Appendix G3
Air Quality - FSRU Startup Emissions

G3-1 FSRU Startup Emission Summary Tables
G3-2 FSRU Startup Emissions - Vessels

AVAILABLE ON CD ONLY

G3-1
FSRU Startup Emission Summary Tables

Index: FSRU Startup Emission Summary Tables

Table No.	Table Name
FSRU Startup Table 1	Uncontrolled Emissions Summary
FSRU Startup Table 2	Controlled Emissions Summary
FSRU Startup Table 3	HAPS Emissions Summary
FSRU Startup Table 4	Wartsila 9L50DF Uncontrolled Emissions Summary
FSRU Startup Table 5	Wartsila 9L50DF Controlled Emissions Summary
FSRU Startup Table 6	Firewater Pump Emissions Summary
FSRU Startup Table 7	Emergency Generator Emissions Summary
FSRU Startup Table 8	Freefall Lifeboat Emissions Summary

FSRU Startup Table 1: Uncontrolled Emissions Summary

Quantity	Description	Rating (each)	Fuel	60-Day Emissions, tons					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
1.5	Wartsila 9L50DF Backup Generator	8250 KW	CA Diesel	288.8	12.8	20.2	0.1	3.0	10,215
2	Emergency Fire Pump / Generator	600 / 4200 KW	CA Diesel	0.5	0.1	0.3	0.0	0.0	59
1	Freefall Lifeboat	56 KW	CA Diesel	0.0	0.0	0.0	0.0	0.0	0
Total Emissions				**289.2**	**12.9**	**20.5**	**0.1**	**3.0**	**10,274**

Quantity	Description	Rating (each)	Fuel	Emission Rates, lbs/hr					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
1.5	Wartsila 9L50DF Backup Generator	8250 KW	CA Diesel	401.1	17.8	28.1	0.2	4.2	14,187
2	Emergency Fire Pump / Generator	600 / 4200 KW	CA Diesel	59.3	8.5	37.0	0.1	2.1	7,408
1	Freefall Lifeboat	56 KW	CA Diesel	0.8	0.1	0.6	0.0	0.0	86
Total Emissions				**461.1**	**26.4**	**65.8**	**0.2**	**6.4**	**21,681**

Device Notes:

FSRU startup commissioning period 60 days, 24 hrs/day, no SCR on 9L50DF generators (uncontrolled)

Two backup 9L50DF generators operating at 75% load for 1440 machine hours, diesel fuel, Wartsila specs

Emergency fire pump and generator operating at 100% load for 16 machine hours each, diesel fuel, 2006 Tier 2 standards

Three Life Boats exercising at 100% load for 8 machine hours total, diesel fuel, 2006 Tier 2 standards

Diesel Fuel Usage	1,050,723

FSRU Startup Table 2: Controlled Emissions Summary

Quantity	Description	Rating (each)	Fuel	60-Day Emissions, tons					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
1.5	Wartsila 9L50DF Backup Generator	8250 KW	CA Diesel	41.8	5.8	4.2	0.1	3.1	10,215
2	Emergency Fire Pump / Generator	600 / 4200 KW	CA Diesel	0.5	0.1	0.3	0.0	0.0	59
1	Freefall Lifeboat	56 KW	CA Diesel	0.0	0.0	0.0	0.0	0.0	0
Total Emissions				**42.3**	**5.9**	**4.5**	**0.1**	**3.1**	**10,274**

Quantity	Description	Rating (each)	Fuel	Emission Rates, lbs/hr					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
1.5	Wartsila 9L50DF Backup Generator	8250 KW	CA Diesel	58.0	8.1	5.9	0.2	4.2	14,187
2	Emergency Fire Pump / Generator	600 / 4200 KW	CA Diesel	59.3	8.5	37.0	0.1	2.1	7,408
1	Freefall Lifeboat	56 KW	CA Diesel	0.8	0.1	0.6	0.0	0.0	86
Total Emissions				**118.1**	**16.7**	**43.5**	**0.2**	**6.4**	**21,681**

Device Notes:

FSRU startup commissioning period 60 days, 24 hrs/day, SCR on 9L50DF generators (controlled)

Two backup 9L50DF generators operating at 75% load for 1440 machine hours, diesel fuel, Wartsila specs

Emergency fire pump and generator operating at 100% load for 16 machine hours each, diesel fuel, 2006 Tier 2 standards

Three Life Boats exercising at 100% load for 8 machine hours total, diesel fuel, 2006 Tier 2 standards

Diesel Fuel Usage	1,050,723

FSRU Startup Table 3: HAPS Emissions Summary

HAP EMITTENT NAME	Uncontrolled Emissions, lbs			
	Backup Gen	Emergency	Life Boat	Total
	lbs	lbs	lbs	lbs
Acetaldehyde	3.6	0.0	0.0	3.6
Acrolein	1.1	0.0	0.0	1.1
Benzene	111.2	0.5	0.0	111.7
Butadiene -1,3	5.6	0.0	0.0	5.6
Ethyl Benzene	-	-	-	-
Formaldehyde	11.3	0.1	0.0	11.4
Hexane	-	-	-	-
Naphthalene	18.6	0.1	0.0	18.7
PAHs	11.8	0.1	0.0	11.8
Propylene	399.8	1.9	0.0	401.7
Toluene	40.3	0.2	0.0	40.5
Xylenes	27.7	0.1	0.0	27.8
Facility Total HAPS				**634.0**

HAP EMITTENT NAME	Controlled Emissions, lbs			
	Backup Gen	Emergency	Life Boat	Total
	lbs	lbs	lbs	lbs
Acetaldehyde	1.1	0.0	0.0	1.1
Acrolein	0.3	0.0	0.0	0.3
Benzene	72.3	0.5	0.0	72.8
Butadiene -1,3	3.6	0.0	0.0	3.7
Ethyl Benzene	-	-	-	-
Formaldehyde	3.4	0.1	0.0	3.5
Hexane	-	-	-	-
Naphthalene	12.1	0.1	0.0	12.2
PAHs	7.6	0.1	0.0	7.7
Propylene	259.9	1.9	0.0	261.8
Toluene	26.2	0.2	0.0	26.4
Xylenes	18.0	0.1	0.0	18.1
Facility Total HAPS				**407.5**

Device Notes:

FSRU startup commissioning period 60 days, 24 hrs/day

Two backup 9L50DF generators operating at 75% load for 1440 machine hours, diesel fuel

Emergency fire pump and generator operating at 100% load for 16 machine hours each, diesel fuel, 2006 Tier 2 standards

Three Life Boats exercising at 100% load for 8 machine hours total, diesel fuel, 2006 Tier 2 standards

FSRU Startup Table 4: Wartsila 9L50DF Uncontrolled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Dual Fuel ICE generator, Wartsila 50DF		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	17820	MW-hrs	
HOURLY PROCESS RATE	12.38	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	1440	hrs/yr	
HEAT RATE	8042	BTU/KW-hr	Wartsila Spec 0047057-S504, 13 May 05
CONVERSION EFFICIENCY	42.4%	percent	
HEAT INPUT	99.52	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	3.24	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	577,513	288.76	401.05	14.700	10.962
Reactive Hydrocarbons (ROC) as CH_4	132	1.0000	1.4352	25,576	12.79	17.76	0.651	0.485
Carbon Monoxide (CO)	119	1.0000	2.2708	40,465	20.23	28.10	1.030	0.768
Sulfur Dioxide (SO_2)	0.3	1.0000	0.013	223	0.11	0.15	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.0091	1.0000	0.3395	6,050	3.03	4.20	0.154	0.115
Carbon Dioxide (CO_2)	3.83%	1.0000	1146.4098	20,429,022	10,215	14,187	520	388
Ammonia Slip (NH_3)								

Wartsila Emission Factors (Uncontrolled)

NO_X = 14.70 g/kw-hr (Wartsila Report 10 May 2005)

VOC = 0.651 g/kw-hr (Wartsila Report 10 May 2005)

CO = 1.03 g/kw-hr (Wartsila Report 10 May 2005)

PM_{10} = 0.154 g/kw-hr (Wartsila Report 10 May 2005)

CO_2 = 520 g/kw-hr (Wartsila)

Diesel Fuel Usage	1,045,818	gal/yr

FSRU Startup Table 4: Wartsila 9L50DF Uncontrolled Emissions Summary

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	3.61	0.002	0.003
Acrolein	7.88E-06	1.00	6.34E-05	1.13	0.001	0.001
Benzene	7.76E-04	1.00	6.24E-03	111.21	0.056	0.077
Butadiene -1,3	3.91E-05	1.00	3.14E-04	5.60	0.003	0.004
Ethyl Benzene		1.00	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	1.00	6.35E-04	11.31	0.006	0.008
Hexane		1.00	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.00	1.05E-03	18.63	0.009	0.013
PAHs	8.20E-05	1.00	6.59E-04	11.75	0.006	0.008
Propylene	2.79E-03	1.00	2.24E-02	399.83	0.200	0.278
Toluene	2.81E-04	1.00	2.26E-03	40.27	0.020	0.028
Xylenes	1.93E-04	1.00	1.55E-03	27.66	0.014	0.019

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

FSRU Startup Table 5: 9L50DF Controlled Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Dual Fuel ICE generator, Wartsila 50DF		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	17820	MW-hrs	
HOURLY PROCESS RATE	12.38	MW	from BHP estimates
PROCESS UNITS	PT071	MW-hrs	
HIGHER HEATING VALUE	137030	BTU/gal	USEPA AP-42
OPERATING SCHEDULE	1440	hrs/yr	
HEAT RATE	8042	BTU/KW-hr	Wartsila Spec 0047057-S504, 13 May 05
CONVERSION EFFICIENCY	42.4%	percent	
HEAT INPUT	99.52	mmBTU/hr	
DRY Fd	9190	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	3.24	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	83,547	41.77	58.02	2.127	1.586
Reactive Hydrocarbons (ROC) as CH_4	60	1.0000	0.6523	11,624	5.81	8.07	0.296	0.221
Carbon Monoxide (CO)	25	1.0000	0.4756	8,476	4.24	5.89	0.216	0.161
Sulfur Dioxide (SO_2)	0.29	1.0000	0.013	223	0.11	0.15	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.0092	1.0000	0.3432	6,116	3.06	4.25	0.156	0.116
Carbon Dioxide (CO_2)	3.83%	1.0000	1146.4098	20,429,022	10,215	14,187	520	388
Ammonia Slip (NH_3)	10	1.0000	0.1155	2,058	1.03	1.43	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} = 21 mg/m3, 0.156 g/kw-hr (Wartsila Spec 0047057-S504, 13 May 05)

CO_2 = 520 g/kw-hr (Wartsila)

Backup Diesel Fuel Usage	1,045,818	gal/yr

FSRU Startup Table 5: 9L50DF Controlled Emissions Summary

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	1.08	0.001	0.001
Acrolein	7.88E-06	0.30	1.90E-05	0.34	0.000	0.000
Benzene	7.76E-04	0.65	4.06E-03	72.28	0.036	0.050
Butadiene -1,3	3.91E-05	0.65	2.04E-04	3.64	0.002	0.003
Ethyl Benzene		0.65	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	0.30	1.90E-04	3.39	0.002	0.002
Hexane		0.65	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	0.65	6.80E-04	12.11	0.006	0.008
PAHs	8.20E-05	0.65	4.29E-04	7.64	0.004	0.005
Propylene	2.79E-03	0.65	1.46E-02	259.89	0.130	0.180
Toluene	2.81E-04	0.65	1.47E-03	26.18	0.013	0.018
Xylenes	1.93E-04	0.65	1.01E-03	17.98	0.009	0.012

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

FSRU Startup Table 6: Firewater Pump Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Firewater Pump, 600 KW		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	10	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	16	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	119	0.06	7.41	5.600	4.176
Reactive Hydrocarbons (ROC) as CH_4	134	1.0000	1.7637	17	0.01	1.06	0.800	0.597
Carbon Monoxide (CO)	334	1.0000	7.7162	74	0.04	4.63	3.500	2.610
Sulfur Dioxide (SO_2)	0.3	1.0000	0.015	0	0.00	0.01	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	0.0097	1.0000	0.4409	4	0.00	0.26	0.200	0.149
Carbon Dioxide (CO_2)	4.26%	1.0000	1543.2439	14,815	7	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	683	gal/yr

FSRU Startup Table 6: Firewater Pump Emissions Summary

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	0.1	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	0.0	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	0.3	0.000	0.016
Toluene	2.81E-04	1.00	2.74E-03	0.0	0.000	0.002
Xylenes	1.93E-04	1.00	1.88E-03	0.0	0.000	0.001

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

FSRU Startup Table 7: Emergency Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Emergency Generator, 4200 KW		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	67	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	16	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	830	0.41	51.85	5.600	4.176
Reactive Hydrocarbons (ROC) as CH_4	153	1.0000	1.7637	119	0.06	7.41	0.800	0.597
Carbon Monoxide (CO)	382	1.0000	7.7162	519	0.26	32.41	3.500	2.610
Sulfur Dioxide (SO_2)	0.3	1.0000	0.013	1	0.000	0.056	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.0111	1.0000	0.4409	30	0.01	1.85	0.200	0.149
Carbon Dioxide (CO_2)	4.87%	1.0000	1543.2439	103,706	52	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	4,184	gal/yr

FSRU Startup Table 7: Emergency Generator Emissions Summary

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	0.0	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	0.4	0.000	0.028
Butadiene -1,3	3.91E-05	1.00	3.34E-04	0.0	0.000	0.001
Ethyl Benzene		1.00	0.00E+00	-	0.000	0.000
Formaldehyde	7.89E-05	1.00	6.73E-04	0.0	0.000	0.003
Hexane		1.00	0.00E+00	-	0.000	0.000
Naphthalene	1.30E-04	1.00	1.11E-03	0.1	0.000	0.005
PAHs	8.20E-05	1.00	7.00E-04	0.0	0.000	0.003
Propylene	2.79E-03	1.00	2.38E-02	1.6	0.001	0.100
Toluene	2.81E-04	1.00	2.40E-03	0.2	0.000	0.010
Xylenes	1.93E-04	1.00	1.65E-03	0.1	0.000	0.007

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

FSRU Startup Table 8: Freefall Lifeboat Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Freefall Lifeboat Engine, 75 BHP (56 KW)		
FUEL TYPE/PROCESS INFO	California diesel, 15 ppm S		
TOTAL YEARLY PROCESS RATE	0.4	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	8	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	6	0.00	0.80	6.500	4.847
Reactive Hydrocarbons (ROC) as CH_4	143	1.0000	2.2046	1	0.00	0.12	1.000	0.746
Carbon Monoxide (CO)	410	1.0000	11.0232	5	0.00	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	0	0.00	0.05	0.400	0.298
Carbon Dioxide (CO_2)	3.65%	1.0000	1543.2439	691	0	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	37	gal/yr

FSRU Startup Table 8: Freefall Lifeboat Emissions Summary

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	0.0	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

FSRU Emission Factors

Wartsila 9L50DF Main Generators (3)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	0.081	g/bhp-hr	9	ppmv @ 15% O_2	BACT, Wartsila Spec 0047057-S504, 13 May 05	99% gasified LNG / 1% CA diesel (by weight), 47.1% efficiency
Reactive Hydrocarbons (ROC) as CH_4	0.126	g/bhp-hr	40	ppmv @ 15% O_2	BACT, Wartsila Spec 0047057-S504, 13 May 05	
Carbon Monoxide (CO)	0.110	g/bhp-hr	20	ppmv @ 15% O_2	BACT, Wartsila Spec 0047057-S504, 13 May 05	
Sulfur Dioxide (SO_2)	0.0004	g/bhp-hr	0.03	ppmv @ 15% O_2	Scarborough LNG / CA diesel specifications	
Particulates (as PM_{10})	0.04718	g/bhp-hr	0.0044	grains/dscf	BACT, Wartsila Spec 0047057-S504, 13 May 05	
Carbon Dioxide (CO_2)	331	g/bhp-hr	3.8%	percent volume	Wartsila Report 4 July 2003	
Ammonia Slip (NH_3)	0.033	g/bhp-hr	10	ppmv @ 15% O_2	BACT, VCAPCD (permit engineering, 2003)	

Wartsila 9L50DF Backup Generator (1)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	1.59	g/bhp-hr	150	ppmv @ 15% O_2	BACT, Wartsila Spec 0047057-S504, 13 May 05	CA diesel, 15 ppm S, 42.4% efficiency
Reactive Hydrocarbons (ROC) as CH_4	0.22	g/bhp-hr	60	ppmv @ 15% O_2	BACT, Wartsila Spec 0047057-S504, 13 May 05	
Carbon Monoxide (CO)	0.16	g/bhp-hr	25	ppmv @ 15% O_2	BACT, Wartsila Spec 0047057-S504, 13 May 05	
Sulfur Dioxide (SO_2)	0.0042	g/bhp-hr	0.29	ppmv @ 15% O_2	CA diesel, 15 ppm S	
Particulates (as PM_{10})	0.116	g/bhp-hr	0.0092	grains/dscf	BACT, Wartsila Spec 0047057-S504, 13 May 05	
Carbon Dioxide (CO_2)	388	g/bhp-hr	3.8%	percent volume	Wartsila specification 50DF, diesel	

Firewater Pump (3)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	4.18	g/bhp-hr	326	ppmv @ 15% O_2	USEPA Tier 2 Standards (>560 kw)	CA diesel, 15 ppm S, 35% efficiency
Reactive Hydrocarbons (ROC) as CH_4	0.60	g/bhp-hr	134	ppmv @ 15% O_2	USEPA Tier 2 Standards (>560 kw)	
Carbon Monoxide (CO)	2.61	g/bhp-hr	334	ppmv @ 15% O_2	USEPA Tier 2 Standards (>560 kw)	
Sulfur Dioxide (SO_2)	0.0051	g/bhp-hr	0.29	ppmv @ 15% O_2	CA diesel, 15 ppm S	
Particulates (as PM_{10})	0.149	g/bhp-hr	0.0097	grains/dscf	USEPA Tier 2 Standards (>560 kw)	
Carbon Dioxide (CO_2)	522	g/bhp-hr	4.3%	percent volume	USEPA AP-42, Table 3.3-1	

FSRU Emission Factors

Emergency Generator (1)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	4.18	g/bhp-hr	372	ppmv @ 15% O_2	USEPA Tier 2 Standards (>560 kw)	CA diesel, 15 ppm S, 40% efficiency
Reactive Hydrocarbons (ROC) as CH_4	0.60	g/bhp-hr	153	ppmv @ 15% O_2	USEPA Tier 2 Standards (>560 kw)	
Carbon Monoxide (CO)	2.61	g/bhp-hr	382	ppmv @ 15% O_2	USEPA Tier 2 Standards (>560 kw)	
Sulfur Dioxide (SO_2)	0.0045	g/bhp-hr	0.29	ppmv @ 15% O_2	CA diesel, 15 ppm S	
Particulates (as PM_{10})	0.149	g/bhp-hr	0.0111	grains/dscf	USEPA Tier 2 Standards (>560 kw)	
Carbon Dioxide (CO_2)	522	g/bhp-hr	4.9%	percent volume	USEPA AP-42, Table 3.3-1	

Freefall Lifeboats (3)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	4.85	g/bhp-hr	324	ppmv @ 15% O_2	USEPA Tier 2 Standards (>37 kw, <75 kw)	CA diesel, 15 ppm S, 30% efficiency
Reactive Hydrocarbons (ROC) as CH_4	0.75	g/bhp-hr	143	ppmv @ 15% O_2	USEPA Tier 2 Standards (>37 kw, <75 kw)	
Carbon Monoxide (CO)	3.73	g/bhp-hr	410	ppmv @ 15% O_2	USEPA Tier 2 Standards (>37 kw, <75 kw)	
Sulfur Dioxide (SO_2)	0.0060	g/bhp-hr	0.29	ppmv @ 15% O_2	CA diesel, 15 ppm S	
Particulates (as PM_{10})	0.298	g/bhp-hr	0.0167	grains/dscf	USEPA Tier 2 Standards (>37 kw, <75 kw)	
Carbon Dioxide (CO_2)	522	g/bhp-hr	3.6%	percent volume	USEPA AP-42, Table 3.3-1	

Selas Sub-X Low Emission SCVs (8)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	0.0243	lb/mmbtu	20	ppmv @ 3% O_2	Selas Specification, Sub-XLE, 120-180 t/hr	100% gasified LNG
Reactive Hydrocarbons (ROC) as CH_4	0.0017	lb/mmbtu	4.1	ppmv @ 3% O_2	Costain 2003	
Carbon Monoxide (CO)	0.0739	lb/mmbtu	100	ppmv @ 3% O_2	Selas Specification, Sub-XLE, 120-180 t/hr	
Sulfur Dioxide (SO_2)	0.0002	lb/mmbtu	0.10	ppmv @ 3% O_2	Scarborough LNG specification, 1 ppm S	
Particulates (as PM_{10})	0.0019	lb/mmbtu	0.0013	grains/dscf	USEPA AP-42, Table 1.4-2, non-condensible	
Carbon Dioxide (CO_2)	106.8	lb/mmbtu	9.2%	percent volume	Selas Specification, Sub-XLE, 120-180 t/hr	

Operating Vessels Emission Factors

LNG Carriers	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	2.79	g/bhp-hr	230	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	99% gasified LNG / 1% CA diesel (by weight)
Reactive Hydrocarbons (ROC) as CH_4	0.39	g/bhp-hr	92	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	
Carbon Monoxide (CO)	1.84	g/bhp-hr	248	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	
Sulfur Dioxide (SO_2)	0.0006	g/bhp-hr	0.03	ppmv @ 15% O_2	Scarborough LNG / CA diesel specifications	
Particulates (as PM_{10})	0.035	g/bhp-hr	0.0024	grains/dscf	USEPA AP-42, Table 3.2-2	
Carbon Dioxide (CO_2)	363	g/bhp-hr	3.1%	percent volume	USEPA AP-42, Table 3.2-2	

Tug Supply Boats (2)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	2.79	g/bhp-hr	230	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	99% gasified LNG / 1% CA diesel (by weight)
Reactive Hydrocarbons (ROC) as CH_4	0.39	g/bhp-hr	92	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	
Carbon Monoxide (CO)	1.84	g/bhp-hr	248	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	
Sulfur Dioxide (SO_2)	0.0006	g/bhp-hr	0.03	ppmv @ 15% O_2	Scarborough LNG / CA diesel specifications	
Particulates (as PM_{10})	0.035	g/bhp-hr	0.0024	grains/dscf	USEPA AP-42, Table 3.2-2	
Carbon Dioxide (CO_2)	363	g/bhp-hr	3.1%	percent volume	USEPA AP-42, Table 3.2-2	

Crew Boat (1)	Factor	Units	Conc.	Units	Emission Factor Reference	Fuel
Nitrogen Oxides (as NO_2)	2.79	g/bhp-hr	230	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	100% gasified LNG
Reactive Hydrocarbons (ROC) as CH_4	0.39	g/bhp-hr	92	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	
Carbon Monoxide (CO)	1.84	g/bhp-hr	248	ppmv @ 15% O_2	USEPA AP-42, Table 3.2-2	
Sulfur Dioxide (SO_2)	0.0005	g/bhp-hr	0.03	ppmv @ 15% O_2	Scarborough LNG specification, 1 ppm S	
Particulates (as PM_{10})	0.033	g/bhp-hr	0.0023	grains/dscf	USEPA AP-42, Table 3.2-2	
Carbon Dioxide (CO_2)	363	g/bhp-hr	3.1%	percent volume	USEPA AP-42, Table 3.2-2	

Appendix G3-2
FSRU Startup Emissions - Vessels

Vessel	Duration of Operation (weeks)	Weekly Roundtrips (RT/week)	Area	Duration in Area (hr/RT)	Emission Rate (lb/hr)						Total Emissions (tons)					
					CO	NO_x	PM_{10}	$PM_{2.5}$	ROC	SO_2	CO	NO_x	PM_{10}	$PM_{2.5}$	ROC	SO_2
Tug/Supply	9	1	DW	1	15.7	16.7	0.9	0.9	3.3	0.1	0.071	0.075	0.0041	0.0041	0.015	0.0005
			FW1	1	26.6	28.3	1.5	1.5	5.7	0.17	0.12	0.13	0.0068	0.0068	0.026	0.0008
			FW2	5	5.4	5.6	0.31	0.31	1.1	0.035	0.12	0.13	0.0070	0.0070	0.025	0.0008
Crewboat	9	6	DW	1	1.25	1.2	0.072	0.072	0.24	0.0078	0.034	0.032	0.0019	0.0019	0.006	0.0002
			FW1	1	2.5	2.6	0.14	0.14	0.51	0.016	0.068	0.070	0.0038	0.0038	0.014	0.0004
			FW2	5	0.37	0.33	0.02	0.02	0.067	0.002	0.050	0.045	0.0027	0.0027	0.009	0.0003
TOTAL											**0.46**	**0.48**	**0.026**	**0.026**	**0.095**	**0.003**