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Table DW 1: District Waters Vessel Emission 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	Gasified LNG & CA Diesel	0.26	0.10	0.37	0.000	0.01	92
1	Crew Boat	1,500 BHP Mains	Gasified LNG	0.42	0.08	0.38	0.000	0.01	75
Total Emissions (gasified LNG & CA diesel pilot fuel)				**0.67**	**0.18**	**0.75**	**0.000**	**0.02**	**167**

Vessel Notes:

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

Crew boat making 260 round trips to FSRU per year, time & load weighted engine operation

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

Tug Supply dual fuel is 99% gasified LNG / 1% CA diesel by weight (99.2% / 0.8% by heat input)

Crew boat is 100% gasified LNG

Table DW 2: Tug/Supply Vessel 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	Scarborough LNG, 99.7% methane, 1 ppmv S & 15 ppmw S California diesel pilot charge		
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	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	1.010	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	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)	80	1.0000	2.8660	500	0.250	9.618	1.300	0.969
Reactive Hydrocarbons (ROC) as CH_4	92	1.0000	1.1464	200	0.100	3.847	0.520	0.388
Carbon Monoxide (CO)	192	1.0000	4.1888	731	0.365	14.056	1.900	1.417
Sulfur Dioxide (SO_2)	0.03	1.0654	0.0017	0	0.000	0.006	0.0008	0.0006
Particulates (as PM_{10}) (grains/dscf)	0.0033	1.0000	0.1433	25	0.013	0.481	0.065	0.048
Carbon Dioxide (CO_2)	3.00%	1.0000	1031.7688	180,040	90.020	3462.311	468	349

Wartsila Emission Factors for Series 32DF Engines

NO_X = 1.3 g/kw-hr (Wartsila Specification 16 March 2006)

VOC = 0.52 g/kw-hr (Warsila Report Specification 16 March 2006, corrected to 8% nonmethane per AP-42 Table 3.2-2)

CO = 1.9 g/kw-hr (Wartsila Specification 16 March 2006)

SO_2 = 1.65 E-4 lb/mmBTU (for 1 ppmv S)

PM_{10} = 0.065 g/kw-hr (Wartsila quote 16 February 2006)

CO_2 = 468 g/kw-hr (Wartsila Report 4 July 2003)

Tug Supply dual fuel is 99% gasified LNG / 1% CA diesel by weight (99.2% / 0.8% by heat input)

Power output	234,000	BHP-hr/yr

Table DW 3: Tug/Supply Vessel Generator Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Tug Supply Auxiliary Generator, 150 BHP, 2 vessels alternating port calls		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv 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	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.017	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	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)	165	1.0000	5.9128	17	0.009	0.331	2.682	2.000
Reactive Hydrocarbons (ROC) as CH_4	92	1.0000	1.1507	3	0.002	0.064	0.522	0.389
Carbon Monoxide (CO)	248	1.0000	5.4315	16	0.008	0.304	2.464	1.837
Sulfur Dioxide (SO_2)	0.03	1.0000	0.0016	0	0.000	0.000	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0023	1.0000	0.0975	0	0.000	0.005	0.044	0.033
Carbon Dioxide (CO_2)	3.12%	1.0000	1072.6571	3,120	1.560	59.992	487	363

Gas Emission Factors (AP-42 Table 3.2-2)

NO_X = 2.682 g/kw-hr (CAT Series GLE Engines 2.0 g/bhp-hr)

VOC = 0.118 lb/mmBTU

CO = 0.557 lb/mmBTU

SO_2 = 1.65 E-4 lb/mmBTU (for 1 ppmv S)

PM_{10} = 0.010 lb/mmBTU

CO_2 = 110 lb/mmBTU

Power output	3,900	BHP-hr/yr

Unit conversion from AP-42/CAT	lb/mmBTU	BTU/kw-hr	g/kw-hr
Nitrogen Oxides (as NO_2)	0.606	9751	2.682
Reactive Hydrocarbons (ROC) as CH_4	0.118	9751	0.522
Carbon Monoxide (CO)	0.557	9751	2.464
Sulfur Dioxide (SO_2)	1.65E-04	9751	0.001
Particulates (as PM_{10})	0.01	9751	0.044
Carbon Dioxide (CO_2)	110	9751	486.547

Table DW 4: Tug/Supply Vessel Activity Summary

Tug Supply

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 Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Crew Boat Main Engines, 1500 BHP		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S		
TOTAL YEARLY PROCESS RATE	125	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	273	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	4.47	mmBTU/hr	
DRY Fd	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.138	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	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)	165	1.0000	5.9128	740	0.370	2.712	2.682	2.000
Reactive Hydrocarbons (ROC) as CH_4	92	1.0000	1.1507	144	0.072	0.528	0.522	0.389
Carbon Monoxide (CO)	248	1.0000	5.4315	680	0.340	2.491	2.464	1.837
Sulfur Dioxide (SO_2)	0.03	1.0000	0.0016	0	0.000	0.001	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0023	1.0000	0.0975	12	0.006	0.045	0.044	0.033
Carbon Dioxide (CO_2)	3.12%	1.0000	1072.6571	134,298	67.149	491.934	487	363

Gas Emission Factors (AP-42 Table 3.2-2)

NO_X = 2.682 g/kw-hr (CAT Series GLE Engines 2.0 g/bhp-hr)

VOC = 0.118 lb/mmBTU

CO = 0.557 lb/mmBTU

SO_2 = 1.65 E-4 lb/mmBTU (for 1 ppmv S)

PM_{10} = 0.010 lb/mmBTU

CO_2 = 110 lb/mmBTU

Power output	167,895	BHP-hr/yr

Unit conversion from AP-42/CAT	lb/mmBTU	BTU/kw-hr	g/kw-hr
Nitrogen Oxides (as NO_2)	0.606	9751	2.682
Reactive Hydrocarbons (ROC) as CH_4	0.118	9751	0.522
Carbon Monoxide (CO)	0.557	9751	2.464
Sulfur Dioxide (SO_2)	1.65E-04	9751	0.001
Particulates (as PM_{10})	0.01	9751	0.044
Carbon Dioxide (CO_2)	110	9751	486.547

Table DW 6: Crew Boat Generator Engine Emissions Summary

SIC	1321		
PROCESS EQPT DESCRIPTION	Crew Boat Generator Engine, 150 BHP		
FUEL TYPE/PROCESS INFO	Scarborough LNG, 99.7% methane, 1 ppmv S		
TOTAL YEARLY PROCESS RATE	15	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	273	hrs/yr	from activity profile
HEAT RATE	9751	BTU/KW-hr	
CONVERSION EFFICIENCY	35.0%	percent	
HEAT INPUT	0.55	mmBTU/hr	
DRY Fd	8710	dscf/mmBTU	USEPA Method 19
EXHAUST FLOW	0.017	mmdscf/hr	

EMITTENT NAME	EMITTENT PPMV	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)	165	1.0000	5.9128	90	0.045	0.331	2.682	2.000
Reactive Hydrocarbons (ROC) as CH_4	92	1.0000	1.1507	18	0.009	0.064	0.522	0.389
Carbon Monoxide (CO)	248	1.0000	5.4315	83	0.041	0.304	2.464	1.837
Sulfur Dioxide (SO_2)	0.03	1.0000	0.0016	0	0.000	0.000	0.0007	0.0005
Particulates (as PM_{10}) (grains/dscf)	0.0023	1.0000	0.0975	1	0.001	0.005	0.044	0.033
Carbon Dioxide (CO_2)	3.12%	1.0000	1072.6571	16,378	8.189	59.992	487	363

Gas Emission Factors (AP-42 Table 3.2-2)

NO_X = 2.682 g/kw-hr (CAT Series GLE Engines 2.0 g/bhp-hr)

VOC = 0.118 lb/mmBTU

CO = 0.557 lb/mmBTU

SO_2 = 1.65 E-4 lb/mmBTU (for 1 ppmv S)

PM_{10} = 0.010 lb/mmBTU

CO_2 = 110 lb/mmBTU

Power output	20,475	BHP-hr/yr

Unit conversion from AP-42/CAT	lb/mmBTU	BTU/kw-hr	g/kw-hr
Nitrogen Oxides (as NO_2)	0.606	9751	2.682
Reactive Hydrocarbons (ROC) as CH_4	0.118	9751	0.522
Carbon Monoxide (CO)	0.557	9751	2.464
Sulfur Dioxide (SO_2)	1.65E-04	9751	0.001
Particulates (as PM_{10})	0.01	9751	0.044
Carbon Dioxide (CO_2)	110	9751	486.547

Table DW 7: Crewboat 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 **2.15**

Remarks - District Waters Transit

2 roundtrip/berthing = 5 roundtrips/week or 260 roundtrips/year
260 trips/yr x 1.05 hr/trip = 273 hrs/yr @ 41% power on mains
ship generators run all the time, so
260 trips/yr x 1.05 hrs/trip = 273 hrs/yr @ 50% power

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