Nahid Zoueshtiagh/R9/USEPA/US
03/08/2006 03:07 PM

To Joseph Lapka/R9/USEPA/US@EPA
cc
bcc
Subject old data- Vessels

----- Forwarded by Nahid Zoueshtiagh/R9/USEPA/US on 03/08/2006 03:06 PM -----

BBoyes@entrix.com
01/15/2004 08:45 AM

To Nahid Zoueshtiagh/R9/USEPA/US@EPA
cc
Subject Vessels

Bradford L. Boyes, QEP, REA
Senior Project Engineer
Air Resources Group
ENTRIX Ventura
TEL 805-644-5948 ext. 102
FAX 805-658-0612
bboyes@entrix.com

NOTICE - This message and any attached files may contain information that is confidential and intended only for use by the intended recipient. If you are not the intended recipient any copying or use of this message or attached files, or disclosure of same, is forbidden. If you have received this message in error please notify the sender immediately and delete the message.

Revised FSRU support vessel emissions.xls

Vessels with Gas Carriers

Quantity	Description	Rating (each)	Fuel	Annual Emissions, tons per year					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
2	Assist Tugs	9,250 BHP Total	CA Diesel	98.6	5.8	17.9	0.04	5.9	3,951
1	Crew Boat	875 BHP Total	CA Diesel	1.6	0.1	0.3	0.00	0.1	66
1	Supply Boat	3,250 BHP Total	CA Diesel	13.0	0.8	2.4	0.00	0.8	521
1	LNG Carrier	45,600 BHP Total	Natural Gas	106.2	14.8	69.8	0.0	1.3	13,786
Total Emissions (LNG Carrier on gas)				**219.4**	**21.5**	**90.4**	**0.1**	**8.0**	**18,324**

Vessel Notes:
Assist tugs (pair) conducting LNG carrier to FSRU berthing operations 120 times per year, time & load weighted engine operation
Crew boat making weekly round trip to FSRU, time & load weighted engine operation
Supply boat making semi-weekly round trip to FSRU, time & load weighted engine operation
LNG carrier to FSRU berthing operations, 14 miles slow, 3 miles to FSRU with assist tugs, time & load weighted engine operation

Vessels with all Diesel

Quantity	Description	Rating (each)	Fuel	Annual Emissions, tons per year					
				NO_X	ROC	CO	SO_2	PM_{10}	CO_2
2	Assist Tugs	9,250 BHP Total	CA Diesel	98.6	5.8	17.9	0.04	5.9	3,951
1	Crew Boat	875 BHP Total	CA Diesel	1.6	0.1	0.3	0.00	0.1	66
1	Supply Boat	3,250 BHP Total	CA Diesel	13.0	0.8	2.4	0.00	0.8	521
1	LNG Carrier	45,600 BHP Total	CA Diesel	550.5	43.9	161.9	0.19	16.2	20,553
Total Emissions (all CA diesel vessels)				**663.8**	**50.6**	**182.5**	**0.24**	**23.0**	**25,091**

Vessel Notes:
Assist tugs (pair) conducting LNG carrier to FSRU berthing operations 120 times per year, time & load weighted engine operation
Crew boat making weekly round trip to FSRU, time & load weighted engine operation
Supply boat making semi-weekly round trip to FSRU, time & load weighted engine operation
LNG carrier to FSRU berthing operations, 14 miles slow, 3 miles to FSRU with assist tugs, time & load weighted engine operation

Vessels Controlled Summary

EMITTENT NAME	Tons Per Year (CA diesel fuel, LNG Carrier on Gas)					
	Assist Tugs	Crew Boat	Supply Boat	Total		LNG Carrier
Nitrogen Oxides (as NO_2)	98.6	1.6	13.0	**113.3**		106.2
Reactive Organic Compounds (ROC) as CH_4	5.8	0.1	0.8	**6.7**		14.8
Carbon Monoxide (CO)	17.9	0.3	2.4	**20.6**		69.8
Sulfur Dioxide (SO_2)	0.04	0.001	0.005	**0.0**		0.0
Particulates (as PM_{10})	5.9	0.1	0.8	**6.8**		1.3
Carbon Dioxide (CO_2)	3,951	66	521	**4,538**		13,786

EMITTENT NAME	Emission Rates (CA diesel fuel, LNG Carrier on Gas)					
	Assist Tugs	Crew Boat	Supply Boat	Average		LNG Carrier
	g/BHP-hr	g/BHP-hr	g/BHP-hr	g/BHP-hr		g/BHP-hr
Nitrogen Oxides (as NO_2)	14.00	14.00	14.00	14.00		2.44
Reactive Organic Compounds (ROC) as CH_4	0.83	0.83	0.83	0.83		0.34
Carbon Monoxide (CO)	2.54	2.54	2.54	2.54		1.61
Sulfur Dioxide (SO_2)	0.01	0.01	0.01	0.01		0.00
Particulates (as PM_{10})	0.84	0.84	0.84	0.84		0.03
Carbon Dioxide (CO_2)	560.64	560.64	560.64	560.64		317.47

Vessel Notes:
Assist tugs (pair) conducting LNG carrier to FSRU berthing operations 120 times per year, time & load weighted engine operation
Crew boat making weekly round trip to FSRU, time & load weighted engine operation
Supply boat making semi-weekly round trip to FSRU, time & load weighted engine operation
LNG carrier to FSRU berthing operations, 14 miles slow, 3 miles to FSRU with assist tugs, time & load weighted engine operation

Vessels Uncontrolled Summary

EMITTENT NAME	Tons Per Year (CA diesel fuel)					
	Assist Tugs	Crew Boat	Supply Boat	Total		LNG Carrier
Nitrogen Oxides (as NO_2)	98.6	1.6	13.0	**113.3**		550.5
Reactive Organic Compounds (ROC) as CH_4	5.8	0.1	0.8	**6.7**		43.9
Carbon Monoxide (CO)	17.9	0.3	2.4	**20.6**		161.9
Sulfur Dioxide (SO_2)	0.04	0.001	0.005	**0.0**		0.2
Particulates (as PM_{10})	5.9	0.1	0.8	**6.8**		16.2
Carbon Dioxide (CO_2)	3,951	66	521	**4,538**		20,553

EMITTENT NAME	Emission Rates (CA diesel fuel)					
	Assist Tugs	Crew Boat	Supply Boat	Average		LNG Carrier
	g/BHP-hr	g/BHP-hr	g/BHP-hr	g/BHP-hr		g/BHP-hr
Nitrogen Oxides (as NO_2)	14.00	14.00	14.00	14.00		12.68
Reactive Organic Compounds (ROC) as CH_4	0.83	0.83	0.83	0.83		1.01
Carbon Monoxide (CO)	2.54	2.54	2.54	2.54		3.73
Sulfur Dioxide (SO_2)	0.01	0.01	0.01	0.01		0.00
Particulates (as PM_{10})	0.84	0.84	0.84	0.84		0.37
Carbon Dioxide (CO_2)	560.64	560.64	560.64	560.64		473.32

Vessel Notes:
Assist tugs (pair) conducting LNG carrier to FSRU berthing operations 120 times per year, time & load weighted engine operation
Crew boat making weekly round trip to FSRU, time & load weighted engine operation
Supply boat making semi-weekly round trip to FSRU, time & load weighted engine operation
LNG carrier to FSRU berthing operations, 14 miles slow, 3 miles to FSRU with assist tugs, time & load weighted engine operation

(2) Assist Tugs Mains

SIC	1321	
PROCESS EQPT DESCRIPTION	Assist Tug Main Engines	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	304.13	
AVERAGE HOURLY PROCESS RATE	0.1056	
MAXIMUM HOURLY PROCESS RATE	0.1056	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	2	
COMBINED ENGINE RATING	8000	BHP
LOAD FACTOR	12%	percent
HRS/YEAR	2880	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	1432	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	14.47	mmBTU/hr
MAXIMUM HEAT INPUT	14.47	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	170,616	85.31	59.24	59.24	2.45E+00	7.46E+00
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	10,097	5.05	3.51	3.51	1.45E-01	4.42E-01
Carbon Monoxide (CO)	314.64	102.0	31,021	15.51	10.77	10.77	4.46E-01	1.36E+00
Sulfur Dioxide (SO_2)	0.29	0.213	65	0.03	0.02	0.02	9.32E-04	2.83E-03
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	10,188	5.09	3.54	3.54	1.47E-01	4.46E-01
Carbon Dioxide (CO_2)	4.41%	22472.9	6,834,644	3417.32	2373.14	2373.14	9.83E+01	2.99E+02

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

(2) Assist Tugs Bow

SIC	1321	
PROCESS EQPT DESCRIPTION	Assist Tug Bow Thruster Engine	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	7.92	
AVERAGE HOURLY PROCESS RATE	0.0550	
MAXIMUM HOURLY PROCESS RATE	0.0550	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	2	
COMBINED ENGINE RATING	1000	BHP
LOAD FACTOR	50%	percent
HRS/YEAR	144	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	746	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	7.54	mmBTU/hr
MAXIMUM HEAT INPUT	7.54	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	4,443	2.22	30.86	30.86	6.39E-02	3.89E+00
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	263	0.13	1.83	1.83	3.78E-03	2.30E-01
Carbon Monoxide (CO)	314.64	102.0	808	0.40	5.61	5.61	1.16E-02	7.07E-01
Sulfur Dioxide (SO_2)	0.29	0.213	2	0.00	0.01	0.01	2.43E-05	1.48E-03
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	265	0.13	1.84	1.84	3.82E-03	2.32E-01
Carbon Dioxide (CO_2)	4.41%	22472.9	177,986	88.99	1236.01	1236.01	2.56E+00	1.56E+02

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

(2) Assist Tugs Gen

SIC	1321	
PROCESS EQPT DESCRIPTION	Assist Tug Generator Engine (redundant pair)	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	39.60	
AVERAGE HOURLY PROCESS RATE	0.0138	
MAXIMUM HOURLY PROCESS RATE	0.0138	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	2	
COMBINED ENGINE RATING	250	BHP
LOAD FACTOR	50%	percent
HRS/YEAR	2880	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	186	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	1.88	mmBTU/hr
MAXIMUM HEAT INPUT	1.88	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	22,216	11.11	7.71	7.71	3.20E-01	9.72E-01
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	1,315	0.66	0.46	0.46	1.89E-02	5.75E-02
Carbon Monoxide (CO)	314.64	102.0	4,039	2.02	1.40	1.40	5.81E-02	1.77E-01
Sulfur Dioxide (SO_2)	0.29	0.213	8	0.00	0.00	0.00	1.21E-04	3.69E-04
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	1,327	0.66	0.46	0.46	1.91E-02	5.80E-02
Carbon Dioxide (CO_2)	4.41%	22472.9	889,928	444.96	309.00	309.00	1.28E+01	3.89E+01

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

Assist Tugs

Berthing Activity	Miles	Speed	Time, hrs	Mains	Weighted
Cruise to LNG Carrier	23	16.0	1.4	60%	3.6%
Assist Carrier to FSRU	3	5.0	0.6	100%	2.5%
Unload Standby	0	stop	20.0	0%	0.0%
Assist Carrier to Release	3	5.0	0.6	100%	2.5%
Cruise to Dock	23	16.0	1.4	60%	3.6%
Composite			24.1		12.1%

Remarks

1 carrier every three days = 120 berthings/year
120 bethings/yr x 24 hrs = 2880 hrs/yr @ 12% power on mains
bow thrusters used only during berthing
120 bethings/yr x 1.2 hrs = 144 hrs/yr @ 50% power on thruster
ship generators run all the time, so
120 bethings/yr x 24 hrs = 2880 hrs/yr @ 50% power

Crew Boat Mains

SIC	1321	
PROCESS EQPT DESCRIPTION	Crew Boat Main Engines	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	5.13	
AVERAGE HOURLY PROCESS RATE	0.0141	
MAXIMUM HOURLY PROCESS RATE	0.0141	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	800	BHP
LOAD FACTOR	32%	percent
HRS/YEAR	364	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	191	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	1.93	mmBTU/hr
MAXIMUM HEAT INPUT	1.93	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	2,875	1.44	7.90	7.90	4.14E-02	9.95E-01
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	170	0.09	0.47	0.47	2.45E-03	5.89E-02
Carbon Monoxide (CO)	314.64	102.0	523	0.26	1.44	1.44	7.52E-03	1.81E-01
Sulfur Dioxide (SO_2)	0.29	0.213	1	0.00	0.00	0.00	1.57E-05	3.78E-04
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	172	0.09	0.47	0.47	2.47E-03	5.94E-02
Carbon Dioxide (CO_2)	4.41%	22472.9	115,176	57.59	316.42	316.42	1.66E+00	3.99E+01

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

Crew Boat Gen

SIC	1321	
PROCESS EQPT DESCRIPTION	Crew Boat Generator Engine (redundant pair)	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	0.75	
AVERAGE HOURLY PROCESS RATE	0.0021	
MAXIMUM HOURLY PROCESS RATE	0.0021	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	75	BHP
LOAD FACTOR	50%	percent
HRS/YEAR	364	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	28	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	0.28	mmBTU/hr
MAXIMUM HEAT INPUT	0.28	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	421	0.21	1.16	1.16	6.06E-03	1.46E-01
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	25	0.01	0.07	0.07	3.59E-04	8.63E-03
Carbon Monoxide (CO)	314.64	102.0	77	0.04	0.21	0.21	1.10E-03	2.65E-02
Sulfur Dioxide (SO_2)	0.29	0.213	0	0.00	0.00	0.00	2.30E-06	5.54E-05
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	25	0.01	0.07	0.07	3.62E-04	8.71E-03
Carbon Dioxide (CO_2)	4.41%	22472.9	16,872	8.44	46.35	46.35	2.43E-01	5.84E+00

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

Crew Boat Activity

Crew Boats **Cruise =** **18 kts**

Support Activity	Miles	Speed	Time, hrs	Mains	Weighted
Cruise to FSRU	20	18.0	1.1	100%	16.1%
Loiter FSRU	1.5	2.0	0.8	1%	0.1%
Unload Standby	0	stop	3.2	0%	0.0%
Loiter FSRU	1.5	2.0	0.8	1%	0.1%
Cruise to FSRU	20	18.0	1.1	100%	16.1%
Composite			6.9		32.4%

Remarks

1 trip per week
52 trips/yr x 7 hrs = 364 hrs/yr @ 32% power on mains
ship generators run all the time, so
52 trips/yr x 7 hrs = 364 hrs/yr @ 50% power

Supply Boat Mains

SIC	1321	
PROCESS EQPT DESCRIPTION	Supply Boat Main Engines	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	36.18	
AVERAGE HOURLY PROCESS RATE	0.0316	
MAXIMUM HOURLY PROCESS RATE	0.0316	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	2500	BHP
LOAD FACTOR	23%	percent
HRS/YEAR	1144	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	429	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	4.33	mmBTU/hr
MAXIMUM HEAT INPUT	4.33	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	20,296	10.15	17.74	17.74	2.92E-01	2.24E+00
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	1,201	0.60	1.05	1.05	1.73E-02	1.32E-01
Carbon Monoxide (CO)	314.64	102.0	3,690	1.85	3.23	3.23	5.31E-02	4.06E-01
Sulfur Dioxide (SO_2)	0.29	0.213	8	0.00	0.01	0.01	1.11E-04	8.49E-04
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	1,212	0.61	1.06	1.06	1.74E-02	1.33E-01
Carbon Dioxide (CO_2)	4.41%	22472.9	813,048	406.52	710.71	710.71	1.17E+01	8.95E+01

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

Supply Boat Bow

SIC	1321	
PROCESS EQPT DESCRIPTION	Supply Boat Bow Thruster Engine	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	2.29	
AVERAGE HOURLY PROCESS RATE	0.0138	
MAXIMUM HOURLY PROCESS RATE	0.0138	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	500	BHP
LOAD FACTOR	50%	percent
HRS/YEAR	166	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	186	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	1.88	mmBTU/hr
MAXIMUM HEAT INPUT	1.88	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	1,284	0.64	7.71	7.71	1.85E-02	9.72E-01
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	76	0.04	0.46	0.46	1.09E-03	5.75E-02
Carbon Monoxide (CO)	314.64	102.0	233	0.12	1.40	1.40	3.36E-03	1.77E-01
Sulfur Dioxide (SO_2)	0.29	0.213	0	0.00	0.00	0.00	7.01E-06	3.69E-04
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	77	0.04	0.46	0.46	1.10E-03	5.80E-02
Carbon Dioxide (CO_2)	4.41%	22472.9	51,418	25.71	309.00	309.00	7.40E-01	3.89E+01

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

Supply Boat Gen

SIC	1321	
PROCESS EQPT DESCRIPTION	Supply Boat Generator Engine (redundant pair)	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	7.87	
AVERAGE HOURLY PROCESS RATE	0.0069	
MAXIMUM HOURLY PROCESS RATE	0.0069	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	250	BHP
LOAD FACTOR	50%	percent
HRS/YEAR	1144	
HEAT RATE	10107	BTU/kw-hr
UNIT RATING	93	KW
CONVERSION EFFICIENCY	33.8%	
AVERAGE HEAT INPUT	0.94	mmBTU/hr
MAXIMUM HEAT INPUT	0.94	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1053.36	561.0	4,412	2.21	3.86	3.86	6.35E-02	4.86E-01
Reactive Hydrocarbons (ROC) as CH_4	179.22	33.2	261	0.13	0.23	0.23	3.76E-03	2.88E-02
Carbon Monoxide (CO)	314.64	102.0	802	0.40	0.70	0.70	1.15E-02	8.84E-02
Sulfur Dioxide (SO_2)	0.29	0.213	2	0.00	0.00	0.00	2.41E-05	1.85E-04
Particulates (as PM_{10}) (grains/dscf)	0.0526	33.5	263	0.13	0.23	0.23	3.79E-03	2.90E-02
Carbon Dioxide (CO_2)	4.41%	22472.9	176,750	88.37	154.50	154.50	2.54E+00	1.95E+01

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	18.768	13.996
Reactive Hydrocarbons (ROC) as CH_4	1.111	0.828
Carbon Monoxide (CO)	3.412	2.545
Sulfur Dioxide (SO_2)	0.007	0.005
Particulates (as PM_{10}) (grains/dscf)	1.121	0.836
Carbon Dioxide (CO_2)	751.821	560.642

Supply Boats **Cruise =** **16 kts**

Support Activity	Miles	Speed	Time, hrs	Mains	Weighted
Cruise to FSRU	20	16.0	1.3	100%	11.4%
Loiter FSRU	1.5	2.0	0.8	2%	0.1%
Unload Standby	0	stop	7.0	0%	0.0%
Loiter FSRU	1.5	2.0	0.8	2%	0.1%
Cruise to FSRU	20	16.0	1.3	100%	11.4%
Composite			11.0		22.9%

Remarks

2 trips per week
104 trips/yr x 11 hrs = 1144 hrs/yr @ 23% power on mains
bow thrusters used only during berthing
104 bethings/yr x 1.6 hrs = 166 hrs/yr @ 50% power on thruster
ship generators run all the time, so
104 trips/yr x 11 hrs = 1144 hrs/yr @ 50% power

LNG Carrier (marine diesel)

SIC	1321	
PROCESS EQPT DESCRIPTION	LNG Carrier Ship All Engines, 34,000 KW Total	
FUEL TYPE/PROCESS INFO	Marine Diesel, 1.5% S, 7.3 lb/gal	
TOTAL YEARLY PROCESS RATE	1829.17	
AVERAGE HOURLY PROCESS RATE	0.6351	
MAXIMUM HOURLY PROCESS RATE	0.6351	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	45594	BHP
LOAD FACTOR	30%	percent
HRS/YEAR	2880	
HEAT RATE	8533	BTU/kw-hr
UNIT RATING	10200	KW
CONVERSION EFFICIENCY	40.0%	
AVERAGE HEAT INPUT	87.03	mmBTU/hr
MAXIMUM HEAT INPUT	87.03	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1130.16	601.901	1,100,977	550.49	382.28	382.28	1.58E+01	4.82E+01
Reactive Hydrocarbons (ROC) as CH_4	258.90	48.0	87,728	43.86	30.46	30.46	1.26E+00	3.84E+00
Carbon Monoxide (CO)	546.09	177.030	323,817	161.91	112.44	112.44	4.66E+00	1.42E+01
Sulfur Dioxide (SO_2)	295.55	219.0	400,588	200.29	139.09	139.09	5.76E+00	1.75E+01
Particulates (as PM_{10}) (grains/dscf)	0.0278	17.703	32,382	16.19	11.24	11.24	4.66E-01	1.42E+00
Carbon Dioxide (CO_2)	4.41%	22472.9	#########	20553.36	14273.17	14273.17	5.91E+02	1.80E+03

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	17.000	12.677
Reactive Hydrocarbons (ROC) as CH_4	1.355	1.010
Carbon Monoxide (CO)	5.000	3.729
Sulfur Dioxide (SO_2)	6.185	4.613
Particulates (as PM_{10}) (grains/dscf)	0.500	0.373
Carbon Dioxide (CO_2)	634.722	473.320

LNG Carrier (California diesel)

SIC	1321	
PROCESS EQPT DESCRIPTION	LNG Carrier Ship All Engines, 34,000 KW Total	
FUEL TYPE/PROCESS INFO	Rule 431.2 Diesel, 15 ppm S	
TOTAL YEARLY PROCESS RATE	1829.17	
AVERAGE HOURLY PROCESS RATE	0.6351	
MAXIMUM HOURLY PROCESS RATE	0.6351	
PROCESS UNITS	PT024	1000 Gallons Burned
HIGHER HEATING VALUE	137.03	mmBTU/mgal
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	45594	BHP
LOAD FACTOR	30%	percent
HRS/YEAR	2880	
HEAT RATE	8533	BTU/kw-hr
UNIT RATING	10200	KW
CONVERSION EFFICIENCY	40.0%	
AVERAGE HEAT INPUT	87.03	mmBTU/hr
MAXIMUM HEAT INPUT	87.03	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	1130.16	601.901	1,100,977	550.49	382.28	382.28	1.58E+01	4.82E+01
Reactive Hydrocarbons (ROC) as CH_4	258.90	48.0	87,728	43.86	30.46	30.46	1.26E+00	3.84E+00
Carbon Monoxide (CO)	546.09	177.030	323,817	161.91	112.44	112.44	4.66E+00	1.42E+01
Sulfur Dioxide (SO_2)	0.29	0.213	390	0.19	0.14	0.14	5.60E-03	1.70E-02
Particulates (as PM_{10}) (grains/dscf)	0.0278	17.703	32,382	16.19	11.24	11.24	4.66E-01	1.42E+00
Carbon Dioxide (CO_2)	4.41%	22472.9	#########	20553.36	14273.17	14273.17	5.91E+02	1.80E+03

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	17.000	12.677
Reactive Hydrocarbons (ROC) as CH_4	1.355	1.010
Carbon Monoxide (CO)	5.000	3.729
Sulfur Dioxide (SO_2)	0.006	0.004
Particulates (as PM_{10}) (grains/dscf)	0.500	0.373
Carbon Dioxide (CO_2)	634.722	473.320

LNG Carrier (gas)

SIC	1321	
PROCESS EQPT DESCRIPTION	LNG Carrier Ship All Engines, 34,000 KW Total	
FUEL TYPE/PROCESS INFO	Raw LNG, 95.5% methane, 1 ppm S	
TOTAL YEARLY PROCESS RATE	247.658	
AVERAGE HOURLY PROCESS RATE	0.0860	
MAXIMUM HOURLY PROCESS RATE	0.0860	
PROCESS UNITS	PT074	Million Cubic Feet Burned
HIGHER HEATING VALUE	1012.1	mmBTU/mmcf
NUMBER OF DEVICES	1	
COMBINED ENGINE RATING	45594	BHP
LOAD FACTOR	30%	percent
HRS/YEAR	2880	
HEAT RATE	8533	BTU/kw-hr
UNIT RATING	10200	KW
CONVERSION EFFICIENCY	40.0%	
AVERAGE HEAT INPUT	87.03	mmBTU/hr
MAXIMUM HEAT INPUT	87.03	mmBTU/hr

EMITTENT NAME	EMITTENT PPM	CTL EF LBS/UNIT	AVERAGE LBS/YR	AVERAGE TONS/YR	AVERAGE LBS/HR	MAXIMUM LBS/HR	AVERAGE grams/sec	MAXIMUM grams/sec
Nitrogen Oxides (as NO_2)	229.94	857.234	212,301	106.15	73.72	73.72	3.05E+00	9.29E+00
Reactive Hydrocarbons (ROC) as CH_4	92.10	119.426	29,577	14.79	10.27	10.27	4.25E-01	1.29E+00
Carbon Monoxide (CO)	248.42	563.730	139,612	69.81	48.48	48.48	2.01E+00	6.11E+00
Sulfur Dioxide (SO_2)	0.03	0.166	41	0.02	0.01	0.01	5.92E-04	1.80E-03
Particulates (as PM_{10}) (grains/dscf)	0.0023	10.108	2,503	1.25	0.87	0.87	3.60E-02	1.10E-01
Carbon Dioxide (CO_2)	3.12%	111329.127	#########	13785.79	9573.47	9573.47	3.97E+02	1.21E+03

EMITTENT NAME	g/kw-hr	g/bhp-hr
Nitrogen Oxides (as NO_2)	3.278	2.445
Reactive Hydrocarbons (ROC) as CH_4	0.457	0.341
Carbon Monoxide (CO)	2.156	1.608
Sulfur Dioxide (SO_2)	0.0006	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.039	0.029
Carbon Dioxide (CO_2)	425.728	317.471

LNG Carriers **Cruise =** **19.5 kts**

Berthing Activity	Miles	Speed	Time, hrs	KW	Weighted
25 to 11 miles	14	12.0	1.2	15000	728
11 to 8 miles	3	Towed	0.6	5000	125
Unload	0	stop	20.5	10000	8530
8 to 11 miles	3	Towed	0.6	5000	125
11 to 25 miles	14	12.0	1.2	15000	728
Composite			24.0		10236
Rating					34000
Load Factor					30%

Remarks

1 carrier every three days = 120 berthings/year

120 bethings/yr x 24 hrs = 2880 hrs/yr @ 30% power