GAS TURBINE FUEL USE: 60% LVOC / 40% SVOC ONLY LOADING HOURS

Texas GulfLink, LLC
Facility Emissions Summary

EPN	Source	CO_2e		PM_{10}		$PM_{2.5}$		SO_2		NOx		CO		Total VOC		H_2S		1,3-Butadiene		Acetaldehyde		Acrolien		Benzene		Isopropylbenzene		Ethylbenzene		Formaldehyde		Hexane (-n)		Naphthalene		PAH		Propylene Oxide		2,2,4-Trimethylpentane (isooctane)		Toluene		Xylene (-m)		
		(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	
(P) M-1	Marine Loading													101.26	208.10	0.0025	0.0012							0.45	0.92	0.00	0.01	0.03	0.06			2.31	4.75							0.04	0.08	0.22	0.45	0.09	0.18	
(P) G-1	Generator 1	-	2,428	0.16	0.70	0.16	0.70	0.01	0.03	4.96	21.72	2.78	12.20	0.13	0.58					0.0002	0.001			0.01	0.02					0.001	0.002											0.002	0.01	0.002	0.01	
(P) G-2	Generator 2	-	2,428	0.16	0.70	0.16	0.70	0.01	0.03	4.96	21.72	2.78	12.20	0.13	0.58					0.0002	0.001			0.01	0.02					0.001	0.002											0.002	0.01	0.002	0.01	
(P) C-1	Crane 1	-	2,132	0.14	0.61	0.14	0.61	0.01	0.02	2.59	11.32	2.45	10.71	0.21	0.92															0.004	0.02															
(P) DT-1	Day Tank 1													0.001	0.01																															
(P) BT-1	Belly Tank 1													0.0002	0.001																															
(P) BT-2	Belly Tank 2													0.0002	0.001																															
(P) BT-3	Belly Tank 3													0.0002	0.001																															
(P) BT-4	Belly Tank 4													0.00002	0.0001																															
(P) T-1	Surge Tank													0.40	1.74									0.002	0.01			0.0001	0.001			0.01	0.04									0.001	0.004	0.0003	0.002	
(P) FWP-1	MSS - Firewater Pump	-	20	0.12	0.01	0.12	0.01			2.12	0.11	2.01	0.10	0.18	0.01																															
(P) P-1	MSS - Pigging Operations													83.76	0.50									0.37	0.002							1.91	0.01									0.18	0.001			
(P) F-1	Platform Fugitive Emissions													0.03	0.12										0.00071							0.0005	0.002										0.001177	0.0004	0.002	
(P) F-2	SPM System Fugitives													0.10	0.44																															
(P) S-1	Sampling Activities													0.10	0.05																															
(P) PM-1	MSS - Pump Maintenance													4.00	0.002																															
(P) MSS-1	MSS - Abrasive Blasting / Painting			0.01	0.06	0.002	0.01							0.06	0.26																															
(VRV) UM-1	Uncontrolled Marine Loading (Bad Weather)													3,601.55	31.03	0.09	0.0002							15.89	0.14	0.12	0.001	1.07	0.01			82.23	0.71							1.37	0.01	7.78	0.07	3.12	0.03	
(VRV) GT-1	Gas Turbine Generator 1	-	5,380	0.81	0.54	0.81	0.54	2.12	1.17	58.12	36.04	0.99	1.90	0.05	0.06			0.00100	0.00004	0.0004	0.002	0.0001	0.0003	0.0036	0.0007			0.0003	0.002	0.024	0.038			0.00220	0.0001	0.00252	0.0002	0.0003	0.002			0.001	0.007	0.001	0.003	
(VRV) GT-2	Gas Turbine Generator 2		5,380	0.43	0.54	0.43	0.54	1.04	1.17	29.68	36.04	0.89	1.90	0.03	0.06			0.0005	0.0005	0.0004	0.0009	0.0001	0.0001	0.0018	0.002			0.0003	0.0007	0.015	0.025			0.0011	0.001	0.0012	0.001	0.0003	0.0006			0.001	0.003	0.0006	0.001	
(VRV) EDG-1	CAT 3516C - No. 1	-	5,120	0.33	1.46	0.33	1.46	0.01	0.054	10.37	45.44	5.82	25.51	0.28	1.21					0.0002	0.0008			0.005	0.024					0.0006	0.002											0.002	0.009	0.001	0.006	
(VRV) EDG-3	CAT 3512C - No. 1	-	914	0.05	0.21	0.05	0.21	0.002	0.008	1.46	6.40	0.82	3.59	0.04	0.17					0.00003	0.0001			0.001	0.003					0.0001	0.000											0.000	0.001	0.0002	0.001	
(VRV) F-1	VRV Fugitive Emissions													0.02	0.11	0.0000001	0.000001							0.0001	0.001	0.00002	0.0001	0.0001	0.0004			0.0005	0.002							0.00002	0.0001	0.0002	0.001	0.0003	0.002	
(VRV) F-2	VRV Fugitive Emissions - Hose Disconnects													0.39	0.03	0.00000004	0.0000002							0.002	0.0002	0.00001	0.000001	0.0001	0.00001			0.01	0.001							0.0001	0.00001	0.001	0.0001	0.0003	0.00003	
(VRV) MTC-2	Other Miscellaneous Maintenance													9.37	0.80																															
	TOTAL EMISSIONS (TPY)	**0**	**23,803**	**2.21**	**4.82**	**2.20**	**4.77**	**3.18**	**2.47**	**114.26**	**178.79**	**18.56**	**68.12**	**3,802.10**	**246.80**	**0.093**	**0.001**	**0.001**	**0.001**	**0.001**	**0.005**	**0.0001**	**0.0005**	**16.730**	**1.143**	**0.125**	**0.008**	**1.096**	**0.074**	**0.045**	**0.086**	**86.470**	**5.516**	**0.0033**	**0.0013**	**0.0038**	**0.0015**	**0.0006**	**0.0022**	**1.406**	**0.091**	**8.187**	**0.555**	**3.213**	**0.235**	**Sum total HAPs (tpy) = 7.72 tpy**

Summary of Individual GHG Emissions from TGL's Offshore Facility

GHG emissions will result from the 4 engines on the loading platform (2 electric generators, 1 crane, 1 firewater pump) and 6 engines associated with marine vessels. GHG emissions include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

The VRV sources being added includes 2 turbine generators and 2 diesel electric generator engines.

SCENARIO THREE: 60% LVOC / 40% SVOC AND ONLY LOADING HOURS

	Generator 1	Generator 2	Crane	Firewater Pump	Carrier Main Engine	Carrier Aux Engines	Carrier Boiler	Escort Tug No. 1	Service Support Boat	Line Hose Boat	Generator Turbine 1 - Scenario 3	Generator Turbine 2 - Scenario 3	CAT 3516C - No. 1	CAT 3512C - No. 3		
GHG Pollutant (short tons)															**Total for 1 Year (short tons)**	**Total for 30 Years (short tons) ***
CO_2	4,839	4,839	2,125	20	8,749	8,999	2,660	26,663	4,083	1,586	5,380	5,380	5,623	1,004	81,949	2,458,464
CH_4	5	5	2	0.02	0.4	0.4	0.1	1.1	0.2	0.1	0.2	0.2	5.7	4.1	24	730
N_2O	12	12	5	0.05	0.1	0.1	0.02	0.2	0.03	0.01	0.04	0.04	14	10	52	1,572

* 30-year total assumes same GHG emissions each year

GHG emission rates in short tons. To convert to long (metric) tons: short ton/1.1023

Texas GulfLink, LLC
Offshore Platform
Marine Loading

EPN	Description
(P) M-1	Marine Loading

AP-42, Chapter 5, Section 5.2
Transportation and Marketing of Petroleum Liquids
Equation 2 was developed specifically for estimating emissions from the loading of crude oil into ships and ocean barges.

$C_L = C_A + C_G$
C_L = total loading loss (lb/10^3 gal of crude oil loaded)

C_A = arrival emission factor (lb/10^3 gal loaded)

C_A =	0.86	Taken from Table 5.2-3, based on "Uncleaned" and "Volatile", assumes no ballasting. Vapor pressure is > 1.5 psia.

C_G = generated emission factor (lb/10^3 gal loaded)
Equation 3: $C_G = 1.84*(0.44P-0.42)*((MG)/T)$

P =	8.98	psia	Average true vapor pressure for Crude Oil estimated using TANKS 4.09d and information provided by Abadie-Williams LLC.	
P =	10.00	psia	Maximum true vapor pressure for Crude Oil estimated using AP-42, Figure 7.1-13 and information provided by Abadie-Williams LLC.	Based on 80 deg F and RVP10.
M =	50	lb/lb-mol	VMW of loaded crude	
G =	1.02	dimensionless	AP-42	
T =	529.67	deg R	Average temperature of loaded crude provided by Abadie-Williams LLC.	
T =	539.67	deg R	Maximum temperature of loaded crude provided by Abadie-Williams LLC.	
C_G =	0.63	**ANNUAL EMISSION FACTOR**		
C_G =	0.69	**MAXIMUM EMISSION FACTOR**		

ANNUAL

C_L =	1.49	lb TOC/10^3 gal loaded	1.26	lb VOC/10^3 gal loaded

MAXIMUM

C_L =	1.55	lb TOC/10^3 gal loaded	1.32	lb VOC/10^3 gal loaded

Per Chapter 5, emission factors derived from Equation 3 and Table 5.2-3 represent TOC. When specific vapor composition information is not available, the VOC emission factor can be estimated by taking 85% of the TOC factor.

Pollutant	Maximum Emission Factor (lb/10^3 gal)	Annual Emission Factor (lb/10^3 gal)	Maximum Crude Loading Rate (bbl/hr)	Annual Crude Loaded (bbl/yr)	MW (lb/lbmol)	Average Concentration of H_2S in Crude (ppmv)	Maximum Concentration of H_2S in Crude (ppmv)	VRV Recovery Efficiency (%)	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
VOC	1.32	1.26	85,000	365,000,000	-	-	-	97.85	47.51	101.26	208.10
Benzene	-	-	-	-	-	-	-		0.21	0.45	0.92
Ethylbenzene	-	-	-	-	-	-	-		0.01	0.03	0.06
n-Hexane	-	-	-	-	-	-	-		1.08	2.31	4.75
Isooctane	-	-	-	-	-	-	-		0.02	0.04	0.08
Isopropyl benzene	-	-	-	-	-	-	-		0.00	0.00	0.01
Toluene	-	-	-	-	-	-	-		0.10	0.22	0.45
Xylene	-	-	-	-	-	-	-		0.04	0.09	0.18
H_2S	-	-	-	-	34.1	5	25		0.00	0.00	0.00

Annual Crude Loading Rate provided by Abadie-Williams LLC.
Maximum Crude Loading Rate provided by Abadie-Williams LLC.
Maximum and Annual Concentration of H_2S in Crude is an assumption.

	Tanks 4.09d (rev)	WTI S/T 6008	WTI - Pecos River	WTI - Houston	Bakken 2016
HAP	**Wt Frac**	**Wt Frac**	**Wt Frac**	**Wt Frac**	**Wt Frac**
Benzene	0.0044	0.00398	0.00444	0.00256	0.0017
Ethylbenzene	0.0003	0.0025			
Hexane (-n)	0.0228	0.01507	0.01932	0.01481	
Isooctane	0.0004	0.01748			
Isopropyl benzene	0.0000				
Toluene	0.0022	0.00831			0.0067
Xylene (-m)	0.0009	0.00672			
Unidentified Components	0.9637	0.93483			
Cyclohexane	0.0053	0.01111			
1,2,4-Trimethylbenzene	0.0000				
Sum Wt Fac	1.0000				

HAP	Highest WT FRAC	Source
Benzene	0.0044	Tanks 4.09d
Ethylbenzene	0.0025	WTI S/T 6008
Hexane (-n)	0.0228	Tanks 4.09d
Isooctane	0.0175	WTI S/T 6008
Isopropyl benzene	0.0000	Tanks 4.09d
Toluene	0.0083	WTI S/T 6008
Xylene (-m)	0.0067	WTI S/T 6008
Unidentified Comp	0.9637	Tanks 4.09d
Cyclohexane	0.0111	WTI S/T 6008
1,2,4-Trimethylbenzene	0.0000	Tanks 4.09d
Sum Wt Fac	1.0371	

Texas GulfLink, LLC
Vapor Recovery Vessel (VRV)
Uncontrolled Marine Loading (Bad Weather)

EPN	Description
(VRV) UM -1	Uncontrolled Marine Loading/ Poor Weather/ Safety First

This calculation takes into account emissions from uncontrolled loading in the event that there is bad weather and therefore, the VRV must vacate the area.
It is estimated that this may occur three times per year for six hours per event. Whereas, loading under normal conditions is based on a max load rate of 85,000 bph, this bad weather calculation assumes 65,000 bph.

3	**Events/Yr**
6	**Hours/Event**

AP-42, Chapter 5, Section 5.2
Transportation and Marketing of Petroleum Liquids
Equation 2 was developed specifically for estimating emissions from the loading of crude oil into ships and ocean barges.

$C_L = C_A + C_G$
C_L = total loading loss (lb/10^3 gal of crude oil loaded)

C_A = arrival emission factor (lb/10^3 gal loaded)

C_A =	0.86	Taken from Table 5.2-3, based on "Uncleaned" and "Volatile", assumes no ballasting. Vapor pressure is > 1.5 psia.

C_G = generated emission factor (lb/10^3 gal loaded)
Equation 3: $C_G = 1.84*(0.44P-0.42)*((MG)/T)$

P =	8.98	psia	Average true vapor pressure for Crude Oil estimated using TANKS 4.09d and information provided by Abadie-Williams LLC.	
P =	10.00	psia	Maximum true vapor pressure for Crude Oil estimated using AP-42, Figure 7.1-13 and information provided by Abadie-Williams LLC.	Based on 80 deg F and RVP10.
M =	50	lb/lb-mol	VMW of loaded crude	
G =	1.02	dimensionless	AP-42	
T =	529.67	deg R	Average temperature of loaded crude provided by Abadie-Williams LLC.	
T =	539.67	deg R	Maximum temperature of loaded crude provided by Abadie-Williams LLC.	
C_G =	0.63	**ANNUAL EMISSION FACTOR**		
C_G =	0.69	**MAXIMUM EMISSION FACTOR**		

ANNUAL

C_L =	1.49	lb TOC/10^3 gal loaded	1.26	lb VOC/10^3 gal loaded

MAXIMUM

C_L =	1.55	lb TOC/10^3 gal loaded	1.32	lb VOC/10^3 gal loaded

Per Chapter 5, emission factors derived from Equation 3 and Table 5.2-3 represent TOC. When specific vapor composition information is not available, the VOC emission factor can be estimated by taking 85% of the TOC factor.

Pollutant	Maximum Emission Factor ($lb/10^3$ gal)	Annual Emission Factor ($lb/10^3$ gal)	Maximum Crude Loading Rate (bbl/hr)	Annual Crude Loaded (bbl/yr)	MW (lb/lbmol)	Average Concentration of H_2S in Crude (ppmv)	Maximum Concentration of H_2S in Crude (ppmv)	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
VOC	1.32	1.26	65,000	1,170,000	-	-	-	3,447.37	3,601.55	31.03
Benzene	-	-	-	-	-	-	-	15.21	15.89	0.14
Ethylbenzene	-	-	-	-	-	-	-	1.02	1.07	0.01
n-Hexane	-	-	-	-	-	-	-	78.71	82.23	0.71
Isooctane	-	-	-	-	-	-	-	1.31	1.37	0.01
Isopropyl benzene	-	-	-	-	-	-	-	0.12	0.12	0.001
Toluene	-	-	-	-	-	-	-	7.44	7.78	0.07
Xylene	-	-	-	-	-	-	-	2.98	3.12	0.03
H_2S	-	-	-	-	34.1	5	25	0.00004	0.09	0.0002

Annual Crude Loading Rate provided by Abadie-Williams LLC.

Maximum Crude Loading Rate provided by Abadie-Williams LLC.

Maximum and Annual Concentration of H_2S in Crude is an assumption.

	Tanks 4.09d (rev)	WTI S/T 6008	WTI - Pecos River	WTI - Houston	Bakken 2016
HAP	**Wt Frac**	**Wt Frac**	**Wt Frac**	**Wt Frac**	**Wt Frac**
Benzene	0.0044	0.00398	0.00444	0.00256	0.0017
Ethylbenzene	0.0003	0.0025			
Hexane (-n)	0.0228	0.01507	0.01932	0.01481	
Isooctane	0.0004	0.01748			
Isopropyl benzene	0.0000				
Toluene	0.0022	0.00831			0.0067
Xylene (-m)	0.0009	0.00672			
Unidentified Components	0.9637	0.93483			
Cyclohexane	0.0053	0.01111			
1,2,4-Trimethylbenzene	0.0000				
Sum Wt Fac	1.0000				

HAP	Highest WT FRAC	Source
Benzene	0.0044	Tanks 4.09d
Ethylbenzene	0.0025	WTI S/T 6008
Hexane (-n)	0.0228	Tanks 4.09d
Isooctane	0.0175	WTI S/T 6008
Isopropyl benzene	0.0000	Tanks 4.09d
Toluene	0.0083	WTI S/T 6008
Xylene (-m)	0.0067	WTI S/T 6008
Unidentified Comp	0.9637	Tanks 4.09d
Cyclohexane	0.0111	WTI S/T 6008
1,2,4-Trimethylbenzene	0.0000	Tanks 4.09d
Sum Wt Fac	1.0371	

SCENARIO THREE: 60% LVOC / 40% SVOC AND ONLY LOADING HOURS

Texas GulfLink, LLC
Vapor Recovery Vessel (VRV)
Gas Turbine Electric Generators

Two (2) 1,800 KW generators are used to supply electricity to the VRV.

EPN	Description	Op Hours Firing LVOC (Hr/Yr)	Op Hours Firing SVOC (Hr/Yr)	Firing Rate LVOC (MMBtu/yr)	Firing Rate SVOC (MMBtu/yr)
(VRV) GT-1	Gas Turbine Generator 1	4,692.0	4,554.0	65,990	43,758
(VRV) GT-2	Gas Turbine Generator 2	4,692.0	4,554.0	65,990	43,758

Given:

Power Output of Each Generator	1800 KW[1]
Power Output of Each Engine	3,600 Hp[2]
Power Output of Each Engine	2,685 KW[3]

	Gas Turbine Generator 1				Gas Turbine Generator 2			
Load (%)	30	40	50	90	30	40	50	90
Hours/Month	0.0	11.5	0.0	379.5		11.5		379.5
Hours/Year	0.0	138.0	0.0	4,554.0		138.0		4,554.0
Fuel Flow (kg/s) - LVOC	0.094	0.103	0.111	0.089		0.103		0.089
LHV (MJ/kg) - LVOC	46.2	46.2	46.2	46.2		46.2		46.2
Firing Rate (MJ/s) - LVOC	4.34	4.76	5.13	4.10		4.76		4.10
Firing Rate (MMBtu/hr) - LVOC[4]	14.82	16.24	17.50	14.00		16.24		14.00
Fuel Flow (kg/s) - SVOC				0.141				0.141
LHV (MJ/kg) - SVOC				20.0				20.0
Firing Rate (MJ/s) - SVOC				2.82				2.82
Firing Rate (MMBtu/hr) - SVOC[4]				9.61				9.61

Criteria Emissions

	LVOC Emission Factors		SVOC Emission Factors	
Pollutant	Lb/MMBtu	Source	Lb/MMBtu	Source
Particulate Matter 10	1.2E-02	AP-42, Table 3.1-2a	6.6E-03	AP-42, Table 3.1-2a
Particulate Matter 2.5	1.2E-02	AP-42, Table 3.1-2a	6.6E-03	AP-42, Table 3.1-2a
Sulfur Dioxide	3.333E-02	AP-42, Table 3.1-2a Default for S	3.196E-03	AP-42, Table 3.1-2a Default for S
Nitrogen Oxides	8.8E-01	AP-42, Table 3.1-1	3.2E-01	AP-42, Table 3.1-1
Carbon Monoxide	3.3E-03	AP-42, Table 3.1-1	8.2E-02	AP-42, Table 3.1-1
Volatile Organic Compounds	4.1E-04	AP-42, Table 3.1-2a	2.1E-03	AP-42, Table 3.1-2a

Emission rates assume 60% LVOC and 40% SVOC at 90% load.

	Gas Turbine Generator 1		Gas Turbine Generator 2	
Pollutant	Maximum (Lb/Hr)	Annual (TPY)	Maximum (Lb/Hr)	Annual (TPY)
Particulate Matter 10	0.81	0.54	0.43	0.54
Particulate Matter 2.5	0.81	0.54	0.43	0.54
Sulfur Dioxide	2.12	1.17	1.04	1.17
Nitrogen Oxides	58.12	36.04	29.68	36.04
Carbon Monoxide	0.99	1.90	0.89	1.90
Volatile Organic Compounds	0.05	0.06	0.03	0.06

Greenhouse Gas Emissions

Pollutant	Distillate Fuel Oil No. 2 Emission Factor[5] (kg/MMBtu)	Natural Gas Emission Factor[5] (kg/MMBtu)	Global Warming Potentials[6]	Gas Turbine Generator 1				Gas Turbine Generator 2			
				Average[7] (lb/hr)	Maximum (lb/hr)	Annual (tpy)	CO_2e[8] (tonnes/yr)	Average[7] (lb/hr)	Maximum (lb/hr)	Annual (tpy)	CO_2e[8] (tonnes/yr)
CO_2	73.96	53.06	1	1,040	1,040	5,380	4,882	2,293	2,293	5,380	4,882
CH_4	3.00E-03	1.00E-03	25	0.1	0.09	0.2	0.2	0.1	0.1	0.2	0.2
N_2O	6.00E-04	1.00E-04	298	0.02	0.02	0.04	0.04	0.02	0.02	0.04	0.04
CO_2e	--	--	--	1,040	1,040	5,380	4,882	2,293	2,293	5,380	4,882

Emission rates assume 60% LVOC and 40% SVOC at 90% load.

Toxic Air Pollutant Emission Calculation:

Pollutant	SVOC Emission Factor[9] [lb/MMBtu]	LVOC Emission Factor[10] [lb/MMBtu]	Emission Factor Source	Gas Turbine Generator 1			Gas Turbine Generator 2		
				Average (lb/hr)	Maximum (lb/hr)	Annual (tpy)	Average (lb/hr)	Maximum (lb/hr)	Annual (tpy)
1,3-Butadiene	4.30E-07	1.60E-05	AP-42, Ch. 3.1	9.37E-06	1.00E-03	4.10E-05	1.23E-04	4.88E-04	5.37E-04
Acetaldehyde	4.00E-05	-	AP-42, Ch. 3.1	4.91E-04	3.84E-04	2.15E-03	2.00E-04	3.84E-04	8.75E-04
Acrolien	6.40E-06	-	AP-42, Ch. 3.1	7.85E-05	6.15E-05	3.44E-04	3.20E-05	6.15E-05	1.40E-04
Benzene	1.20E-05	5.50E-05	AP-42, Ch. 3.1	1.61E-04	3.56E-03	7.07E-04	4.74E-04	1.78E-03	2.08E-03
Ethylbenzene	3.20E-05	-	AP-42, Ch. 3.1	3.93E-04	3.07E-04	1.72E-03	1.60E-04	3.07E-04	7.00E-04
Formaldehyde	7.10E-04	2.80E-04	AP-42, Ch. 3.1	8.79E-03	2.43E-02	3.85E-02	5.66E-03	1.53E-02	2.48E-02
Naphthalene	1.30E-06	3.50E-05	AP-42, Ch. 3.1	2.49E-05	2.20E-03	1.09E-04	2.70E-04	1.07E-03	1.18E-03
PAH	2.20E-06	4.00E-05	AP-42, Ch. 3.1	3.72E-05	2.52E-03	1.63E-04	3.12E-04	1.23E-03	1.37E-03
Propylene Oxide	2.90E-05	-	AP-42, Ch. 3.1	3.56E-04	2.79E-04	1.56E-03	1.45E-04	2.79E-04	6.34E-04
Toluene	1.30E-04	-	AP-42, Ch. 3.1	1.60E-03	1.25E-03	6.99E-03	6.49E-04	1.25E-03	2.84E-03
Xylene	6.40E-05	-	AP-42, Ch. 3.1	7.85E-04	6.15E-04	3.44E-03	3.20E-04	6.15E-04	1.40E-03

Notes:

(1) Taken from https://www.opraturbines.com/gas-turbine/

(2) Taken from https://www.electricgeneratorsdirect.com/stories/22-How-to-Pick-the-Perfect-Power-Take-Off-Generator.html, "The rule of thumb is that you need 2 HP to produce 1 kW of electricity."

(3) 1.341 hp/Kw

(4) 0.00094782 MMBtu/MJ

LVOC: Distillate Fuel Oil No. 2 for CO_2 emission factor, Petroleum (all fuel type in Table C-1) for CH_4 and N_2O emission factors.

(6) Global warming potentials for converting to CO_2e taken from Table A-1 to Subpart A of Part 98 - Global Warming Potentials.

(7) Emissions converted from kg to lbs using 2.20462 lb/kg.

(8) CO_2e tonnes calculated using 2,204 lbs/tonne and global warming potentials from Table A-1 to Subpart A of Part 98 - Global Warming Potentials.

(9) AP-42

(10) AP-42

Texas GulfLink, LLC
Vapor Recovery Vessel (VRV)
Diesel Generators

Two (2) 1,800 KW generators are used to supply electricity to the VRV.
Supplemental power is sourced, when needed, from four diesel engines. Hours of use assume pumping at maximum rate 25% of cycle, during this time additional power demand requires use of second diesel engine (CAT 3512C-No. 1). During normal pumping (75% of cycle), conservatively assuming that one of the larger two engines (CAT 3516C-No. 1) is used.

EPN	Description[1]	Power Output of Engine KW[1]	Power Output of Engine Hp[1]	Firing Rate[3] (MMBtu/hr)	Load during Loading	Operating Hours
(VRV) EDG-1	CAT 3516C - No. 1	2,000	2,100	14.70	90%	4,692
(VRV) EDG-2	CAT 3516C - No. 2	2,000	2,100	14.70	71%	0
(VRV) EDG-3	CAT 3512C - No. 1	1,700	1,500	10.50	71%	1,173
(VRV) EDG-4	CAT 3512C - No. 2	1,700	1,500	10.50	71%	0

Calculation Methodology:
Average Hourly Rate [lb/hr] = Annual Emission Rate [tpy] x Conversion Factor [2000 lbs/ton] / Operating Hours [hrs/yr]
Max Hourly Rate [lb/hr] = Average Hourly Rate [lb/hr]
Annual Emission Rate [tpy] = Power Output [hp] x Operating Hours x Emission Factor [lb/hp-hr] / Conversion Factor [2000 lbs/1 ton]

Criteria Emission Calculation:

					CAT 3516C - No. 1			CAT 3512C - No. 1		
Pollutant	Emission Factor[4] [g/kW-hr]	Emission Factor[2] [g/hp-hr]	Emission Factor [lb/hp-hr]	Emission Factor Source	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
PM_{10}	0.2	0.15	0.0003	NSPS 4I	0.33	0.33	1.46	0.05	0.05	0.21
$PM_{2.5}$	0.2	0.15	0.0003	NSPS 4I	0.33	0.33	1.46	0.05	0.05	0.21
SO_2	-	-	0.00001	AP-42, Ch. 3.4 15 ppm	0.01	0.01	0.05	0.00	0.00	0.01
CO	3.5	2.61	0.01	NSPS 4I	5.82	5.82	25.51	0.82	0.82	3.59
NMHC + NOx	6.40	-	-	NSPS 4I	-	-	-	-	-	-
NO_x	6.23	4.65	0.01	NSPS 4I	10.37	10.37	45.44	1.46	1.46	6.40
Total VOC	0.17	0.12	0.0003	NSPS 4I	0.28	0.28	1.21	0.04	0.04	0.17

Greenhouse Gases Emission Calculation:

			CAT 3516C - No. 1				CAT 3512C - No. 1			
Pollutant	Emission Factor[5] (kg/MMBtu)	Global Warming Potentials[6]	Average[7] (lb/hr)	Maximum (lb/hr)	Annual (tpy)	CO_2e[8] (tonnes/yr)	Average[7] (lb/hr)	Maximum (lb/hr)	Annual (tpy)	CO_2e[8] (tonnes/yr)
CO_2	73.96	1	2,397	2,397	5,623	5,103	1,712	1,712	1,004	911
CH_4	3.00E-03	25	0.1	0.1	5.7	5.2	0.1	0.1	4.1	0.9
N_2O	6.00E-04	298	0.02	0.02	14	12.3	0.01	0.01	10	2.2
CO_2e	--	--	2,397	2,397	5,642	5,120	1,712	1,712	1,018	914

Toxic Air Pollutant Emission Calculation:

			CAT 3516C - No. 1			CAT 3512C - No. 1		
Pollutant	Emission Factor [lb/MMBtu]	Emission Factor Source	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
Acetaldehyde	0.0000252	AP-42, Ch. 3.4	0.0002	0.0002	0.001	0.00003	0.00003	0.0001
Benzene	0.000776	AP-42, Ch. 3.4	0.005	0.005	0.024	0.001	0.001	0.003
Formaldehyde	0.0000789	AP-42, Ch. 3.4	0.001	0.001	0.002	0.0001	0.0001	0.0003
Toluene	0.000281	AP-42, Ch. 3.4	0.002	0.002	0.009	0.0003	0.0003	0.001
Xylene	0.000193	AP-42, Ch. 3.4	0.001	0.001	0.006	0.0002	0.0002	0.001

Notes:

(1) Generator Model Numbers and KW provided by Abadie. HP taken from Caterpillar website is Max Hp for that Model Number.

(2) 1.341 hp/Kw

(3) Converted using 7,000 Btu/hp-hr from AP-42, Chapter 3.

(4) NMHC + NO_x, CO, and PM taken from 40 CFR 89.112(a) Table 1; PM factor used for PM_{10} and $PM_{2.5}$; NMHC + NO_x factor used for VOC and NOx by assuming 97% NO_x and 3% VOC, based on the ratios of NO_x and VOC AP-42 emission factors in Chapter 3.4.

(5) All emission factors taken from Tables C-1 and C-2 to Subpart C of Part 98. Distillate Fuel Oil No. 2 for CO_2 emission factor, Petroleum (all fuel type in Table C-1) for CH_4 and N_2O emission factors.

(6) Global warming potentials for converting to CO_2e taken from Table A-1 to Subpart A of Part 98 - Global Warming Potentials.

(7) Emissions converted from kg to lbs using 2.20462 lb/kg.

(8) CO_2e tonnes calculated using 2,204 lbs/tonne and global warming potentials from Table A-1 to Subpart A of Part 98 - Global Warming Potentials.

Texas GulfLink, LLC
Vapor Recovery Vessel (VRV)
VRV Fugitive Emissions

EPN	Description
(VRV) F-1	VRV Fugitive Emissions

Given:

Component Type	Service	Component Count
Valves	Light liquid (LL)	52
Pump seals	Light liquid (LL)	0
Flanges	Light liquid (LL)	141
Valves	G/V	143
Pump seals	G/V	0
Flanges	G/V	455
Other	-	3

Reference:
Air Permit Technical Guidance for Chemical Sources - Fugitive Guidance, APDG 6422, Air Permits Division TCEQ, June 2018, Table II
Gas/vapor "flange" and "other" emission factors not available in Table II; therefore, applied the gas/vapor valve emission factor to be conservative.

Calculation Methodology:
VOC Average Hourly Rate [lb/hr] = TCEQ Emission Factor [lb/hr/component] x Component Count
VOC TAP Speciated Hourly Rate [lb/hr] = Liquid Mass Fraction x Total VOC Average Hourly Rate [lb/hr]
Max Hourly Rate [lb/hr] = Average Hourly Rate [lb/hr]
Annual Emission Rate [tpy] = Average Hourly Rate [lb/hr] / Conversion Factor [2000 lb/ton] x Annual Operating Hours

Emission Calculation:

Component Type	Gas/Vapor Emission Factor [lb/hr/component]	Light Liquid Emission Factor [lb/hr/component]	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
Valves	0.0000287	0.0000948	0.01	0.01	0.04
Pump seals		0.00119	0.E+00	0.E+00	0.E+00
Flanges	0.0000287	0.00001762	0.02	0.02	0.07
Other	0.0000287		0.0001	0.0001	0.0004
		Total VOC	**0.02**	**0.02**	**0.11**

VOC TAP Speciation	Liquid Mass Fraction(1)	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
Benzene	0.006	0.0001	0.0001	0.0006
Ethylbenzene	0.004	0.00010	0.00010	0.0004
n-Hexane	0.019	0.00048	0.00048	0.0021
Toluene	0.010	0.0002	0.0002	0.0011
Xylenes	0.014	0.0003	0.0003	0.002
Cumene (Isopropyl benzene)	0.001	0.00002	0.00002	0.00011
Iso-octane	0.001	0.00002	0.00002	0.00011

Notes:
(1) VOC TAP Speciation Profile from TANKS 4.09d for Crude Oil.

Hydrogen Sulfide Emissions:

Molecular Weight of H_2S (lb/lbmol):	34.1
Average Concentration of H_2S in Crude (ppmv):	5
Molecular Weight of Crude (lb/lbmol):	50
Average TVP of Crude (psia):	8.98

Average Concentration of H_2S in Crude is an assumption.

Pollutant	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
Hydrogen Sulfide	1.38E-07	1.38E-07	6.03E-07

Texas GulfLink, LLC
Vapor Recovery Vessel (VRV)
VRV Fugitive Emissions - Hose Disconnects

EPN	Description
(VRV) F-2	VRV Fugitive Emissions - Hose Disconnects

Hose disconnected after each VLCC load. Hose is 250' in length with a 16" diameter.

Hose diameter	16	in
Hose length	2	ft
Hose pressure	1	psig
Hose volume	2.79	cu ft
Gas volume	2.98	SCF
Releases per year	180	

VMW of Crude from TANKS 4.09d:	50.00	lb/lbmol
	385.30	scf/lbmol
	0.01	lbmol
	0.39	lbs VOC per event
	69.67	lbs VOC per year

From TANKS 4.09d:

NAME	V_WT_FRACT
Hexane (-n)	0.022831039
Benzene	0.004411371
Isooctane	0.000379612
Toluene	0.002159389
Ethylbenzene	0.00029583
Xylene (-m)	0.000865592
Isopropyl benzene	3.37653E-05

	0.03	tons VOC per year
	0.001	tons/yr n-Hexane
	0.0002	tons/yr Benzene
	0.00001	tons/yr Isooctane
	0.0001	tons/yr Toluene
	0.00001	tons/yr Ethylbenzene
	0.00003	tons/yr Xylene
	0.000001	tons/yr Cumene
	0.39	lbs VOC per hr
	0.01	lbs/hr n-Hexane
	0.002	lbs/hr Benzene
	0.0001	lbs/hr Isooctane
	0.001	lbs/hr Toluene
	0.0001	lbs/hr Ethylbenzene
	0.0003	lbs/hr Xylene
	0.00001	lbs/hr Cumene

Hydrogen Sulfide Emissions:

Molecular Weight of H2S (lb/lbmol):	34.1
Average Concentration of H_2S in Crude (ppmv):	5
Molecular Weight of Crude (lb/lbmol):	50
Average TVP of Crude (psia):	8.98

Average Concentration of H_2S in Crude is an assumption.

Pollutant	Average Hourly Rate [lb/hr]	Max Hourly Rate [lb/hr]	Annual Emission Rate [tpy]
Hydrogen Sulfide	4.44E-08	4.44E-08	1.94E-07

Texas GulfLink, LLC
Vapor Recovery Vessel (VRV)
MSS Emissions - Other Miscellaneous Maintenance

EPN	Description
(VRV) MTC-2	Other Miscellaneous Maintenance

Filter/Oil Changes, Other Equipment Maintenance

Emissions from miscellaneous maintenance after 20 VLCC loadings are estimated based on the following:

Quantity	Units
6.08	Events/Yr
1	kg VOC/event
2.20	lb VOC/event
4	hr/event
24	hr/yr
1	lb/hr
13.41	lb VOC/yr
0.01	ton VOC/yr

Clearing Module Lines

Emissions from clearing module lines after each VLCC loading are estimated based on the following:

Quantity	Units
180	VLCC Loadings/Yr
4	kg VOC/event
8.82	lb VOC/event
1	hr/event
180	hr/yr
9	lb/hr
1,587.33	lb VOC/yr
0.79	ton VOC/yr