TABLE 2-1: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
Hot Water Heaters Emissions

Parameter	Value
Fuel	Nat. Gas
MMBtu/hr, MCR, ea. Heater	345
Btu/CF	1,000
CF/hr Nat. Gas	345,000
CF/yr Nat. Gas	3.0E+9
Max. hrs/yr	8,760
MMBtu/yr ea. Heater @ MCR	3,022,200
Stack Temp., deg. F	275
Flue gas rate ea. heater, ACFM	96,500
Flue gas rate ea. boiler, DSCFM	57,100
Stack Height, ft.	100
Stack diameter (ea. flue[1]), ft.	4.5
Stack exit velocity, ft/s	101.1

Pollutant	Emission Factor	Emission Factor Units	Emssion Factor Source	1 HW Heater @ 100% MCR[2], lb/hr (1-hr to 24-hr avg.)	3 Boilers[3] @ 100% MCR, TPY	Catalyst Malfunctions[4] TPY	Startup Emissions[5], TPY	Total HW Heaters, TPY
NOX	3	ppmvd @ 3% O_2	Mfg. guarantee	1.24	16.29	1.79	0.011	18.09
CO	10	ppmvd @ 3% O_2	Mfg. guarantee	2.52	33.11	1.81	0.011	34.94
VOC	10	ppmvd @ 3% O_2	Mfg. guarantee	1.44	18.92			18.92
PM-10/PM-2.5	2.60	lb/hr	Mfg. guarantee	2.60	34.16			34.16
SOX	0.07	ppmvd @ 3% O_2	Mfg. guarantee	0.04	0.50			0.50
NH3	5	ppmvd @ 3% O_2	Mfg. guarantee	0.76	9.99			9.99
POM/PAH	8.8E-05	lb/MMSCF	AP-42, T1.4-3 (7/98)	3.0E-05	4.0E-04			4.0E-04
Benzene	2.1E-03	lb/MMSCF	AP-42, T1.4-3 (7/98)	7.2E-04	9.5E-03			9.5E-03
Dichlorobenzene	1.2E-03	lb/MMSCF	AP-42, T1.4-3 (7/98)	4.1E-04	5.4E-03			5.4E-03
Formaldehyde	7.5E-02	lb/MMSCF	AP-42, T1.4-3 (7/98)	2.6E-02	3.4E-01			3.4E-01
Hexane	1.8	lb/MMSCF	AP-42, T1.4-3 (7/98)	6.2E-01	8.2E+00			8.2E+00
Naphthalene	6.1E-04	lb/MMSCF	AP-42, T1.4-3 (7/98)	2.1E-04	2.8E-03			2.8E-03
Toluene	3.4E-03	lb/MMSCF	AP-42, T1.4-3 (7/98)	1.2E-03	1.5E-02			1.5E-02
Arsenic	2.00E-04	lb/MMSCF	AP-42, T1.4-4 (7/98)	6.9E-05	9.1E-04			9.1E-04
Beryllium	1.20E-05	lb/MMSCF	AP-42, T1.4-4 (7/98)	4.1E-06	5.4E-05			5.4E-05
Cadmium	1.10E-03	lb/MMSCF	AP-42, T1.4-4 (7/98)	3.8E-04	5.0E-03			5.0E-03
Chromium	1.40E-03	lb/MMSCF	AP-42, T1.4-4 (7/98)	4.8E-04	6.3E-03			6.3E-03
Cobalt	8.40E-05	lb/MMSCF	AP-42, T1.4-4 (7/98)	2.9E-05	3.8E-04			3.8E-04
Lead	5.00E-04	lb/MMSCF	AP-42, T1.4-2 (7/98)	1.7E-04	2.3E-03			2.3E-03
Manganese	3.80E-04	lb/MMSCF	AP-42, T1.4-4 (7/98)	1.3E-04	1.7E-03			1.7E-03
Mercury	2.60E-04	lb/MMSCF	AP-42, T1.4-4 (7/98)	9.0E-05	1.2E-03			1.2E-03
Nickel	2.10E-03	lb/MMSCF	AP-42, T1.4-4 (7/98)	7.2E-04	9.5E-03			9.5E-03
Selenium	2.40E-05	lb/MMSCF	AP-42, T1.4-4 (7/98)	8.3E-06	1.1E-04			1.1E-04

Total HAPs 8.6E+00

Notes:
1. Two stacks serving 4 HW Heaters, independent (per boiler basis) flues within shared stack
2. Annual emissions based on 100% of Maximum Capacity Rating (MCR) @ 8,760 hr/yr.
3. Assumes spare (4th) heater is kept in hot standby using a heating coil, not by firing gas at low load. Also assumes all heaters are rotated once per week to obtain even run time throughout the year.
4. Two SCR and/or oxidation catalyst malfunctions per year, per heater times 3 heaters, 48 hours duration each malfunction. Only NOX and CO emissions are controlled and, therefore, would be increased as a result of control system malfunction.
5. Three cold iron startups per year per heater at average 15% load, uncontrolled for duration of 1 hour per startup.

TABLE 2-2: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
Diesel Fire Water Pump (Fresh Water) Emissions

Parameter	Value
Fuel	Diesel
Number of Units	1
BHP, MCR	375
MMBtu/hr[1]	2.625
Diesel Sulfur content, wt. %	0.0015
Max. hrs/yr	60
Stack Temp., deg. F[2]	800
Exhaust Rate, ACFM[2]	1,969
Stack Height, ft.	25.0
Stack diameter, ft.[2]	0.58
Stack exit velocity, ft/s	122.8

Pollutant	Emission Factor	Emission Factor Units	Emssion Factor Source	100% Load, lb/hr (1-hr to 24-hr avg.)	TPY
NOX	5.08	g/hp-hr	Mfg. data[4]	4.20	1.3E-01
CO	0.36	g/hp-hr	Mfg. data[4]	0.30	8.9E-03
VOC	0.10	g/hp-hr	Mfg. data[4]	0.08	2.5E-03
PM-10/PM-2.5	0.08	g/hp-hr	Mfg. data[4]	0.07	2.0E-03
SOX	4.65E-03	g/hp-hr	AP-42, T3.3-1(10/96)	0.0038	1.2E-04
NH3	6.62	lb/1000 gal	3	0.12	3.7E-03
Pb	1.08E-05	lb/MMBtu	AP-42 T 1.3-11	2.8E-05	8.5E-07
Acetaldehyde	7.67E-04	lb/MMBtu	AP-42, T 3.3-2(10/96)	2.0E-03	6.0E-05
Acrolein	9.25E-05	lb/MMBtu	AP-42, T 3.3-2(10/96)	2.4E-04	7.3E-06
Benzene	9.33E-04	lb/MMBtu	AP-42, T 3.3-2(10/96)	2.4E-03	7.3E-05
1,3-Butadiene	3.91E-05	lb/MMBtu	AP-42, T 3.3-2(10/96)	1.0E-04	3.1E-06
Formaldehyde	1.18E-03	lb/MMBtu	AP-42, T 3.3-2(10/96)	3.1E-03	9.3E-05
Naphthalene	8.48E-05	lb/MMBtu	AP-42, T 3.3-2(10/96)	2.2E-04	6.7E-06
POM/PAH	1.68E-04	lb/MMBtu	AP-42, T 3.3-2(10/96)	4.4E-04	1.3E-05
Toluene	4.09E-04	lb/MMBtu	AP-42, T 3.3-2(10/96)	1.1E-03	3.2E-05
Xylene	2.85E-04	lb/MMBtu	AP-42, T 3.3-2(10/96)	7.5E-04	2.2E-05

Total HAPs 3.1E-04

Notes:
1. Estimated - 7,000 Btu/hp-hr
2. Estimated from typical diesel engine manufacturer's specifications (Caterpillar, Inc.). Exhaust volume rate estimated from 105 cfm/gph based on review of specifications.
3. EPA Emission Inventory Improvement Program, "Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report", April 2004.
4. Based on maximum of emission factors for similar size engines obtained from Caterpillar, Inc. specification sheets, (www.cat.com).

TABLE 2-3: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
Diesel Fire Water Pump (Salt Water) Emissions

Parameter	Value
Fuel	Diesel
Number of units	6
BHP, MCR	700
MMBtu/hr[1]	4.9
Diesel Sulfur content, wt. %	0.0015
Max. hrs/yr	60
Stack Temp., deg. F[2]	800
Exhaust Rate, ACFM[2]	3,675
Stack Height, ft.	25.0
Stack diameter, ft.[2]	0.7
Stack exit velocity, ft/s	175.5

Pollutant	Emission Factor	Emission Factor Units	Emssion Factor Source	100% Load, lb/hr (1-hr to 24-hr avg.)	1 Engine, TPY	6 Engines, TPY
NOX	5.77	g/hp-hr	Mfg. data[4]	8.90	0.27	1.60
CO	0.39	g/hp-hr	Mfg. data[4]	0.60	0.02	0.11
VOC	0.12	g/hp-hr	Mfg. data[4]	0.19	0.006	0.033
PM-10/PM-2.5	0.033	g/hp-hr	Mfg. data[4]	0.051	0.002	0.009
SOX	5.50E-03	g/hp-hr	AP-42, T3.3-1(10/96)	0.008	2.55E-04	0.002
NH3	6.62	lb/1000 gal	3	0.23	5.7E-04	3.4E-03
Pb	1.08E-05	lb/MMBtu	AP-42 T 1.3-11	5.3E-05	1.6E-06	9.5E-06
Benzene	7.76E-04	lb/MMBtu	AP-42 T 3.4-3 (10/96)	3.8E-03	1.1E-04	6.8E-04
Toluene	2.81E-04	lb/MMBtu	AP-42 T 3.4-3 (10/96)	1.4E-03	4.1E-05	2.5E-04
Xylene	1.93E-04	lb/MMBtu	AP-42 T 3.4-3 (10/96)	9.5E-04	2.8E-05	1.7E-04
Formaldehyde	7.89E-05	lb/MMBtu	AP-42 T 3.4-3 (10/96)	3.9E-04	1.2E-05	7.0E-05
Acetaldehyde	2.52E-05	lb/MMBtu	AP-42 T 3.4-3 (10/96)	1.2E-04	3.7E-06	2.2E-05
Acrolein	7.88E-06	lb/MMBtu	AP-42 T 3.4-3 (10/96)	3.9E-05	1.2E-06	7.0E-06
Naphthalene	1.30E-04	lb/MMBtu	AP-42 T 3.4-4 (10/96)	6.4E-04	1.9E-05	1.1E-04
POM/PAH	2.57E-07	lb/MMBtu	AP-42 T 3.4-4 (10/96)	1.3E-06	3.8E-08	2.3E-07

Total HAPs 1.3E-03

Notes:
1. Estimated - 7,000 Btu/hp-hr
2. Estimated from typical diesel engine manufacturer's specifications (Caterpillar, Inc.). Exhaust volume rate estimated from 105 cfm/gph based on review of specifications.
3. EPA Emission Inventory Improvement Program, "Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report", April 2004.
4. Based on maximum of emission factors for similar size engines obtained from Caterpillar, Inc. specification sheets, (www.cat.com).

TABLE 2-4: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
Standby Generator Emissions

Parameter	Value
Fuel	Diesel
Number of units	1
BHP, MCR	2937
MMBtu/hr[1]	20.559
Diesel Sulfur content, wt. %	0.0015
Max. hrs/yr	60
Stack Temp., deg. F[2]	762
Exhaust Rate, ACFM[2]	15,136
Stack Height, ft.	25.0
Stack diameter, ft.[2]	0.7
Stack exit velocity, ft/s	722.7

Pollutant	Emission Factor	Emission Factor Units	Emssion Factor Source	100% Load, lb/hr (1-hr to 24-hr avg.)	1 Engine, TPY
NOX	6.47	g/hp-hr	Mfg. data[4]	41.87	1.26
CO	0.53	g/hp-hr	Mfg. data[4]	3.43	0.10
VOC	0.14	g/hp-hr	Mfg. data[4]	0.91	0.03
PM-10/PM-2.5	0.04	g/hp-hr	Mfg. data[4]	0.23	0.01
SOX	5.50E-03	lb/hp-hr	AP-42, T3.4-1	0.04	1.07E-03
NH3	6.62	lb/1000 gal	3	0.97	1.0E-02
Pb	1.08E-05	lb/MMBtu	AP-42 T 1.3-11	2.2E-04	6.7E-06
Benzene	7.76E-04	lb/MMBtu	AP-42 T 3.4-3 (10/96)	1.6E-02	4.8E-04
Toluene	2.81E-04	lb/MMBtu	AP-42 T 3.4-3 (10/96)	5.8E-03	1.7E-04
Xylene	1.93E-04	lb/MMBtu	AP-42 T 3.4-3 (10/96)	4.0E-03	1.2E-04
Formaldehyde	7.89E-05	lb/MMBtu	AP-42 T 3.4-3 (10/96)	1.6E-03	4.9E-05
Acetaldehyde	2.52E-05	lb/MMBtu	AP-42 T 3.4-3 (10/96)	5.2E-04	1.6E-05
Acrolein	7.88E-06	lb/MMBtu	AP-42 T 3.4-3 (10/96)	1.6E-04	4.9E-06
Naphthalene	1.30E-04	lb/MMBtu	AP-42 T 3.4-4 (10/96)	2.7E-03	8.0E-05
POM/PAH	2.57E-07	lb/MMBtu	AP-42 T 3.4-4 (10/96)	5.3E-06	1.6E-07

Total HAPs 9.2E-04

Notes:
1. Estimated - 7,000 Btu/hp-hr
2. Estimated from typical diesel engine manufacturer's specifications (Caterpillar, Inc.). Exhaust volume rate estimated from 105 cfm/gph based on review of specifications.
3. EPA Emission Inventory Improvement Program, "Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report", April 2004.
4. Based on maximum of emission factors for similar size engines obtained from Caterpillar, Inc. specification sheets, (www.cat.com).

TABLE 2-5: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
Vent Stack Heater Emissions

Parameter	Value
Fuel	Nat. Gas
MMBtu/hr, MCR, ea. Boiler	5.5
Btu/CF	1,000
CF/hr Nat. Gas	5,500
CF/yr Nat. Gas	48.2E+6
Max. hrs/yr	50
MMBtu/yr ea. Boiler @ MCR	48,180
Stack Temp., deg. F	-100
Flue gas rate, ACFM	29,167
Stack Height, ft.	179.5
Stack diameter, ft.	2.0
Stack exit velocity, ft/s	154.7

Pollutant	Emission Factor	Emission Factor Units	Emssion Factor Source	100% Load, lb/hr (1-hr to 24-hr avg.)	TPY
NOX	0.005	lb/MMBtu	Mfg. data	0.03	6.9E-04
CO	0.025	lb/MMBtu	Mfg. data	0.14	3.4E-03
VOC	0.025	lb/MMBtu	Mfg. data	0.14	3.4E-03
PM-10/PM-2.5	0.01	lb/MMBtu	Mfg. data	0.06	1.4E-03
SOX	0.01	lb/MMBtu	Mfg. data	0.04	9.6E-04
POM/PAH	8.8E-05	lb/MMSCF	AP-42, T1.4-3 (7/98)	4.9E-07	1.2E-08
NH3	3.2E+00	lb/MMSCF	1	1.8E-02	4.4E-04
Benzene	2.1E-03	lb/MMSCF	AP-42, T1.4-3 (7/98)	1.2E-05	2.9E-07
Dichlorobenzene	1.2E-03	lb/MMSCF	AP-42, T1.4-3 (7/98)	6.6E-06	1.7E-07
Formaldehyde	7.5E-02	lb/MMSCF	AP-42, T1.4-3 (7/98)	4.1E-04	1.0E-05
Hexane	1.8	lb/MMSCF	AP-42, T1.4-3 (7/98)	9.9E-03	2.5E-04
Naphthalene	6.1E-04	lb/MMSCF	AP-42, T1.4-3 (7/98)	3.4E-06	8.4E-08
Toluene	3.4E-03	lb/MMSCF	AP-42, T1.4-3 (7/98)	1.9E-05	4.7E-07
Arsenic	2.00E-04	lb/MMSCF	AP-42, T1.4-4 (7/98)	1.1E-06	2.8E-08
Beryllium	1.20E-05	lb/MMSCF	AP-42, T1.4-4 (7/98)	6.6E-08	1.7E-09
Cadmium	1.10E-03	lb/MMSCF	AP-42, T1.4-4 (7/98)	6.1E-06	1.5E-07
Chromium	1.40E-03	lb/MMSCF	AP-42, T1.4-4 (7/98)	7.7E-06	1.9E-07
Cobalt	8.40E-05	lb/MMSCF	AP-42, T1.4-4 (7/98)	4.6E-07	1.2E-08
Lead	5.00E-04	lb/MMSCF	AP-42, T1.4-2 (7/98)	2.8E-06	6.9E-08
Manganese	3.80E-04	lb/MMSCF	AP-42, T1.4-4 (7/98)	2.1E-06	5.2E-08
Mercury	2.60E-04	lb/MMSCF	AP-42, T1.4-4 (7/98)	1.4E-06	3.6E-08
Nickel	2.10E-03	lb/MMSCF	AP-42, T1.4-4 (7/98)	1.2E-05	2.9E-07
Selenium	2.40E-05	lb/MMSCF	AP-42, T1.4-4 (7/98)	1.3E-07	3.3E-09

Total HAPs 7.0E-04

1. EPA Emission Inventory Improvement Program, "Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report", April 2004.

TABLE2-6: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
LNG Tanker Ship Unloading Operations Emissions

Shipping Assumptions used for air quality impact dispersion modeling:

Background:

AES reviewed available information from the Maritime Institute of Technology and Graduate Studies (MITAGS) and Maritime Business Strategies, LLC website (http://www.coltoncompany.com/shipbldg/worldsbldg/gas.htm) to obtain data on the existing world fleet of LNG carriers as well as LNG carriers under construction and on order. Based on this information, AES determined that there are 182 ships currently in the fleet that fall into the range of 125,000 cubic meters (cum) to 217,000 cum, with the largest currently in operation being 147,000 cum. Of these ships, AES has reviewed the availability and the likelihood that these vessels could deliver LNG to AES's facility and determined that there is a potential for 114 of these 182 ships that fall into this category. All of these vessels run on steam power plants for both propulsion and auxiliary power and can be run on heavy fuel oil (HFO) or boil-off gas.

There are currently 117 ships on order or in construction within AES's design envelope that potentially could deliver to AES's facility. These consist of 61 (52%) steam powered ships, 30 slow speed diesels, 27 medium speed diesels. This gives us a total of 52% steam power driven and 48% are diesel driven – for the assumptions and calculations summarized below a 50 / 50 ratio was used to add a small degree of conservatism. The diesel ships typically run on HFO with an average global 2.7% sulfur content. They have auxiliary diesel generator sets that can be run while in port to supply the unloading pumps. These diesel engines have the capability of burning low sulfur diesel fuel (typically 1-1.5% global average) while in port. Twenty nine of the newer vessels on order are also set up to run these auxiliary generator sets on dual fuel (90% gas / 10% low sulfur distillate) – this is roughly 24% of the ships under construction. An assumption of 20% was used in the calculations to add a level of conservatism.

Based on the AES LNG Terminal system design, the head required at the ship unloading flange is 60 m. Based on an anticipated average unloading rate of 11,500 cum / hour this translates to 1147 kw / hour of auxiliary power required for the unloading pumps. For steam ships this would require 4.09 MW of heat input assuming a 28% steam cycle efficiency and for diesel generators this would require 2.44 MW of heat input assuming a 47% efficiency.

The capacity throughput of the LNG Terminal on a daily and annual basis is 1.5 BSCFD / 547 BSCFY. Using the standard conversion of 1 cubic meter of LNG equals 20,631 cubic feet of gas a 217,000 cum vessel would last 2.98 days at 1.5 BCFD and using only 217,000 cum vessels to supply the facility would require approximately 123 ships / year. If using 125,000 cum vessels, 215 ships / year would be required. Average unloading time for a 217,000 cum vessel at 12,000 cum/hr is 18 hours and for a 125,000 cum vessel at 10,500 cum/hr is 12 hours

Assumptions to use for Modeling Input:

If the maximum number of vessels per year was assumed (i.e., assuming all 125,000 cum vessels), this would not be the worst-case emission scenario because all of these can be operated on natural gas while in port. Therefore, a mix of the various types of ships was assumed. In order to provide for a reasonable number of vessels burning fuel oil into this mix, it was assumed that 40% of the ships on an annual basis will be the larger 217,000 cum vessels and the remainder (60%) would be the smaller 125,000 cum vessels on average for the life of the facility. This translates into 50 ships / year of the 217,000 cum capacity and 130 ships / year of the 125,000 cum capacity. This is believed to a conservatively high estimate with respect to emissions and impacts.

The assumptions for ship power and fuel by ship class are further categorized as follows:

<u>217,000 cum vessels – [50 Total]</u>

- 50 x 50% = 25 ships are powered by steam and only use natural gas while in port for auxiliary power generation (for offloading and hoteling).
- 50 x 50%x 20% = 5 ships will use dual-fueled auxiliary engine generators.
- 50 x 50%x 80% = 20 ships will use diesel engine powered auxiliary generators fired with distillate (1.5% sulfur) oil.
- Ships will take 18 hours to unload.

25 of the 50 ships will transit up the bay and maneuver to the port while burning HFO 2.7% sulfur. The other 25 will transit burning 90% gas and 10% pilot oil (2.7% sulfur). Transit times remain the same as previous assumptions. While the ship is moving up the channel and in the turning circle it is entirely under assist tug power with its engines in standby and steam boilers on hot standby (i.e., ship engines are not used fo propulsion in the turning circle and safety & security zone). Three assist tugs and two security vessels will also be operating within the 500 yard safety & security zone.

<u>125,000 cum vessels – [130 total]</u>

All 130 ships will be steam powered and operate on only on natural gas while at berth and unloading. Ships will take 12 hours to unload.

All 130 ships will transit up the bay and maneuver with a dual fuel mix of 90% gas, 10% distillate oil (1.5% sulfur) for safety purposes. Transit times remain the same as previous assumptions. While the ship is moving up the channel and in the turning circle it is under tug power with its steam boilers in hot standby. Three assist tugs and two security vessels will also be operating within the 500 yard safety & security zone.

TABLE 2-7: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
LNG Tanker Ship Unloading Operations Emissions

ASSUMPTIONS:

	217,000 m^3 LNG Carrier Capacity Steam Turbine Power Plant			125,000 m^3 LNG Carrier Capacity Steam Turbine Power Plant			217,000 m^3 LNG Carrier Capacity Auxiliary Engine (Diesel-Electric) Powered Pumps			125,000 m^3 LNG Carrier Capacity Auxiliary Engine (Diesel-Electric) Powered Pumps		
Fuel	**Residual Oil**	**Marine Diesel Oil**	**Natural Gas**	**Residual Oil**	**Marine Diesel Oil**	**Natural Gas**	**Residual Oil**	**Marine Diesel Oil**	**Marine Gas Oil**	**Residual Oil**	**Marine Diesel Oil**	**Marine Gas Oil**
NO. of ship calls assumed for potential emissions and modeling purposes			25			130		20	5			
Sulfur content, % wt.	2.7	1.5		2.7	1.5		2.7	1.5	0.5	2.7	1.5	0.5
LNG plant capacity, BSCF/yr	547.5	547.5	547.5	547.5	547.5	547.5	547.5	547.5	547.5	547.5	547.5	547.5
LNG unloading rate, m^3/hr	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
NO. of annual ships/yr	123	123	123	215	215	215	123	123	123	215	215	215
Total pump power requirement for LNG offloading, kW[1]	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
Boiler MMBtu/hr input for offloading operation[1]	14.0	14.0	14.0	14.0	14.0	14.0	---	---	---	---	---	---
Btu/gal	154,225	140,000	---	154,225	140,000	---	154,225	140,000	---	154,225	140,000	---
Btu/CF nat. gas	---	---	1,000	---	---	1,000	---	---	1,000	---	---	1,000
Total propulsion power, Bhp output	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
NO. of propulsion boilers/engines	2	2	2	2	2	2	2	2	2	2	2	2
Auxiliary Engine Rated Power, kW	N/A	N/A	N/A	N/A	N/A	N/A	3,750	3,750	3,750	3,750	3,750	3,750
Operating Load for 1 boiler/engine due to unloading[2]	0.08	0.08	0.08	0.08	0.08	0.08	0.31	0.31	0.31	0.31	0.31	0.31
Operating Load for 1 boiler/engine due to hoteling[2]	0.13	0.13	0.13	0.13	0.13	0.13	0.53	0.53	0.53	0.53	0.53	0.53
Hours per offload	18	18	18	12	12	12	18	18	18	12	12	12
Annual operating hours[3]	2,214	2,214	2,214	2,580	2,580	2,580	2,214	2,214	2,214	2,580	2,580	2,580
gal/hr oil, 1 unit while unloading (1 - 12 hr avg.)	90.7	99.9	---	90.7	99.9	---	---	---	---	---	---	---
gal/hr oil, 1 unit while unloading (24 hr avg.)	68.0	74.9	---	45.3	50.0	---	---	---	---	---	---	---
gal/yr oil, total offloading	200,790.3	221,192.0	---	233,983.2	257,757.6	---	---	---	---	---	---	---
CF/hr Nat. Gas, 1 Boiler while unloading (1 - 12 hr avg.)	---	---	13,987	---	---	13,987	---	---	---	---	---	---
CF/hr Nat. Gas, 1 Boiler while unloading (24-hr avg.)	---	---	10,490	---	---	6,993	---	---	---	---	---	---
CF/yr Nat. Gas, total offloading	---	---	30,966,876	---	---	36,086,062	---	---	---	---	---	---
Stack Temp., deg. F	350	350	350	350	350	350	900	900	800	900	900	800
Stack Temp., deg. K	450	450	450	450	450	450	755	755	700	755	755	700
Exhaust rate, ACFM[8]	10,667	10,667	11,298	10,667	10,667	11,298	15,429	16,997	29,119	15,429	16,997	29,119
Exhaust rate, m^3/sec	5.04	5.04	5.33	5.04	5.04	5.33	7.28	8.02	13.74	7.28	8.02	13.74
Stack Height, ft.	131	131	131	131	131	131	131	131	131	131	131	131
Stack Height, m.	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Stack diameter, ft.	5.5	5.5	5.5	5.5	5.5	5.5	2.0	2.0	2.0	2.0	2.0	2.0
Stack diameter, m.	1.7	1.7	1.7	1.7	1.7	1.7	0.6	0.6	0.6	0.6	0.6	0.6
Stack exit velocity, ft/s	7.5	7.5	7.9	7.5	7.5	7.9	81.9	90.2	154.5	81.9	90.2	154.5
Stack exit velocity, m/s	2.3	2.3	2.4	2.3	2.3	2.4	24.9	27.5	47.1	24.9	27.5	47.1

	Marine Residual Oil-Fired Steam Boiler Emissions - One Boiler								
			217,000 m^3 Ship (lb/hr)			125,000 m^3 Ship (lb/hr)			
Pollutant	**Emission Factor lb/1000 gal[4]**	**Emission Factor lb/MMBtu**	**1-12 hr avg.**	**24-hr avg.**	**annual avg.[7]**	**1-12 hr avg.**	**24-hr avg.**	**annual avg.[7]**	**Emission Factor Source**
TSP	28.0	0.18	2.54	1.91	0.64	2.54	1.27	0.75	AP-42 T 1.3-1
PM-10	28.0	0.18	2.54	1.91	0.64	2.54	1.27	0.75	AP-42 T 1.3-1
SO_X	423.9	2.75	38.44	28.83	9.72	38.44	19.22	11.32	AP-42 T 1.3-1
NOX	47	0.30	4.26	3.20	1.08	4.26	2.13	1.26	AP-42 T 1.3-1
VOC	0.76	0.005	0.07	0.05	0.02	0.07	0.03	0.020	AP-42 T 1.3-3
CO	5	0.03	0.45	0.34	0.11	0.45	0.23	0.13	AP-42 T 1.3-1
NH3	0.8	0.01	0.07	0.05	0.02	0.07	0.04	0.02	5
CO2	24,400	158	2,213	1,660	559	2,213	1106	652	AP-42 T 1.3-12
Pb	1.51E-03	9.79E-06	1.37E-04	1.03E-04	3.46E-05	1.37E-04	6.85E-05	4.03E-05	AP-42 T 1.3-11
POM/PAH	1.30E-03	8.43E-06	1.18E-04	8.84E-05	2.98E-05	1.18E-04	5.89E-05	3.47E-05	AP-42 T1.3-8
1,1,1-Trichloroethane	2.36E-04	1.53E-06	2.14E-05	1.61E-05	5.41E-06	2.14E-05	1.07E-05	6.30E-06	AP-42 T1.3-9
Benzene	2.14E-04	1.39E-06	1.94E-05	1.46E-05	4.91E-06	1.94E-05	9.70E-06	5.72E-06	AP-42 T1.3-9
Ethylbenzene	6.36E-05	4.12E-07	5.77E-06	4.33E-06	1.46E-06	5.77E-06	2.88E-06	1.70E-06	AP-42 T1.3-9
Formaldehyde	6.10E-02	3.96E-04	5.53E-03	4.15E-03	1.40E-03	5.53E-03	2.77E-03	1.63E-03	AP-42 T1.3-8
Naphthalene	1.13E-03	7.33E-06	1.02E-04	7.69E-05	2.59E-05	1.02E-04	5.12E-05	3.02E-05	AP-42 T1.3-9
Toluene	6.20E-03	4.02E-05	5.62E-04	4.22E-04	1.42E-04	5.62E-04	2.81E-04	1.66E-04	AP-42 T1.3-9
Xylene	1.09E-04	7.07E-07	9.89E-06	7.41E-06	2.50E-06	9.89E-06	4.94E-06	2.91E-06	AP-42 T1.3-9
Antimony	5.25E-03	3.40E-05	4.76E-04	3.57E-04	1.20E-04	4.76E-04	2.38E-04	1.40E-04	AP-42 T1.3-11
Arsenic	1.32E-03	8.56E-06	1.20E-04	8.98E-05	3.03E-05	1.20E-04	5.99E-05	3.53E-05	AP-42 T1.3-11
Beryllium	2.78E-05	1.80E-07	2.52E-06	1.89E-06	6.37E-07	2.52E-06	1.26E-06	7.43E-07	AP-42 T1.3-11
Cadmium	3.98E-04	2.58E-06	3.61E-05	2.71E-05	9.12E-06	3.61E-05	1.80E-05	1.06E-05	AP-42 T1.3-11
Chromium	8.45E-04	5.48E-06	7.66E-05	5.75E-05	1.94E-05	7.66E-05	3.83E-05	2.26E-05	AP-42 T1.3-11
Cobalt	6.02E-03	3.90E-05	5.46E-04	4.09E-04	1.38E-04	5.46E-04	2.73E-04	1.61E-04	AP-42 T1.3-11
Lead	1.51E-03	9.79E-06	1.37E-04	1.03E-04	3.46E-05	1.37E-04	6.85E-05	4.03E-05	AP-42 T1.3-11
Manganese	3.00E-03	1.95E-05	2.72E-04	2.04E-04	6.88E-05	2.72E-04	1.36E-04	8.01E-05	AP-42 T1.3-11
Mercury	1.13E-04	7.33E-07	1.02E-05	7.69E-06	2.59E-06	1.02E-05	5.12E-06	3.02E-06	AP-42 T1.3-11
Nickel	8.45E-02	5.48E-04	7.66E-03	5.75E-03	1.94E-03	7.66E-03	3.83E-03	2.26E-03	AP-42 T1.3-11
Selenium	6.83E-04	4.43E-06	6.19E-05	4.65E-05	1.57E-05	6.19E-05	3.10E-05	1.82E-05	AP-42 T1.3-11

	Marine Distillate Oil-Fired Steam Boiler Emissions - One Boiler								
			217,000 m^3 Ship (lb/hr)			125,000 m^3 Ship (lb/hr)			
Pollutant	Emission Factor lb/1000 gal^3	Emission Factor lb/MMBtu	1-12 hr avg.	24-hr avg.	annual avg.[7]	1-12 hr avg.	24-hr avg.	annual avg.[7]	Emission Factor Source
TSP	17.0	0.12	1.54	1.16	0.39	1.54	0.77	0.45	AP-42 T 1.3-1
PM-10	17.0	0.12	1.54	1.16	0.39	1.54	0.77	0.45	AP-42 T 1.3-1
SO_X	235.5	1.68	21.36	16.02	5.40	21.36	10.68	6.29	AP-42 T 1.3-1
NOX	47	0.34	4.26	3.20	1.08	4.26	2.13	1.26	AP-42 T 1.3-1
VOC	0.76	0.005	0.07	0.05	0.02	0.07	0.03	0.020	AP-42 T 1.3-2
CO	5	0.04	0.45	0.34	0.11	0.45	0.23	0.13	AP-42 T 1.3-1
NH3	0.8	0.01	0.07	0.05	0.02	0.07	0.04	0.02	5
CO2	25,000	179	2,267	1,700	573	2,267	1134	668	AP-42 T 1.3-12
Pb	1.51E-03	1.08E-05	1.37E-04	1.03E-04	3.46E-05	1.37E-04	6.85E-05	4.03E-05	AP-42 T 1.3-11
POM/PAH	1.30E-03	9.29E-06	1.18E-04	8.84E-05	2.98E-05	1.18E-04	5.89E-05	3.47E-05	AP-42 T1.3-8
1,1,1-Trichloroethane	2.36E-04	1.69E-06	2.14E-05	1.61E-05	5.41E-06	2.14E-05	1.07E-05	6.30E-06	AP-42 T1.3-9
Benzene	2.14E-04	1.53E-06	1.94E-05	1.46E-05	4.91E-06	1.94E-05	9.70E-06	5.72E-06	AP-42 T1.3-9
Ethylbenzene	6.36E-05	4.54E-07	5.77E-06	4.33E-06	1.46E-06	5.77E-06	2.88E-06	1.70E-06	AP-42 T1.3-9
Formaldehyde	6.10E-02	4.36E-04	5.53E-03	4.15E-03	1.40E-03	5.53E-03	2.77E-03	1.63E-03	AP-42 T1.3-8
Naphthalene	1.13E-03	8.07E-06	1.02E-04	7.69E-05	2.59E-05	1.02E-04	5.12E-05	3.02E-05	AP-42 T1.3-9
Toluene	6.20E-03	4.43E-05	5.62E-04	4.22E-04	1.42E-04	5.62E-04	2.81E-04	1.66E-04	AP-42 T1.3-9
Xylene	1.09E-04	7.79E-07	9.89E-06	7.41E-06	2.50E-06	9.89E-06	4.94E-06	2.91E-06	AP-42 T1.3-9
Antimony	5.25E-03	3.75E-05	4.76E-04	3.57E-04	1.20E-04	4.76E-04	2.38E-04	1.40E-04	AP-42 T1.3-11
Arsenic	1.32E-03	9.43E-06	1.20E-04	8.98E-05	3.03E-05	1.20E-04	5.99E-05	3.53E-05	AP-42 T1.3-11
Beryllium	2.78E-05	1.99E-07	2.52E-06	1.89E-06	6.37E-07	2.52E-06	1.26E-06	7.43E-07	AP-42 T1.3-11
Cadmium	3.98E-04	2.84E-06	3.61E-05	2.71E-05	9.12E-06	3.61E-05	1.80E-05	1.06E-05	AP-42 T1.3-11
Chromium	8.45E-04	6.04E-06	7.66E-05	5.75E-05	1.94E-05	7.66E-05	3.83E-05	2.26E-05	AP-42 T1.3-11
Cobalt	6.02E-03	4.30E-05	5.46E-04	4.09E-04	1.38E-04	5.46E-04	2.73E-04	1.61E-04	AP-42 T1.3-11
Lead	1.51E-03	1.08E-05	1.37E-04	1.03E-04	3.46E-05	1.37E-04	6.85E-05	4.03E-05	AP-42 T1.3-11
Manganese	3.00E-03	2.14E-05	2.72E-04	2.04E-04	6.88E-05	2.72E-04	1.36E-04	8.01E-05	AP-42 T1.3-11
Mercury	1.13E-04	8.07E-07	1.02E-05	7.69E-06	2.59E-06	1.02E-05	5.12E-06	3.02E-06	AP-42 T1.3-11
Nickel	8.45E-02	6.04E-04	7.66E-03	5.75E-03	1.94E-03	7.66E-03	3.83E-03	2.26E-03	AP-42 T1.3-11
Selenium	6.83E-04	4.88E-06	6.19E-05	4.65E-05	1.57E-05	6.19E-05	3.10E-05	1.82E-05	AP-42 T1.3-11

	Natural Gas Fired Steam Boiler Emissions - One Boiler								
			217,000 m^3 Ship (lb/hr)			125,000 m^3 Ship (lb/hr)			
Pollutant	Emission Factor lb/MMSCF[3]	Emission Factor lb/MMBtu	1-12 hr avg.	24-hr avg.	annual avg.[7]	1-12 hr avg.	24-hr avg.	annual avg.[7]	Emission Factor Source
TSP	1.9	0.0019	0.03	0.02	0.01	0.03	0.01	0.01	AP-42 T 1.4-2
PM-10	1.9	0.0019	0.03	0.02	0.01	0.027	0.01	0.008	AP-42 T 1.4-2
SO_X	0.6	0.0006	0.008	0.006	0.002	0.008	0.004	0.002	AP-42 T 1.4-2
NOX	280	0.28	3.92	2.94	0.99	3.92	1.96	1.153	AP-42 T 1.4-1
VOC	5.5	0.0055	0.08	0.06	0.02	0.08	0.04	0.023	AP-42 T 1.4-2
CO	84	0.084	1.17	0.88	0.30	1.17	0.59	0.346	AP-42 T 1.4-1
NH3	3.2	0.0032	0.04	0.03	0.01	0.04	0.02	0.013	5
CO2	120,000	120	1678.42	1258.82	424.20	1,678	839	494	AP-42 T 1.4-2
Pb	5.00E-04	5.00E-07	6.99E-06	5.25E-06	1.77E-06	6.99E-06	3.50E-06	2.06E-06	AP-42 T1.4-2
POM/PAH	8.82E-05	8.82E-08	1.23E-06	9.25E-07	3.12E-07	1.23E-06	6.17E-07	3.63E-07	AP-42 T1.4-3
Benzene	2.10E-03	2.10E-06	2.94E-05	2.20E-05	7.42E-06	2.94E-05	1.47E-05	8.65E-06	AP-42 T1.4-3
Dichlorobenzene	1.20E-03	1.20E-06	1.68E-05	1.26E-05	4.24E-06	1.68E-05	8.39E-06	4.94E-06	AP-42 T1.4-3
Formaldehyde	7.50E-02	7.50E-05	1.05E-03	7.87E-04	2.65E-04	1.05E-03	5.25E-04	3.09E-04	AP-42 T1.4-3
Hexane	1.8	1.80E-03	2.52E-02	1.89E-02	6.36E-03	2.52E-02	1.26E-02	7.41E-03	AP-42 T1.4-3
Naphthalene	6.10E-04	6.10E-07	8.53E-06	6.40E-06	2.16E-06	8.53E-06	4.27E-06	2.51E-06	AP-42 T1.4-3
Toluene	3.40E-03	3.40E-06	4.76E-05	3.57E-05	1.20E-05	4.76E-05	2.38E-05	1.40E-05	AP-42 T1.4-3
Arsenic	2.00E-04	2.00E-07	2.80E-06	2.10E-06	7.07E-07	2.80E-06	1.40E-06	8.24E-07	AP-42 T1.4-4
Beryllium	1.20E-05	1.20E-08	1.68E-07	1.26E-07	4.24E-08	1.68E-07	8.39E-08	4.94E-08	AP-42 T1.4-4
Cadmium	1.10E-03	1.10E-06	1.54E-05	1.15E-05	3.89E-06	1.54E-05	7.69E-06	4.53E-06	AP-42 T1.4-4
Chromium	1.40E-03	1.40E-06	1.96E-05	1.47E-05	4.95E-06	1.96E-05	9.79E-06	5.77E-06	AP-42 T1.4-4
Cobalt	8.40E-05	8.40E-08	1.17E-06	8.81E-07	2.97E-07	1.17E-06	5.87E-07	3.46E-07	AP-42 T1.4-4
Lead	5.00E-04	5.00E-07	6.99E-06	5.25E-06	1.77E-06	6.99E-06	3.50E-06	2.06E-06	AP-42 T1.4-2
Manganese	3.80E-04	3.80E-07	5.32E-06	3.99E-06	1.34E-06	5.32E-06	2.66E-06	1.57E-06	AP-42 T1.4-4
Mercury	2.60E-04	2.60E-07	3.64E-06	2.73E-06	9.19E-07	3.64E-06	1.82E-06	1.07E-06	AP-42 T1.4-4
Nickel	2.10E-03	2.10E-06	2.94E-05	2.20E-05	7.42E-06	2.94E-05	1.47E-05	8.65E-06	AP-42 T1.4-4
Selenium	2.40E-05	2.40E-08	3.36E-07	2.52E-07	8.48E-08	3.36E-07	1.68E-07	9.89E-08	AP-42 T1.4-4

	Residual Oil-Fired MSD Auxiliary Engine Emissions - One Engine								
			217,000 m^3 Ship (lb/hr)			125,000 m^3 Ship (lb/hr)			
Pollutant	Emission Factor g/kWh output	Emission Factor lb/MMBtu (input)	1-12 hr avg.	24-hr avg.	annual avg.[7]	1-12 hr avg.	24-hr avg.	annual avg.[7]	Emission Factor Source
TSP	1.11		2.81	2.11	0.71	2.81	1.40	0.83	EPA/ICF[6]
PM-10	1.11		2.81	2.11	0.71	2.81	1.40	0.827	EPA/ICF[6]
SO_X	11.1		28.07	21.05	7.09	28.07	14.03	8.27	EPA/ICF[6]
NOX	14.7		37.17	27.88	9.39	37.17	18.59	10.95	EPA/ICF[6]
VOC	0.4		1.01	0.76	0.26	1.01	0.51	0.30	EPA/ICF[6]
CO	1.1		2.78	2.09	0.70	2.78	1.39	0.82	EPA/ICF[6]
NH3		0.043	0.36	0.27	0.090	0.36	0.18	0.11	5
CO2		165	1795	1031	347	1,375	687	405	AP-42 T3.4-1
Pb		1.08E-05	1.17E-04	6.75E-05	2.27E-05	9.00E-05	4.50E-05	2.65E-05	AP-42 T1.3-11
POM/PAH		2.57E-07	2.80E-06	1.61E-06	5.41E-07	2.14E-06	1.07E-06	6.31E-07	AP-42 T3.4-4
Acetaldehyde		2.52E-05	2.74E-04	1.57E-04	5.31E-05	2.10E-04	1.05E-04	6.18E-05	AP-42 T3.4-3
Acrolein		7.88E-06	8.57E-05	4.92E-05	1.66E-05	6.57E-05	3.28E-05	1.93E-05	AP-42 T3.4-3
Benzene		7.76E-04	8.44E-03	4.85E-03	1.63E-03	6.47E-03	3.23E-03	1.90E-03	AP-42 T3.4-3
Formaldehyde		7.89E-05	8.58E-04	4.93E-04	1.66E-04	6.57E-04	3.29E-04	1.94E-04	AP-42 T3.4-3
Naphthalene		1.30E-04	1.41E-03	8.12E-04	2.74E-04	1.08E-03	5.42E-04	3.19E-04	AP-42 T3.4-4
Toluene		2.81E-04	3.06E-03	1.76E-03	5.92E-04	2.34E-03	1.17E-03	6.90E-04	AP-42 T3.4-3
Xylene		1.93E-04	2.10E-03	1.21E-03	4.06E-04	1.61E-03	8.04E-04	4.74E-04	AP-42 T3.4-3
Lead		1.08E-05	1.17E-04	6.75E-05	2.27E-05	9.00E-05	4.50E-05	2.6504E-05	AP-42 T1.3-11

Marine Diesel Oil-Fired MSD Auxiliary Engine Emissions - One Engine									
	Emission Factor g/kWh output	Emission Factor lb/MMBtu (input)	217,000 m^3 Ship (lb/hr)			125,000 m^3 Ship (lb/hr)			
Pollutant			1-12 hr avg.	24-hr avg.	annual avg.[7]	1-12 hr avg.	24-hr avg.	annual avg.[7]	Emission Factor Source
TSP	0.71		1.80	1.35	0.45	1.80	0.90	0.53	EPA/ICF[6]
PM-10	0.71		1.80	1.35	0.45	1.80	0.90	0.529	EPA/ICF[6]
SO_X	6.2		15.58	11.68	3.94	15.58	7.79	4.59	EPA/ICF[6]
NOX	13.9		35.15	26.36	8.88	35.15	17.57	10.35	EPA/ICF[6]
VOC	0.4		1.01	0.76	0.26	1.01	0.51	0.30	EPA/ICF[6]
CO	1.1		2.78	2.09	0.70	2.78	1.39	0.82	EPA/ICF[6]
NH3		0.047	0.39	0.30	0.100	0.39	0.20	0.12	5
CO2		165	1375	1031	347	1,375	687	405	AP-42 T3.4-1
Pb		1.08E-05	9.00E-05	6.75E-05	2.27E-05	9.00E-05	4.50E-05	2.65E-05	AP-42 T1.3-11
POM/PAH		2.57E-07	2.14E-06	1.61E-06	5.41E-07	2.14E-06	1.07E-06	6.31E-07	AP-42 T3.4-4
Acetaldehyde		2.52E-05	2.10E-04	1.57E-04	5.31E-05	2.10E-04	1.05E-04	6.18E-05	AP-42 T3.4-3
Acrolein		7.88E-06	6.57E-05	4.92E-05	1.66E-05	6.57E-05	3.28E-05	1.93E-05	AP-42 T3.4-3
Benzene		7.76E-04	6.47E-03	4.85E-03	1.63E-03	6.47E-03	3.23E-03	1.90E-03	AP-42 T3.4-3
Formaldehyde		7.89E-05	6.57E-04	4.93E-04	1.66E-04	6.57E-04	3.29E-04	1.94E-04	AP-42 T3.4-3
Naphthalene		1.30E-04	1.08E-03	8.12E-04	2.74E-04	1.08E-03	5.42E-04	3.19E-04	AP-42 T3.4-4
Toluene		2.81E-04	2.34E-03	1.76E-03	5.92E-04	2.34E-03	1.17E-03	6.90E-04	AP-42 T3.4-3
Xylene		1.93E-04	1.61E-03	1.21E-03	4.06E-04	1.61E-03	8.04E-04	4.74E-04	AP-42 T3.4-3
Lead		1.08E-05	9.00E-05	6.75E-05	2.27E-05	9.00E-05	4.50E-05	2.6504E-05	AP-42 T1.3-11

Marine Gas Oil-Fired MSD Auxiliary Engine Emissions - One Engine									
	Emission Factor g/kWh output	Emission Factor lb/MMBtu (input)	217,000 m^3 Ship (lb/hr)			125,000 m^3 Ship (lb/hr)			
Pollutant			1-12 hr avg.	24-hr avg.	annual avg.[7]	1-12 hr avg.	24-hr avg.	annual avg.[7]	Emission Factor Source
TSP	0.38		0.96	0.72	0.24	0.96	0.48	0.28	EPA/ICF[6]
PM-10	0.38		0.96	0.72	0.24	0.96	0.48	0.283	EPA/ICF[6]
SO_X	2.1		5.18	3.89	1.31	5.18	2.59	1.53	EPA/ICF[6]
NOX	13.9		35.15	26.36	8.88	35.15	17.57	10.35	EPA/ICF[6]
VOC	0.4		1.01	0.76	0.26	1.01	0.51	0.30	EPA/ICF[6]
CO	1.1		2.78	2.09	0.70	2.78	1.39	0.82	EPA/ICF[6]
NH3		0.047	0.39	0.30	0.100	0.39	0.20	0.12	5
CO2		110	917	687	232	917	458	270	AP-42 T3.4-1
Pb		1.08E-05	9.00E-05	6.75E-05	2.27E-05	9.00E-05	4.50E-05	2.65E-05	AP-42 T1.3-11
POM/PAH		2.57E-07	2.14E-06	1.61E-06	5.41E-07	2.14E-06	1.07E-06	6.31E-07	AP-42 T3.4-4
Acetaldehyde		2.52E-05	2.10E-04	1.57E-04	5.31E-05	2.10E-04	1.05E-04	6.18E-05	AP-42 T3.4-3
Acrolein		7.88E-06	6.57E-05	4.92E-05	1.66E-05	6.57E-05	3.28E-05	1.93E-05	AP-42 T3.4-3
Benzene		7.76E-04	6.47E-03	4.85E-03	1.63E-03	6.47E-03	3.23E-03	1.90E-03	AP-42 T3.4-3
Formaldehyde		7.89E-05	6.57E-04	4.93E-04	1.66E-04	6.57E-04	3.29E-04	1.94E-04	AP-42 T3.4-3
Naphthalene		1.30E-04	1.08E-03	8.12E-04	2.74E-04	1.08E-03	5.42E-04	3.19E-04	AP-42 T3.4-4
Toluene		2.81E-04	2.34E-03	1.76E-03	5.92E-04	2.34E-03	1.17E-03	6.90E-04	AP-42 T3.4-3
Xylene		1.93E-04	1.61E-03	1.21E-03	4.06E-04	1.61E-03	8.04E-04	4.74E-04	AP-42 T3.4-3
Lead		1.08E-05	9.00E-05	6.75E-05	2.27E-05	9.00E-05	4.50E-05	2.6504E-05	AP-42 T1.3-11

	Emissions (lbs/ship call)												Composite Annual Emissions Based on Ship Call Assumptions (TPY)
	217,000 m^3 LNG Carrier Capacity Steam Turbine Power Plant			125,000 m^3 LNG Carrier Capacity Steam Turbine Power Plant			217,000 m^3 LNG Carrier Capacity Auxiliary Engine (Diesel-Electric) Powered Pumps			125,000 m^3 LNG Carrier Capacity Auxiliary Engine (Diesel-Electric) Powered Pumps			
Pollutant	Residual Oil	Marine Diesel Oil	Natural Gas	Residual Oil	Marine Diesel Oil	Natural Gas	Residual Oil	Marine Diesel Oil	Marine Gas Oil	Residual Oil	Marine Diesel Oil	Marine Gas Oil	
TSP	45.76	27.76	0.48	30.51	18.51	0.32	50.52	32.32	17.30	33.68	21.54	11.53	0.39
PM-10	45.76	27.76	0.48	30.51	18.51	0.32	50.52	32.32	17.30	33.68	21.54	11.53	0.39
SO_X	691.99	384.44	0.15	461.33	256.29	0.10	505.23	280.38	93.31	336.82	186.92	62.21	3.05
NOX	76.72	76.72	70.49	51.15	51.15	47.00	669.08	632.67	632.67	446.06	421.78	421.78	11.84
VOC	1.24	1.24	1.38	0.83	0.83	0.92	18.21	18.21	18.21	12.14	12.14	12.14	0.30
CO	8.16	8.16	21.15	5.44	5.44	14.10	50.07	50.07	50.07	33.38	33.38	33.38	1.81
NH3	1.31	1.31	0.81	0.87	0.87	0.54	6.44	7.09	7.09	4.29	4.73	4.73	0.13
CO2	39,832	40,811	30,212	26,554	27,207	20,141	24,748	24,748	16,499	16,499	16,499	10,999	1,976
Pb	2.46E-03	2.46E-03	1.26E-04	1.64E-03	1.64E-03	8.39E-05	1.62E-03	1.62E-03	1.62E-03	1.08E-03	1.08E-03	1.08E-03	2.73E-05
POM/PAH	2.12E-03	2.12E-03	2.22E-05	1.41E-03	1.41E-03	1.48E-05	3.85E-05	3.85E-05	3.85E-05	2.57E-05	2.57E-05	2.57E-05	1.72E-06
1,1,1-Trichloroethane	3.85E-04	3.85E-04		2.57E-04	2.57E-04								
Benzene	3.49E-04	3.49E-04	5.29E-04	2.33E-04	2.33E-04	3.52E-04	1.16E-01	1.16E-01	1.16E-01	7.76E-02	7.76E-02	7.76E-02	1.48E-03
Dichlorobenzene			3.02E-04			2.01E-04							1.69E-05
Ethylbenzene	1.04E-04	1.04E-04		6.92E-05	6.92E-05								
Formaldehyde	9.96E-02	9.96E-02	1.89E-02	6.64E-02	6.64E-02	1.26E-02	1.18E-02	1.18E-02	1.18E-02	7.89E-03	7.89E-03	7.89E-03	1.20E-03
Hexane			4.53E-01			3.02E-01							2.53E-02
Naphthalene	1.84E-03	1.84E-03	1.54E-04	1.23E-03	1.23E-03	1.02E-04	1.95E-02	1.95E-02	1.95E-02	1.30E-02	1.30E-02	1.30E-02	2.52E-04
Toluene	1.01E-02	1.01E-02	8.56E-04	6.75E-03	6.75E-03	5.71E-04	4.21E-02	4.21E-02	4.21E-02	2.81E-02	2.81E-02	2.81E-02	5.75E-04
Xylene	1.78E-04	1.78E-04		1.19E-04	1.19E-04		2.89E-02	2.89E-02	2.89E-02	1.93E-02	1.93E-02	1.93E-02	3.62E-04
Antimony	8.57E-03	8.57E-03		5.71E-03	5.71E-03								
Arsenic	2.15E-03	2.15E-03	5.04E-05	1.44E-03	1.44E-03	3.36E-05							2.81E-06
Beryllium	4.54E-05	4.54E-05	3.02E-06	3.03E-05	3.03E-05	2.01E-06							1.69E-07
Cadmium	6.50E-04	6.50E-04	2.77E-04	4.33E-04	4.33E-04	1.85E-04							1.55E-05
Chromium	1.38E-03	1.38E-03	3.52E-04	9.20E-04	9.20E-04	2.35E-04							1.97E-05
Cobalt	9.83E-03	9.83E-03	2.11E-05	6.55E-03	6.55E-03	1.41E-05							1.18E-06
Lead	2.46E-03	2.46E-03	1.26E-04	1.64E-03	1.64E-03	8.39E-05	1.62E-03	1.62E-03	1.62E-03	1.08E-03	1.08E-03	1.08E-03	2.73E-05
Manganese	4.90E-03	4.90E-03	9.57E-05	3.26E-03	3.26E-03	6.38E-05							5.34E-06
Mercury	1.84E-04	1.84E-04	6.55E-05	1.23E-04	1.23E-04	4.36E-05							3.65E-06
Nickel	1.38E-01	1.38E-01	5.29E-04	9.20E-02	9.20E-02	3.52E-04							2.95E-05
Selenium	1.11E-03	1.11E-03	6.04E-06	7.43E-04	7.43E-04	4.03E-06							3.37E-07

1. Based on ship information provided by AES, 1147 kW needed for pump power / (0.28 steam cycle efficiency factor for thermal heat input to electrical power output) x 3414.4 Btu/kW-hr = 14.0 MMBtu/hr total fuel heat input. Assumes 1 boiler operating.
2. Approximate operating load fraction of 1 boiler or engine capacity - used for purposes of estimating realistic total exhaust volume rate and stack velocity for modeling purposes. For steam boiler power plant case, assumes 1 of 2 boilers is operating to provide total power needs while ship is at berth. For auxiliary engine power cases, assumes 1 engine provides all auxiliary power needs while at berth for LNG pumping and hotelling. Auxiliary power needs for hotelling based on 2,000 kW, based on information obtained from Tables 2-4 and 2-7 of ICF Final Report prepared for EPA, "Current Methodologies and Best Practices in Preparing Port Emission Inventories", January 5, 2006.
3. Based on number of ship calls/yr x hrs/offload operation, assuming exclusive use of respective ship size and power plant type. Does not represent assumed mix of ship sizes and power plants on annual basis.
4. Emission factors based on EPA AP-42, Section 1.3 (No. 6 residual fuel oil) and Section 1.4 (nat. gas combustion). TSP and PM-10 emissions are total filterable particulate matter and assumed to all be less than 10 microns. PM-2.5 is conservatively estimated as 100% of PM-10 emissions.
5. EPA Emission Inventory Improvement Program, "Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report", April 2004.
6. Based on emission factors for auxiliary engines in Table 2-10 of ICF Final Report prepared for EPA, "Current Methodologies and Best Practices in Preparing Port Emission Inventories", January 5, 2006.
7. Based on exclusive use of respective LNG ship size and power plant type for deliveries to AES LNG Terminal (does not represent assumed mix of ship sizes and power plants on annual basis).
8. Boiler exhaust volume rate calculated from fuel consumption and 15% excess air, assuming 1 of 2 boilers operating at part load for all activities while ship is at berth. Diesel engine exhaust volume estimated based on 6300 cf/gal diesel consumed. Dual-fuel engine exhaust volume rate estimated based on 6.9 cfm/BHp.

TABLE 2-7A: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
LNG Tanker Ship Unloading Operations - Ship Boiler Exhaust Volume Calculation

TYPICAL GAS VOLUME CALCULATION, 100% LOAD - Heavy Oil Fired Boiler

Total ship power	40,000	hp (output)
NO. of boilers	2	
ea. Boiler heat input	169.8	MMBtu/hr (based on 30% steam cycle efficiency, 2546.4 Btu/hp-hr)

Fuel Data :	NO. 6 Fuel Oil					
HHV Consumption =	169.8	MMBtu/hr				
Fuel Consumption =	169.8	MMBtu/hr /	0.01864	MMBtu/lb=	9107.30	lb/hr
Excess Air =	15	%				
Relative Humidity =	60	%				
Stack Exhaust Temp. =	350	deg. F				

Fuel Composition	Wt. %	lb/hr	O2 (lb/hr) Consumed	H2O(lb/hr) Produced	CO2 (lb/hr) Produced
C	85.7	7805.0	-20813.2	0.0	28618.2
H2	10.5	956.3	-7650.1	8606.4	0.0
	96.20	8761.2	-28463.3	8606.4	28618.2

Exhaust Composition

Component	From Fuel Combustion	From Air lb/hr	Total lb/hr	Wt. %	Moles/hr	Vol. %
O2	-28463.33619	32732.83662	4269.5	2.85	133.42	2.60
H2O	8606.39485		8606.4	5.74	477.87	9.31
CO2	28618.16023		28618.2	19.09	650.26	12.67
N2		108398.1557	108398.2	72.32	3869.98	75.42
Ar			0.0	0.00	0.00	0.00
	8761.218884	141130.9924	149892.2112	100.00	5131.53	100.00

Total Exhaust Vol. Rate =	5131.534967	moles/hr x 385.3 cu.ft./mole / 60min/hr =	32953	scfm
			29884	dscfm
			50553	acfm

TABLE 2-7B: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
LNG Tanker Ship Unloading Operations - Ship Boiler Exhaust Volume Calculations

TYPICAL GAS VOLUME CALCULATION, 100% LOAD - Natural Gas Fired Boiler

Total ship power	40,000	hp (output)
NO. of boilers	2	
ea. Boiler heat input	169.8	MMBtu/hr (based on 30% steam cycle efficiency, 2546.4 Btu/hp-hr)

Fuel Data :	Natural Gas					
HHV Consumption =	169.760	MMBtu/hr				
Fuel Consumption =	169.760	MMBtu/hr /	0.02331	MMBtu/lb=	7282.71	lb/hr
Excess Air =	15	%				
Relative Humidity =	60	%				
Exhaust Temperatue =	350	deg. F				

Fuel Composition	Wt. %	lb/hr	O2 (lb/hr) Consumed	H2O(lb/hr) Produced	CO2 (lb/hr) Produced
C	75.32	5485.3	-14627.6	0.0	20112.9
H2	24.68	1797.4	-14379.0	16176.4	0.0
	100.00	7282.7	-29006.6	16176.4	20112.9

Exhaust Composition

Component	From Fuel Combustion	From Air lb/hr	Total lb/hr	Wt. %	Moles/hr	Vol. %
O2	-29006.55352	33357.53655	4351.0	2.88	135.97	2.50
H2O	16176.3583		16176.4	10.71	898.19	16.53
CO2	20112.90651		20112.9	13.31	457.01	8.41
N2		110466.9138	110466.9	73.11	3943.84	72.56
Ar			0.0	0.00	0.00	0.00
	7282.711283	143824.4504	151107.1617	100.00	5435.00	100.00

Total Exhaust Vol. Rate =	5435.001853	moles/hr x 385.3cu.ft./mole / 60min/hr =	34902	scfm
			29134	dscfm
			53542	acfm

TABLE 2-8: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
LNG Terminal Stationary Source Emissions Summary

	Potential Emissions (tons/year)							
Pollutant	**Hot Water Heaters**	**Fire Pump (Fresh Water)**	**6 Fire Pumps (Salt Water)**	**Emergency Standby Generator**	**Stack Vent Heater**	**LNG Ship Offloading**	**Total LNG Terminal**	**Major Source Threshold**
NOX	18.1	0.1	1.6	1.3	0.0007	11.84	32.9	25
CO	34.9	0.009	0.1	0.1	0.003	1.8	37.0	100
VOC	18.9	0.002	0.03	0.03	0.003	0.30	19.3	25
PM-10	34.2	0.002	0.009	0.007	0.001	0.393	34.6	100
SOX	0.5	0.000	0.00	0.00	0.001	3.05	3.6	100
NH3	10.0	0.004	0.003	0.01	0.0004	0.13	10.1	
POM/PAH	4.0E-04	1.3E-05	2.3E-07	1.6E-07	1.2E-08	1.7E-06	4.2E-04	10
1,1,1-Trichloroethane								
Acetaldehyde		6.0E-05	2.2E-05	1.6E-05			9.8E-05	10
Acrolein		7.3E-06	7.0E-06	4.9E-06			1.9E-05	10
Antimony								
Benzene	9.5E-03	7.3E-05	6.8E-04	4.8E-04	2.9E-07	1.5E-03	1.2E-02	10
1,3-Butadiene		3.1E-06					3.1E-06	10
Dichlorobenzene	5.4E-03				1.7E-07	1.7E-05	5.5E-03	10
Ethylbenzene								
Formaldehyde	3.4E-01	9.3E-05	7.0E-05	4.9E-05	1.0E-05	1.2E-03	3.4E-01	10
Hexane	8.2E+00				2.5E-04	2.5E-02	8.2E+00	10
Naphthalene	2.8E-03	6.7E-06	1.1E-04	8.0E-05	8.4E-08	2.5E-04	3.2E-03	10
Toluene	1.5E-02	3.2E-05	2.5E-04	1.7E-04	4.7E-07	5.7E-04	1.6E-02	10
Xylene		2.2E-05	1.7E-04	1.2E-04		3.6E-04	6.7E-04	10
Arsenic	9.1E-04				2.8E-08	2.8E-06	9.1E-04	10
Beryllium	5.4E-05				1.7E-09	1.7E-07	5.5E-05	10
Cadmium	5.0E-03				1.5E-07	1.5E-05	5.0E-03	10
Chromium	6.3E-03				1.9E-07	2.0E-05	6.4E-03	10
Cobalt	3.8E-04				1.2E-08	1.2E-06	3.8E-04	10
Lead	2.3E-03				6.9E-08	2.7E-05	2.3E-03	10
Manganese	1.7E-03				5.2E-08	5.3E-06	1.7E-03	10
Mercury	1.2E-03				3.6E-08	3.7E-06	1.2E-03	10
Nickel	9.5E-03				2.9E-07	3.0E-05	9.5E-03	10
Selenium	1.1E-04				3.3E-09	3.4E-07	1.1E-04	10
Total HAPs							8.6	25

TABLE 2-9: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
National and Maryland Ambient Air Quality Standards

Pollutant	Averaging Period	National AAQS		Maryland AAQS
		Primary ($\mu g/m^3$)	Secondary ($\mu g/m^3$)	($\mu g/m^3$)
SO_2	3-Hour	---	1300	1300
	24-Hour	365	---	365
	Annual	80	---	80
NO_2	Annual	100	100	100
O3 (ppm)	1-Hour[(b)]	0.12	0.12	0.12
	8-Hour	0.08	0.08	0.08
$PM_{2.5}$	24-Hour[(c)]	35	35	
	Annual	15	15	15
PM_{10}	24-Hour[(d)]	150	150	150
	Annual	50	50	50
TSP	Annual	---	---	---
CO	1-Hour	40,000	40,000	40,000
	8-Hour	10,000	10,000	10,000
Lead	3-Month[(e)]	1.5	---	1.5
Gaseous Fluorides [(f)]	24-Hour	---	---	1.2
	72-Hour	---	---	0.4

Notes:

(a) All short-term (24 hours or less) values are not to be exceeded more than once per year, except $PM_{2.5}$, for which the 3-year average of the 98th percentile of 24-hour concentrations must not exceed the listed value. All long-term values are not to be exce

(b) The 1-hour ambient air quality standard for ozone no longer applies after June 15, 2005, or on such later date as the revocation of the 1-hour standard is effective.

(c) Effective December 18, 2006, EPA has revised the 24-hour PM2.5 standard from 65 to 35 µg/m3 to provide increased protection of public health and welfare. However, pending EPA rules that will clarify issues such as attainment designation, conformity, and

(d) Effective December 18, 2006, EPA has revoked the annual PM10 standard. However, pending EPA rules that will clarify issues such as attainment designation, conformity, and New Source Review during SIP development, compliance with existing PM10 standards

(e) Maximum arithmetic mean averaged over a calendar year quarter.

(f) MDE also has a standard for total fluorides in and on field crops, forage for consumption by grazing ruminants and trees, grases, herbs, etc.

TABLE 2-10: EMISSIONS CALCULATIONS - LNG TERMINAL OPERATING EMISSIONS
Sparrows Point LNG Terminal
Air Quality Control Region Attainment Status

Criteria Pollutant	Metro. Baltimore Intrastate AQCR 115 (Baltimore and Harford Counties, MD)	Eastern Shore Intrastate AQCR 114 (Cecil County, MD)
Sulfur Dioxide (SO_2)	Better than National Standards	Better than National Standards
Carbon Monoxide (CO)	Unclassifiable / Attainment	Unclassifiable / Attainment
Ozone, 1-Hour (O_3)	Nonattainment (severe-15)	Nonattainment (severe-15)
Ozone, 8-Hour (O_3)	Nonattainment (moderate)	Nonattainment (moderate)
Nitrogen Dioxide (NO_2)	Cannot be classified or better than National Standards	Cannot be classified or better than National Standards
Total Suspended Particulate (TSP)	Nonattainment (portions of AQCR)	Better than National Standards
PM-2.5	Nonattainment	Unclassifiable / Attainment
PM-10	Unclassifiable / Attainment	Unclassifiable / Attainment

TABLE 2-11: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS
Sparrows Point LNG Terminal
Representative Ambient Background Data from Monitoring Stations As Noted[a]

Pollutant	Averaging Period	Representative Ambient Background Concentrations[a]		NAAQS			MDE Air Quality Monitoring Site IDs Used to Represent Background Concentrations	
		AQCR 115	AQCR 114	Standard	Units	Standard Type[b]	AQCR 115	AQCR 114
PM-2.5	24-hour	38.6	33.3	35[c]	µg/m^3	Primary and Secondary	240053001, 245100008 and 245100035	240150003
	Annual	15.1	13.2	15	µg/m^3	Primary and Secondary		
PM-10	24-hour	50.7	48.7	150	µg/m^3	Primary and Secondary	240053001, 245100008 and 245100035	240053001
	Annual	23.3	21.3	50[d]	µg/m^3	Primary and Secondary		
NO2	Annual	37.6	11.3	100	µg/m^3	Primary and Secondary	240053001 and 245100040	240259001
SO2	3-hour	172.8	172.8	1300	µg/m^3	Secondary	240053001	240053001
	24-hour	44.5	44.5	365	µg/m^3	Primary		
	Annual	13.1	13.1	80	µg/m^3	Primary		
CO	1-hour	6,755.0	2,862.3	40,000	µg/m^3	Primary	245100040	240051007
	8-hour	3,091.3	1,831.9	10,000	µg/m^3	Primary		
Pb	3-Month	ND	ND	1.5	µg/m^3	Primary and Secondary		
Ozone	1-hour	0.103	0.119	0.12	ppmv	Primary and Secondary	240051007 and 240130001	240251001 and 240259001
	8-hour	0.08	0.089	0.08	ppmv	Primary and Secondary		

Monitoring Site Descriptions

Monitor ID	Pollutants	Monitor Address	City	Urbanized Area	MSA	AQCR	Longitude	Latitude
24-005-1007	CO, O3, PM2.5	Greenspring Dr.	Cockeysville, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.631111	39.460833
24-005-3001	CO, NO2, O3, PM10, PM2.5, SO2	Woodward And Franklin Roads	Essex. MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.474444	39.310833
24-510-0040	CO, NO2	1100 Hillen Street	Baltimore, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.604722	39.298056
24-025-9001	NO2, O3	3538 Aldino Road	Churchville, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.203889	39.563333
24-013-0001	O3	1300 W. Old Liberty Road	Sykesville, MD		Baltimore, MD	Metropolitan Baltimore	-77.041667	39.444167
24-025-1001	O3	Waehli Road Edgewood Army Chem Center	Edgewood, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.296667	39.41
24-510-0008	PM10, PM2.5	5700 Eastern Ave	Baltimore, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.547616	39.28768
24-510-0035	PM10, PM2.5	1900 E Patapsco Ave	Baltimore, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.579722	39.232778
24-015-0003	PM2.5	Rte.273 Fair Hill Ceil Co.	Elkton, MD	Wilmington, DE-NJ-MD-PA	Wilmington-Newark, DE-MD	Eastern Shore	-75.86	39.701111

[a] Three-year average concentrations (2003-2005) from monitoring locations as noted. Short-term values based on second highest monitored values. Annual averages based on maximum values for monitoring location and year.

[b] Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limit to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

[c] Effective December 18, 2006, EPA has revised the 24-hour PM2.5 standard from 65 to 35 µg/m^3 to provide increased protection of public health and welfare. However, pending EPA rules that will clarify issues such as attainment designation, conformity, and New Source Review during SIP development, compliance with existing PM10 standards are used as a surrogate for PM2.5 compliance.

[d] Effective December 18, 2006, EPA has revoked the annual PM10 standard. However, pending EPA rules that will clarify issues such as attainment designation, conformity, and New Source Review during SIP development, compliance with existing PM10 standards will continue to be evaluated.

TABLE 5-1: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS
Sparrows Point LNG Terminal
Stack Parameters and Emission Rates for Model Input

	Stack #1	Stack #2	Stack #3	Stack #4	Stack #5	Stack #6	Stack #7	Stack #8	Stack #9	Stack #10
Parameter	HW Heater #1	HW Heater #2	HW Heater Malfunction Condition	HW Heater @ 25% Load (Power Plant Scenario)	Fresh Water Fire Pump	Salt Water Fire Pump #1	Salt Water Fire Pump #2	Salt Water Fire Pump #3	Salt Water Fire Pump #4	Salt Water Fire Pump #5
UTM X coord. (NAD27, Zone 18), m	371,009.7	371,009.7	371,005.6	371,005.6	370,911.4	370,814.7	370,810.8	370,806.9	370,802.9	370,799.0
UTM Y coord. (NAD27, Zone 18), m	4,341,708.3	4,341,708.3	4,341,745.1	4,341,745.1	4,341,850.2	4,341,804.3	4,341,804.0	4,341,803.6	4,341,803.2	4,341,802.8
Stack Height, m.	30.48	30.48	30.48	30.48	7.62	7.62	7.62	7.62	7.62	7.62
Stack Temp., deg. K	408.0	408.0	408.0	408.00	699.7	699.7	699.7	699.7	699.7	699.7
Stack diameter, m.	1.37	1.37	1.37	1.37	0.18	0.20	0.20	0.20	0.20	0.20
Stack exit velocity, m/s	30.82	30.82	30.82	7.71	37.42	53.48	53.48	53.48	53.48	53.48
Exhaust rate, m3/sec	45.55	45.55	45.55	11.39	0.93	1.73	1.73	1.73	1.73	1.73
PM10/PM2.5 (24-hr) , g/sec	0.3276	0.3276	0.3276	0.082	0.0083	0.0064	0.0064	0.0064	0.0064	0.0064
PM10/PM2.5 (annual) , g/sec	0.3276	0.3276	0.3276	0.082	5.71E-05	4.39E-05	4.39E-05	4.39E-05	4.39E-05	4.39E-05
SO2 (3-hr) , g/sec	0.0048	0.0048	0.0048	0.0012	0.0005	0.0011	0.0011	0.0011	0.0011	0.0011
SO2 (24-hr) , g/sec	0.0048	0.0048	0.0048	0.0012	0.0005	0.0011	0.0011	0.0011	0.0011	0.0011
SO2 (annual) , g/sec	0.0048	0.0048	0.0048	0.0012	3.32E-06	7.33E-06	7.33E-06	7.33E-06	7.33E-06	7.33E-06
NO2 (annual) , g/sec	0.1735	0.1735	0.1735	0.043	0.0036	0.0077	0.0077	0.0077	0.0077	0.0077
CO (1-hr) , g/sec	0.3175	0.3175	1.5876	0.079	0.0375	0.0758	0.0758	0.0758	0.0758	0.0758
CO (8-hr) , g/sec	0.3175	0.3175	0.3969	0.079	0.0375	0.0758	0.0758	0.0758	0.0758	0.0758
Pb (3-month) , g/sec	2.17E-05	2.17E-05	2.17E-05	5.43E-06	3.57E-06	6.67E-06	6.67E-06	6.67E-06	6.67E-06	6.67E-06

	Stack #11	Stack #12	Stack #13	Stack #14	Stack #15	Stack #16	Stack #17	Stack #18	Stack #19
Parameter	Salt Water Fire Pump #6	Standby Diesel Generator	Vent Stack	LNG Ship Offloading	LNG Ship hoteling	Tug Boats in Security & Safety Zone	USCG Boats in Security & Safety Zone	Power Plant (CTG/HRSG)	Cooling Tower
UTM X coord. (NAD27, Zone 18), m	370,795.1	370,959.8	370,777.4	370,753.2	370,771.6	370,257.4	370,201.9	371,003.7	370,924.9
UTM Y coord. (NAD27, Zone 18), m	4,341,802.4	4,341,861.8	4,341,599.6	4,341,887.2	4,341,955.5	4,341,921.5	4,341,871.1	4,341,886.1	4,341,790.4
Stack Height, m.	7.62	7.62	54.71	40.00	40.00	10.67		30.48	14.94
Stack Temp., deg. K	699.7	678.6	199.7	755.2	755.2	755.22	755.22	321.89	298.00
Stack diameter, m.	0.20	0.20	0.61	0.61	0.61	0.46	0.08	8.53	10.06
Stack exit velocity, m/s	53.48	220.28	47.16	27.48	17.47	15.04	102.97	8.30	7.43
Exhaust rate, m3/sec	1.73	7.14	13.77	8.02	5.10	2.47	0.47	474.84	590.04
PM10/PM2.5 (24-hr) , g/sec	0.0064	0.0290	0.0069	0.17	0.10	0.137	0.0022	2.04	0.071
PM10/PM2.5 (annual) , g/sec	4.39E-05	1.98E-04	3.96E-05	0.057	0.033	0.068	0.0007	2.05	0.071
SO2 (3-hr) , g/sec	0.0011	0.0045	0.0049	1.96	3.42	0.122	0.0012	0.04	
SO2 (24-hr) , g/sec	0.0011	0.0045	0.0049	1.47	0.86	0.040	0.0008	0.04	
SO2 (annual) , g/sec	7.33E-06	3.08E-05	2.77E-05	0.50	0.29	0.020	0.0003	0.04	
NO2 (annual) , g/sec	0.0077	0.0361	0.00002	1.12	0.65	1.240	0.069	3.04	
CO (1-hr) , g/sec	0.0758	0.4322	0.0173	0.35	0.61	0.89	11.96	4.14	
CO (8-hr) , g/sec	0.0758	0.4322	0.0173	0.35	0.61	0.33	4.98	4.14	
Pb (3-month) , g/sec	6.67E-06	2.80E-05	3.47E-07	8.50E-06	4.94E-06	1.13E-05			

TABLE 5-2: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS

Sparrows Point LNG Terminal

Source Groups Used in Modeling Analysis

Source Group	Description	Source IDs
1	LNG Terminal stationary sources (without Power Plant), including HW Heaters, emergency fire pumps and generator, and vent stack	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13
2	LNG Terminal stationary sources (Source Group 1) + LNG Ship Offloading	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
3	Emergency Fire Pumps and Standby Generator	5, 6, 7, 8, 9, 10, 11, 12
4	All LNG Terminal stationary sources + LNG ship offloading + hoteling + tugs and USCG security boats in moored safety zone	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
5	LNG Terminal stationary sources (with Power Plant), including CTG/HRSG, HW Heaters (1 @ 25% load), emergency fire pumps and generator, vent stack, and cooling tower	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 18, 19
6	LNG Terminal with Power Plant stationary sources (Source Group 5) + LNG Ship Offloading	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 18, 19
7	All LNG Terminal with Power Plant stationary sources + LNG ship offloading + hoteling + tugs and USCG security boats in moored safety zone	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

TABLE 5-3: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATION
Sparrows Point LNG Terminal
Building/Structure Dimensional Data

Object	Structure/Equipment Description	Height (meters)	Length (meters)	Width (meters)	Base Elev. (meters)
BLD_1	Fabrication Building (HW Heater and Power Plant Bldg.)	20.12	192.33	49.38	4.0
BLD_2	LNG Storage Tank A	51.65	82.30	82.30	3.1
BLD_3	LNG Storage Tank B	52.65	82.30	82.30	3.1
BLD_4	LNG Storage Tank C	53.65	82.30	82.30	3.1
BLD_5	LNG Storage Tank D (Potential future tank)	54.65	82.30	82.30	3.1
BLD_6	LNG Ship A (138,000 m^3)				
	Tier 1	23.0	280.0	42.0	0.0
	Tier 2	35.0	26.0	16.0	0.0
	Tier 3	34.0	31.0	25.0	0.0
	Tier 4	30.0	36.0	24.0	0.0
BLD_7	LNG Ship B (210,000 m^3)				
	Tier 1	23.0	315.0	50.0	0.0
	Tier 2	42.0	30.0	17.0	0.0
	Tier 3	36.0	136.0	19.0	0.0
	Tier 4	30.0	42.0	39.0	0.0
BLD_8	LNG Ship B (210,000 m^3) in Turning Basin				
	Tier 1	23.0	315.0	50.0	0.0
	Tier 2	42.0	30.0	17.0	0.0
	Tier 3	36.0	136.0	19.0	0.0
	Tier 4	30.0	42.0	39.0	0.0

TABLE 5-4: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS
Sparrows Point LNG Terminal
Sectors and Site Characteristics Used for AERMET Input

Sector	Staring Azimuth	Ending Azimuth
1	0	30
2	30	60
3	60	90
4	90	120
5	120	150
6	150	180
7	180	210
8	210	240
9	240	270
10	270	300
11	300	330
12	330	360

Site Characteristics by Season and Sector				
Season	Sector	Albedo	Bowen Ration	Surface Roughness (m)
1	1	0.356	1.5	0.998
2	1	0.138	0.962	1.005
3	1	0.157	1.827	1.012
4	1	0.175	1.876	1.003
1	2	0.356	1.5	0.996
2	2	0.138	0.97	1.008
3	2	0.157	1.853	1.017
4	2	0.175	1.899	1.003
1	3	0.377	1.5	0.905
2	3	0.139	0.914	0.914
3	3	0.162	1.761	0.936
4	3	0.177	1.81	0.914
1	4	0.373	1.5	0.928
2	4	0.139	0.916	0.93
3	4	0.161	1.753	0.946
4	4	0.176	1.804	0.932
1	5	0.381	1.5	0.918
2	5	0.137	0.873	0.92
3	5	0.16	1.584	0.941
4	5	0.172	1.677	0.923
1	6	0.384	1.5	0.908
2	6	0.137	0.86	0.91
3	6	0.16	1.547	0.934
4	6	0.171	1.647	0.913

Site Characteristics by Season and Sector				
Season	Sector	Albedo	Bowen Ration	Surface Roughness (m)
1	7	0.366	1.548	0.978
2	7	0.139	0.932	0.981
3	7	0.157	1.662	0.991
4	7	0.172	1.775	0.982
1	8	0.359	1.769	0.993
2	8	0.146	1.057	1.002
3	8	0.16	1.792	1.004
4	8	0.175	2.005	1.002
1	9	0.36	1.631	1.029
2	9	0.139	0.956	1.038
3	9	0.153	1.539	1.045
4	9	0.166	1.746	1.037
1	10	0.368	1.5	1.028
2	10	0.132	0.87	1.079
3	10	0.144	1.293	1.112
4	10	0.156	1.519	1.059
1	11	0.375	1.5	0.975
2	11	0.134	0.876	1.019
3	11	0.15	1.416	1.053
4	11	0.162	1.594	1.002
1	12	0.363	1.5	0.988
2	12	0.137	0.923	0.989
3	12	0.157	1.695	0.998
4	12	0.172	1.772	0.99

TABLE 5-5: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS
Sparrows Point LNG Terminal
Representative Ambient Background Data from Monitoring Stations As Noted[a]

Pollutant	Averaging Period	Representative Ambient Background Concentrations[a]		NAAQS			MDE Air Quality Monitoring Site IDs Used to Represent Background Concentrations	
		AQCR 115	AQCR 114	Standard	Units	Standard Type[b]	AQCR 115	AQCR 114
PM-2.5	24-hour	38.6	33.3	35[c]	µg/m^3	Primary and Secondary	240053001, 245100008 and 245100035	240150003
	Annual	15.1	13.2	15	µg/m^3	Primary and Secondary		
PM-10	24-hour	50.7	48.7	150	µg/m^3	Primary and Secondary	240053001, 245100008 and 245100035	240053001
	Annual	23.3	21.3	50[d]	µg/m^3	Primary and Secondary		
NO2	Annual	37.6	11.3	100	µg/m^3	Primary and Secondary	240053001 and 245100040	240259001
SO2	3-hour	172.8	172.8	1300	µg/m^3	Secondary	240053001	240053001
	24-hour	44.5	44.5	365	µg/m^3	Primary		
	Annual	13.1	13.1	80	µg/m^3	Primary		
CO	1-hour	6,755.0	2,862.3	40,000	µg/m^3	Primary	245100040	240051007
	8-hour	3,091.3	1,831.9	10,000	µg/m^3	Primary		
Pb	3-Month	ND	ND	1.5	µg/m^3	Primary and Secondary		
Ozone	1-hour	0.103	0.119	0.12	ppmv	Primary and Secondary	240051007 and 240130001	240251001 and 240259001
	8-hour	0.08	0.089	0.08	ppmv	Primary and Secondary		

Monitoring Site Descriptions

Monitor ID	Pollutants	Monitor Address	City	Urbanized Area	MSA	AQCR	Longitude	Latitude
24-005-1007	CO, O3, PM2.5	Greenspring Dr.	Cockeysville, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.631111	39.460833
24-005-3001	CO, NO2, O3, PM10, PM2.5, SO2	Woodward And Franklin Roads	Essex. MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.474444	39.310833
24-510-0040	CO, NO2	1100 Hillen Street	Baltimore, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.604722	39.298056
24-025-9001	NO2, O3	3538 Aldino Road	Churchville, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.203889	39.563333
24-013-0001	O3	1300 W. Old Liberty Road	Sykesville, MD		Baltimore, MD	Metropolitan Baltimore	-77.041667	39.444167
24-025-1001	O3	Waehli Road Edgewood Army Chem Center	Edgewood, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.296667	39.41
24-510-0008	PM10, PM2.5	5700 Eastern Ave	Baltimore, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.547616	39.28768
24-510-0035	PM10, PM2.5	1900 E Patapsco Ave	Baltimore, MD	Baltimore, MD	Baltimore, MD	Metropolitan Baltimore	-76.579722	39.232778
24-015-0003	PM2.5	Rte.273 Fair Hill Ceil Co.	Elkton, MD	Wilmington, DE-NJ-MD-PA	Wilmington-Newark, DE-MD	Eastern Shore	-75.86	39.701111

[a] Three-year average concentrations (2003-2005) from monitoring locations as noted. Short-term values based on second highest monitored values. Annual averages based on maximum values for monitoring location and year.

[b] Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limit to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

[c] Effective December 18, 2006, EPA has revised the 24-hour PM2.5 standard from 65 to 35 µg/m^3 to provide increased protection of public health and welfare. However, pending EPA rules that will clarify issues such as attainment designation, conformity, and New Source Review during SIP development, compliance with existing PM10 standards are used as a surrogate for PM2.5 compliance.

[d] Effective December 18, 2006, EPA has revoked the annual PM10 standard. However, pending EPA rules that will clarify issues such as attainment designation, conformity, and New Source Review during SIP development, compliance with existing PM10 standards will continue to be evaluated.

TABLE 5-6: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS

Sparrows Point LNG Terminal

Summary of AERMOD Modeling Results By Scenario and Model Year

		AERMOD NO2 Impacts, Annual Average (µg/m3) (AAQS = 100, SIL = 1)							UTM Coordinates			
Source Group	Description	1990	1991	1992	1993	1994	Max.	Max. Year	East (m)	North (m)	Distance from Stack (m)	Azimuth, degrees from N.
1	Terminal sources	1.8	1.6	2.0	2.0	2.1	2.1	1994	371,113	4,341,703	115	111
2	Terminal + LNG offloading	3.1	2.9	3.5	3.5	3.7	3.7	1994	371,113	4,341,703	115	111
3	Emergency fire pumps and engine	0.7	0.7	0.6	0.6	0.6	0.7	1991	371,092	4,341,869	151	35
4	All: Terminal+Offloading+Marine	6.2	6.0	5.6	5.7	6.1	6.2	1990	370,960	4,341,930	190	346
5	Terminal + Power Plant	10.5	8.8	11.1	10.9	11.6	11.6	1994	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	12.1	10.2	12.8	12.5	13.4	13.4	1994	371,143	4,341,825	159	60
7	All: Terminal+Power Plant+Offloading+Marine	14.7	12.3	15.4	15.0	16.1	16.1	1994	371,143	4,341,825	159	60

		AERMOD SO2 Impacts, Annual Average (µg/m^3) (AAQS = 80, SIL = 1)							UTM Coordinates			
Source Group	Description	1990	1991	1992	1993	1994	Max.	Max. Year	East (m)	North (m)	Distance from Stack (m)	Azimuth, degrees from N.
1	Terminal sources	0.04	0.04	0.04	0.05	0.05	0.05	1994	371,113	4,341,703	115	111
2	Terminal + LNG offloading	0.81	0.94	0.79	0.87	0.94	0.94	1994	371,102	4,341,786	105	67
3	Emergency fire pumps and engine	0.0006	0.0006	0.0005	0.0005	0.0006	0.0006	1994	371,102	4,341,786	105	67
4	All: Terminal+Offloading+Marine	1.24	1.14	1.28	1.36	1.46	1.46	1994	371,102	4,341,786	105	67
5	Terminal + Power Plant	0.13	0.11	0.12	0.99	0.14	0.99	1993	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	0.90	0.93	0.90	0.90	1.07	1.07	1994	371,102	4,341,786	105	67
7	All: Terminal+Power Plant+Offloading+Marine	1.32	1.18	1.40	1.48	1.59	1.59	1994	371,102	4,341,786	105	67

		AERMOD SO2 Impacts, 24-Hour Average (µg/m^3) (AAQS = 365, SIL = 5)							UTM Coordinates			
Source Group	Description	1990	1991	1992	1993	1994	Max.	Max. Year	East (m)	North (m)	Distance from Stack (m)	Azimuth, degrees from N.
1	Terminal sources	0.20	0.28	0.28	0.27	0.30	0.30	1994	371,116	4,341,725	112	100
2	Terminal + LNG offloading	15.46	13.45	12.71	15.63	14.46	15.63	1993	370,893	4,341,975	256	334
3	Emergency fire pumps and engine	0.29	0.28	0.28	0.26	0.27	0.29	1990	371,092	4,341,869	151	35
4	All: Terminal+Offloading+Marine	16.50	14.45	14.00	17.06	16.30	17.06	1993	370,909	4,342,022	293	341
5	Terminal + Power Plant	0.81	0.74	0.72	0.70	0.77	0.81	1990	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	15.46	13.44	12.71	15.63	14.46	15.63	1993	370,893	4,341,975	256	334
7	All: Terminal+Power Plant+Offloading+Marine	16.50	14.45	14.48	17.06	16.45	17.06	1993	370,909	4,342,022	293	341

		AERMOD SO2 Impacts, 3-Hour Average (µg/m^3) (AAQS = 1,300, SIL = 25)							UTM Coordinates			
Source Group	Description	1990	1991	1992	1993	1994	Max.	Max. Year	East (m)	North (m)	Distance from Stack (m)	Azimuth, degrees from N.
1	Terminal sources	0.58	0.58	0.57	0.51	0.57	0.58	1991	371,092	4,341,869	151	35
2	Terminal + LNG offloading	44.59	43.46	43.60	44.74	42.83	44.74	1993	370,893	4,341,975	256	334
3	Emergency fire pumps and engine	0.58	0.58	0.57	0.51	0.53	0.58	1991	371,092	4,341,869	151	35
4	All: Terminal+Offloading+Marine	82.43	79.53	76.30	74.20	79.12	82.43	1990	371,239	4,341,878	269	60
5	Terminal + Power Plant	1.22	1.16	1.30	1.21	1.27	1.30	1992	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	44.59	43.46	43.60	44.74	42.83	44.74	1993	370,893	4,341,975	256	334
7	All: Terminal+Power Plant+Offloading+Marine	82.49	79.53	76.40	74.36	79.46	82.49	1990	371,239	4,341,878	269	60

Source Group	Description	AERMOD PM10/PM2.5 Impacts, Annual Average (µg/m^3) (AAQS = 50/15, SIL = 1/0.3)					Max.	Max. Year	UTM Coordinates		Distance from Stack (m)	Azimuth, degrees from N.
		1990	1991	1992	1993	1994			East (m)	North (m)		
1	Terminal sources	2.79	2.38	3.00	3.10	3.24	3.24	1994	371,113	4,341,703	115	111
2	Terminal + LNG offloading	2.85	2.44	3.10	3.18	3.32	3.32	1994	371,113	4,341,703	115	111
3	Emergency fire pumps and engine	0.004	0.004	0.004	0.004	0.004	0.004	1994	371,102	4,341,786	105	67
4	All: Terminal+Offloading+Marine	2.95	2.52	3.20	3.29	3.44	3.44	1994	371,113	4,341,703	115	111
5	Terminal + Power Plant	6.73	5.65	7.10	7.03	7.45	7.45	1994	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	6.81	5.72	7.20	7.11	7.56	7.56	1994	371,143	4,341,825	159	60
7	All: Terminal+Power Plant+Offloading+Marine	6.95	5.82	7.40	7.24	7.70	7.70	1994	371,143	4,341,825	159	60

Source Group	Description	AERMOD PM10/PM2.5 Impacts, 24-Hr. Average (µg/m^3) (AAQS = 150/35, SIL = 5/2)					Max.	Max. Year	UTM Coordinates		Distance from Stack (m)	Azimuth, degrees from N.
		1990	1991	1992	1993	1994			East (m)	North (m)		
1	Terminal sources	11.2	9.8	11.6	9.7	11.0	11.6	1992	370,788	4,341,417	394	214
2	Terminal + LNG offloading	12.1	10.5	12.8	10.4	11.7	12.8	1992	371,113	4,341,703	115	111
3	Emergency fire pumps and engine	1.0	1.0	0.9	1.0	1.1	1.1	1994	370,960	4,341,930	190	346
4	All: Terminal+Offloading+Marine	12.7	11.4	13.5	10.9	12.5	13.5	1992	371,113	4,341,703	115	111
5	Terminal + Power Plant	31.7	29.1	28.3	27.5	28.0	31.7	1990	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	32.2	29.7	28.8	28.4	28.6	32.2	1990	371,143	4,341,825	159	60
7	All: Terminal+Power Plant+Offloading+Marine	32.8	30.5	29.5	29.1	29.5	32.8	1990	371,143	4,341,825	159	60

Source Group	Description	AERMOD CO Impacts, 8-Hour Average (µg/m^3) (AAQS = 10,000, SIL = 500)					Max.	Max. Year	UTM Coordinates		Distance from Stack (m)	Azimuth, degrees from N.
		1990	1991	1992	1993	1994			East (m)	North (m)		
1	Terminal sources	72.0	71.0	80.4	74.2	82.4	82.4	1994	371,116	4,341,725	112	100
2	Terminal + LNG offloading	73.3	73.5	82.1	76.4	83.4	83.4	1994	371,116	4,341,725	112	100
3	Emergency fire pumps and engine	39.9	39.7	37.9	35.9	37.7	39.9	1990	371,092	4,341,869	151	35
4	All: Terminal+Offloading+Marine	692.8	645.3	840.8	647.6	682.5	840.8	1992	369,686	4,341,862	1325	275
5	Terminal + Power Plant	97.5	95.1	100.5	98.7	107.8	107.8	1994	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	99.2	97.5	103.9	101.5	112.1	112.1	1994	371,143	4,341,825	159	60
7	All: Terminal+Power Plant+Offloading+Marine	693.9	645.3	842.9	647.6	683.4	842.9	1992	369,686	4,341,862	1325	275

Source Group	Description	AERMOD CO Impacts, 1-Hour Average (µg/m^3) (AAQS = 40,000, SIL = 2,000)					Max.	Max. Year	UTM Coordinates		Distance from Stack (m)	Azimuth, degrees from N.
		1990	1991	1992	1993	1994			East (m)	North (m)		
1	Terminal sources	113.6	116.4	117.8	114.0	118.4	118.4	1994	371,113	4,341,703	115	111
2	Terminal + LNG offloading	119.0	119.7	120.6	117.8	121.7	121.7	1994	371,113	4,341,703	115	111
3	Emergency fire pumps and engine	65.3	63.7	63.6	64.4	61.8	65.3	1990	371,143	4,341,825	159	60
4	All: Terminal+Offloading+Marine	11532.9	11608.8	12066.1	9812.9	10808.0	12066.1	1992	369,830	4,341,647	1180	265
5	Terminal + Power Plant	147.4	147.0	147.3	151.3	144.4	151.3	1993	371,143	4,341,825	159	60
6	Terminal + Power Plant + Offload	153.1	151.2	151.3	155.6	148.7	155.6	1993	371,143	4,341,825	159	60
7	All: Terminal+Power Plant+Offloading+Marine	11548.6	11609.1	12066.5	9816.7	10808.0	12066.5	1992	369,686	4,341,862	1325	275

Source Group	Description	AERMOD Pb Impacts, 3-Month Average (µg/m^3) (AAQS = 1.5, SIL = 0.3)					Max.	Max. Year	UTM Coordinates		Distance from Stack (m)	Azimuth, degrees from N.
		1990	1991	1992	1993	1994			East (m)	North (m)		
1	Terminal sources	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67
2	Terminal + LNG offloading	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67
3	Emergency fire pumps and engine	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67
4	All: Terminal+Offloading+Marine	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67
5	Terminal + Power Plant	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67
6	Terminal + Power Plant + Offload	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67
7	All: Terminal+Power Plant+Offloading+Marine	0.002	0.002	0.002	0.002	0.002	0.002	1994	371,102	4,341,786	105	67

TABLE 5-7: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS

Sparrows Point LNG Terminal

Summary of Maximum AERMOD Impacts By Model Scenario

Modeling Results - Source Group 1 - LNG Terminal Stationary Sources (Without Power Plant)

Pollutant	Averaging Period	Max. Impact ($\mu g/m^3$)[1]	Significant Impact Level ($\mu g/m^3$)	Background Conc. ($\mu g/m^3$)[3]	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Receptor Location of Maximum Impact: UTM East (m)	UTM North (m)	Distance from Stack (m)	Azimuth, degrees from N.	Year
PM10	24-hour average	11.6	5	51	62.3	150	370,788	4,341,417	394	214	1992
	Annual average	3.2	1	23	26.5	50	371,113	4,341,703	115	111	1994
NO2	Annual average	2.1	1	37.6	39.7	100	371,113	4,341,703	115	111	1994
SO_2	3-hour average	0.6	25	172.8	173.4	1300	371,092	4,341,869	151	35	1991
	24-hour average	0.3	5	44.5	44.8	365	371,116	4,341,725	112	100	1994
	Annual average	0.05	1	13.1	13.1	80	371,113	4,341,703	115	111	1994
CO	1-hour average	118.4	2,000	6,755	6,873	40,000	371,113	4,341,703	115	111	1994
	8-hour average	82.4	500	3,091	3,174	10,000	371,116	4,341,725	112	100	1994
Pb	3-Month average[2]	0.002	0.3	ND	0.002	1.5	371,102	4,341,786	105	67	1994

Modeling Results - Source Group 2 - LNG Terminal Stationary Sources + LNG Ship Offloading (Without Power Plant)

Pollutant	Averaging Period	Max. Impact ($\mu g/m^3$)[1]	Significant Impact Level ($\mu g/m^3$)	Background Conc. ($\mu g/m^3$)[3]	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Receptor Location of Maximum Impact: UTM East (m)	UTM North (m)	Distance from Stack (m)	Azimuth, degrees from N.	Year
PM10	24-hour average	12.8	5	51	63.5	150	371,113	4,341,703	115	111	1992
	Annual average	3.3	1	23	26.6	50	371,113	4,341,703	115	111	1994
NO2	Annual average	3.7	1	37.6	41.3	100	371,113	4,341,703	115	111	1994
SO_2	3-hour average	44.7	25	172.8	217.6	1300	370,893	4,341,975	256	334	1993
	24-hour average	15.6	5	44.5	60.1	365	370,893	4,341,975	256	334	1993
	Annual average	0.94	1	13.1	14.0	80	371,102	4,341,786	105	67	1994
CO	1-hour average	121.7	2,000	6,755	6,877	40,000	371,113	4,341,703	115	111	1994
	8-hour average	83.4	500	3,091	3,175	10,000	371,116	4,341,725	112	100	1994
Pb	3-Month average[2]	0.002	0.3	ND	0.002	1.5	371,102	4,341,786	105	67	1994

Modeling Results - Source Group 4 - LNG Terminal Stationary Sources + LNG Ship Offloading + Marine Vessels (Without Power Plant)

Pollutant	Averaging Period	Max. Impact ($\mu g/m^3$)[1]	Significant Impact Level ($\mu g/m^3$)	Background Conc. ($\mu g/m^3$)[3]	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Receptor Location of Maximum Impact: UTM East (m)	UTM North (m)	Distance from Stack (m)	Azimuth, degrees from N.	Year
PM10	24-hour average	13.5	5	51	64.2	150	371,113	4,341,703	115	111	1992
	Annual average	3.4	1	23	26.7	50	371,113	4,341,703	115	111	1994
NO2	Annual average	6.2	1	37.6	43.8	100	370,960	4,341,930	190	346	1990
SO_2	3-hour average	82.4	25	172.8	255.2	1300	371,239	4,341,878	269	60	1990
	24-hour average	17.1	5	44.5	61.6	365	370,909	4,342,022	293	341	1993
	Annual average	1.46	1	13.1	14.6	80	371,102	4,341,786	105	67	1994
CO	1-hour average	12066.1	2,000	6,755	18,821	40,000	369,830	4,341,647	1,180	265	1992
	8-hour average	840.8	500	3,091	3,932	10,000	369,686	4,341,862	1,325	275	1992
Pb	3-Month average[2]	0.002	0.3	ND	0.002	1.5	371,102	4,341,786	105	67	1994

Modeling Results - Source Group 5 - LNG Terminal + Power Plant Stationary Sources

Pollutant	Averaging Period	Max. Impact ($\mu g/m^3$)[1]	Significant Impact Level ($\mu g/m^3$)	Background Conc. ($\mu g/m^3$)[3]	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Receptor Location of Maximum Impact				Year
							UTM East (m)	UTM North (m)	Distance from Stack (m)	Azimuth, degrees from N.	
PM10	24-hour average	31.7	5	51	82.4	150	371,143	4,341,825	159	60	1990
	Annual average	7.5	1	23	30.8	50	371,143	4,341,825	159	60	1994
NO2	Annual average	11.6	1	37.6	49.2	100	371,143	4,341,825	159	60	1994
SO_2	3-hour average	1.3	25	172.8	174.1	1300	371,143	4,341,825	159	60	1992
	24-hour average	0.8	5	44.5	45.3	365	371,143	4,341,825	159	60	1990
	Annual average	0.99	1	13.1	14.1	80	371,143	4,341,825	159	60	1993
CO	1-hour average	151.3	2,000	6,755	6,906	40,000	371,143	4,341,825	159	60	1993
	8-hour average	107.8	500	3,091	3,199	10,000	371,143	4,341,825	159	60	1994
Pb	3-Month average[2]	0.002	0.3	ND	0.002	1.5	371,102	4,341,786	105	67	1994

Modeling Results - Source Group 6 - LNG Terminal + Power Plant Stationary Sources + LNG Ship Offloading

Pollutant	Averaging Period	Max. Impact ($\mu g/m^3$)[1]	Significant Impact Level ($\mu g/m^3$)	Background Conc. ($\mu g/m^3$)[3]	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Receptor Location of Maximum Impact				Year
							UTM East (m)	UTM North (m)	Distance from Stack (m)	Azimuth, degrees from N.	
PM10	24-hour average	32.2	5	51	82.9	150	371,143	4,341,825	159	60	1990
	Annual average	7.6	1	23	30.9	50	371,143	4,341,825	159	60	1994
NO2	Annual average	13.4	1	37.6	51.0	100	371,143	4,341,825	159	60	1994
SO_2	3-hour average	44.7	25	172.8	217.6	1300	370,893	4,341,975	256	334	1993
	24-hour average	15.6	5	44.5	60.1	365	370,893	4,341,975	256	334	1993
	Annual average	1.07	1	13.1	14.2	80	371,102	4,341,786	105	67	1994
CO	1-hour average	155.6	2,000	6,755	6,911	40,000	371,143	4,341,825	159	60	1993
	8-hour average	112.1	500	3,091	3,203	10,000	371,143	4,341,825	159	60	1994
Pb	3-Month average[2]	0.002	0.3	ND	0.002	1.5	371,102	4,341,786	105	67	1994

Modeling Results - Source Group 7 - LNG Terminal + Power Plant Stationary Sources + LNG Ship Offloading + Marine Vessels

Pollutant	Averaging Period	Max. Impact ($\mu g/m^3$)[1]	Significant Impact Level ($\mu g/m^3$)	Background Conc. ($\mu g/m^3$)[3]	Total Conc. ($\mu g/m^3$)	AAQS ($\mu g/m^3$)	Receptor Location of Maximum Impact				Year
							UTM East (m)	UTM North (m)	Distance from Stack (m)	Azimuth, degrees from N.	
PM10	24-hour average	32.8	5	51	83.5	150	371,143	4,341,825	159	60	1990
	Annual average	7.7	1	23	31.0	50	371,143	4,341,825	159	60	1994
NO2	Annual average	16.1	1	37.6	53.7	100	371,143	4,341,825	159	60	1994
SO_2	3-hour average	82.5	25	172.8	255.3	1300	371,239	4,341,878	269	60	1990
	24-hour average	17.1	5	44.5	61.6	365	370,909	4,342,022	293	341	1993
	Annual average	1.59	1	13.1	14.7	80	371,102	4,341,786	105	67	1994
CO	1-hour average	12066.5	2,000	6,755	18,822	40,000	369,686	4,341,862	1,325	275	1992
	8-hour average	842.9	500	3,091	3,934	10,000	369,686	4,341,862	1,325	275	1992
Pb	3-Month average[2]	0.002	0.3	ND	0.002	1.5	371,102	4,341,786	105	67	1994

1. Highest second high modeled concentrations were used to evaluate all short-term impacts (1-hour to 24-hour). Highest modeled concentrations were used to evaluate annual impacts.

TABLE 5-8: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS
Sparrows Point LNG Terminal
Maryland Counties Emissions Inventory

Source: http://www.epa.gov/air/data/geosel.html
Geographic Area: Maryland
Year: 2001

EPA Region	State	County Code	County	Source Category	Emissions Year	CO Emissions (Tons)	NOx Emissions (Tons)	VOC Emissions (Tons)	SO2 Emissions (Tons)	PM2.5 Emissions (Tons)	PM10 Emissions (Tons)	NH3 Emissions (Tons)	Total Pollutant Emissions
3	MD	24001	Allegany Co	All Categories	2001	44,845	12,262	4,990	20,453	3,234	5,620	387	88,556
3	MD	24003	Anne Arundel Co	All Categories	2001	148,538	36,715	18,185	71,439	5,955	10,410	932	286,220
3	MD	24005	Baltimore Co	All Categories	2001	305,419	43,464	26,218	42,719	9,311	16,974	1,546	436,339
3	MD	24009	Calvert Co	All Categories	2001	23,310	3,146	3,338	647	983	2,642	152	33,234
3	MD	24011	Caroline Co	All Categories	2001	10,839	1,472	1,507	310	692	2,573	2,104	18,805
3	MD	24013	Carroll Co	All Categories	2001	50,833	12,164	6,312	3,266	2,911	7,717	1,766	82,059
3	MD	24015	Cecil Co	All Categories	2001	36,330	5,502	4,441	949	1,143	3,308	501	51,030
3	MD	24017	Charles Co	All Categories	2001	34,593	20,927	5,146	79,120	8,115	10,385	200	150,372
3	MD	24019	Dorchester Co	All Categories	2001	17,434	2,004	3,966	2,346	692	1,682	1,351	28,783
3	MD	24021	Frederick Co	All Categories	2001	108,415	12,701	8,766	10,114	3,054	8,767	2,257	151,019
3	MD	24023	Garrett Co	All Categories	2001	30,816	4,445	2,423	709	791	2,295	717	41,404
3	MD	24025	Harford Co	All Categories	2001	68,046	8,662	8,607	1,946	1,840	5,058	997	93,316
3	MD	24027	Howard Co	All Categories	2001	84,686	9,987	9,468	2,702	1,582	4,329	416	111,588
3	MD	24029	Kent Co	All Categories	2001	8,715	1,009	1,846	228	501	1,642	704	14,144
3	MD	24031	Montgomery Co	All Categories	2001	276,154	32,890	30,429	41,024	8,640	17,216	1,068	398,782
3	MD	24033	Prince George's Co	All Categories	2001	211,743	34,697	24,877	44,813	7,533	13,166	1,095	330,390

EPA Region	State	County Code	County	Source Category	Emissions Year	CO Emissions (Tons)	NOx Emissions (Tons)	VOC Emissions (Tons)	SO2 Emissions (Tons)	PM2.5 Emissions (Tons)	PM10 Emissions (Tons)	NH3 Emissions (Tons)	Total Pollutant Emissions
3	MD	24035	Queen Anne's Co	All Categories	2001	15,981	2,149	2,631	428	1,031	3,666	1,125	25,981
3	MD	24037	St. Mary's Co	All Categories	2001	36,896	3,823	5,915	1,098	1,070	2,683	342	50,756
3	MD	24039	Somerset Co	All Categories	2001	12,776	1,404	2,627	252	438	1,196	2,050	20,306
3	MD	24041	Talbot Co	All Categories	2001	17,896	2,435	2,994	353	710	2,272	812	26,762
3	MD	24043	Washington Co	All Categories	2001	68,135	13,064	7,379	6,256	2,145	5,296	1,543	101,674
3	MD	24045	Wicomico Co	All Categories	2001	30,835	3,577	4,657	1,089	1,062	2,836	4,061	47,055
3	MD	24047	Worcester Co	All Categories	2001	20,086	1,929	3,364	417	716	1,747	2,974	30,516
3	MD	24510	Baltimore city	All Categories	2001	173,337	34,810	21,261	10,686	2,898	7,413	1,532	249,039

TABLE 5-9: AIR QUALITY IMPACT ANALYSIS CALCULATIONS AND SUMMARIES - LNG TERMINAL OPERATIONS
Sparrows Point LNG Terminal
Comparison of Project Direct and Indirect Emissions With County Emissions Inventory

	CO Emissions (Tons/Year)	NOx Emissions (Tons/Year)	VOC Emissions (Tons/Year)	SO2 Emissions (Tons/Year)	PM2.5 Emissions (Tons/Year)	PM10 Emissions (Tons/Year)	NH3 Emissions (Tons/Year)	Total Pollutant Emissions
Total LNG Terminal + LNG Ship Offloading (w/out Power Plant)	37	33	19	4	35	35	10	172
Total Stationary Sources + LNG Ship Offloading (w/ Power Plant)	160	122	52	5	77	77	175	667
Total Marine, Maint. Dredging and Indirect Emissions (MD)	304	523	22	273	29	29	6	1,187
Total Direct and Indirect Emissions (w/out Power Plant)	341	555	41	276	64	64	16	1,359
Total Direct and Indirect Emissions (w/ Power Plant)	464	645	74	277	106	106	182	1,854
Baltimore County Emissions (2001)[1]	305,419	43,464	26,218	42,719	9,311	16,974	1,546	436,339
Worst-Case Project Emissions as Percentage of Baltimore Co. Inventory	**0.2%**	**1.5%**	**0.3%**	**0.6%**	**1.1%**	**0.6%**	**11.8%**	**0.4%**

1. Source: http://www.epa.gov/air/data/geosel.html