Appendix G2
Air Quality - Operating Emissions

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Table FSRU 1: FSRU Controlled Equipment Emissions Summary

Quantity	Description	Rating (each)	Fuel	Annual Emissions, tons per year						
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2	NH_3
3	Wartsila 9L50DF Main Generators	8250 KW	Gas / CA Diesel	12.2	24.5	20.8	0.08	8.1	54,279	6.01
1	Wartsila 9L50DF Backup Generator	8250 KW	Gas / CA Diesel	1.9	0.3	0.2	0.01	0.1	473	0.05
8	Sub-X Submerged Combustion Vaporizers	115 mmBTU/hr	Natural Gas	48.9	3.5	148.9	0.33	3.8	215,271	-
2	Emergency Fire Pump / Generator	600 / 4200 KW	CA Diesel	3.0	0.4	1.9	0.00	0.1	370	-
1	Freefall Lifeboat	56 KW	CA Diesel	0.0	0.0	0.0	0.00	0.0	2	-
1	LNG Carrier (pumping only)	3733 KW	Gas / CA Diesel	9.4	2.7	6.6	0.00	0.4	2,773	-
1	Diesel Fuel Storage Tank	144,500 gallons	CA Diesel	-	0.03	-	-	-	-	-
Total Emissions				**75.4**	**31.4**	**178.4**	**0.42**	**12.6**	**273,168**	**6.06**

Device Notes:

FSRU throughput 800 mmcf/day, 365 days/yr, 292 mmmcf/yr total

Three 9L50DF main generators (8.25 MW each) operating at 100% load for hourly max, 110,903 MW-hr annual total, 99.4% gas fuel, 0.6% diesel pilot fuel (heat input)

Backup 9L50DF generator operating at 100% load for 100 machine hours per year, diesel fuel, 2006 Tier 2 standards

Four SCVs operating at 100% capacity factor for 8,760 hrs/yr, low-NOx burners

Emergency fire pump and generator operating at 100% load for 100 machine hours each per year, diesel fuel, 2006 Tier 2 standards

Three Life Boats exercising at 100% load for 50 machine hours per year total, diesel fuel, 2006 Tier 2 standards

Diesel Storage Tank, 144,500 gallon capacity, throughput based on diesel fuel usage defined above for applicable devices

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

Table FSRU 2: FSRU Uncontrolled Equipment Emissions Summary

Quantity	Description	Rating (each)	Fuel	Annual Emissions, tons per year						
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2	NH_3
3	Wartsila 9L50DF Main Generators	8250 KW	Gas / CA Diesel	183.4	52.7	129.6	0.1	8.1	54,279	-
1	Wartsila 9L50DF Backup Generator	8250 KW	Gas / CA Diesel	13.4	0.6	0.9	0.0	0.1	473	-
8	Sub-X Submerged Combustion Vaporizers	115 mmBTU/hr	Natural Gas	97.9	3.5	119.1	0.3	3.8	215,271	-
2	Emergency Fire Pump / Generator	600 / 4200 KW	CA Diesel	3.0	0.4	1.9	0.0	0.1	370	-
1	Freefall Lifeboat	56 KW	CA Diesel	0.0	0.0	0.0	0.0	0.0	2	-
1	LNG Carrier (pumping only)	3733 KW	Gas / CA Diesel	9.4	2.7	6.6	0.0	0.4	2,773	-
1	Diesel Fuel Storage Tank	144,500 gallons	CA Diesel	-	0.03	-	-	-	-	-
Total Emissions				**306.9**	**59.9**	**258.1**	**0.4**	**12.6**	**273,168**	**-**

Device Notes:

FSRU throughput 800 mmcf/day, 365 days/yr, 292 mmmcf/yr total

Three 9L50DF main generators (8.25 MW each) operating at 100% load for hourly max, 110,903 MW-hr annual total, 99.4% gas fuel, 0.6% diesel pilot fuel (heat input)

Backup 9L50DF generator operating at 100% load for 100 machine hours per year, diesel fuel, 2006 Tier 2 standards

Four SCVs operating at 100% capacity factor for 8,760 hrs/yr, low-NOx burners

Emergency fire pump and generator operating at 100% load for 100 machine hours each per year, diesel fuel, 2006 Tier 2 standards

Three Life Boats exercising at 100% load for 50 machine hours per year total, diesel fuel, 2006 Tier 2 standards

Diesel Storage Tank, 144,500 gallon capacity, throughput based on diesel fuel usage defined above for applicable devices

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

Table FSRU 3: FSRU HAP Emissions Summary

HAP EMITTENT NAME	Emission Rates (Controlled)											Hourly GLC		Annual GLC	
	Main Gens	Backup Gen	Vaporizers	Emerg. Pump	Emerg. Gen	Life Boat	LNG Carrier	Startup	Diesel Tank	Total	Combined	25,000 m	500 m	25,000 m	500 m
	lbs/yr	lbs/yr	lbs/yr	lbs/yr	lbs/yr	lbs/yr	lbs/yr	lbs/yr	lbs/yr	tons/yr	g/sec	ug/m^3	ug/m^3	ug/m^3	ug/m^3
Acetaldehyde	2,215	0.05	12	0.01	-	0.02	303.14	3.6		1.27	3.64E-02	2.00E-02	7.47E-02	1.60E-03	5.98E-03
Acrolein	1,362	0.02	11	0.00	0.03	0.00	186.38	1.1		0.78	2.24E-02	1.23E-02	4.60E-02	9.87E-04	3.68E-03
Ammonia	12,026	95.30								6.06	1.74E-01	9.59E-02	3.57E-01	7.67E-03	2.86E-02
Benzene	253	3.35	8	0.45	2.78	0.03	15.95	111.2	0.1	0.20	5.68E-03	3.12E-03	1.16E-02	2.50E-04	9.31E-04
Butadiene -1,3	153	0.17	-	0.02	0.14	0.00	9.68	5.6		0.08	2.43E-03	1.34E-03	4.98E-03	1.07E-04	3.98E-04
Ethyl Benzene	23	-	28	-	-	-	1.44	-		0.03	7.45E-04	4.10E-04	1.53E-03	3.28E-05	1.22E-04
Formaldehyde	13,988	0.16	300	0.05	0.28	0.04	1,914.57	11.3		8.11	2.33E-01	1.28E-01	4.78E-01	1.03E-02	3.82E-02
Hexane	637	-	18	-	-	-	40.25	-		0.35	1.00E-02	5.50E-03	2.05E-02	4.40E-04	1.64E-03
Naphthalene	43	0.56	2	0.08	0.47	0.00	2.70	18.6		0.03	9.72E-04	5.35E-04	1.99E-03	4.28E-05	1.59E-04
PAHs	15	0.35	0	0.05	0.29	0.00	0.98	11.8		0.01	4.20E-04	2.31E-04	8.62E-04	1.85E-05	6.89E-05
Propylene	-	12.03	2,120	1.63	10.00	0.08	-	399.8		1.27	3.66E-02	2.01E-02	7.50E-02	1.61E-03	6.00E-03
Toluene	234	1.21	14	0.16	1.01	0.01	14.79	40.3	0.3	0.15	4.39E-03	2.42E-03	9.01E-03	1.93E-04	7.21E-04
Xylenes	106	0.83	79	0.11	0.69	0.01	6.67	27.7	0.3	0.11	3.17E-03	1.75E-03	6.51E-03	1.40E-04	5.20E-04
Facility Total HAPS										**18.45**	**0.53**				

Composite Emisison Rate, lb/yr	31,055	114	2,592	3	16	0.2	2,496.6	631	0.6
Contribution, percent	84.1%	0.3%	7.0%	0.01%	0.04%	0.001%	6.8%	1.7%	0.002%
Composite Emisison Rate, g/s	4.47E-01	1.64E-03	3.73E-02	3.71E-05	2.26E-04	2.96E-06	3.59E-02	9.08E-03	8.50E-06

Device Notes:

FSRU throughput 800 mmcf/day, 365 days/yr, 292 mmmcf/yr total

Three 9L50DF main generators (8.25 MW each) operating at 100% load for hourly max, 110,903 MW-hr annual total, 99.4% gas fuel, 0.6% diesel pilot fuel (heat input)

Backup 9L50DF generator operating at 100% load for 100 machine hours per year, diesel fuel, 2006 Tier 2 standards

Four SCVs operating at 100% capacity factor for 8,760 hrs/yr, low-NOx burners

Emergency fire pump and generator operating at 100% load for 100 machine hours each per year, diesel fuel, 2006 Tier 2 standards

Three Life Boats exercising at 100% load for 50 machine hours per year total, diesel fuel, 2006 Tier 2 standards

Diesel Storage Tank, 144,500 gallon capacity, throughput based on diesel fuel usage defined above for applicable devices

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

Table FSRU 4: Release Parameters

Release Parameter	Units	Main Gens	Backup Gen	Vaporizers	Emerg. Pump	Emerg. Gen	Life Boat	LNG Carrier	Startup
Fuel	Type	Dual Fuel	Diesel	Gas	Diesel	Diesel	Diesel	Dual Fuel	Diesel
Heat Input	mmBTU/hr	197.1	66.3	460.0	5.9	35.8	0.64	31.8	99.52
Wet Fd Factor	wscf/mmBTU	10,608	10,320	10,610	10,320	10,320	10,320	10,608	10,320
Oxygen Content	percent	15%	15%	3%	15%	15%	15%	15%	15%
Exhaust Temperature	Deg F	800	800	70	800	800	800	800	800
Stack Diameter (each)	inches	39.37	39.37	39.37	10.0	26.0	3.0	31.50	39.37
Number of Active Stacks	each	3	1	4	1	1	1	1	2
Stack Diameter (combined)	inches	68.2	39.4	78.7	10.0	26.0	3.0	31.5	55.7
Stack Area	sq. ft.	25.36	8.45	33.82	0.55	3.69	0.05	5.41	16.91
Stack Flow	wscf/min	123,434	40,424	94,976	3,565	21,835	388	19,947	60,636
Stack Flow	wacf/min	294,558	96,467	95,336	8,507	52,106	926	47,600	144,700
Stack Velocity	ft/min	11,614	11,411	2,819	15,597	14,132	18,871	8,798	8,558
Release Height	meters	33	33	35	25	25	1	44	33
Release Diameter (h)	meters	1.73	1.00	2.00	0.25	0.66	0.08	0.80	1.41
Release Velocity	meters/sec	59.0	58.0	14.3	79.2	71.8	95.9	44.7	43.5
Release Temperature (T)	degrees K	700	700	294	700	700	700	700	700
Release Flowrate (V)	wacm/sec	139.01	45.53	44.99	4.01	24.59	0.44	22.46	68.29
HAP Emission Rate (Q)	g/sec	4.47E-01	1.64E-03	3.73E-02	3.71E-05	2.26E-04	2.96E-06	3.59E-02	9.08E-03
Merged Stack Parameter	M = hVT/Q	377,233	19,426,073	710,183	19,259,507	50,362,958	7,884,079	350,236	7,446,687

Downwash Dimensions	Units	FSRU Hull
Height	meters	21
Width (min horizontal)	meters	65
Length (max horizontal)	meters	286

GLC for unit emission rate	Units	Hourly GLC	Ann. Factor	Annual GLC	Class
25,000 meters (shoreline, residential)	ug/m^3 per g/sec	0.55	0.08	0.044	E
500 meters (safety zone, worker)	ug/m^3 per g/sec	2.05	0.08	0.164	D

Notes:
Merged stack: EPA-454/R-92-019, page 2-2
Hourly GLC: SCREEN3 Version 96043
Annual GLC: EPA-454/R-92-019, page 4-17

Table FSRU 5: Warsila Generators Controlled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Dual Fuel ICE generator, Wartsila 50DF		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S (with 0.6% diesel pilot charge, 15 ppmw S)		
TOTAL YEARLY PROCESS RATE	110903	MW-hrs	from BHP estimates
HOURLY PROCESS RATE	24.75	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cf	Scarborough LNG specification
OPERATING SCHEDULE	8760	hrs/yr	
HEAT RATE	7963	BTU/KW-hr	Wartsila Spec 0047057-S504, 13 May 05, corrected to HHV (110% of LHV)
CONVERSION EFFICIENCY	42.9%	percent	
HEAT INPUT	197.08	mmBTU/hr	HHV correction applies
DRY Fd	8713	dscf/mmBTU	USEPA Method 19, corrected for 0.6% diesel pilot fuel heat input
EXHAUST FLOW	6.08	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	7.5	1.0000	0.2205	24,450	12.23	5.46	0.100	0.075
Reactive Hydrocarbons (ROC) as CH_4	43.2	1.0000	0.4409	48,900	24.45	10.91	0.200	0.149
Carbon Monoxide (CO)	21.0	1.0000	0.3748	41,565	20.78	9.28	0.170	0.127
Sulfur Dioxide (SO_2)	0.034	1.0484	0.0014	153	0.08	0.03	0.0006	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0042	1.0000	0.1459	16,186	8.09	3.61	0.0662	0.049
Carbon Dioxide (CO_2)	3.49%	1.0000	978.8576	108,558,240	54,279	24,227	444	331
Ammonia Slip (NH_3)	10	1.0000	0.1084	12,026	6.01	2.68	0.049	0.037

Wartsila Emission Factors (BACT)

NO_x = 0.10 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.20 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 0.17 g/kw-hr (Wartsila Specification 16 March 2006)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

Pilot Diesel Fuel Usage	38,668	gal/yr

Average generation	110,903	MW-hrs/yr
Maximum generation	216,810	MW-hrs/yr
Average Capacity Factor	51.2%	percent

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	8.36E-03	0.30	2.00E-02	2,215	1.11	0.49
Acrolein	5.14E-03	0.30	1.23E-02	1,362	0.68	0.30
Benzene	4.40E-04	0.65	2.28E-03	253	0.13	0.06
Butadiene -1,3	2.67E-04	0.65	1.38E-03	153	0.08	0.03
Ethyl Benzene	3.97E-05	0.65	2.05E-04	23	0.01	0.01
Formaldehyde	5.28E-02	0.30	1.26E-01	13,988	6.99	3.12
Hexane	1.11E-03	0.65	5.75E-03	637	0.32	0.14
Naphthalene	7.44E-05	0.65	3.85E-04	43	0.02	0.01
PAHs	2.69E-05	0.65	1.39E-04	15	0.01	0.00
Propylene		0.65	0.00E+00	-	0.00	0.00
Toluene	4.08E-04	0.65	2.11E-03	234	0.12	0.05
Xylenes	1.84E-04	0.65	9.52E-04	106	0.05	0.02

HAP Emission Factors: AP-42 Table 3.2-2

EMITTENT NAME	RATE g/kw-hr	RATE g/bhp-hr	EMITTENT ppmv
Nitrogen Oxides (as NO_2)	0.100	0.075	7.5
Reactive Hydrocarbons (ROC) as CH_4	0.200	0.149	43.2
Carbon Monoxide (CO)	0.170	0.127	21.0
Sulfur Dioxide (SO_2)	0.0006	0.0005	0.0
Particulates (as PM_{10})	0.0662	0.0494	0.0
Carbon Dioxide (CO_2)	444	331	0.0
Ammonia Slip (NH_3)	0.049	0.037	10.0

Heat Rate	7963	BTU/kw-hr
Load (each)	8250	kw
Heat Input (each)	65.69	mmBTU/hr
Dry Fd	8713	dscf/mmBTU, USEPA Method 19, corrected for pilot fuel
Exhaust Flow (each)	2.028	mmdscf/hr

Table V-4, Proposed Emission Levels for Fossil-Fueld Reciprocating Engines, ARB, July 2002

EMITTENT NAME	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	0.201	0.150
Reactive Hydrocarbons (ROC) as CH_4	0.201	0.150
Carbon Monoxide (CO)	0.805	0.600
Particulates (as PM_{10})	0.027	0.020

Table FSRU 6: Warsila Generators Uncontrolled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Dual Fuel ICE generator, Wartsila 50DF		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S (with 0.6% diesel pilot charge, 15 ppmw S)		
TOTAL YEARLY PROCESS RATE	110903	MW-hrs	from BHP estimates
HOURLY PROCESS RATE	24.75	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cf	Scarborough LNG specification
OPERATING SCHEDULE	8760	hrs/yr	
HEAT RATE	7963	BTU/KW-hr	Wartsila Spec 0047057-S504, 13 May 05, corrected to HHV (110% of LHV)
CONVERSION EFFICIENCY	42.9%	percent	
HEAT INPUT	197.08	mmBTU/hr	HHV correction applies
DRY Fd	8713	dscf/mmBTU	USEPA Method 19, corrected for 0.6% diesel pilot fuel heat input
EXHAUST FLOW	6.08	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	112.7	1.0000	3.3070	366,751	183.38	81.85	1.500	1.119
Reactive Hydrocarbons (ROC) as CH_4	93.1	1.0000	0.9502	105,380	52.69	23.52	0.431	0.321
Carbon Monoxide (CO)	130.8	1.0000	2.3369	259,171	129.59	57.84	1.060	0.790
Sulfur Dioxide (SO_2)	0.034	1.0484	0.0014	153	0.08	0.03	0.0006	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0042	1.0000	0.1459	16,186	8.09	3.61	0.0662	0.049
Carbon Dioxide (CO_2)	3.49%	1.0000	978.8576	108,558,240	54,279	24,227	444	331
Ammonia Slip (NH_3)								

Wartsila Emission Factors (Uncontrolled)

NO_X = 1.50 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.431 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.06 g/kw-hr (Wartsila Specification 16 March 2006)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	8.36E-03	1.00	6.66E-02	7,383	3.69	1.65
Acrolein	5.14E-03	1.00	4.09E-02	4,539	2.27	1.01
Benzene	4.40E-04	1.00	3.50E-03	389	0.19	0.09
Butadiene -1,3	2.67E-04	1.00	2.13E-03	236	0.12	0.05
Ethyl Benzene	3.97E-05	1.00	3.16E-04	35	0.02	0.01
Formaldehyde	5.28E-02	1.00	4.20E-01	46,628	23.31	10.41
Hexane	1.11E-03	1.00	8.84E-03	980	0.49	0.22
Naphthalene	7.44E-05	1.00	5.92E-04	66	0.03	0.01
PAHs	2.69E-05	1.00	2.14E-04	24	0.01	0.01
Propylene		1.00	0.00E+00	-	0.00	0.00
Toluene	4.08E-04	1.00	3.25E-03	360	0.18	0.08
Xylenes	1.84E-04	1.00	1.47E-03	162	0.08	0.04

HAP Emission Factors: AP-42 Table 3.2-2

Table FSRU 7: Wartsila Back-up Generator Controlled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Dual Fuel ICE generator, Wartsila 50DF		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppmw S		
TOTAL YEARLY PROCESS RATE	825	MW-hrs	
HOURLY PROCESS RATE	8.25	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	100	hrs/yr	
HEAT RATE	8042	BTU/KW-hr	Wartsila Spec 0047057-S504, 13 May 05
CONVERSION EFFICIENCY	42.4%	percent	
HEAT INPUT	66.35	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	2.16	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	150	1.0000	4.6884	3,868	1.93	38.68	2.127	1.586
Reactive Hydrocarbons (ROC) as CH_4	60	1.0000	0.6523	538	0.27	5.38	0.296	0.221
Carbon Monoxide (CO)	25	1.0000	0.4756	392	0.20	3.92	0.216	0.161
Sulfur Dioxide (SO_2)	0.29	1.0000	0.013	10	0.01	0.10	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.0091	1.0000	0.3395	280	0.14	2.80	0.154	0.115
Carbon Dioxide (CO_2)	3.83%	1.0000	1146.4098	945,788	473	9,458	520	388
Ammonia Slip (NH_3)	10	1.0000	0.1155	95	0.05	0.95	0.052	0.039

Wartsila Emission Factors (Controlled)

NO_X = 150 ppm, 2.127 g/kw-hr (Wartsila Spec 0047057-S504, 13 May 05)

VOC = 60 ppm, 0.296 g/kw-hr (Wartsila Spec 0047057-S504, 13 May 05)

CO = 25 ppm, 0.216 g/kw-hr (Wartsila Spec Spec 0047057-S504, 13 May 05)

PM_{10} = 0.154 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 520 g/kw-hr (Wartsila)

Backup Diesel Fuel Usage	48,417	gal/yr

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	0.30	6.08E-05	0.05	0.000	0.001
Acrolein	7.88E-06	0.30	1.90E-05	0.02	0.000	0.000
Benzene	7.76E-04	0.65	4.06E-03	3.35	0.002	0.033
Butadiene -1,3	3.91E-05	0.65	2.04E-04	0.17	0.000	0.002
Ethyl Benzene		0.65	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	0.30	1.90E-04	0.16	0.000	0.002
Hexane		0.65	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	0.65	6.80E-04	0.56	0.000	0.006
PAHs	8.20E-05	0.65	4.29E-04	0.35	0.000	0.004
Propylene	2.79E-03	0.65	1.46E-02	12.03	0.006	0.120
Toluene	2.81E-04	0.65	1.47E-03	1.21	0.001	0.012
Xylenes	1.93E-04	0.65	1.01E-03	0.83	0.000	0.008

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table FSRU 8: Wartsila Back-up Generator Uncontrolled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Dual Fuel ICE generator, Wartsila 50DF		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppmw S		
TOTAL YEARLY PROCESS RATE	825	MW-hrs	
HOURLY PROCESS RATE	8.25	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	100	hrs/yr	
HEAT RATE	8042	BTU/KW-hr	Wartsila Spec 0047057-S504, 13 May 05
CONVERSION EFFICIENCY	42.4%	percent	
HEAT INPUT	66.35	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	2.16	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	1037	1.0000	32.4081	26,737	13.37	267.37	14.700	10.962
Reactive Hydrocarbons (ROC) as CH_4	132	1.0000	1.4352	1,184	0.59	11.84	0.651	0.485
Carbon Monoxide (CO)	119	1.0000	2.2708	1,873	0.94	18.73	1.030	0.768
Sulfur Dioxide (SO_2)	0.3	1.0000	0.0125	10	0.01	0.10	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.0091	1.0000	0.3395	280	0.14	2.80	0.154	0.115
Carbon Dioxide (CO_2)	3.83%	1.0000	1146.4098	945,788	473	9,458	520	388
Ammonia Slip (NH_3)								

Wartsila Emission Factors (Uncontrolled)

NO_X = 14.70 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.651 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.03 g/kw-hr (Wartsila Specification 16 March 2006)

PM_{10} = 0.154 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 520 g/kw-hr (Wartsila)

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	1.00	2.03E-04	0.17	0.000	0.002
Acrolein	7.88E-06	1.00	6.34E-05	0.05	0.000	0.001
Benzene	7.76E-04	1.00	6.24E-03	5.15	0.003	0.051
Butadiene -1,3	3.91E-05	1.00	3.14E-04	0.26	0.000	0.003
Ethyl Benzene		1.00	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	1.00	6.35E-04	0.52	0.000	0.005
Hexane		1.00	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.00	1.05E-03	0.86	0.000	0.009
PAHs	8.20E-05	1.00	6.59E-04	0.54	0.000	0.005
Propylene	2.79E-03	1.00	2.24E-02	18.51	0.009	0.185
Toluene	2.81E-04	1.00	2.26E-03	1.86	0.001	0.019
Xylenes	1.93E-04	1.00	1.55E-03	1.28	0.001	0.013

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table FSRU 9: SCV Controlled Average Emissions Summary

SIC	1321	
PROCESS EQPT DESCRIPTION	Submerged Combustion Vaporizer, Selas Sub-X, 120-180 ton LNG/hr, Low NØBurner	
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S	
TOTAL YEARLY PROCESS RATE	3999.206	
HOURLY PROCESS RATE	0.456530	
PROCESS UNITS	PT074	Million Cubic Feet Burned
HIGHER HEATING VALUE	1007.6	mmBTU/mmcf
OPERATING SCHEDULE	8760	hrs/yr
NUMBER OF DEVICES	4.00	Average
UNIT RATING	115.000	mmBTU/hr
HEAT INPUT	460.00	mmBTU/hr
DRY Fd	8710	dscf/mmBTU USEPA Method 19
EXHAUST FLOW	4.68	mmdscf/hr

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE lb/mmBTU
Nitrogen Oxides (as NO_x)	20.0	1.0000	24.467	97,850	48.93	11.17	0.0243
Reactive Hydrocarbons (ROC) as CH_4	4.1	1.0000	1.745	6,977	3.49	0.80	0.0017
Carbon Monoxide (CO)	100.0	1.0000	74.466	297,805	148.90	34.00	0.0739
Sulfur Dioxide (SO_2)	0.10	1.0000	0.166	664	0.33	0.08	0.0002
Particulates (as PM_{10}) (grains/dscf)	0.0013	1.0000	1.900	7,598	3.80	0.87	0.0019
Carbon Dioxide (CO_2)	9.2%	1.0000	107656.700	430,541,325	215270.66	49148.55	106.8447
Ammonia Slip (NH_3)							

Emission Factors @ 3% oxygen

NO_x = 20 ppmv (Selas Specification)

ROC = 4.1 ppmv (Costain Report)

CO = 100 ppmv (Selas Specification)

PM_{10} = 1.9 lb/mmcf (AP-42 Table 1.4-2, non-condensible filterable fraction, condensibles remain in 70 F water solution)

CO_2 = 9.2% (Selas Specification, 6.6% @ 8% oxygen)

Device Notes:

FSRU throughput 800 mmcf/day, 365 days/yr, 292 mmmcf/yr total

SCV sendout rate =200 mmscf/day (guarantee)

Throughput, mmcf/day	800	design
SCV Sendout, mmcf/day each	200	guarantee
Equivalent SCVs Operating	4.00	average

HAP NAME	UNCTL EF lb/mmcf	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	3.10E-03	1.00	3.10E-03	12.4	0.006	0.001
Acrolein	2.70E-03	1.00	2.70E-03	10.8	0.005	0.001
Benzene	2.10E-03	1.00	2.10E-03	8.4	0.004	0.001
Butadiene -1,3		1.00	0.00E+00	-	0.000	0.000
Ethyl Benzene	6.90E-03	1.00	6.90E-03	27.6	0.014	0.003
Formaldehyde	7.50E-02	1.00	7.50E-02	299.9	0.150	0.034
Hexane	4.60E-03	1.00	4.60E-03	18.4	0.009	0.002
Naphthalene	6.10E-04	1.00	6.10E-04	2.4	0.001	0.000
PAHs	8.82E-05	1.00	8.82E-05	0.4	0.000	0.000
Propylene	5.30E-01	1.00	5.30E-01	2,119.6	1.060	0.242
Toluene	3.40E-03	1.00	3.40E-03	13.6	0.007	0.002
Xylenes	1.97E-02	1.00	1.97E-02	78.8	0.039	0.009

HAP Emission Factors: AP-42 Table 1.4-3 (benzene, formaldehyde, napthalene, PAHs, toluene)

VCAPCD 8/25/95 all others

Exhaust Gas (Selas)	**Vol %**	**MW**	**MW**	**Wt %**	**Cp**	**Cp**
Carbon Dioxide	0.066	44.010	2.90	0.100	0.1991	0.0199
Nitrogen	0.815	28.013	22.83	0.787	0.2482	0.1954
Oxygen	0.080	31.999	2.56	0.088	0.2188	0.0193
Water vapor	0.039	18.015	0.70	0.024	0.4446	0.0108
TOTAL	**1.000**		**29.00**	**1.000**		**0.2454**
			lb/mole			**BTU/lb-F**

Exhaust flowrate	28,605	scfm
Exhaust flowrate	2,186	lb/min
TOTAL flowrate (4 running)	524,573	lb/hr
Exhaust temperature, F	70	lower
SCR Inlet, F	650	upper
Delta T , F	580	max
Specific Heat, BTU/lb-F	0.2454	
Heat Input, mmBTU/hr	74.68	
Recuperative heat revovery	85%	
Net heat, mmBTU/hr	**11**	
Fuel gas, mmcf/yr	**96**	
Percent Increase	2.4%	

Duct Burner GHG emissions	**lb/mmcf**	**ton/yr**
CO	84	4.0
CO_2	120,000	5,760
PM	7.6	0.4
ROC	5.5	0.3
SO_x	0.166	0.0

Table FSRU 10: SCV Controlled Max Day Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Submerged Combustion Vaporizer, Selas Sub-X, 120-180 ton LNG/hr, Low NO_x Burner		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S		
TOTAL YEARLY PROCESS RATE	16.435		
HOURLY PROCESS RATE	0.684796		
PROCESS UNITS	PT074	Million Cubic Feet Burned	
HIGHER HEATING VALUE	1007.6	mmBTU/mmcf	
OPERATING SCHEDULE	24	hrs/yr	
NUMBER OF DEVICES	6.00	Average	
UNIT RATING	115.000	mmBTU/hr	
HEAT INPUT	690.00	mmBTU/hr	
DRY Fd	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	7.02	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE lb/mmBTU
Nitrogen Oxides (as NO_2)	20.0	1.0000	24.467	402	0.20	16.76	0.0243
Reactive Hydrocarbons (ROC) as CH_4	4.1	1.0000	1.745	29	0.01	1.19	0.0017
Carbon Monoxide (CO)	100.0	1.0000	74.466	1,224	0.61	50.99	0.0739
Sulfur Dioxide (SO_2)	0.10	1.0000	0.166	3	0.00	0.11	0.0002
Particulates (as PM_{10}) (grains/dscf)	0.0013	1.0000	1.900	31	0.02	1.30	0.0019
Carbon Dioxide (CO_2)	9.2%	1.0000	107656.700	1,769,348	884.67	73722.83	106.8447
Ammonia Slip (NH_3)							

Emission Factors @ 3% oxygen

NO_X = 20 ppmv (Selas Specification)

ROC = 4.1 ppmv (Costain Report)

CO = 100 ppmv (Selas Specification)

PM_{10} = 1.9 lb/mmcf (AP-42 Table 1.4-2, non-condensible filterable fraction, condensibles remain in 70 F water solution)

CO_2 = 9.2% (Selas Specification, 6.6% @ 8% oxygen)

Device Notes:

FSRU throughput 1200 mmcf/day

SCV sendout rate =200 mmscf/day (guarantee)

Throughput, mmcf/day	1200	design
SCV Sendout, mmcf/day each	200	guarantee
Equivalent SCVs Operating	6.00	average

HAP NAME	UNCTL EF lb/mmcf	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	3.10E-03	1.00	3.10E-03	0.1	0.000	0.002
Acrolein	2.70E-03	1.00	2.70E-03	0.0	0.000	0.002
Benzene	2.10E-03	1.00	2.10E-03	0.0	0.000	0.001
Butadiene -1,3		1.00	0.00E+00	-	0.000	0.000
Ethyl Benzene	6.90E-03	1.00	6.90E-03	0.1	0.000	0.005
Formaldehyde	7.50E-02	1.00	7.50E-02	1.2	0.001	0.051
Hexane	4.60E-03	1.00	4.60E-03	0.1	0.000	0.003
Naphthalene	6.10E-04	1.00	6.10E-04	0.0	0.000	0.000
PAHs	8.82E-05	1.00	8.82E-05	0.0	0.000	0.000
Propylene	5.30E-01	1.00	5.30E-01	8.7	0.004	0.363
Toluene	3.40E-03	1.00	3.40E-03	0.1	0.000	0.002
Xylenes	1.97E-02	1.00	1.97E-02	0.3	0.000	0.013

HAP Emission Factors: AP-42 Table 1.4-3 (benzene, formaldehyde, napthalene, PAHs, toluene)

VCAPCD 8/25/95 all others

Table FSRU 11: Controlled Max Hour Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Submerged Combustion Vaporizer, Selas Sub-X, 120-180 ton LNG/hr, Low NO_x Burner		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S		
TOTAL YEARLY PROCESS RATE	0.856		
HOURLY PROCESS RATE	0.855994		
PROCESS UNITS	PT074	Million Cubic Feet Burned	
HIGHER HEATING VALUE	1007.6	mmBTU/mmcf	
OPERATING SCHEDULE	1	hrs/yr	
NUMBER OF DEVICES	7.50	Average	
UNIT RATING	115.000	mmBTU/hr	
HEAT INPUT	862.50	mmBTU/hr	
DRY Fd	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	8.77	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE lb/mmBTU
Nitrogen Oxides (as NO_2)	20.0	1.0000	24.467	21	0.01	20.94	0.0243
Reactive Hydrocarbons (ROC) as CH_4	4.1	1.0000	1.745	1	0.00	1.49	0.0017
Carbon Monoxide (CO)	100.0	1.0000	74.466	64	0.03	63.74	0.0739
Sulfur Dioxide (SO_2)	0.10	1.0000	0.166	0	0.00	0.14	0.0002
Particulates (as PM_{10}) (grains/dscf)	0.0013	1.0000	1.900	2	0.00	1.63	0.0019
Carbon Dioxide (CO_2)	9.2%	1.0000	107656.700	92,154	46.08	92153.54	106.8447
Ammonia Slip (NH_3)							

Emission Factors @ 3% oxygen

NO_X = 20 ppmv (Selas Specification)

ROC = 4.1 ppmv (Costain Report)

CO = 100 ppmv (Selas Specification)

PM_{10} = 1.9 lb/mmcf (AP-42 Table 1.4-2, non-condensible filterable fraction, condensibles remain in 70 F water solution)

CO_2 = 9.2% (Selas Specification, 6.6% @ 8% oxygen)

Device Notes:

FSRU throughput 1500 mmcf/day

SCV sendout rate =200 mmscf/day (guarantee)

Throughput, mmcf/day	1500	design
SCV Sendout, mmcf/day each	200	guarantee
Equivalent SCVs Operating	7.50	average

HAP NAME	UNCTL EF lb/mmcf	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	3.10E-03	1.00	3.10E-03	0.0	0.000	0.003
Acrolein	2.70E-03	1.00	2.70E-03	0.0	0.000	0.002
Benzene	2.10E-03	1.00	2.10E-03	0.0	0.000	0.002
Butadiene -1,3		1.00	0.00E+00	-	0.000	0.000
Ethyl Benzene	6.90E-03	1.00	6.90E-03	0.0	0.000	0.006
Formaldehyde	7.50E-02	1.00	7.50E-02	0.1	0.000	0.064
Hexane	4.60E-03	1.00	4.60E-03	0.0	0.000	0.004
Naphthalene	6.10E-04	1.00	6.10E-04	0.0	0.000	0.001
PAHs	8.82E-05	1.00	8.82E-05	0.0	0.000	0.000
Propylene	5.30E-01	1.00	5.30E-01	0.5	0.000	0.454
Toluene	3.40E-03	1.00	3.40E-03	0.0	0.000	0.003
Xylenes	1.97E-02	1.00	1.97E-02	0.0	0.000	0.017

HAP Emission Factors: AP-42 Table 1.4-3 (benzene, formaldehyde, napthalene, PAHs, toluene)

VCAPCD 8/25/95 all others

Table FSRU 12: SCV Uncontrolled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Submerged Combustion Vaporizer, Selas Sub-X, 120-180 ton LNG/hr, Standard Burner		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S		
TOTAL YEARLY PROCESS RATE	3999.206		
HOURLY PROCESS RATE	0.456530		
PROCESS UNITS	PT074	Million Cubic Feet Burned	
HIGHER HEATING VALUE	1007.6	mmBTU/mmcf	
OPERATING SCHEDULE	8760	hrs/yr	
NUMBER OF DEVICES	4.00	Average	
UNIT RATING	115.000	mmBTU/hr	
HEAT INPUT	460.00	mmBTU/hr	
DRY Fd	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	4.68	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE lb/mmBTU
Nitrogen Oxides (as NO_2)	40.0	1.0000	48.935	195,701	97.85	22.34	0.0486
Reactive Hydrocarbons (ROC) as CH_4	4.1	1.0000	1.745	6,977	3.49	0.80	0.0017
Carbon Monoxide (CO)	80.0	1.0000	59.573	238,244	119.12	27.20	0.0591
Sulfur Dioxide (SO_2)	0.10	1.0000	0.166	664	0.33	0.08	0.0002
Particulates (as PM_{10}) (grains/dscf)	0.0013	1.0000	1.900	7,598	3.80	0.87	0.0019
Carbon Dioxide (CO_2)	9.2%	1.0000	107656.700	430,541,325	215270.66	49148.55	106.8447
Ammonia Slip (NH_3)							

Emission Factors @ 3% oxygen

NO_X = 40 ppmv (Selas Specification)

ROC = 4.1 ppmv (Costain Report)

CO = 80 ppmv (Selas Specification)

PM_{10} = 1.9 lb/mmcf (AP-42 Table 1.4-2, non-condensible filterable fraction, condensibles remain in 70 F water solution)

CO_2 = 9.2% (Selas Specification, 6.6% @ 8% oxygen)

Device Notes:

FSRU throughput 800 mmcf/day, 365 days/yr, 292 mmmcf/yr total

SCV sendout rate =200 mmscf/day (guarantee)

Throughput, mmcf/day	800	design
SCV Sendout, mmcf/day each	200	guarantee
Equivalent SCVs Operating	4.00	average

HAP NAME	UNCTL EF lb/mmcf	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	3.10E-03	1.00	3.10E-03	12.4	0.006	0.001
Acrolein	2.70E-03	1.00	2.70E-03	10.8	0.005	0.001
Benzene	2.10E-03	1.00	2.10E-03	8.4	0.004	0.001
Butadiene -1,3		1.00	0.00E+00	-	0.000	0.000
Ethyl Benzene	6.90E-03	1.00	6.90E-03	27.6	0.014	0.003
Formaldehyde	7.50E-02	1.00	7.50E-02	299.9	0.150	0.034
Hexane	4.60E-03	1.00	4.60E-03	18.4	0.009	0.002
Naphthalene	6.10E-04	1.00	6.10E-04	2.4	0.001	0.000
PAHs	8.82E-05	1.00	8.82E-05	0.4	0.000	0.000
Propylene	5.30E-01	1.00	5.30E-01	2,119.6	1.060	0.242
Toluene	3.40E-03	1.00	3.40E-03	13.6	0.007	0.002
Xylenes	1.97E-02	1.00	1.97E-02	78.8	0.039	0.009

HAP Emission Factors: AP-42 Table 1.4-3 (benzene, formaldehyde, napthalene, PAHs, toluene)

VCAPCD 8/25/95 all others

Table FSRU 13: Firewater Pump Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Firewater Pump, 600 KW		
FUEL TYPE/PROCESS INFO	California Diesel, 15 ppmw S		
TOTAL YEARLY PROCESS RATE	60	MW-hrs	
HOURLY PROCESS RATE	0.60	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	100	hrs/yr	
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	5.85	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.19	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	326	1.0000	12.3460	741	0.37	7.41	5.600	4.176
Reactive Hydrocarbons (ROC) as CH_4	134	1.0000	1.7637	106	0.05	1.06	0.800	0.597
Carbon Monoxide (CO)	334	1.0000	7.7162	463	0.23	4.63	3.500	2.610
Sulfur Dioxide (SO_2)	0.3	1.0000	0.015	1	0.00	0.01	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0097	1.0000	0.4409	26	0.01	0.26	0.200	0.149
Carbon Dioxide (CO_2)	4.26%	1.0000	1543.2439	92,595	46	926	700	522
Ammonia Slip (NH_3)								

* USEPA Tier 2 Standards (>560 kw)

NO_X + ROC = 6.4 g/kw-hr

CO = 3.5 g/kw-hr

PM_{10} = 0.2 g/kw-hr

CO_2 = 700 g/kw-hr (AP-42, Table 3.3-1)

Diesel Fuel Usage	4,270	gal/yr

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	1.00	2.46E-04	0.0	0.000	0.000
Acrolein	7.88E-06	1.00	7.68E-05	0.0	0.000	0.000
Benzene	7.76E-04	1.00	7.57E-03	0.5	0.000	0.005
Butadiene -1,3	3.91E-05	1.00	3.81E-04	0.0	0.000	0.000
Ethyl Benzene		1.00	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	1.00	7.69E-04	0.0	0.000	0.000
Hexane		1.00	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.00	1.27E-03	0.1	0.000	0.001
PAHs	8.20E-05	1.00	8.00E-04	0.0	0.000	0.000
Propylene	2.79E-03	1.00	2.72E-02	1.6	0.001	0.016
Toluene	2.81E-04	1.00	2.74E-03	0.2	0.000	0.002
Xylenes	1.93E-04	1.00	1.88E-03	0.1	0.000	0.001

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table FSRU 14: Emergency Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Emergency Generator, 4200 KW		
FUEL TYPE/PROCESS INFO	California Diesel, 15 ppmw S		
TOTAL YEARLY PROCESS RATE	420	MW-hrs	
HOURLY PROCESS RATE	4.20	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	100	hrs/yr	
HEAT RATE	8533	BTU/KW-hr	
CONVERSION EFFICIENCY	40.0%	percent	
HEAT INPUT	35.84	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	1.17	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	372	1.0000	12.3460	5,185	2.59	51.85	5.600	4.176
Reactive Hydrocarbons (ROC) as CH_4	153	1.0000	1.7637	741	0.37	7.41	0.800	0.597
Carbon Monoxide (CO)	382	1.0000	7.7162	3,241	1.62	32.41	3.500	2.610
Sulfur Dioxide (SO_2)	0.3	1.0000	0.013	6	0.003	0.056	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.0111	1.0000	0.4409	185	0.09	1.85	0.200	0.149
Carbon Dioxide (CO_2)	4.87%	1.0000	1543.2439	648,162	324	6,482	700	522
Ammonia Slip (NH_3)								

* USEPA Tier 2 Standards (>560 kw)

NO_X + ROC = 6.4 g/kw-hr

CO = 3.5 g/kw-hr

PM_{10} = 0.2 g/kw-hr

CO_2 = 700 g/kw-hr (AP-42, Table 3.3-1)

Diesel Fuel Usage	26,152	gal/yr

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	1.00	2.15E-04	0.1	0.000	0.001
Acrolein	7.88E-06	1.00	6.72E-05	0.0	0.000	0.000
Benzene	7.76E-04	1.00	6.62E-03	2.8	0.001	0.028
Butadiene -1,3	3.91E-05	1.00	3.34E-04	0.1	0.000	0.001
Ethyl Benzene		1.00	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	1.00	6.73E-04	0.3	0.000	0.003
Hexane		1.00	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.00	1.11E-03	0.5	0.000	0.005
PAHs	8.20E-05	1.00	7.00E-04	0.3	0.000	0.003
Propylene	2.79E-03	1.00	2.38E-02	10.0	0.005	0.100
Toluene	2.81E-04	1.00	2.40E-03	1.0	0.001	0.010
Xylenes	1.93E-04	1.00	1.65E-03	0.7	0.000	0.007

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table FSRU 15: Freefall Lifeboat Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Freefall Lifeboat Engine, 75 BHP (56 KW)		
FUEL TYPE/PROCESS INFO	California Diesel, 15 ppmw S		
TOTAL YEARLY PROCESS RATE	2.8	MW-hrs	
HOURLY PROCESS RATE	0.056	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	50	hrs/yr	
HEAT RATE	11377	BTU/KW-hr	
CONVERSION EFFICIENCY	30.0%	percent	
HEAT INPUT	0.64	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.02	mmdscf/hr	

EMITTENT NAME	EMITTENT PPM	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	324	1.0000	14.3301	40	0.02	0.80	6.500	4.847
Reactive Hydrocarbons (ROC) as CH_4	143	1.0000	2.2046	6	0.00	0.12	1.000	0.746
Carbon Monoxide (CO)	410	1.0000	11.0232	31	0.02	0.62	5.000	3.729
Sulfur Dioxide (SO_2)	0.3	1.0000	0.018	0	0.00	0.00	0.008	0.006
Particulates (as PM_{10}) (grains/dscf)	0.0167	1.0000	0.8819	2	0.00	0.05	0.400	0.298
Carbon Dioxide (CO_2)	3.65%	1.0000	1543.2439	4,321	2	86	700	522

* USEPA Tier 2 Standards (>37 kw, <75 kw)

NO_X + ROC = 7.5 g/kw-hr

CO = 5.0 g/kw-hr

PM_{10} = 0.4 g/kw-hr

CO_2 = 700 g/kw-hr (AP-42, Table 3.3-1)

Diesel Fuel Usage	232	gal/yr

HAP NAME	UNCTL EF lb/mmBTU	CORR FACTOR	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	7.67E-04	1.00	8.73E-03	0.0	0.000	0.000
Acrolein	9.25E-05	1.00	1.05E-03	0.0	0.000	0.000
Benzene	9.33E-04	1.00	1.06E-02	0.0	0.000	0.001
Butadiene -1,3	3.91E-05	1.00	4.45E-04	0.0	0.000	0.000
Ethyl Benzene		1.00	0.00E+00	-	0.000	0.000
Formaldehyde	1.18E-03	1.00	1.34E-02	0.0	0.000	0.001
Hexane		1.00	0.00E+00	-	0.000	0.000
Naphthalene	8.48E-05	1.00	9.65E-04	0.0	0.000	0.000
PAHs	8.32E-05	1.00	9.47E-04	0.0	0.000	0.000
Propylene	2.58E-03	1.00	2.94E-02	0.1	0.000	0.002
Toluene	4.09E-04	1.00	4.65E-03	0.0	0.000	0.000
Xylenes	2.85E-04	1.00	3.24E-03	0.0	0.000	0.000

HAP Emission Factors: AP-42 Table 3.3-2

Averaging Period	EPA Factor
3 hours	0.9
8 hours	0.7
24 hours	0.4
Annual	0.08

Reference

Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (Revised)
EPA-454/R-92-019, pages 4-16.

Table FSRU 16: LNG Transfer from Carrier Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	LNG Carrier auxiliary generator, 4450 KW pumping load		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S & 15 ppmw S California diesel pilot charge		
TOTAL YEARLY PROCESS RATE	4250	MW-hrs	
HOURLY PROCESS RATE	3.733	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
OPERATING SCHEDULE	1139	hrs/yr	
HEAT RATE	8533	BTU/KW-hr	
CONVERSION EFFICIENCY	40.0%	percent	
HEAT INPUT	31.85	mmBTU/hr	
DRY Fd	8714	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.98	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	140	4.4093	18,738	9.37	16.46	2.000	1.491
Reactive Hydrocarbons (ROC) as CH_4	116	1.2669	5,384	2.69	4.73	0.575	0.429
Carbon Monoxide (CO)	163	3.1159	13,242	6.62	11.63	1.413	1.054
Sulfur Dioxide (SO_2)	0.04	0.0015	7	0.00	0.01	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0052	0.1946	827	0.41	0.73	0.0883	0.066
Carbon Dioxide (CO_2)	4.34%	1305.1434	5,546,499	2,773	4,872	592	441

Wartsila Emission Factors (Uncontrolled)

NO_X = 1.50 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.431 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.06 g/kw-hr (Wartsila Specification 16 March 2006)

SO_2 = 0.0007 g/kw-hr (99.2% gas 1 ppmv S & 0.8% CA diesel 15 ppmw S)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

Notes:

All Wartsila emission factors except SO_2 increased by 33.3% margin for other engine types

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

99 berthings/yr, 138 km3

8.5 hrs pumping at FSRU per berthing

3 hrs ramp down at FSRU per berthing

HAP NAME	UNCTL EF lb/mmBTU	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	8.36E-03	7.13E-02	303.1	0.15	0.27
Acrolein	5.14E-03	4.39E-02	186.4	0.093	0.164
Benzene	4.40E-04	3.75E-03	16.0	0.008	0.014
Butadiene -1,3	2.67E-04	2.28E-03	9.7	0.005	0.009
Ethyl Benzene	3.97E-05	3.39E-04	1.4	0.001	0.001
Formaldehyde	5.28E-02	4.51E-01	1,914.6	0.957	1.682
Hexane	1.11E-03	9.47E-03	40.2	0.020	0.035
Naphthalene	7.44E-05	6.35E-04	2.7	0.001	0.002
PAHs	2.69E-05	2.30E-04	1.0	0.000	0.001
Propylene		0.00E+00	-	0.000	0.000
Toluene	4.08E-04	3.48E-03	14.8	0.007	0.013
Xylenes	1.84E-04	1.57E-03	6.7	0.003	0.006

HAP Emission Factors: AP-42 Table 3.2-2

Pumping Power for Berthing, 210 km3	Hours	KW	KW-hrs
Full Rate	8.5	4477	38055
Ramp Down	3	1624	4872
Weighted Average	11.5	3733	
Scaler	99	1	
Weighted Average	1139	3733	

Table FSRU 17: Diesel Storage Tank Emissions Summary

SIC	1321	
PROCESS EQPT DESCRIPTION	Standby Diesel Fuel Storage Tank, 144,500 gallons	
FUEL TYPE/PROCESS INFO	California Diesel, 15 ppmw S	
TOTAL YEARLY PROCESS RATE	117.740	
AVERAGE HOURLY PROCESS RATE	0.013	
MAXIMUM HOURLY PROCESS RATE	0.013	
PROCESS UNITS	PT031	1000 GALLONS THROUGHPUT
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
HRS/YEAR	8760	
TOTAL YEARLY PROCESS RATE	59.7	
AVERAGE HOURLY PROCESS RATE	0.0068	
MAXIMUM HOURLY PROCESS RATE	0.0068	
PROCESS UNITS	PT079	POUNDS (VOC)

EMITTENT NAME	EMITTENT PPM		CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Nitrogen Oxides (as NO_2)						
Reactive Hydrocarbons (ROC) as CH_4			1.0	59.7	0.030	0.0068
Carbon Monoxide (CO)						
Sulfur Dioxide (SO_2)						
Particulates (as PM_{10}) (grains/dscf)						
Carbon Dioxide (CO_2)						
Ammonia Slip (NH_3)						
Benzene			0.00088	0.05	0.000	0.000
Toluene			0.00482	0.29	0.000	0.000
Xylenes			0.00420	0.25	0.000	0.000

HAP speciation SJVUAPCD 7/14/95

SCAQMD AP-42 Fixed Roof Eqns.	Value	Units		
Number of Tanks	1			
Tank Diameter, D	40.000	ft		
Shell Height, Hs	15.380	ft	144,577	gallons
Vapor Outage Headspace, Hvo	7.690	ft		
Tank Capacity, C	3442.300	bbl		
Throughput, Q	2803	bbl/yr	117,740	gal/yr
Turnovers, N	0.814	#/yr		
True Vapor Pressure, P	0.009	psia		
Vapor Molecular Weight, Mv	130	lb/lb-mole		
Storage Temperature, Ts	65	F		
Delta Temp, Tv	25	F		
Paint Alpha, a	0.1700	a		
Product Factor, Kp	1.0000			
Vapor Space Volume, Vv	9663.5390	ft3		
Vapor Density, Wv	0.0002	lb/ft3		
Vapor Space Expansion Factor, Ke	0.0352			
Vapor Saturation Factor, Kv	0.9963			
Turnover Factor, Kn	1.0000			
Beathing Loss, Lb	25.6641	lb/yr		
Working Loss, Lw	3.2799	lb/yr		
Total Tank Losses, Lt	28.9440	lb/yr		

Fugitive Components	lb/yr	EF, lb/hr	Count
Valves, Gas	0.0000	0.012	
Valves, Light Liquid	0.0000	0.016	
Valves, Heavy Liquid	67.0140	0.00051	15
Flanges, General	31.5360	0.0018	2
Pump Seals, Light Liquid	0.0000	0.11	
Pump Seals, Heavy Liquid	823.4400	0.047	2
Pressure Relief Valves	0.0000	0.23	
Low Pressure Correction Factor	0.0333		
Total Fugitive Losses, Lf	30.7238		
Total Emissions, Et	59.6678	lb/yr	

Appendix G2-2
District Waters Emission Summary Index

Table No.	Table Name
DW 1	District Waters Emissions Summary
DW 2	Tug/Supply Boat Main Engines Emissions Summary
DW 3	Tug/Supply Boat Generators Emissions Summary
DW 4	Tug/Supply Boat Activity Summary
DW 5	Crew Boat Main Engine Emissions Summary
DW 6	Crew Boat Generator Emissions Summary
DW 7	Crew Boat Activity Summary

Table DW 1: District Waters Emissions Summary

Quantity	Description	Rating (each)	Fuel	Annual Emissions, tons per year					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
2	Tug Supply Boat	15,000 BHP Mains	CA Diesel w/controls	0.22	0.09	0.21	0.001	0.01	143
1	Crew Boat	1,500 BHP Mains	CA Diesel w/controls	0.06	0.03	0.06	0.000	0.00	43
Total Emissions (CA diesel)				**0.28**	**0.12**	**0.27**	**0.002**	**0.02**	**186**

Vessel Notes:

Tug Supply boat making 52 round trips to FSRU per year, time & load weighted engine operation

Crew boat making 198 round trips to FSRU per year, time & load weighted engine operation

Operating component in state waters only (inside 3-mile limit)

Support vessel fuel is 15 ppm S CA Diesel

Support vessels controlled with SCR + oxidation catalyst + PM trap (mains & gens) for equivalence to LNG fuel for NO_X, ROC, CO amd PM_{10}

Support vessel SO_2 & CO_2 uncontrolled

Table DW 2: Tug/Supply Boat Main Engine Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Tug Supply Main Generator Set Engines, 15,000 BHP, 2 vessels alternating port calls		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	174	MW-hrs	
HOURLY PROCESS RATE	3.36	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/scf	
COMBINED ENGINE RATING	15000	BHP	from BHP estimates
LOAD FACTOR	30%	percent	from activity profile
OPERATING SCHEDULE	52	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	32.72	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	1.065	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	65	2.4692	431	0.215	8.286	1.120	0.835
Reactive Hydrocarbons (ROC) as CH_4	80	1.0582	185	0.092	3.551	0.480	0.358
Carbon Monoxide (CO)	100	2.3149	404	0.202	7.768	1.050	0.783
Sulfur Dioxide (SO_2)	0.29	0.0152	3	0.001	0.051	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0029	0.1323	23	0.012	0.444	0.060	0.045
Carbon Dioxide (CO_2)	4.44%	1608.9857	280,763	140.381	5399.281	730	544

USEPA Tier 2 Standards (>560 kw)

NO_X + ROC = 6.4 g/kw-hr

CO = 3.5 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.2 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	234,000	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 2/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	5.600	0.200	1.120	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.800	0.600	0.480	40.0%
Carbon Monoxide (CO)		9751	3.500	0.300	1.050	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.200	0.300	0.060	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

HAP NAME	UNCTL EF lb/mmBTU	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	2.46E-04	0.04	0.000	0.001
Acrolein	7.88E-06	7.68E-05	0.01	0.000	0.000
Benzene	7.76E-04	7.57E-03	1.32	0.001	0.025
Butadiene -1,3	3.91E-05	3.81E-04	0.07	0.000	0.001
Ethyl Benzene		0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	7.69E-04	0.13	0.000	0.003
Hexane		0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.27E-03	0.22	0.000	0.004
PAHs	8.20E-05	8.00E-04	0.14	0.000	0.003
Propylene	2.79E-03	2.72E-02	4.75	0.002	0.091
Toluene	2.81E-04	2.74E-03	0.48	0.000	0.009
Xylenes	1.93E-04	1.88E-03	0.33	0.000	0.006

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table DW 3: Tug Supply Boat Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Tug Supply Auxiliary Generator, 150 BHP, 2 vessels alternating port calls		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	3	MW-hrs	
HOURLY PROCESS RATE	0.06	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/scf	
COMBINED ENGINE RATING	150	BHP	from BHP estimates
LOAD FACTOR	50%	percent	from activity profile
OPERATING SCHEDULE	52	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	0.55	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.018	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	41	1.5432	4	0.002	0.086	0.700	0.522
Reactive Hydrocarbons (ROC) as CH_4	50	0.6614	2	0.001	0.037	0.300	0.224
Carbon Monoxide (CO)	143	3.3070	10	0.005	0.185	1.500	1.119
Sulfur Dioxide (SO_2)	0.29	0.0152	0	0.000	0.001	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0044	0.1984	1	0.000	0.011	0.090	0.067
Carbon Dioxide (CO_2)	4.44%	1608.9857	4,679	2.340	89.988	730	544

USEPA Tier 3 Standards (75-130 kw)

NO_X + ROC = 4.0 g/kw-hr

CO = 5.0 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.3 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	3,900	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 3/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	3.500	0.200	0.700	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.500	0.600	0.300	40.0%
Carbon Monoxide (CO)		9751	5.000	0.300	1.500	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.300	0.300	0.090	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

HAP NAME	UNCTL EF lb/mmBTU	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	2.46E-04	0.00	0.000	0.000
Acrolein	7.88E-06	7.68E-05	0.00	0.000	0.000
Benzene	7.76E-04	7.57E-03	0.02	0.000	0.000
Butadiene -1,3	3.91E-05	3.81E-04	0.00	0.000	0.000
Ethyl Benzene		0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	7.69E-04	0.00	0.000	0.000
Hexane		0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.27E-03	0.00	0.000	0.000
PAHs	8.20E-05	8.00E-04	0.00	0.000	0.000
Propylene	2.79E-03	2.72E-02	0.08	0.000	0.002
Toluene	2.81E-04	2.74E-03	0.01	0.000	0.000
Xylenes	1.93E-04	1.88E-03	0.01	0.000	0.000

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table DW 4: Tug/Supply Boat Activity Summary

District Waters Transit	Miles	Speed	Time, hrs	Mains	Weighted	Mode
Engine start & idle at dock	0	0	0.12	10%	1.2%	4.0%
Transit harbor zone outbound	0.75	5	0.15	14%	2.1%	7.0%
Due south to boundary	3.5	18.5	0.19	51%	9.7%	32.1%
Federal Waters						
Due north from boundary	3.5	18.5	0.19	51%	9.7%	32.1%
Transit harbor zone inbound	0.75	5	0.15	14%	2.1%	7.0%
Docking & engine stop	0	0	0.20	27%	5.4%	17.9%
Composite			**1.00**		**30%**	**100%**

Cruising in District waters per week **0.38**

Remarks - District Waters Transit

1 roundtrip/week = 52 roundtrips/year
52 trips/yr x 1 hr/trip = 52 hrs/yr @ 30% power on mains
ship generators run all the time, so
52 trips/yr x 1 hrs/trip = 52 hrs/yr @ 50% power

Start/Stop/Idle	21.9%
Harbor Transit	14.0%
Cruise to/from Boundary	64.1%
	100.0%

Table DW 5: Crew Boat Main Engine Emission Sumarry

SIC	1321		
PROCESS EQPT DESCRIPTION	Crew Boat Main Engines, 1500 BHP		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	48	MW-hrs	
HOURLY PROCESS RATE	0.46	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/scf	
COMBINED ENGINE RATING	1500	BHP	from BHP estimates
LOAD FACTOR	41%	percent	from activity profile
OPERATING SCHEDULE	104	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	4.47	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.146	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	65	2.4692	118	0.059	1.132	1.120	0.835
Reactive Hydrocarbons (ROC) as CH_4	80	1.0582	50	0.025	0.485	0.480	0.358
Carbon Monoxide (CO)	100	2.3149	110	0.055	1.062	1.050	0.783
Sulfur Dioxide (SO_2)	0.29	0.0152	1	0.000	0.007	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0029	0.1323	6	0.003	0.061	0.060	0.045
Carbon Dioxide (CO_2)	4.44%	1608.9857	76,742	38.371	737.902	730	544

USEPA Tier 2 Standards (>560 kw)

NO_X + ROC = 6.4 g/kw-hr

CO = 3.5 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.2 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	63,960	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 2/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	5.600	0.200	1.120	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.800	0.600	0.480	40.0%
Carbon Monoxide (CO)		9751	3.500	0.300	1.050	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.200	0.300	0.060	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

HAP NAME	UNCTL EF lb/mmBTU	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	2.46E-04	0.01	0.000	0.000
Acrolein	7.88E-06	7.68E-05	0.00	0.000	0.000
Benzene	7.76E-04	7.57E-03	0.36	0.000	0.003
Butadiene -1,3	3.91E-05	3.81E-04	0.02	0.000	0.000
Ethyl Benzene		0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	7.69E-04	0.04	0.000	0.000
Hexane		0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.27E-03	0.06	0.000	0.001
PAHs	8.20E-05	8.00E-04	0.04	0.000	0.000
Propylene	2.79E-03	2.72E-02	1.30	0.001	0.012
Toluene	2.81E-04	2.74E-03	0.13	0.000	0.001
Xylenes	1.93E-04	1.88E-03	0.09	0.000	0.001

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table DW 6: Crew Boat Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Crew Boat Generator Engine, 150 BHP		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	6	MW-hrs	
HOURLY PROCESS RATE	0.06	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/scf	
COMBINED ENGINE RATING	150	BHP	from BHP estimates
LOAD FACTOR	50%	percent	from activity profile
OPERATING SCHEDULE	104	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	0.55	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.018	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	41	1.5432	9	0.004	0.086	0.700	0.522
Reactive Hydrocarbons (ROC) as CH_4	50	0.6614	4	0.002	0.037	0.300	0.224
Carbon Monoxide (CO)	143	3.3070	19	0.010	0.185	1.500	1.119
Sulfur Dioxide (SO_2)	0.29	0.0152	0	0.000	0.001	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0044	0.1984	1	0.001	0.011	0.090	0.067
Carbon Dioxide (CO_2)	4.44%	1608.9857	9,359	4.679	89.988	730	544

USEPA Tier 3 Standards (75-130 kw)

NO_X + ROC = 4.0 g/kw-hr

CO = 5.0 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.3 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	7,800	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 3/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	3.500	0.200	0.700	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.500	0.600	0.300	40.0%
Carbon Monoxide (CO)		9751	5.000	0.300	1.500	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.300	0.300	0.090	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

HAP NAME	UNCTL EF lb/mmBTU	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR
Acetaldehyde	2.52E-05	2.46E-04	0.00	0.000	0.000
Acrolein	7.88E-06	7.68E-05	0.00	0.000	0.000
Benzene	7.76E-04	7.57E-03	0.04	0.000	0.000
Butadiene -1,3	3.91E-05	3.81E-04	0.00	0.000	0.000
Ethyl Benzene		0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	7.69E-04	0.00	0.000	0.000
Hexane		0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.27E-03	0.01	0.000	0.000
PAHs	8.20E-05	8.00E-04	0.00	0.000	0.000
Propylene	2.79E-03	2.72E-02	0.16	0.000	0.002
Toluene	2.81E-04	2.74E-03	0.02	0.000	0.000
Xylenes	1.93E-04	1.88E-03	0.01	0.000	0.000

HAP Emission Factors: AP-42 Table 3.4-3 , -4
(1,3 Butadiene AP-42 Table 3.3-2)

Table DW 7: Crew Boat Activity Summary

Crew Boats

District Waters Transit	Miles	Speed	Time, hrs	Mains	Weighted	Mode
Engine start & idle at dock	0	0	0.12	13%	1.5%	3.7%
Transit harbor zone outbound	0.75	5	0.15	24%	3.4%	8.4%
Due south to boundary	3.5	16.3	0.21	70%	14.3%	35.3%
Federal Waters						
Due north from boundary	3.5	16.3	0.21	70%	14.3%	35.3%
Transit harbor zone inbound	0.75	5	0.15	24%	3.4%	8.4%
Docking & engine stop	0	0	0.20	19%	3.6%	8.9%
District waters composite per trip			**1.05**		**41%**	**100%**
Cruising in District waters per week			**0.82**			

Remarks - District Waters Transit

99 berthings/yr, 138 km3
2 roundtrip/berthing = 198 roundtrips/year
99 trips/yr x 1.05 hr/trip = 104 hrs/yr @ 41% power on mains
ship generators run all the time, so
99 trips/yr x 1.05 hrs/trip = 104 hrs/yr @ 50% power

Start/Stop/Idle	12.6%
Harbor Transit	16.9%
Cruise to/from Boundary	70.5%
	100.0%

Appendix G2-3
Federal Waters Emission Summary Index

Table No.	Table Name
FW 1	Federal Waters Emission Summary
FW 2	Tug/Supply Boat Main Engine Emissions Summary
FW 3	Tug/Supply Boat Generator Emissions Summary
FW 4	Tug/Supply Boat Activity Summary
FW 5	Crew Boat Main Engine Emissions Summary
FW 6	Crew Boat Generator Emissions Summary
FW 7	Crew Boat Activity Summary
FW 8	LNG 138 km3 Carrier Gasified LNG Fuel Emissions Summary
FW 9	LNG 210 km3 Carrier Gasified LNG Fuel Emissions Summary
FW 10	LNG Carrier Activity Summary

Table FW 1: Federal Waters Emissions Summary

Quantity	Description	Rating (each)	Fuel	Annual Emissions, tons per year					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
2	Tug Supply Boat	15,000 BHP Mains	CA Diesel w/controls	27.0	11.6	26.2	0.17	1.5	17,866
1	Crew Boat	1,500 BHP Mains	CA Diesel w/controls	0.8	0.3	0.8	0.01	0.0	536
1	LNG Carrier	33,000 KW Total	Gasified LNG & CA Diesel	21.1	6.1	14.9	0.01	0.9	6,238
Total Emissions (gasified LNG & CA diesel)				**48.8**	**18.0**	**41.9**	**0.18**	**2.5**	**24,640**

Vessel Notes:

Assist tugs (pair) conducting LNG carrier to FSRU berthing operations 99 times per year, time & load weighted engine operation

Tug Supply boat making 52 round trips to FSRU per year, time & load weighted engine operation

Crew boat making 198 round trips to FSRU per year, time & load weighted engine operation

LNG carrier to FSRU berthing operations, 15 miles slow, 3 miles to FSRU with assist tugs, time & load weighted engine operation

Operating component in federal waters only (outside 3-mile limit)

Support vessel fuel is 15 ppm S CA Diesel

LNG Carrier is 99.2% gasified LNG / 0.8% CA diesel pilot fuel by heat input

Support vessels controlled with SCR + oxidation catalyst + PM trap (mains & gens) for equivalence to LNG fuel for NO_X, ROC, CO amd PM_{10}

Support vessel SO_2 & CO_2 uncontrolled

Carrier emission factors except SO_2 increased by 33.3% margin for other engine types (Wartsila 50DF as standard)

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

Carrier emissions from hoteling allocated to vessels

Revision Date: 9/21/06

Table FW 2: Tug/Supply Boat Main Engine Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Tug Supply Main Generator Set Engines, 15,000 BHP, 2 vessels alternating port calls		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	21242	MW-hrs	
HOURLY PROCESS RATE	1.23	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
COMBINED ENGINE RATING	15000	BHP	from BHP estimates
LOAD FACTOR	11%	percent	from activity profile
OPERATING SCHEDULE	17264	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	12.00	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.39	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	2 Vessels ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	65	2.4692	52,451	26.23	6.08	1.120	0.835
Reactive Hydrocarbons (ROC) as CH_4	80	1.0582	22,479	11.24	2.60	0.480	0.358
Carbon Monoxide (CO)	100	2.3149	49,173	24.59	5.70	1.050	0.783
Sulfur Dioxide (SO_2)	0.29	0.0152	322	0.16	0.04	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0029	0.1323	2,810	1.40	0.33	0.060	0.045
Carbon Dioxide (CO_2)	4.44%	1608.9857	34,178,168	17,089	3,959	730	544

USEPA Tier 2 Standards (>560 kw)

NO_X + ROC = 6.4 g/kw-hr

CO = 3.5 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.2 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	28,485,600	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 2/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	5.600	0.200	1.120	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.800	0.600	0.480	40.0%
Carbon Monoxide (CO)		9751	3.500	0.300	1.050	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.200	0.300	0.060	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

Revision Date: 9/21/06

Table FW 3: Tug/Supply Boat Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Tug Supply Auxiliary Generator, 150 BHP, 2 vessels alternating port calls		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	966	MW-hrs	
HOURLY PROCESS RATE	0.06	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
COMBINED ENGINE RATING	150	BHP	from BHP estimates
LOAD FACTOR	50%	percent	from activity profile
OPERATING SCHEDULE	17264	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	0.55	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.02	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	2 Vessels ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	41	1.5432	1,490	0.75	0.17	0.700	0.522
Reactive Hydrocarbons (ROC) as CH_4	50	0.6614	639	0.32	0.07	0.300	0.224
Carbon Monoxide (CO)	143	3.3070	3,193	1.60	0.37	1.500	1.119
Sulfur Dioxide (SO_2)	0.29	0.0152	15	0.01	0.00	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0044	0.1984	192	0.10	0.02	0.090	0.067
Carbon Dioxide (CO_2)	4.44%	1608.9857	1,553,553	777	180	730	544

USEPA Tier 3 Standards (75-130 kw)

NO_X + ROC = 4.0 g/kw-hr

CO = 5.0 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.3 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	1,294,800	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 3/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	3.500	0.200	0.700	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.500	0.600	0.300	40.0%
Carbon Monoxide (CO)		9751	5.000	0.300	1.500	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.300	0.300	0.090	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

Revision Date: 9/21/06

Table FW 4: Tug/Supply Boat Activity Summary

Assist Tugs

Berthing Activity	Miles	Speed	Time, hrs	Mains	Weighted	Mode 1	Mode 2	Gens	Weighted	Mode 1	Mode 2
Standby/Patrol to LNG Carrier	3	18.5	0.16	51%	0.3%	2.7%	0.7%	50%	0.3%	0.7%	0.2%
Assist Carrier to FSRU	3	5	0.60	43%	1.1%	8.4%	2.3%	50%	1.2%	2.5%	0.7%
Assist Big Push			0.04	100%	0.2%	1.3%	0.4%	50%	0.1%	0.2%	0.0%
Safety Zone	0.3	1	0.30	22%	0.3%	2.1%	0.6%	50%	0.6%	1.2%	0.3%
Unload Standby/Patrol Safety Zone	0	min	21.80	10%	9.1%	70.9%	19.7%	50%	45.4%	90.8%	25.2%
Safety Zone	0.3	1	0.30	22%	0.3%	2.1%	0.6%	50%	0.6%	1.2%	0.3%
Safety Zone Big Push			0.04	100%	0.2%	1.3%	0.4%	50%	0.1%	0.2%	0.0%
Assist Carrier to Release	3	5	0.60	43%	1.1%	8.4%	2.3%	50%	1.2%	2.5%	0.7%
Release to Standby/Patrol	3	18.5	0.16	51%	0.3%	2.7%	0.7%	50%	0.3%	0.7%	0.2%
Composite			**24.00**		**13%**	**100.0%**	**27.7%**		**50.0%**	**100.0%**	**27.7%**
Two Vessels (per week)			**92.0**								

Remarks - Berthing
99 berthings/yr, 138 km3
1.9 berthings/wk x 24 hrs x 2 vessels = 92 hrs/wk @ 13% power on mains
ship generators run all the time, so
1.9 berthings/wk x 24 hrs x 2 vessels = 92 hrs/wk @ 50% power on gens

Federal Waters Transit	Miles	Speed	Time, hrs	Mains	Weighted	Mode 1	Mode 2	Gens	Weighted	Mode 1	Mode 2
Loiter to Safety Zone	0.7	5	0.1	14%	0.5%	3.3%	0.1%	50%	1.7%	3.5%	0.1%
Safety Zone	0.3	1	0.3	12%	0.9%	6.1%	0.1%	50%	3.7%	7.5%	0.2%
Load/Unload Safety Zone	0	stop	2.3	0%	0.0%	0.0%	0.0%	50%	28.7%	57.3%	1.4%
Safety Zone	0.3	1	0.3	12%	0.9%	6.1%	0.1%	50%	3.7%	7.5%	0.2%
Cruise from Safety Zone to Boundary	18	18.5	1.0	51%	12.4%	84.4%	2.0%	50%	12.1%	24.2%	0.6%
Composite Each Way			**4.0**		**15%**	**100.0%**	**2.4%**		**50.0%**	**100.0%**	**2.4%**
Round Trip (per week)			**8.0**								

Remarks - Federal Waters Transit
1 roundtrip/week = 52 roundtrips/year
1 trips/wk x 8 hr/trip = 8 hrs/wk @ 15% power on mains
ship generators run all the time, so
1 trips/wk x 8 hr/trip = 8 hrs/wk @ 50% power on gens

Time Balance (hrs/wk)	Miles	Speed	Time, hrs	Mains	Weighted	Mode 1	Mode 2	Gens	Weighted	Mode 1	Mode 2
Hours per week (2 vessels)			336								
District Waters & Port Time			4								
In Federal Waters			332								
Berthing Activity			92	13%	3.5%						
Transit			8	15%	0.4%						
Standby/Patrol Safety Zone (balance)			232	10%	7.0%	100.0%	69.9%	50%	50.0%	100.0%	69.9%
Total Time in Federal Waters			**332**		**11%**	**100.0%**	**69.9%**		**50%**	**100.0%**	**69.9%**
Per Year			**17,264**		**11%**				**50%**		

Remarks - Federal Waters
52 wks/yr x 332 hrs/wk = 17,264 hrs/yr (2 vessels) @ 11% power on mains
ship generators run all the time, so
17,264 hrs/yr @ 50% power

	29,780,400	28,485,600	1,294,800
	Modal Wt	**Mains**	**Gens**
Assist/Standby/Loiter	6.4%	6.6%	1.9%
Safety Zone/Patrol	91.6%	91.4%	96.1%
Load/Unload	0.1%	0.0%	1.4%
Transit to/from Boundary/Limit	2.0%	2.0%	0.6%
	100.0%	100.0%	100.0%

Revision Date: 9/21/06

Table FW 5: Crew Boat Main Engine Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Crew Boat Main Engines, 1500 BHP		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	589	MW-hrs	
HOURLY PROCESS RATE	0.43	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
COMBINED ENGINE RATING	1500	BHP	from BHP estimates
LOAD FACTOR	38%	percent	from activity profile
OPERATING SCHEDULE	1386	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	4.14	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.13	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	65	2.4692	1,455	0.73	1.05	1.120	0.835
Reactive Hydrocarbons (ROC) as CH_4	80	1.0582	623	0.31	0.45	0.480	0.358
Carbon Monoxide (CO)	100	2.3149	1,364	0.68	0.98	1.050	0.783
Sulfur Dioxide (SO_2)	0.29	0.0152	9	0.00	0.01	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0029	0.1323	78	0.04	0.06	0.060	0.045
Carbon Dioxide (CO_2)	4.44%	1608.9857	947,898	474	684	730	544

USEPA Tier 2 Standards (>560 kw)

NO_X + ROC = 6.4 g/kw-hr

CO = 3.5 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.2 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	790,020	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 2/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	5.600	0.200	1.120	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.800	0.600	0.480	40.0%
Carbon Monoxide (CO)		9751	3.500	0.300	1.050	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.200	0.300	0.060	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

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Table FW 6: Crew Boat Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Crew Boat Generator Engine, 150 BHP		
FUEL TYPE/PROCESS INFO	CA Diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	78	MW-hrs	
HOURLY PROCESS RATE	0.06	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
COMBINED ENGINE RATING	150	BHP	from BHP estimates
LOAD FACTOR	50%	percent	from activity profile
OPERATING SCHEDULE	1386	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	0.55	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.018	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE* g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	41	1.5432	120	0.06	0.09	0.700	0.522
Reactive Hydrocarbons (ROC) as CH_4	50	0.6614	51	0.03	0.04	0.300	0.224
Carbon Monoxide (CO)	143	3.3070	256	0.13	0.18	1.500	1.119
Sulfur Dioxide (SO_2)	0.29	0.0152	1	0.00	0.00	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0044	0.1984	15	0.01	0.01	0.090	0.067
Carbon Dioxide (CO_2)	4.44%	1608.9857	124,723	62	90	730	544

USEPA Tier 3 Standards (75-130 kw)

NO_X + ROC = 4.0 g/kw-hr

CO = 5.0 g/kw-hr

SO_2 = 1.55 E-3 lb/mmBTU (for 15 ppmv S)

PM_{10} = 0.3 g/kw-hr

CO_2 = 165 lb/mmBTU

Power output	103,950	BHP-hr/yr				
			Uncontrolled	Control	Controlled	Reduction
Unit conversion from Tier 3/AP-42	lb/mmBTU	BTU/kw-hr	g/kw-hr	factor	g/kw-hr	percent
Nitrogen Oxides (as NO_2)		9751	3.500	0.200	0.700	80.0%
Reactive Hydrocarbons (ROC) as CH_4		9751	0.500	0.600	0.300	40.0%
Carbon Monoxide (CO)		9751	5.000	0.300	1.500	70.0%
Sulfur Dioxide (SO_2)	1.55E-03	9751	0.007	1.000	0.007	0.0%
Particulates (as PM_{10})		9751	0.300	0.300	0.090	70.0%
Carbon Dioxide (CO_2)	165	9751	729.820	1.000	729.820	0.0%

Revision Date: 9/21/06

Table FW 7: Crew Boat Activity Summary

Support Activity	Miles	Speed	Time, hrs	Mains	Weighted	Mode	Gens	Weighted	Mode
Boundary to FSRU	18	18	1.00	90%	12.9%	33.6%	50%	7.1%	14.3%
Loiter FSRU/Patrol	3.50	2	1.75	19%	4.8%	12.4%	50%	12.5%	25.0%
Safety Zone	0.3	1	0.30	16%	0.7%	1.8%	50%	2.1%	4.3%
Load/Unload Standby	0	stop	0.90	13%	1.7%	4.4%	50%	6.4%	12.9%
Safety Zone	0.3	1	0.30	16%	0.7%	1.8%	50%	2.1%	4.3%
Loiter FSRU/Patrol	3.50	2	1.75	19%	4.8%	12.4%	50%	12.5%	25.0%
Cruise to Boundary	18	18	1.00	90%	12.9%	33.6%	50%	7.1%	14.3%
Composite			**7.00**		**38%**	**100.0%**		**50%**	**100.0%**
Per Year			**1386**		**38%**			**50%**	

Remarks - Federal Waters Transit

99 berthings/yr, 138 km3
2 roundtrip/berthing = 198 roundtrips/year
198 trips/yr x 7 hrs/trip = 1386 hrs/yr @ 38% power on mains
ship generators run all the time, so
198 trips/yr x 7 hrs/trip = 1386 hrs/yr @ 50% power

BHP-hr/yr		893,970	790,020	103,950
		Modal Wt	**Mains**	**Gens**
Assist/Standby/Loiter/Patrol		27.8%	24.8%	50.0%
Safety Zone		4.2%	3.6%	8.6%
Load/Unload		5.4%	4.4%	12.9%
Transit to/from Boundary/Limit		62.7%	67.2%	28.6%
		100.0%	100.0%	100.0%

Revision Date: 9/21/06

Table FW 8: LNG 138 km3 Carrier Gasified LNG Fuel Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	LNG Carrier, 33,000 KW Total		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S & 15 ppmw S California diesel pilot charge		
TOTAL YEARLY PROCESS RATE	9559	MW-hrs	
HOURLY PROCESS RATE	4.62	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
COMBINED ENGINE RATING	33000	KW	from activity profile
LOAD FACTOR	14%	percent	from activity profile
OPERATING SCHEDULE	2069	hrs/yr	from activity profile
HEAT RATE	8533	BTU/KW-hr	
CONVERSION EFFICIENCY	40.0%	percent	
HEAT INPUT	39.42	mmBTU/hr	
DRY Fd	8714	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	1.22	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	140	4.4093	42,147	21.07	20.37	2.000	1.491
Reactive Hydrocarbons (ROC) as CH_4	116	1.2669	12,110	6.06	5.85	0.575	0.429
Carbon Monoxide (CO)	163	3.1159	29,784	14.89	14.40	1.413	1.054
Sulfur Dioxide (SO_2)	0.04	0.0015	15	0.01	0.01	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0052	0.1946	1,860	0.93	0.90	0.0883	0.066
Carbon Dioxide (CO_2)	4.34%	1305.1434	12,475,579	6,238	6,030	592	441

Wartsila Emission Factors (Uncontrolled)

NO_X = 1.50 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.431 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.06 g/kw-hr (Wartsila Specification 16 March 2006)

SO_2 = 0.0007 g/kw-hr (99.2% gas 1 ppmv S & 0.8% CA diesel 15 ppmw S)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

Notes:

Carrier emission factors except SO_2 increased by 33.3% margin for other engine types (Wartsila 50DF as standard)

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

Carrier emissions from hoteling allocated to vessels

Revision Date: 9/21/06

Table FW 9: LNG 210 km3 Carrier Gasified LNG Fuel Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	LNG Carrier, 44,000 KW Total		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S & 15 ppmw S California diesel pilot charge		
TOTAL YEARLY PROCESS RATE	12745	MW-hrs	
HOURLY PROCESS RATE	6.16	MW	
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG
COMBINED ENGINE RATING	44000	KW	from activity profile
LOAD FACTOR	14%	percent	from activity profile
OPERATING SCHEDULE	2069	hrs/yr	from activity profile
HEAT RATE	8533	BTU/KW-hr	
CONVERSION EFFICIENCY	40.0%	percent	
HEAT INPUT	52.56	mmBTU/hr	
DRY Fd	8714	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	1.62	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	140	4.4093	56,196	28.10	27.16	2.000	1.491
Reactive Hydrocarbons (ROC) as CH_4	116	1.2669	16,147	8.07	7.80	0.575	0.429
Carbon Monoxide (CO)	163	3.1159	39,712	19.86	19.19	1.413	1.054
Sulfur Dioxide (SO_2)	0.04	0.0015	20	0.01	0.01	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0052	0.1946	2,480	1.24	1.20	0.0883	0.066
Carbon Dioxide (CO_2)	4.34%	1305.1434	16,634,105	8,317	8,040	592	441

Wartsila Emission Factors (Uncontrolled)

NO_X = 1.50 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.431 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.06 g/kw-hr (Wartsila Specification 16 March 2006)

SO_2 = 0.0007 g/kw-hr (99.2% gas 1 ppmv S & 0.8% CA diesel 15 ppmw S)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

Notes:

Carrier emission factors except SO_2 increased by 33.3% margin for other engine types (Wartsila 50DF as standard)

Carrier emissions from transfer pump operation allocated to stationary source (FSRU)

Carrier emissions from hoteling allocated to vessels

Revision Date: 9/21/06

Table FW 10: LNG Carrier Activity Summary

Sequence No.	Time	Total time Hrs.	Event	Ship Speed in knots	Distance From FSRU	Total Load (kW)	Total Load Percent of Maximum	Time Weighted Percent	Mode Percent	Main Engine (kW)	Ships Services (kW)
1	0.5	0	Ship at **full sea speed** - commences to reduce over 1/2 an hour.	20	18nm	39416	89.6%	2.14%	15.60%	37500	1916
2	0.5	1.0	Ship slows to manoeuvring speed - ready to commence reducing to pick up pilot	12	10nm	30416	69.1%	1.65%	12.03%	28500	1916
3	0.2	1.2	**Half ahead**	10	9nm	13316	30.3%	0.29%	2.11%	11400	1916
4	0.2	1.4	**Slow ahead**	8	7nm	10416	23.7%	0.23%	1.65%	8500	1916
5	0.2	1.6	**Dead Slow** Ahead	6	6nm	5516	12.5%	0.12%	0.87%	3600	1916
6	0.2	1.8	Picking up pilot - speed 6 knots	6	5nm	5516	12.5%	0.12%	0.87%	3600	1916
7	0.1	1.9	**Slow Ahead**	6	4.5nm	10416	23.7%	0.11%	0.82%	8500	1916
8	0.3	2.2	Making tugs fast	8	3nm	10416	23.7%	0.34%	2.47%	8500	1916
9	0.3	2.5	**Dead Slow Ahead**	6	1.5nm	5516	12.5%	0.18%	1.31%	3600	1916
10	0.2	2.7	Stop	6 to 4 to 3	1nm	1916	4.4%	0.04%	0.30%		1916
11	0.3	3.0	Tugs assisting ship to stop / Ship manoeuvring parallel to the FSRU. Ship stopped parallel to FSRU - 70 to 100 metres off		70 metres	1916	4.4%	0.06%	0.45%		1916
12	0.2	3.2	Lines boats running lines from FSRU winches to ship /Ship's crew take up lines and make fast on ship.	0	70 metres	1916	4.4%	0.04%	0.30%		1916
13	0.3	3.5	Tugs keep vessel in position F and A, also pull stern or bow off if this is needed - winches wind ship in at (30 cm/sec?) - slowing to 10 cm/sec before ship contacts fenders. Most work here will be done by the tugs - there may be the odd occasion where the vessel will need kicks either dead slow ahead or dead slow astern.	30cm/s to 10cm/s	70 metres to 0	1946	4.4%	0.06%	0.46%		1946
14	0.7	4.2	Alongside making fast Ship all fast	0	0	1946	4.4%	0.15%	1.08%		1946
15	2.7	6.9	Safety checks / arm connection /cool down/ commence cargo to full rate	0	0	1946	4.4%	0.57%	4.16%		1946
16	**8.5**	**15.4**	**Full rate discharge (excludes pumping power)**	**0**	**0**	**1946**	**4.4%**	**1.80%**	**13.09%**		**1946**
17	**3.0**	**18.4**	**Ramp down to complete cargo / disconnection / Custody transfer (excludes pumping power)**	**0**	**0**	**1946**	**4.4%**	**0.63%**	**4.62%**		**1946**
18	0.2	18.6	Make tugs fast / prepare FSRU winch wires	0	0	1946	4.4%	0.04%	0.31%		1946
19	0.2	18.8	Let go all ship's lines. Winches release weight / tugs get in position to lift off / commence lifting ship away from FSRU	0	0	1946	4.4%	0.04%	0.31%		1946
20	0.2	19.0	Tugs lifting off / wires released / ship to dead slow ahead	0 forward	30 metres	1946	4.4%	0.04%	0.31%		1946
21	0.1	19.1	Ship to **slow ahead**	4	0.5nm	10416	23.7%	0.11%	0.82%	8500	1916
22	0.3	19.4	Ship to **dead slow ahead**	6	2nm	5516	12.5%	0.18%	1.31%	3600	1916
23	0.2	19.6	Pilot transferring to launch	6	2nm	5516	12.5%	0.12%	0.87%	3600	1916
24	0.3	19.9	**Ship Dead Slow to Slow to Half to Full Ahead**	12	5nm	12916	29.4%	0.42%	3.07%	11000	1916
25	1.0	20.9	Increasing from manoeuvring speed to full sea speed	12 to 20	21nm	38916	88.4%	4.23%	30.80%	37000	1916
Composite	**20.9**							**14%**	**100%**		
Per Year	**2069**							**14%**			

Engines:	2x18V50DF	33,000 kW
210 km3	2x6L50DF	11,000 kW
	Total	44,000 kW

Engines:	2x12V50DF	22,000 kW
138 km3	2x6L50DF	11,000 kW
	Total	33,000 kW

	Mode
Assist/Standby/Loiter	25.45%
Safety Zone/Patrol	7.38%
Load/Unload	17.71%
Transit to/from Boundary/Limit	49.46%
	100.00%

Remarks - Federal Waters Transit

99 berthings/yr, 138 km3
99 berthings/yr x 20.9 hrs = 2069 hrs/yr @ 14% power
Carrier emissions from hoteling allocated to federal waters vessels
Carrier emissions from pumping allocated to FSRU stationary source
The in port load (Cargo Transfer) has been revised. Power rating for 10 Ebara cargo pumps (12EC-24 1700 m3/H @ 470 kw @ 95.25% = 4477 kw)
Pumps run at 1619 m3/hr each, 16190 m3/hr total
210 km3 carrier is 13 hrs pumping, 138 km3 carrier is 8.5 hrs pumping

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Appendix G2-4
Federal Waters/California Coastal Waters (>25 NM) Emission Summary Index

Table No.	Table Name
CCW 1	LNG 138 km3 Carrier Gasified LNG Fuel Emissions Summary
CCW 2	LNG 210 km3 Carrier Gasified LNG Fuel Emissions Summary

Table CCW 1: LNG 138 km3 Carrier Gasified LNG Fuel Emissions Summary

SIC	1321			
PROCESS EQPT DESCRIPTION	LNG Carrier, 33,000 KW Total			
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S & 15 ppmw S California diesel pilot charge			
TOTAL YEARLY PROCESS RATE	16115	MW-hrs		
HOURLY PROCESS RATE	29.57	MW		
PROCESS UNITS	PT071	MW-hrs		
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG	
COMBINED ENGINE RATING	33000	KW	from activity profile	
LOAD FACTOR	89.6%	percent	from activity profile	
OPERATING SCHEDULE	545	hrs/yr	99 roundtrips x 5.5 hr/roundtrip	(one-way 55NM at 20 knots = 2.75 hours)
HEAT RATE	8533	BTU/KW-hr		
CONVERSION EFFICIENCY	40.0%	percent		
HEAT INPUT	252.29	mmBTU/hr		
DRY Fd	8714	dscf/mmBTU	USEPA Method 19	
EXHAUST FLOW	7.79	mmdscf/hr		

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	140	4.4093	71,053	35.53	130.37	2.000	1.491
Reactive Hydrocarbons (ROC) as CH_4	116	1.2669	20,416	10.21	37.46	0.575	0.429
Carbon Monoxide (CO)	163	3.1159	50,211	25.11	92.13	1.413	1.054
Sulfur Dioxide (SO_2)	0.04	0.0015	25	0.01	0.05	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0052	0.1946	3,136	1.57	5.75	0.0883	0.066
Carbon Dioxide (CO_2)	4.34%	1305.1434	21,031,812	10,516	38,590	592	441

Wartsila Emission Factors (Uncontrolled)

NO_X = 1.50 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.431 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.06 g/kw-hr (Wartsila Specification 16 March 2006)

SO_2 = 0.0007 g/kw-hr (99.2% gas 1 ppmv S & 0.8% CA diesel 15 ppmw S)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

Notes:

Carrier emission factors except SO_2 increased by 33.3% margin for other engine types (Wartsila 50DF as standard)

Table CCW 2: LNG 210 km3 Carrier Gasified LNG Fuel Emissions Summary

SIC	1321			
PROCESS EQPT DESCRIPTION	LNG Carrier, 44,000 KW Total			
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S & 15 ppmw S California diesel pilot charge			
TOTAL YEARLY PROCESS RATE	14114	MW-hrs		
HOURLY PROCESS RATE	39.42	MW		
PROCESS UNITS	PT071	MW-hrs		
HIGHER HEATING VALUE	1007.6	BTU/cu ft	Scarborough LNG	
COMBINED ENGINE RATING	44000	KW	from activity profile	
LOAD FACTOR	89.6%	percent	from activity profile	
OPERATING SCHEDULE	358	hrs/yr	65 roundtrips x 5.5 hr/roundtrip	(one-way 55NM at 20 knots = 2.75 hours)
HEAT RATE	8533	BTU/KW-hr		
CONVERSION EFFICIENCY	40.0%	percent		
HEAT INPUT	336.39	mmBTU/hr		
DRY Fd	8714	dscf/mmBTU	USEPA Method 19	
EXHAUST FLOW	10.38	mmdscf/hr		

EMITTENT NAME	EMITTENT PPMV	CTL EF LBS/UNIT	ACTUAL LBS/YR	ACTUAL TONS/YR	ACTUAL LBS/HR	RATE g/kw-hr	RATE g/bhp-hr
Nitrogen Oxides (as NO_2)	140	4.4093	62,231	31.12	173.83	2.000	1.491
Reactive Hydrocarbons (ROC) as CH_4	116	1.2669	17,881	8.94	49.95	0.575	0.429
Carbon Monoxide (CO)	163	3.1159	43,977	21.99	122.84	1.413	1.054
Sulfur Dioxide (SO_2)	0.04	0.0015	22	0.01	0.06	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0052	0.1946	2,746	1.37	7.67	0.0883	0.066
Carbon Dioxide (CO_2)	4.34%	1305.1434	18,420,523	9,210	51,454	592	441

Wartsila Emission Factors (Uncontrolled)

NO_X = 1.50 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.431 g/kw-hr (Wartsila Specification 16 March 2006)

CO = 1.06 g/kw-hr (Wartsila Specification 16 March 2006)

SO_2 = 0.0007 g/kw-hr (99.2% gas 1 ppmv S & 0.8% CA diesel 15 ppmw S)

PM_{10} = 0.0662 g/kw-hr (Wartsila Specification 16 March 2006)

CO_2 = 444 g/kw-hr (Wartsila Report 4 July 2003)

Notes:

Carrier emission factors except SO_2 increased by 33.3% margin for other engine types (Wartsila 50DF as standard)

Appendix G2-5
Annual Methane Emissions

Table 1: Annual Methane Emissions from Combustion Sources

Location	Equipment	Yearly Process Rate (MW-hrs)	Heat Rate (Btu/kW-hr)	Annual Heat Input (MMBtu)	Methane Emission Factor[a] (lb/MMBtu)	Methane Emissions (tpy)
FSRU	Main Generators	110903	7963	883,121	0.6	265
	Generators (w/ backup diesel)	825	8042	6,635	0.0081	0.03
	SCVs[b]	-	-	4,031,000	0.0023	5
	Emergency Fire Pump	60	9751	585	0.0081	0.002
	Emergency Generator	420	8533	3,584	0.0081	0.01
	Freefall Lifeboat	2.8	11377	32	0.0081	0.0001
	LNG Carriers (pumping only)	4250	8533	36,265	0.6	11
	Subtotal	**-**	**-**	**-**	**-**	**280**
District Waters	Tug Supply Boats	177	9751	1,726	0.0081	0.007
	Crewboat	54	9751	527	0.0081	0.002
	Subtotal	**-**	**-**	**-**	**-**	**0.009**
Federal Waters	Tug Supply Boats	22208	9751	216,550	0.0081	0.9
	Crewboat	667	9751	6,504	0.0081	0.03
	LNG Carriers (<25 NM of shore)	12745	8533	108,753	0.6	33
	LNG Carriers (>25 NM of shore)	16115	8533	137,509	0.6	41
	Subtotal	**-**	**-**	**-**	**-**	**75**
TOTAL		**-**	**-**	**-**	**-**	**355**

Notes:

a. Emission factor references:

AP-42, Table 1.4-2 [for SCVs]; factor of 0.0023 lb/MMBtu derived by dividing listed factor by 1008 MMBtu/MMcf

AP-42, Table 3.4-1 [for natural gas internal comb. engines with diesel pilot]; factor of 0.6 lb/MMBtu

AP-42, Table 3.4-1 [for diesel internal comb. engines]; factor of 0.0081 lb/MMBtu derived by mutliplying TOC factor by 9%

b. Annual Heat Input Rate = 3999 MMcf/yr x 1008 MMBtu/MMcf

Table 2: Annual Methane Emissions from FSRU LNG Tank Purges

Location	Operation	Tank Volume (m^3)	Number of Purges (per yr)	Density of Methane in Tank[a] (kg/m^3)	Conversion Factor (kg/ton)	Methane Emissions (tpy)
FSRU	LNG Tank Purging	91000	4	1.121	907	450

Notes:

a. Based on ideal gas law for methane with pressure of 5 psig and temperature of -40 ^{o}C.

Table 3: Total Annual Methane Emissions

Source	Methane Emissions (tpy)	Global Warming Potential	GHG Equiv. (tpy)
Combustion	355	21	7461
Tank Purges	450	21	9448
TOTAL	**805**	**21**	**16909**

Appendix G2-6
Annual Inert Gas Generator Emissions

Table 1: Annual Emissions from Inert Gas Generator

Source	Annual Operation (hr/yr)	Natural Gas Burner Size (MMBtu/hr)	Natural Gas Heating Value (MMBtu/MMcf)	Emission Factor[a] (lb/MMcf)					Emissions (tpy)				
				CO	NO2	PM	SO2	ROC	CO	NO2	PM	SO2	ROC
Inert Gas Generator	36	70	1008	84	100	7.6	0.6	5.5	0.11	0.13	0.01	0.0008	0.007

Notes:

a. Emission factors from AP-42, Section 1.4.