Purge Gas Heat Input = 1719.28 MMBtu/hr
15473.55 MMBtu/yr

Emissions From Combustor Changeout/Hot Section Startup

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	2.60E+05	7.80E+02
CH ₄			[2]	1.08E+00	4.85E-03
N ₂ O	1.0E-04	kg/MMBtu	[3]	3.79E-01	1.71E-03
CO ₂ e	--	--	[4]	2.60E+05	7.81E+02

[1] Based on mass balance of carbon in purge gas.

[2] Emission rate estimated at a DRE of 99%

[3] Based on EPA default factors in U.S. EPA, 40 CFR 98 Subpart C, Tables C-1 and C-2 for natural gas.

[4] CH₄, CO₂, and N₂O are included in the emissions of CO₂ equivalent (CO₂e), weighted according to their global warming potentials (GWP). The GWP of CH₄ is 21, of CO₂ is 1, and of N₂O is 310.

Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
Wet/Dry Flare Major Overhaul Intermittent MSS Emissions

LNG Train Planned Maintenance Emissions

Purge of Feed Gas

Purge Gas Heat Input = 5.23E+03 MMBtu/hr
7.75E+05 MMBtu/yr

Emissions From Purge of Feed Gas

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	6.81E+05	5.05E+04
CH ₄			[2]	2.30E+03	1.70E+02
N ₂ O	1.0E-04	kg/MMBtu	[3]	1.15E+00	8.54E-02
CO ₂ e	--	--	[4]	7.30E+05	5.41E+04

Major Overhaul Purge Depressurization

Purge Gas Heat Input = 9.17E+02 MMBtu/hr
7.34E+03 MMBtu/yr

Emissions From Major Overhaul Purge Depressurization

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	1.22E+05	4.88E+02
CH ₄			[2]	5.30E+01	2.12E-01
N ₂ O	1.0E-04	kg/MMBtu	[3]	2.02E-01	8.09E-04
CO ₂ e	--	--	[4]	1.23E+05	4.93E+02

Major Overhaul Purge Fuel Gas

Purge Gas Heat Input = 6.10E+02 MMBtu/hr
3.66E+03 MMBtu/yr

Emissions From Major Overhaul Purge Fuel Gas

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	9.26E+04	2.78E+02
CH ₄			[2]	5.58E-01	1.67E-03
N ₂ O	1.0E-04	kg/MMBtu	[3]	1.35E-01	4.04E-04
CO ₂ e	--	--	[4]	9.26E+04	2.78E+02

Major Overhaul Startup Fuel Gas

Purge Gas Heat Input = 6.10E+02 MMBtu/hr
3.66E+03 MMBtu/yr

Emissions From Major Overhaul Startup Fuel Gas

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	9.26E+04	2.78E+02
CH ₄			[2]	5.58E-01	1.67E-03
N ₂ O	1.0E-04	kg/MMBtu	[3]	1.35E-01	4.04E-04
CO ₂ e	--	--	[4]	9.26E+04	2.78E+02

Major Overhaul Startup Refrigerant

Purge Gas Heat Input = 2.08E+03 MMBtu/hr
1.66E+04 MMBtu/yr

Emissions From Major Overhaul Startup Refrigerant

Pollutant	Emission Factor		References	Emission Rate	
				Average (lb/hr)	Annual (tpy)
CO ₂			[1]	3.11E+05	1.25E+03
CH ₄			[2]	6.96E+01	2.78E-01
N ₂ O	1.0E-04	kg/MMBtu	[3]	4.59E-01	1.84E-03
CO ₂ e	--	--	[4]	3.13E+05	1.25E+03

Emissions Summary from Major Overhaul

Pollutant	Emission Rate		
	Hourly [5] (lb/hr)	Maximum [6] (lb/hr)	Annual (tpy)
CO ₂	6.81E+05	7.50E+05	5.28E+04
CH ₄	2.30E+03	2.53E+03	1.71E+02
N ₂ O	1.15E+00	1.27E+00	8.89E-02
CO ₂ e	7.30E+05	8.03E+05	5.64E+04

[1] Based on mass balance of carbon in purge gas.

[2] Emission rate estimated at a DRE of 99%

[3] Based on EPA default factors in U.S. EPA, 40 CFR 98 Subpart C, Tables C-1 and C-2 for natural gas.

[4] CH₄, CO₂, and N₂O are included in the emissions of CO₂ equivalent (CO₂e), weighted according to their global warming potentials (GWP). The GWP of CH₄ is 21, of CO₂ is 1, and of N₂O is 310.

[5] Purge flows will not occur in same hour as purge of feedgas. Hourly rates are maximum of all scenarios.

[6] Maximum hourly emission rates are based on maximum expected variability during routine operations.

**Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project
BOG Compressor Major Overhaul**

BOG Compressor Purge

Methane Purge Flowrate = 97 lb/purge
BOG Purge per year = 1
Duration of BOG Purge = 3 hr
BOG Compressors = 5

Methane Gas Composition

Constituents	Mol %	Molecular Weight (lb/lb-mol)	NHV [4] Btu/lb	Molar mass	Weight Fraction	Net Heat Release Btu/lb	Emission Rates	
							Hourly (lb/hr)	Annual (tpy)
Nitrogen	3.00E+00	28.01		0.84	0.0512	0.00	8.28E+00	1.24E-02
Methane	9.70E+01	16.04	21508.9	15.56	0.9488	20406.77	1.53E+02	2.30E-01
						16.40	20406.77	

BOG Compressor Startup

Methane Purge Flowrate = 221 lb/purge
BOG Startup per year = 1
Duration of BOG Startup = 4 hr
BOG Compressors = 5

Methane Gas Composition

Constituents	Mol %	Molecular Weight (lb/lb-mol)	NHV [4] Btu/lb	Molar mass	Weight Fraction	Net Heat Release Btu/lb	Emission Rates	
							Hourly (lb/hr)	Annual (tpy)
Nitrogen	3.00E+00	28.01		0.84	0.0512	0.00	1.42E+01	2.83E-02
Methane	9.70E+01	16.04	21508.9	15.56	0.9488	20406.77	2.62E+02	5.24E-01
						16.40	20406.77	

Pollutant	Emission Rates		
	Hourly (lb/hr)	Maximum (lb/hr)	Annual (tpy)
Methane	2.62E+02	2.88E+02	7.54E-01

**Corpus Christi Liquefaction, LLC
Corpus Christi Liquefaction Project**

Fugitive Emissions

BD-Hydrocarbon Blowdown

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	881	0.0089	75%	7.841	34.343	1.960	8.586
Total							1.960	8.586

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	0.03	28.01	0.84	0.05	9.92E-04	4.35E-03
CO2	0.01	44.01	0.44	0.03	5.20E-04	2.28E-03
Methane	96.89	16.04	1554.12	93.61	1.83E+00	8.04E+00
Ethane	2.43	30.07	73.07	4.40	8.63E-02	3.78E-01
Propane	0.42	44.10	18.52	1.12	2.19E-02	9.58E-02
i-Butane	0.1	58.12	5.81	0.35	6.86E-03	3.01E-02
n-Butane	0.09	58.12	5.23	0.32	6.18E-03	2.71E-02
i-Pentane	0.01	72.15	0.72	0.04	8.52E-04	3.73E-03
n-Pentane	0.02	72.15	1.44	0.09	1.70E-03	7.46E-03

1660.20

DF-Defrost Gas (Fuel Gas)

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	267	0.0089	75%	2.376	10.408	0.594	2.602
Relief Valves	Gas/Vapor	3	0.2293	75%	0.688	3.013	0.172	0.753
Total							0.766	3.355

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	0.52	28.01	14.57	0.87	6.68E-03	2.93E-02
CO2	0.01	44.01	0.44	0.03	2.02E-04	8.84E-04
Methane	96.45	16.04	1547.06	92.62	7.10E-01	3.11E+00
Ethane	2.24	30.07	67.36	4.03	3.09E-02	1.35E-01
Propane	0.39	44.10	17.20	1.03	7.89E-03	3.45E-02
i-Butane	0.09	58.12	5.23	0.31	2.40E-03	1.05E-02
n-Butane	0.09	58.12	5.23	0.31	2.40E-03	1.05E-02
i-Pentane	0.02	72.15	1.44	0.09	6.62E-04	2.90E-03
n-Pentane	0.07	72.15	5.05	0.30	2.32E-03	1.01E-02
n-Hexane	0.01	86.07	0.86	0.05	3.95E-04	1.73E-03
n-Heptane	0.02	100.21	2.00	0.12	9.19E-04	4.03E-03
n-Octane	0.01	114.23	1.14	0.07	5.24E-04	2.29E-03
n-Nonane	0.01	128.26	1.28	0.08	5.88E-04	2.58E-03
H2O	0.04	18.02	0.72	0.04	3.30E-04	1.45E-03
m-cyclopentane	0.01	70.10	0.70	0.04	3.22E-04	1.41E-03

1670.29

FD-Dry Flare

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	1,129	0.0089	75%	10.048	44.011	2.512	11.003
Total							2.512	11.003

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	5.43E+00	28.01	152.19	9.02	2.27E-01	9.92E-01
CO2	2.48E-01	44.01	10.93	0.65	1.63E-02	7.13E-02
Methane	9.37E+01	16.04	1502.61	89.06	2.24E+00	9.80E+00
Ethane	4.48E-01	30.07	13.47	0.80	2.01E-02	8.78E-02
Propane	6.51E-02	44.10	2.87	0.17	4.27E-03	1.87E-02
i-Butane	1.77E-02	58.12	1.03	0.06	1.53E-03	6.70E-03
n-Butane	1.47E-02	58.12	0.85	0.05	1.27E-03	5.57E-03
i-Pentane	6.47E-03	72.15	0.47	0.03	6.95E-04	3.04E-03
n-Pentane	3.23E-03	72.15	0.23	0.01	3.47E-04	1.52E-03
n-Hexane	7.63E-03	86.07	0.66	0.04	9.78E-04	4.28E-03
Benzene	2.05E-03	78.11	0.16	0.01	2.38E-04	1.04E-03
n-Heptane	4.55E-03	100.21	0.46	0.03	6.79E-04	2.97E-03
H2O	7.06E-02	18.02	1.27	0.08	1.89E-03	8.30E-03
H2S	3.08E-04	34.08	0.01	0.001	1.57E-05	6.85E-05
aMDEA Solution	2.92E-15	119.16	3.48E-13	2.06E-14	5.18E-16	2.27E-15

1687.20

FG-Fuel Gas

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	895	0.0089	75%	7.966	34.889	1.991	8.722
Relief Valves	Gas/Vapor	18	0.2293	75%	4.127	18.078	1.032	4.520
Total							3.023	13.242

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	5.43E+00	28.01	152.19	9.02	2.73E-01	1.19E+00
CO2	2.48E-01	44.01	10.93	0.65	1.96E-02	8.58E-02
Methane	9.37E+01	16.04	1502.61	89.06	2.69E+00	1.18E+01
Ethane	4.48E-01	30.07	13.47	0.80	2.41E-02	1.06E-01
Propane	6.51E-02	44.10	2.87	0.17	5.14E-03	2.25E-02
i-Butane	1.77E-02	58.12	1.03	0.06	1.84E-03	8.06E-03
n-Butane	1.47E-02	58.12	0.85	0.05	1.53E-03	6.70E-03
i-Pentane	6.47E-03	72.15	0.47	0.03	8.36E-04	3.66E-03
n-Pentane	3.23E-03	72.15	0.23	0.01	4.18E-04	1.83E-03
n-Hexane	7.63E-03	86.07	0.66	0.04	1.18E-03	5.15E-03
Benzene	2.05E-03	78.11	0.16	0.01	2.87E-04	1.26E-03
n-Heptane	4.55E-03	100.21	0.46	0.03	8.17E-04	3.58E-03
H2O	7.06E-02	18.02	1.27	0.08	2.28E-03	9.99E-03
H2S	3.08E-04	34.08	0.01	0.0006	1.88E-05	8.25E-05
aMDEA Solution	2.92E-15	119.16	3.48E-13	2.06E-14	6.24E-16	2.73E-15

1687.20

FL-Wet Flare

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	785	0.0089	75%	6.987	30.601	1.747	7.650
Total							1.747	7.650

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	5.43E+00	28.01	152.19	9.02	1.58E-01	6.90E-01
CO2	2.48E-01	44.01	10.93	0.65	1.13E-02	4.95E-02
Methane	9.37E+01	16.04	1502.61	89.06	1.56E+00	6.81E+00
Ethane	4.48E-01	30.07	13.47	0.80	1.39E-02	6.11E-02
Propane	6.51E-02	44.10	2.87	0.17	2.97E-03	1.30E-02
i-Butane	1.77E-02	58.12	1.03	0.06	1.06E-03	4.66E-03
n-Butane	1.47E-02	58.12	0.85	0.05	8.84E-04	3.87E-03
i-Pentane	6.47E-03	72.15	0.47	0.03	4.83E-04	2.12E-03
n-Pentane	3.23E-03	72.15	0.23	0.01	2.42E-04	1.06E-03
n-Hexane	7.63E-03	86.07	0.66	0.04	6.80E-04	2.98E-03
Benzene	2.05E-03	78.11	0.16	0.01	1.66E-04	7.25E-04
n-Heptane	4.55E-03	100.21	0.46	0.03	4.72E-04	2.07E-03
H2O	7.06E-02	18.02	1.27	0.08	1.32E-03	5.77E-03
H2S	3.08E-04	34.08	0.01	0.001	1.09E-05	4.77E-05
aMDEA Solution	2.92E-15	119.16	3.48E-13	2.06E-14	3.61E-16	1.58E-15

1687.20

GN-Sendout Natural Gas

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	15	0.0089	75%	0.134	0.585	0.033	0.146
Relief Valves	Gas/Vapor	4	0.2293	75%	0.917	4.017	0.229	1.004
Total							0.263	1.151

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	2.30E-01	28.01	6.44	0.38	9.97E-04	4.37E-03
Methane	9.53E+01	16.04	1529.25	90.07	2.37E-01	1.04E+00
Ethane	3.03E+00	30.07	91.11	5.37	1.41E-02	6.17E-02
Propane	7.80E-01	44.10	34.40	2.03	5.32E-03	2.33E-02
i-Butane	2.90E-01	58.12	16.85	0.99	2.61E-03	1.14E-02
n-Butane	2.90E-01	58.12	16.85	0.99	2.61E-03	1.14E-02
i-Pentane	4.00E-02	72.15	2.89	0.17	4.47E-04	1.96E-03

1697.80

HC-Hydrocarbons

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	6,399	0.0089	75%	56.951	249.446	14.238	62.361
Pumps	Gas/Vapor	58	0.00529	75%	0.307	1.344	0.077	0.336
Relief Valves	Gas/Vapor	254	0.2293	75%	58.242	255.101	14.561	63.775
Total							28.875	126.473

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Methane	49.5	14.293	62.604
Ethane	49.5	14.293	62.604
Propane	1	0.289	1.265

HO-Hot Oil

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Light Liquid	1,425	0.0035	97%	4.988	21.845	0.150	0.655
Pumps	Light Liquid	12	0.0386	93%	0.463	2.029	0.032	0.142
Relief Valves	Light Liquid	47	0.2293	97%	10.777	47.204	0.323	1.416
Total							0.505	2.213

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
THERMINOL® 55	100	0.505	2.213

LO-Lube Oil

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Light Liquid	195	0.0035	97%	0.683	2.989	0.020	0.090
Flanges	Light Liquid	6,100	0.0005	97%	3.050	13.359	0.092	0.401
Total							0.112	0.490

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Lube Oil	100	0.112	0.490

RE-Ethylene

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	1,635	0.0089	97%	14.552	63.736	0.437	1.912
Pumps ^[4]	Gas/Vapor	3	0.00529	93%	0.016	0.070	0.001	0.005
Relief Valves	Gas/Vapor	77	0.2293	97%	17.656	77.334	0.530	2.320
Total							0.967	4.237

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Ethylene	99	0.958	4.195
Methane	1	0.010	0.042

RM-Methane

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	1,026	0.0089	75%	9.131	39.996	2.283	9.999
Relief Valves	Gas/Vapor	60	0.2293	75%	13.758	60.260	3.440	15.065
Total							5.722	25.064

Speciation ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	0.03	28.01	0.84	0.05	2.90E-03	1.27E-02
CO2	0.01	44.01	0.44	0.03	1.52E-03	6.64E-03
Methane	96.89	16.04	1554.12	93.61	5.36E+00	2.35E+01
Ethane	2.43	30.07	73.07	4.40	2.52E-01	1.10E+00
Propane	0.42	44.10	18.52	1.12	6.38E-02	2.80E-01
i-Butane	0.1	58.12	5.81	0.35	2.00E-02	8.77E-02
n-Butane	0.09	58.12	5.23	0.32	1.80E-02	7.90E-02
i-Pentane	0.01	72.15	0.72	0.04	2.49E-03	1.09E-02
n-Pentane	0.02	72.15	1.44	0.09	4.97E-03	2.18E-02

1660.20

RP-Propane

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Valves	Gas/Vapor	3,518	0.0089	97%	31.310	137.139	0.939	4.114
Pumps ^[4]	Gas/Vapor	4	0.00529	93%	0.021	0.093	0.001	0.006
Relief Valves	Gas/Vapor	102	0.2293	97%	23.389	102.442	0.702	3.073
Total							1.642	7.194

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Propane	98	1.610	7.050
Ethylene	1	0.016	0.072
Hexane	0.17	0.003	0.012
Heptane	0.33	0.005	0.024
Octane	0.17	0.003	0.012
Nonane	0.17	0.003	0.012
m-cyclopentane	0.16	0.003	0.012

HO/HC-Hot Oil + Regen Gas

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Flanges	Light Liquid	2,400	0.0005	97%	1.200	5.256	0.036	0.158
Flanges	Gas/Vapor	2,400	0.0029	30%	6.960	30.485	4.872	21.339
Total							4.908	21.497

Speciation for hot oil ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
THERMINOL® 55	100	0.036	0.158

Speciation for regen gas ^[3]

Compound	mol %	molecular weight (g/mol)	weight in mixture (g)	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Nitrogen	0.52	28.01	14.57	0.87	4.25E-02	1.86E-01
CO2	0.01	44.01	0.44	0.03	1.28E-03	5.62E-03
Methane	96.45	16.04	1547.06	92.62	4.51E+00	1.98E+01
Ethane	2.24	30.07	67.36	4.03	1.96E-01	8.61E-01
Propane	0.39	44.10	17.20	1.03	5.02E-02	2.20E-01
i-Butane	0.09	58.12	5.23	0.31	1.53E-02	6.68E-02
n-Butane	0.09	58.12	5.23	0.31	1.53E-02	6.68E-02
i-Pentane	0.02	72.15	1.44	0.09	4.21E-03	1.84E-02
n-Pentane	0.07	72.15	5.05	0.30	1.47E-02	6.45E-02
n-Hexane	0.01	86.07	0.86	0.05	2.51E-03	1.10E-02
n-Heptane	0.02	100.21	2.00	0.12	5.85E-03	2.56E-02
n-Octane	0.01	114.23	1.14	0.07	3.33E-03	1.46E-02
n-Nonane	0.01	128.26	1.28	0.08	3.74E-03	1.64E-02
H2O	0.04	18.02	0.72	0.04	2.10E-03	9.21E-03
m-cyclopentane	0.01	70.10	0.70	0.04	2.04E-03	8.96E-03

1670.29

All H/C-All Hydrocarbons

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Flanges	Gas/Vapor	32,550	0.0029	30%	94,395	413.450	66,077	289.415
Total							66,077	289.415

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Methane	99	65,416	286.521
Condensate	1	0.661	2.894

ALL Refr.-Refrigerants

Component Name ^[1]	Stream Type ^[1]	Number of Components ^[1]	Emission Factor (lb/hr) ^[2]	Control Efficiency ^[2]	Uncontrolled Emissions		Controlled Emissions	
					lb/hr	tons/year	lb/hr	tons/year
Flanges	Gas/Vapor	4,600	0.0029	97%	13,340	58.429	0.400	1.753
Total							0.400	1.753

Speciation ^[3]

Compound	Fraction wt. %	Short-Term Emission Rate lb/hr	Annual Emission Rate tons/year
Ethylene	50	0.200	0.876
Propane	50	0.200	0.876

FUGITIVES SUMMARY

Pollutant	Emission Rates	
	Hourly (lb/hr)	Annual (tpy)
VOC	4.926	21.574
CO2	0.051	0.222
CH4	98.854	432.981

^[1] Data for each service provided in spreadsheet from Cheniere ("CCLIQ - Valves-PSVs-Pumps-Flanges in Hydrocarbon Service.xlsx")

^[2] 28LAER control factors used for equipment in >10% VOC service. 28M control factors used for equipment in methane service.

^[3] Composition of each service provided by Cheniere.

^[4] Used emission factor from TCEQ guidance document (http://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/fac_specific.pdf) because there was no gas emission factor for 28VHP pumps.