Outer Continental Shelf Pre-Construction Air Permit Application

Frontier *Discoverer* Beaufort Sea Exploration Drilling Program

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Abbreviations/Acronyms

AAAQS .....Alaska Ambient Air Quality Standards
AAC .....Alaska Administrative Code
AC.....Intake air cooling
ADEC .....Alaska Department of Environmental Conservation
ASTM.....American Society of Testing and Materials
BACT .....Best available control technology
BP .....British Petroleum
BPX.....British Petroleum Exploration
BPIP.....Building Profile Input Program
CAA .....Clean Air Act
CDPF.....Catalytic diesel particulate filter
CEM.....Continuous emissions monitor
CFR .....Code of Federal Regulations
CI .....Compression ignition
CISWI .....Commercial and industrial solid waste incinerator
CPAI .....Conoco Phillips Alaska Inc.
DPF.....Diesel particulate filter
EDMS .....Emissions Data Management System
EGR .....Exhaust gas recirculation
Em .....Emergency
EPA.....United States Environmental Protection Agency
ESP.....Electrostatic precipitators
FGR .....Flue gas recirculation
GCP .....Good combustion practices
GMP.....Good maintenance practices
HIP.....High injection pressure
HPU .....Hydraulic power unit
IC .....Internal combustion
ISC3.....Industrial Source Complex
ITR .....Ignition timing retard
LAER .....Lowest achievable emission rate
LNB.....Low NO_x burner
LND.....Low NO_x design
LSF .....Low sulfur fuel
MLC .....Mud line cellars
MSW .....Municipal solid waste
NA.....Not Applicable
NAAQS .....National Ambient Air Quality Standards
NAICS.....North American Industry Classification System
NESHAPs .....National Emission Standard for Hazardous Air Pollutants
NSPS .....New source performance standard
NSR .....New source review
OCS .....Outer Continental Shelf
ORL .....Owner Requested Limit under 18 ACC 50.225
ORR.....Owner-Requested Restriction
OSR .....Oil Spill Response

OxyCat.....Oxidation catalyst
PCV .....Positive crankcase ventilation
PSD .....Prevention of significant deterioration
RACT .....Reasonably available control technology
RBLC .....RACT/BACT/LAER Clearinghouse
RSCs ..... Reduced sulfur compounds
RICE .....Reciprocating internal combustion engines
SCR .....Selective catalytic reduction
SDS .....Semi-dry scrubber
SIA .....Significant impact area
SIL .....Significant impact level
SIP .....State Implementation Plan
SNCR.....Selective non-catalytic reduction
SOF .....Soluble organic fraction
SSBOP .....Subsea blowout preventer
ULSD .....Ultra-low sulfur distillate fuel (15 ppm sulfur content)
Unit ID .....Emission Unit Identification Number
WI .....Water Injection
WRAP .....Western Regional Air Partnership

Units and Measures

g.....grams
bhp.....brake horsepower
hp.....horsepower
km .....kilometers
kts .....knots
kW.....kiloWatts
lbs .....pounds
MMBtu .....million British thermal units
ppm.....parts per million
tpy .....tons per year

Pollutants

CO .....Carbon Monoxide
H_2S.....Hydrogen Sulfide
HAPs.....Hazardous Air Pollutants
HC.....Hydrocarbons
NH_3 .....Ammonia
NMHC .....Non Methane Hydrocarbons
NO_X.....Oxides of Nitrogen
NO_2 .....Nitrogen Dioxide
PM_{10}.....Particulate Matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ .....Particulate Matter with an aerodynamic diameter less than 2.5 microns
SO_2 .....Sulfur Dioxide
SO_3 .....Sulfur Trioxide
VOC .....Volatile Organic Compounds

SECTION 1

INTRODUCTION

Shell Offshore Inc. (Shell) is applying for a preconstruction permit from EPA Region 10 for the operation of the *Discoverer* drill ship (the source when it is attached to and erected on the seabed and used for exploring resources from the seabed) and its associated fleet in the Beaufort Sea, both within and beyond 25 miles of the Alaska seaward boundary. It is to be used for exploratory drilling activity (NAICS category 211111) on the Outer Continental Shelf (OCS) of the Beaufort Sea. As such, the application is made under the OCS permitting rules (40 CFR 55).

Shell has also applied for a preconstruction permit for the *Discoverer* and its associated fleet for exploration activities in the Chukchi Sea. That permit is following a separate approval path with EPA Region 10. The permits will give Shell the flexibility to explore either sea but not both at the same time. Except for the addition of a tug boat and barge to the Oil Spill Response fleet and one slightly larger Oil Spill Response work boat, the emission units addressed in this application are the same as those proposed for operation in the Chukchi Sea.

Exploration beyond 25 miles of the Alaska seaward boundary is subject to Section 55.13 of the federal OCS Air Regulations. Exploration within 25 miles of the Alaska seaward boundary is subject to Section 55.13 as well as the Alaska regulations applicable to OCS sources, as incorporated by reference through Section 55.14 and Appendix A of the OCS Air Regulations. The Alaska permitting rules for major stationary sources are in 18 AAC 50.306 and 18 AAC 50.040(h), and there are no substantive differences in the Alaska rules between the current Section 55.14 State Implementation Plan (SIP) and the current Alaska rules (amended through November 9, 2008) as related to permitting of a stationary source. Therefore, this application can be considered to address both sets of rules. Because EPA will be applying Alaska Administrative Code provisions (which, for the most part, simply incorporate by reference federal PSD regulations) for project operations within 25 miles of the Alaska seaward boundary, this application provides parallel citations for references to PSD regulations, citing both the federal provision in 40 CFR 52.21 and the corresponding state provision in 18 AAC 50.

This application is for a permit to allow the *Discoverer* and its associated fleet to operate as a portable stationary source under 40 CFR 52.21(i)(1)(viii) and 18 AAC 50.306(b)/18 AAC 50.040(h)(7) at Shell Offshore Inc.'s current leases in the Beaufort Sea (see Figure 1-1). Shell seeks approval for a maximum drilling season of 168 drilling days, beginning as early as July 1 of each year. During this season, Shell requires the flexibility to drill one or more wells or parts of wells. In practice, it is likely that extreme conditions, particularly ice, will limit the drilling season to less than 168 days for the period of July 1 through December 31 each year. Drilling is planned to begin as early as July of 2010 and continue seasonally until the resource is adequately defined.

1.1 Lease Blocks

This application seeks authority to construct and operate the Frontier Discoverer drillship at particular lease blocks in the Beaufort Sea. Figure 1-1 shows the location of Shell's current Beaufort Sea leases. The currently proposed drilling locations lie within approximately latitude 70.1° N to 70.8° N and longitude 143.7° W and 146.4°W. This application is for the group of lease blocks labeled "Shell Proposed Permit Blocks" (in olive green) on Figure 1-1.

Figure 1-2 is a more precise close-up view of these lease. The specific identifier block numbers for the leases covered by this application are:

> Sale BF202: 6259, 6308, 6309, 6310, 6359, 6406, 6407, 6409, 6410, 6457, 6459, 6460, 6461, 6508, 6510, 6511, 6512, 6558, 6559, 6560, 6561, 6562, 6609, 6610, 6611, 6612, 6660, 6662
>
> Sale BF195: 6657, 6658, 6659, 6707, 6708, 6709, 6712, 6713, 6751, 6752, 6757, 6758, 6764, 6773, 6774, 6801, 6802, 6814, 6815, 6822, 6823, 6824, 6851, 6873, 6874

In Figure 1-2, the black dashed line is the 3-mile Seaward Boundary for the State of Alaska (3 miles from the Alaska coastline). The gold line in the figure is a line depicting the 25-mile limit from the Alaska Seaward boundary, or 28 miles from the Alaska coastline.

The leases can be divided into three groups as follows:

- Those lease blocks entirely outside the 28 statute mile coastal boundary include 6529, 6308, 6309, 6310, 6359, and 6410.
- Those lease blocks with portions both inside and outside of the 28 statute mile coastal boundary include 6406, 6407, 6409, 6459, 6460, 6461, and 6512.
- Those lease blocks entirely within the 28 statute mile coastal boundary include 6457, 6508, 6510, 6511, 6558, 6559, 6560, 6561, 6562, 6609, 6610, 6611, 6612, 6657, 6658, 6659, 6660, 6662, 6707, 6708, 6709, 6712, 6713, 6757, 6758, 6764, 6814, 6815, 6773, 6774, 6751, 6752, 6822, 6823, 6824, 6801, 6802, 6873, 6874, and 6851.

1.2 How does this Project differ from Shell's Chukchi Sea Proposal?

Shell is also seeking a PSD permit for exploratory drilling in the Chukchi Sea. The only substantive difference between the Beaufort and Chukchi Sea proposals is that the Beaufort Sea fleet includes a tug and a barge with the OSR fleet and one slightly larger Oil Spill Response work boat.

The primary differences between the two permit applications are: (1) the Beaufort Sea application addresses requirements that apply to proposals within 25 miles of the Alaska seaward boundary, and (2) the Beaufort Sea application evaluates onshore sources of emissions in the cumulative impact analyses.

The Chukchi Sea lease blocks are more than 100 kilometers from shore – too far to have a significant effect on air quality in the project area.

At the time of this application submittal, EPA has issued a proposed permit for Chukchi operations. Shell expects the permits for the Chukchi Sea and Beaufort Sea exploration projects to be similar.

1.3 How does this Application differ from the September 30, 2009 Application?

The application submitted on September 30, 2009 for the Beaufort Sea exploration program was submitted during the first pubic comment period for the Chukchi permit. Shell and others provided comments to EPA on the proposed permit for the Chukchi project. Based on those comments a number of revisions were made to the Chukchi proposal and on January 8, 2010, EPA issued a revised proposed permit for Chukchi Sea exploration for public comment. Many of the changes to the Chukchi proposal were incorporated in the September 30 Beaufort application, but other changes were made after that submission. Those changes are incorporated in this revised application and are summarized as follows:

- Shell has committed to use Ultra Low Sulfur Diesel (ULSD) as the only fuel to be used by all engines and boilers that are part of the project, including all the support vessels. Previously, only the *Discoverer* emissions sources were to be fueled with ULSD.

- The Best Available Control Technology (BACT) analysis has been significantly augmented with an evaluation of BACT on the smaller engines on the *Discoverer*.

- Shell has replaced the logging winch engine proposed in the previous application — an older 128 horsepower Detroit Diesel 4-71 engine — with a newer, larger, but lower-emitting 250 horsepower Caterpillar C7 Tier 3 engine, equipped with a catalytic diesel particulate filter to control particulate and carbon monoxide emissions.

- As a result of re-examining BACT, Shell added oxidation catalyst air pollution controls to the Mud-Line Cellar (MLC) Compressor engines.

- The emission inventory is revised to separately identify emissions from boilers on the Ice Breaker and Anchor Handler vessels, instead of combined with the internal combustion engine emissions as in the previous application.

- The re-supply ship discussion is expanded, because the *Jim Kilabuk* supply ship may not always be available. The *Jim Kilabuk* remains the model for the re-supply ship, but Shell seeks approval for alternate vessels with equal or lower emissions and air quality impacts.

- Shell is considering avoiding direct return of drill cuttings and other extracted muds to the sea floor as allowed by the EPA General NPDES Permit for the Beaufort Sea. One alternative would

be to locate a disposal barge next to the *Discoverer* as a temporary repository for these extracted materials. The barge would have no air emission sources, so there is no air quality issue with the barge itself, but placing and removing the barge would require using a tug. The September 30 application did not include such a tug in the emission inventory and did not directly evaluate one. This revised application addresses this potential activity and includes it in the emission inventory.

- Some minor revisions were incorporated to the emission inventory, including a change in the emission factor for carbon monoxide for the anchor handler, applying fuel restrictions and emission control devices to just the *Nanuq* instead of the entire Oil Spill Recovery (OSR) fleet, and emission factor changes made to be consistent with the approach EPA used in the Chukchi Sea re-proposed permit to calculate daily and annual emissions.

- Potential annual emissions of particulate matter, carbon monoxide, volatile organic compounds, and hazardous air pollutants were reduced to reflect ice management for only 38% of the 168-day season.

Figure 1-1: Shell Offshore Inc. Current Leases in the Beaufort Sea

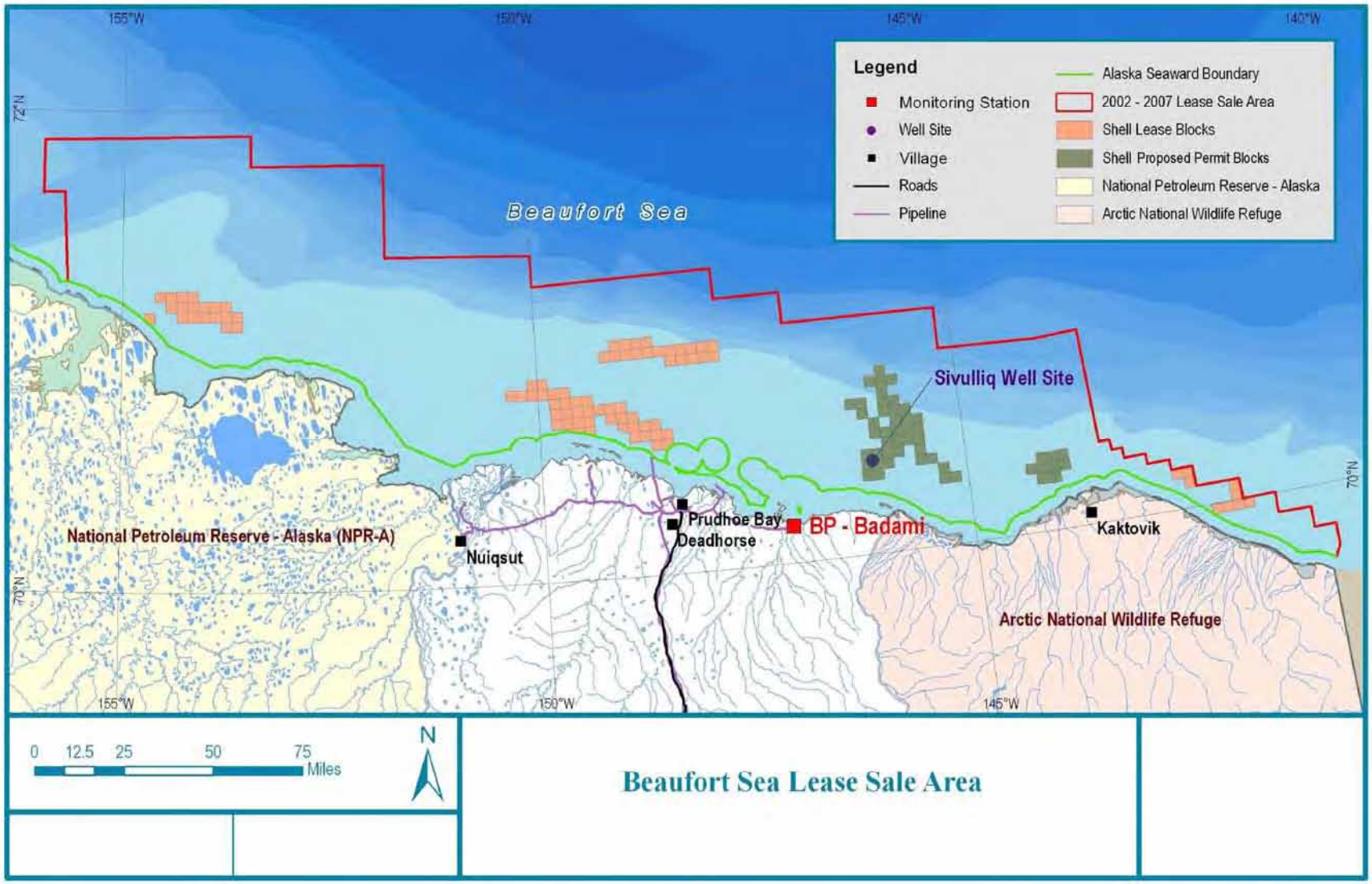
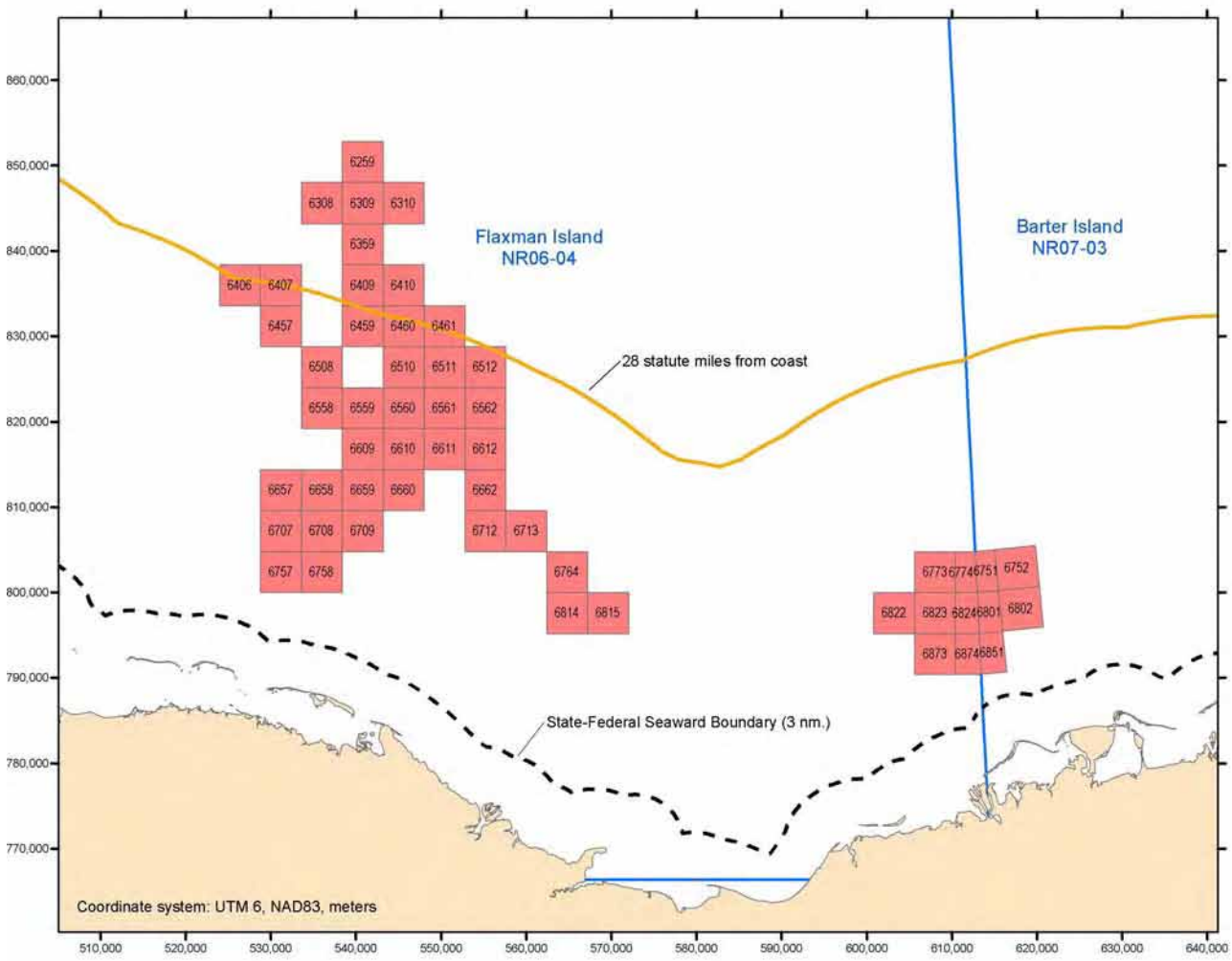


Figure 1-2: Close-up View of Lease Blocks Addressed in this Permit Application



SECTION 2

PROJECT DESCRIPTION AND EMISSIONS

This application seeks authorization for the drill ship *Discoverer* to conduct exploratory drilling on the OCS of the Beaufort Sea. The *Discoverer* will be supported by an icebreaker and an anchor handler/ice management vessel. The icebreaker will typically operate approximately five kilometers upstream (depending on current and wind) of the *Discoverer*; the anchor handler vessel will typically operate closer (approximately 1 to 9 kilometers upstream). Downstream of the *Discoverer*, Oil Spill Response (OSR) vessels will be stationed to assist in the unlikely event of an oil spill at the *Discoverer*. In addition, helicopters and an occasional supply ship will bring workers and supplies to the *Discoverer* and its associated fleet.

This section further describes these vessels, their emission units, and their operations. In addition, we identify how emissions are calculated and the anticipated maximum short and long-term emission rates. A discussion of Shell's proposed Best Available Control Technology (BACT) is provided in Section 4.

2.1 The *Discoverer*

The *Discoverer* is a 514-foot long ship that was converted for drilling in 1975 and substantially upgraded in 2007 to enable operation in the Arctic Ocean (Figure 2-1). It is currently undergoing additional retrofits, including substantial investment to install the emission controls identified as BACT. The *Discoverer* is a turret-moored drill ship, meaning that the hull pivots around the drill rig to enable the bow to face into the wind or current. It is equipped with generators for the drilling systems, other associated self-powered equipment (such as air compressors, hydraulic pumps, cranes, boilers and other small sources), and an emergency generator for the critical non-drilling loads when the main power supply is not operating. All of the emission units are existing equipment except for the mud line cellar (MLC) air compressors and the logging winch engine and generator, which will be new engines added to the ship.

Prior to mobilizing to sea, the drill ship is provisioned with supplies sufficient for the initial drilling operations. Together with the ice management and anchor handler fleet, consisting of an icebreaker and an arctic class anchor handler/ice management vessel, the rig mobilizes to the desired location. Alternate locations within the lease area are available in the event that ice conditions at the desired location exceed the fleet's capability to manage ice or conduct operations. Upon arrival at the drill site, anchors are run and set by the anchor handler/ice management vessel, the mooring lines are tensioned, and the rig is thus positioned over the area targeted for drilling.

Figure 2-1: Photograph of the *Discoverer*

When the mooring operation is complete the process to drill the mud line cellar (MLC) is initiated. The MLC is a 20-foot diameter hole excavated to approximately 35 feet below the mud line. The MLC allows installation of the rig's Subsea Blowout Preventers (SSBOPs) below the mud line to avoid potential damage by ice. Utilizing compressed air, the excavated seabed material is lifted out of the MLC and allowed to settle to the surrounding seafloor. The MLC operation is estimated to take about six days per drill hole. A 36-inch diameter hole is drilled for the next interval, and a 30-inch diameter tube (casing) is installed and cemented. Cementing the casing anchors it in the hole and prevents annular formation fluid migration between formations or to the surface. Atop the 30-inch casing is a guide base with receptacles for guidelines that facilitate re-entry into the well.

After drilling and installing casing in the next interval, the SSBOPs are installed in the MLC. During installation, the Oil Spill Response (OSR) fleet moves into position and is prepared to deploy in the unlikely event of an oil spill. After installation of the SSBOPs, additional intervals are drilled, cased, and cemented as required to reach and evaluate the geologic objective.

When the evaluation operations are complete the well is properly secured or plugged and abandoned (P&A'd) using mechanical and/or cement plugs. The well may also be temporarily abandoned (T&A'd), which generally occurs upon completion of interim operations of cementing the casing. After the well is abandoned, the SSBOPs are retrieved. The *Discoverer's* anchors can then be retrieved and the rig can depart the drill site. The rig can move from the drill site after P&A'ing or T&A'ing a well. The rig may leave a drill site for a variety of reasons, including P&A or T&A activities, adverse ice conditions, end of the drilling season, or desire to move to another drill site to start or finish a well previously T&A'd.

The *Discoverer* crew works 12-hour shifts and lives on the rig in accommodations located at the stern of the ship. They work for three to four weeks and would be transported to and from the rig by helicopter to Deadhorse or Barrow, Alaska.

As noted above, the *Discoverer's* propulsion engine is shut down after the ship is anchored. Drilling is supported by a number of smaller diesel-fueled engines. These smaller engines, a boiler, and an incinerator are the focus of the remainder of this section. The locations of the various emission units on the *Discoverer* are shown on Figure 2-2.

Table 2-1 identifies emission units and presents the maximum hourly emission rates for all the emission units of the *Discoverer* and associated fleets that could operate simultaneously. Table 2-2 identifies annual emissions that include consideration of owner requested restrictions (ORRs). As discussed in Section 3, at EPA's request, Shell has also identified annual emissions absent ORRs; those annual emissions are presented in Appendix H.

Emission calculation details for each emission unit are provided in Appendix A; emissions related to modeling scenarios are presented in Appendix B. Appendix A and B also provide maximum daily emission rates for modeling purposes. In Table 2-3, Shell identifies a number of ORRs that limit both short-term (up to 24 hours) and long-term (one drilling season) operations and emissions. These ORRs are incorporated in the emission calculations used for modeling (Appendices A and B). As discussed further in Section 5, the results of the conservative screening level model Shell was required to use reflect 1-hour averaging periods. Pollutant concentrations for longer averaging periods, including the annual averages, are estimated using ratios from the 1-hour model results.

The short-term engine emissions are estimated based on fuel consumption when the engines are operating at maximum capacity (e.g., horsepower or kilowatts). Emissions are then calculated using fuel consumption and manufacturer or generic (when model-specific factors are not available) emission factors. We then consider emission reductions attributable to ORRs (Table 2-3) that affect short-term emissions and to emission controls (see Table 2-4). Shell's proposed Best Available Control Technology (BACT), expressed as fuel quality and control efficiencies, is incorporated in Tables 2-3 and 2-4. BACT is further discussed in Section 4. The long-term (seasonal) ORRs, listed in Table 2-3, are taken into account through a restriction in the length of the operating season as a second ratio applied to the short-term concentrations. Incinerator emissions are calculated on the basis of emissions per unit charge and using an EPA generic emission factor because no manufacturer emission factors are available for this small device.

The remainder of this section provides information specific to each of the small units operating on the *Discoverer*.

2.1.1 Generators (FD-1 through FD-6)

Six Caterpillar D399 generator sets provide the primary systems power for drilling and ship utilities and are operational at varying load levels throughout the drilling process. Normally, no more than five engines will operate at one time, leaving one as a spare. The normal ramping procedure is to operate the fewest number of engines needed to power the load; as load increases, operators add engines so that the operating engines are at 50 percent capacity or greater. In recognition of the excess capacity and to limit potential emissions, Shell requests the continuous electrical production limit of 71 percent of the six-engine design capacity as an ORR.

Figure 2-2: Plan view: Emission Units on the *Discoverer*

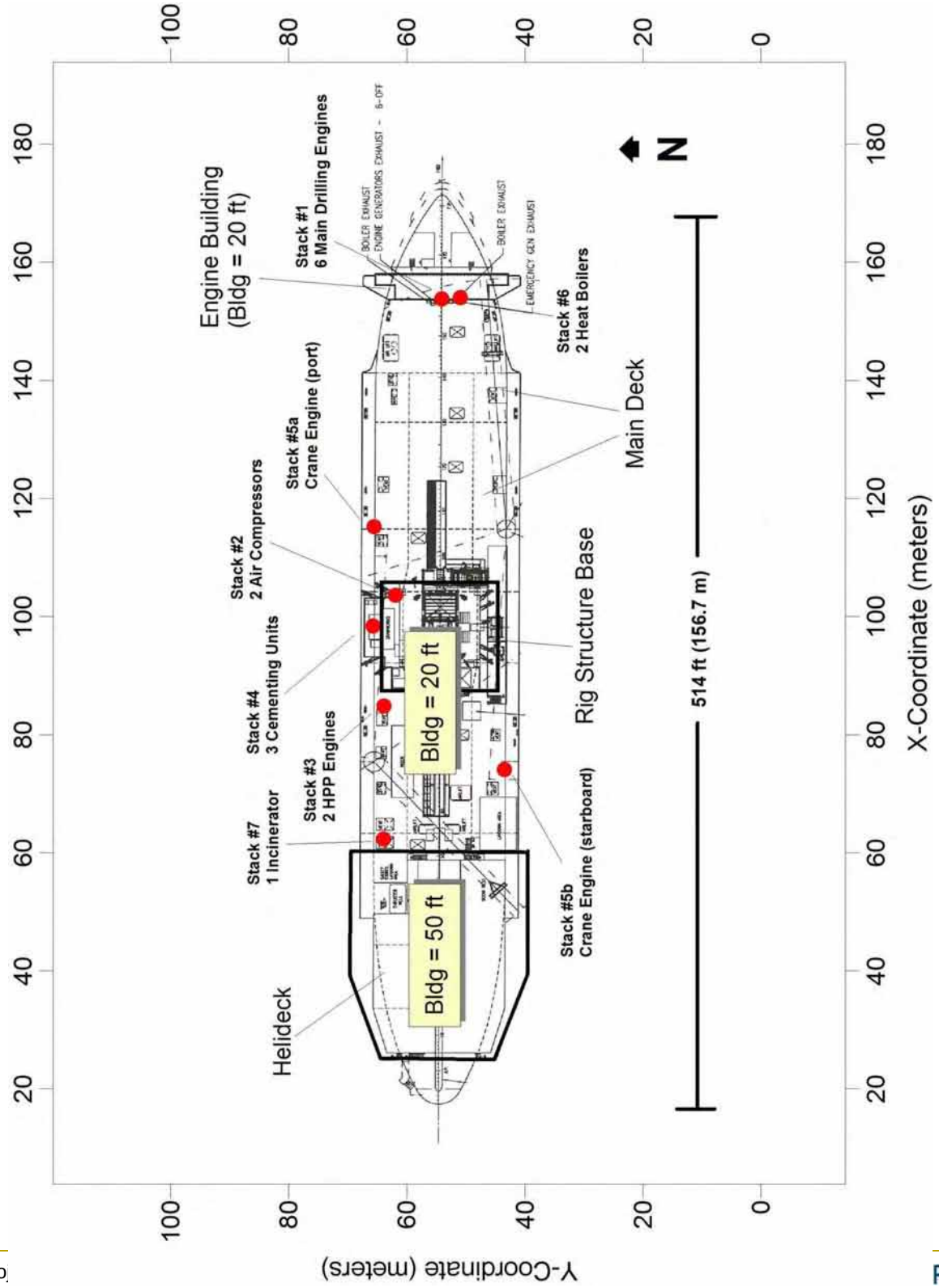


Table 2-1: *Discoverer* and Associated Vessels Emission Units with Maximum Hourly Emissions That Could Occur Simultaneously

		Rating		Maximum Fuel Consumption (MMBtu/hr) [1]	Maximum Emissions (lb/hr) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Frontier *Discoverer*											
FD-1	Generator Engine	1,325	hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04
FD-2	Generator Engine	1,325	hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04
FD-3	Generator Engine	1,325	hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04
FD-4	Generator Engine	1,325	hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04
FD-5	Generator Engine	1,325	hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04
FD-6	Generator Engine	1,325	hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04
FD-7	Propulsion Engine	7,200	hp	0.00	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00
FD-8	Em Generator	131	hp	0.92	0.64	0.64	3.26	1.46E-03	1.79	0.34	2.66E-05
FD-9	MLC Compressor	540	hp	3.58	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04
FD-10	MLC Compressor	540	hp	3.58	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04
FD-11	MLC Compressor	540	hp	3.58	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04
FD-12	HPU Engine	250	hp	1.95	0.10	0.10	5.41	3.11E-03	0.16	0.08	5.66E-05
FD-13	HPU Engine	250	hp	1.95	0.10	0.10	5.41	3.11E-03	0.16	0.08	5.66E-05
FD-14	Port Deck Crane	365	hp	2.77	0.04	0.04	6.20	4.41E-03	0.13	0.04	8.02E-05
FD-15	Starbd Deck Crane	365	hp	2.77	0.04	0.04	6.20	4.41E-03	0.13	0.04	8.02E-05
FD-16	Cementing Unit	335	hp	2.62	0.14	0.14	7.25	4.17E-03	0.22	0.22	7.58E-05
FD-17	Cementing Unit	335	hp	2.62	0.14	0.14	7.25	4.17E-03	0.22	0.22	7.58E-05
FD-18	Cementing Unit	147	hp	1.15	0.09	0.09	3.80	1.83E-03	0.21	0.10	3.33E-05
FD-19	Logging Winch	250	hp	1.75	0.01	0.01	1.74	2.79E-03	0.30	1.48	5.08E-05
FD-20	Logging Generator	35	Hp	0.25	0.01	0.01	0.43	3.91E-04	0.03	0.04	7.11E-06
FD-21	Heat Boiler	7.97	MMBtu/hr	7.97	0.19	0.19	1.60	1.27E-02	0.62	0.01	7.17E-05
FD-22	Heat Boiler	7.97	MMBtu/hr	7.97	0.19	0.19	1.60	1.27E-02	0.62	0.01	7.17E-05
FD-23	Incinerator	276	lb/hr		1.13	0.97	0.69	0.35	4.28	0.41	0.03
FD-31	Resupply Ship - docked			2.04	0.63	0.63	9.01	0.00	1.94	0.72	5.93E-05
	Total: *Discoverer*			88.93	4.91	4.74	75.14	0.49	17.43	14.67	3.17E-02

Associated Fleet			Maximum Emissions (lb/hr) [1]						
		Maximum Fuel Consumption (MMBtu/hr) [1]	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Ice Breaker									
Diesel Engines		178.64	44.51	39.30	1,049.66	0.29	140.36	25.19	5.18E-03
IB Boiler	10.00		0.25	0.25	1.50	1.60E-02	0.38	0.03	9.00E-05
Incinerators	Lb/hr		1.02	0.70	0.23	0.19	23.10	7.70	1.64E-02
Ice Breaker Total		188.64	45.78	40.25	1,051.40	0.49	163.84	32.92	2.17E-02
Anchor Handler									
Diesel Engines		180.16	10.59	10.59	91.78	0.31	211.72	16.25	5.22E-03
AH Boiler		4.00	0.10	0.10	0.21	0.01	0.15	3.50E-03	3.60E-05
Incinerator	lb/hr		1.01	0.69	0.23	0.19	22.68	7.56	1.61E-02
Anchor Handler Total		184.16	11.69	11.37	92.22	0.51	234.56	23.82	2.14E-02
Total Ice Management Fleet		372.80	57.47	51.62	1,143.61	1.00	398.39	56.73	4.30E-02
Resupply Vessel – In Transit		44.41	333.65	20.04	16.07	265.11	0.07	34.89	6.26
Nanuq ICE Propulsion Engines		46.01	345.67	0.30	0.30	162.70	0.07	0.87	1.18
Nanuq ICE Generators		17.99	135.16	1.22	0.98	107.40	0.03	1.41	0.25
Other Main Ship ICE Propulsion Engines		13.30	99.95	0.59	0.59	47.04	0.02	2.52	3.42
Other Main Ship ICE Generators		5.99	45.02	2.70	2.17	35.77	0.01	4.71	0.84
OSR Main Ship Incinerator				0.83	0.57	0.19	0.16	18.75	6.25
OSR Fleet – OSR Main Ship Total		83.29	5.65	4.61	353.10	0.29	28.27	11.95	1.57E-02
OSR Work Boat ICE Propulsion Engines		18.20	0.44	0.44	26.62	0.03	0.89	0.45	5.28E-04
OSR Work Boat ICE Generators		0.23	0.07	0.07	1.02	0.00	0.22	0.08	6.70E-06
OSR Work Boat Total		18.43	0.51	0.51	27.64	0.03	1.11	0.53	5.34E-04
OSR TOTAL		101.72	6.16	5.12	380.74	0.32	29.37	12.48	1.63E-02
Total: Associated Fleet		518.93	83.67	72.82	1,789.46	1.39	462.66	75.48	6.06E-02
Total: *Discoverer* and Associated Fleet		607.87	88.58	77.56	1,864.60	1.88	480.08	90.14	9.22E-02

[1] All emissions are shown as the maximum one-hour value.

[2] Logging winches cannot operate simultaneously with cementing units.

Table 2-2: *Discoverer* and Associated Vessels Emission Units with Annual Emissions

		Maximum Fuel Consumption Rating		(MMBtu/yr)	Maximum Emissions (ton/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	HAPs
Frontier *Discoverer*												
FD-1	Generator Engine	1,325	Hp	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02
FD-2	Generator Engine	1,325	Hp	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02
FD-3	Generator Engine	1,325	Hp	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02
FD-4	Generator Engine	1,325	Hp	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02
FD-5	Generator Engine	1,325	Hp	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02
FD-6	Generator Engine	1,325	Hp	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02
FD-7	Propulsion Engine	7,200	Hp	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00
FD-8	Em Generator	131	Hp	44	1.53E-02	1.53E-02	7.82E-02	3.51E-05	4.30E-02	8.06E-03	6.38E-07	8.65E-05
FD-9	MLC Compressor	540	Hp	5,413	0.07	0.07	2.69	4.32E-03	1.25	2.69	7.85E-05	0.01
FD-10	MLC Compressor	540	Hp	5,413	0.07	0.07	2.69	4.32E-03	1.25	2.69	7.85E-05	0.01
FD-11	MLC Compressor	540	Hp	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00
FD-12	HPU Engine	250	Hp	2,951	0.08	0.08	4.09	2.35E-03	0.12	0.06	4.28E-05	0.00
FD-13	HPU Engine	250	Hp	2,951	0.08	0.08	4.09	2.35E-03	0.12	0.06	4.28E-05	0.00
FD-14	Port Deck Crane	365	Hp	4,181	0.03	0.03	4.68	3.33E-03	0.10	0.03	6.06E-05	0.00
FD-15	Starbd Deck Crane	365	Hp	4,181	0.03	0.03	4.68	3.33E-03	0.10	0.03	6.06E-05	0.00
FD-16	Cementing Unit	335	Hp	2,931	0.12	0.12	4.85	2.34E-03	0.27	0.12	4.25E-05	0.00
FD-17	Cementing Unit	335	Hp	2,931	0.12	0.12	4.85	2.34E-03	0.27	0.12	4.25E-05	0.00
FD-18	Cementing Unit	147	Hp	1,286	0.05	0.05	2.13	1.03E-03	0.12	0.05	1.86E-05	0.00
FD-19	Logging Winch[1]	250	Hp	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00
FD-20	Logging Generator[1]	36	Hp	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00
FD-21	Heat Boiler	7.97	MMBtu/hr	32,135	0.38	0.38	3.23	2.56E-02	1.24	0.02	1.45E-04	0.01
FD-22	Heat Boiler	7.97	MMBtu/hr	32,135	0.38	0.38	3.23	2.56E-02	1.24	0.02	1.45E-04	0.01
FD-23	Incinerator	276	lb/hr		0.10	0.09	0.06	0.03	0.39	0.04	2.68E-03	0.00
FD-31	Resupply Ship – Docked			196	0.03	0.03	0.43	0.00	0.09	0.03	2.85E-06	3.86E-04
	Total *Discoverer*			264,019	3.93	3.92	51.15	0.24	9.96	6.41	5.87E-03	0.14

Associated Fleet	Maximum Fuel Consumption (MMBtu/yr)	Fuel Use gal/yr	Maximum Emissions (ton/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	HAPs
Ice Breaker										
Diesel Engines	288,081	2,164,424	35.89	31.69	846.36	0.23	113.17	20.31	4.18E-03	0.57
IB Boiler	40,320	302,935	0.50	0.50	3.03	0.03	0.76	0.05	1.81E-04	6.68E-03
Incinerators			2.06	1.41	0.47	0.39	46.57	15.52	3.31E-02	3.89E-02
Ice Breaker Total	328,401	2,467,359	38.45	33.60	849.86	0.65	160.50	35.89	3.74E-02	0.61
Anchor Handler										
Diesel Engines	276,035	2,073,926	9.56	9.56	70.31	0.28	191.20	14.68	4.72E-03	5.42E-01
AH Boiler	16,128	121,174	0.20	0.20	0.42	0.01	0.30	0.01	7.26E-05	2.67E-03
Incinerator			2.03	1.39	0.46	0.38	45.73	15.24	3.25E-02	3.82E-02
Anchor Handler Total	292,163	2,195,099	11.79	11.15	71.19	0.68	237.24	29.93	3.73E-02	5.83E-01
Total Ice Management Fleet	620,564	4,662,458	50.24	44.75	921.04	1.33	397.74	65.82	7.47E-02	1.20E+00
Resupply Vessel – In Transit	1,421	10,677	0.32	0.26	4.24	0.00	0.56	0.10	2.06E-05	2.79E-03
Nanuq ICE Propulsion Engines	67,081.39	504,000	0.22	0.22	118.61	0.05	0.64	0.86	9.73E-04	1.32E-02
Nanuq ICE Generators	17,888.37	134,400	0.61	0.49	53.40	0.01	0.70	0.13	2.59E-04	3.52E-03
Other Main Ship ICE Prop. Engines	53637.27	402,991	1.18	1.18	94.84	0.04	5.08	6.90	7.78E-04	1.05E-01
Other Main Ship ICE Generators	24159.74	181,518	5.45	4.37	72.12	0.02	9.49	1.70	3.50E-04	4.75E-02
OSR Main Ship Incinerator			1.68	1.15	0.38	0.32	37.80	12.60	2.68E-02	3.16E-02
OSR Fleet – OSR Main Ship Total	162,767	1,222,909	9.14	7.41	339.34	0.44	53.71	22.19	2.92E-02	2.01E-01
OSR Work Boat ICE Prop. Engines	73382.40	551,341	0.89	0.89	53.66	0.06	1.79	0.90	1.06E-03	1.44E-01
OSR Work Boat ICE Generators	931.39	6,998	0.14	0.14	2.05	0.00	0.44	0.16	1.35E-05	1.83E-03
OSR Work Boat Total	74,314	558,339	1.03	1.03	55.72	0.06	2.23	1.06	1.08E-03	1.46E-01
OSR Fleet	237,081	1,781,248	10	8	395	1	56	23	3.03E-02	3.47E-01
Total: Associated Fleet	859,066	6,454,383	61	53	1,320	2	454	89	1.05E-01	1.55
Total: *Discoverer* and Associated Fleet	1,123,085	8,438,027	65	57	1,371	2	464	96	1.11E-01	1.69

[1] Logging winch emissions are included with cementing units.

Table 2-3: Proposed Owner-Requested Restrictions

Compliance Condition	Restriction		How Calculated			How Documented
Operational Restrictions						
Season maximum drilling duration	168	days/season	168 days/season x 24 hr/day =	4,032	hrs	Last anchor attached to first anchor removed, by clock.
Discoverer						
Generators (six units combined) combined production maximum	71%		0.71 x 6 engines x 1325 hp x kW/1.340 hp =	4,212	kW	Demonstrated by power system meter with accuracy of +/- 5% of 4212 kW or +/- 211 kW.
MLC compressors maximum use per drilling season	63	Days/season	63 day/season x 24 hr/day x 2 engines x 26.9 gal/hr-engine=	81,346	gal/ season	Demonstrated using fuel consumption – dipstick on the combined MLC compressor consumption at day fuel tank. Dipstick with accuracy of +/- 5% of daily max of 1291 gallons or +/- 65 gallons.
HPUs (two units combined) maximum use per season	63	Days/season	63 day/season x 24 hr/day x 2 engines x 250 hp/engine x 0.415 lb/hp-hr / 7.08 lb/gal=	44,338	gal/ season	Demonstrated using fuel consumption – dipstick on the combined HPU consumption at day fuel tank. Dipstick with accuracy of +/- 5% of daily max of 704 gallons or +/- 35 gallons.
HPUs alternate operating scenario #2 maximum use per day:	1	Equivalent number of units operating	1 engine x 250 hp/engine x 0.415 lb/hp-hr x 24 hr/day / 7.08 lb/gal=	352	gal/day	Demonstrated using fuel consumption – dipstick on the combined cementing & logging consumption at day fuel tank. Dipstick with accuracy of +/- 5% of daily max of 352 gallons or +/- 18 gallons.
Cementing (three units) & Logging (two units) combined maximum	27.8%	per day (of Cementing)	28% x (335 hp x 2 engines +147 hp) x 0.415 lb/hp-hr x 24 hr/day /7.08 lb/gal =	320	gal/day	Demonstrated using fuel consumption – dipstick on the combined cementing & logging consumption at day fuel tank. Dipstick with accuracy of +/- 5% of daily max of 320 gallons or +/- 16 gallons.
Crane (two units combined) maximum	63	days/season	Max Fuel Consumption	62,824	gal/seas on	Demonstrated using fuel consumption – dipstick on the combined cranes consumption at

Compliance Condition	Restriction		How Calculated			How Documented
						day fuel tank. Dipstick with accuracy of +/- 5% of daily max of 997 gallons or +/- 50 gallons.
Discoverer Incinerator, when two HPUs are operating, limited to	300	lb/trash per day				Mass measurement using scales with accuracy +/- 5%.
Discoverer Incinerator, when one HPU is operating, limited to	800	lb/trash per day				Mass measurement using scales with accuracy +/- 5%.
Discoverer Incinerator, when no HPUs are operating, limited to	1300	lb/trash per day				Mass measurement using scales with accuracy +/- 5%.
Discoverer incinerator emissions	7	Lb $PM_{2.5}$ /ton				Demonstrated by initial stack test
	8.2	Lb PM_{10} /ton				
	2.5	Lb SO_2 /ton				
Sulfur content on non-propulsion engines on *Discoverer* & *Nanuq*	0.0015%	by wt.				Supplier documentation
Associated Fleet						
Fuel sulfur content for ice breaker, anchor handler, re-supply ship and OSR work boats	0.0015%	by wt.				Supplier documentation
Ice Management Vessels						
Primary Icebreaker while within 25 miles from drill site	850	Tons NOx/season	Daily sum of engine power level x power level emission factor + daily total fuel x boiler fuel consumption + incinerator mass per unit mass feed emission factor x daily mass incinerated.			Demonstrated using 10-minute load monitoring for IC engines, fuel monitoring for boilers and hours of use monitoring for the incinerator. Accuracy of +/- 5% of full scale for load monitoring, +/- 5% of max daily fuel consumption for fuel monitoring, and +/- 1 lb for incineration monitoring.

Compliance Condition	Restriction		How Calculated	How Documented
	40.2	Lb $PM_{2.5}$ / hour	(Propulsion engine power (kW) capacity (80% of design rating) x $PM_{2.5}$ emission factor (lb/kWh)) + (boiler design rate (btu/hr) x $PM_{2.5}$ emission factor (lb/Btu)) x 24 hours + incinerator capacity (lb/hr) x $PM_{2.5}$ emission factor (lb $PM_{2.5}$/lb waste)	Propulsion emission factor by stack test, boiler and incinerator emission factors from this workbook. Compliance demonstrated prior to startup.
	45.8	Lb PM_{10} / hour	(Propulsion engine power (kW) capacity (80% of design rating) x PM_{10} emission factor (lb/kWh)) + (boiler design rate (btu/hr) x PM_{10} emission factor (lb/Btu)) x 24 hours + incinerator capacity (lb/hr) x PM_{10} emission factor (lb PM_{10}/lb waste)	Propulsion emission factor by stack test, boiler and incinerator emission factors from this workbook. Compliance demonstrated prior to startup.
Anchor handler while within 25 miles of drill site	71	tons of NOx/season	Daily sum of engine power level x power level emission factor + daily total fuel x boiler fuel consumption + incinerator mass per unit mass feed emission factor x daily mass incinerated.	Demonstrated using 10-minute load monitoring for IC engines, fuel monitoring for boilers and hours of use monitoring for the incinerator. Accuracy of +/- 5% of full scale for load monitoring, +/- 5% of max daily fuel consumption for fuel monitoring, and +/- 1 lb for incineration monitoring.
	11.4	Lb $PM_{2.5}$ / hour	(Propulsion engine power (kW) capacity (80% of design rating) x $PM_{2.5}$ emission factor (lb/kWh)) + (boiler design rate (btu/hr) x $PM_{2.5}$ emission factor (lb/Btu)) x 24 hours + incinerator capacity (lb/hr) x $PM_{2.5}$ emission factor (lb $PM_{2.5}$/lb waste)	Propulsion emission factor by stack test, boiler and incinerator emission factors from this workbook. Compliance demonstrated prior to startup.
	11.7	Lb PM_{10} / hour	(Propulsion engine power (kW) capacity (80% of design rating) x PM_{10} emission factor (lb/kWh)) + (boiler design rate (btu/hr) x PM_{10} emission factor (lb/Btu)) x 24 hours + incinerator capacity (lb/hr) x PM_{10} emission factor (lb PM_{10}/lb waste)	Propulsion emission factor by stack test, boiler and incinerator emission factors from this workbook. Compliance demonstrated prior to startup.
Resupply Ship				
Resupply ship while docked:	Generation limited to 1 engine			Electrical switch allows only 1 generator to operate at a time.
	12	hrs/visit		Record hours.
Oil Spill Response Vessels				
OSR *Nanuq* propulsion	3000	gal/day	3000 gal/day x 7.08 lb/gal x 453.59 g/lb / 204.7 g/kW-hr	Demonstrated using 10-minute

Compliance Condition	Restriction		How Calculated	How Documented
limited to:			(47.039 kW-hr/day)	load monitoring for IC engines. Accuracy of +/- 5% of full scale for load monitoring.
OSR *Nanuq* generation limited to :	800	gal/day	800 gal/day x 133098 Btu/gal / 7000 Btu/hp-hr /1.34 hp/kw (11,352 kW-hr/day)	Demonstrated using 10-minute load monitoring for IC engines. Accuracy of +/- 5% of full scale for load monitoring.

Table 2-4: Proposed BACT Control Device Effectiveness

Compliance Condition	Restriction		Comments		Reference
Control Device Effectiveness					
Generator SCR NOx control effectiveness	0.5	g/kW-hr	50-100% of capacity	CEM	D.E.C. Marine AB letter, October 9, 2008, initial stack test and CEM.
Generator Oxidation Catalyst CO reduction efficiency	80%		50-100% of capacity		D.E.C. Marine AB letter, October 9, 2008, and initial stack test.
Generator Oxidation Catalyst VOC, HAPs, Formaldehyde reduction efficiency	70%		50-100% of capacity		D.E.C. Marine AB letter, October 9, 2008.
Generator Oxidation Catalyst PM_{10} reduction efficiency	50%				D.E.C. Marine AB email, February 9, 2009.
MLC Compressor Oxidation Catalyst PM reduction efficiency	50%				CARB, 2003. Staff Report: Initial Statement of Reasons for Proposed Rulemaking. Airborne Toxic Control Measure for Stationary Compression Ignition Engines
MLC Compressor Oxidation Catalyst CO reduction efficiency	47%				CARB, 2003. Staff Report: Initial Statement of Reasons for Proposed Rulemaking. Airborne Toxic Control Measure for Stationary Compression Ignition Engines
Discoverer small engines (other than Tier 3 engines) and *Nanuq* propulsion and generation: Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%				CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and *Nanuq* propulsion and generation: CDPF PM reduction efficiency	85%				California Air Resource Board, Currently Verified, January 2009, CleanAIR Systems PERMIT™.
Logging Winch Caterpillar C7 CDPF PM reduction efficiency	85%				EPA
Logging Winch Caterpillar C7 CDPF CO reduction efficiency	80%				EPA

The generators will be retrofitted with selective catalytic reduction (SCR) and oxidation catalyst (OxyCat) control devices to be installed by D.E.C. Marine AB, a Swedish company that has installed NO_x emission control systems on more ships than any other company.[1] The D.E.C. Marine AB control guarantees for NO_x, CO, and VOCs are provided in Table 2-4. The estimated control efficiency of particulate matter is also guaranteed by D.E.C. Marine AB and provided in Table 2-4.[2] Except for a short period at startup and shutdown, these engines will be operated at 50 percent capacity or greater so that the emission control devices will function effectively.

SCR technology involves injecting urea into the exhaust stream with a catalyst to convert the NO_x to nitrogen and water. Ideally, the urea will reduce NO_x at a 1-to-1 ratio. However, because mixing within the stack is not ideal, a small portion passes through the system converted to ammonia, rather than to nitrogen and water, and is released to the atmosphere. This process is known as ammonia slip. The amount of ammonia slip from an SCR control device theoretically begins at near zero and increase over the life of the catalyst (8 to 10 years). Other factors affecting ammonia slip are the amount of sulfur in the fuel, the water and oxygen content, and the exhaust temperature. Thus, operating the SCR control system properly and efficiently will further minimize ammonia slip. The D.E.C. Marine AB SCR system design is based on an algorithm that determines urea injection according to engine load and other operational factors. The system also includes a continuous NO_x exhaust monitor that cycles through the six SCR units. The cycle time, including the necessary zero and spanning, is one measurement per engine per hour. This measurement essentially verifies the load-based algorithm and adjusts it if necessary.[3]

The D.E.C. Marine AB system controls ammonia slip through routine measurement of the NO_x emissions and adjusts the urea injection rate to match the conversion needs. The operation of this feedback system is verified during initial stack tests and system certification.[4]

Because sulfur in the fuel can lead to SO_2 and SO_3 conversion (typically on the order of one percent), the presence of SO_3 in the exhaust stream can lead to the formation of ammonium bisulfate and ammonium sulfate particles (aerosols). In-stack sulfate formation can be minimized by limiting the sulfur in the fuel and limiting ammonia slip to three to five ppm for high sulfur fuels and less than 10 ppm for low sulfur fuels. For the *Discoverer's* Caterpillar D399s, which will be fueled with ultra-low sulfur diesel (less than 15 ppm sulfur) and which will be equipped with oxidation catalysts, D.E.C. Marine AB believes that the ammonia exhaust emissions will be much less than 10 ppm and close to zero.[5] For the purposes of emissions calculations, a 10 ppm worst-case assumption has been made to estimate ammonia slip.

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[1] Holmström, Per, D.E.C. Marine AB. [Letter to K. Craik, Shell]. October 9, 2008.
[2] Holmström, Per. D.E.C. Marine AB. [Communication with R. Steen, Air Sciences Inc.]. February 9, 2009.
[3] Ibid. footnote 1.
[4] Liljegren, Karin, D.E.C. Marine AB. [Communications with R. Steen, Air Sciences Inc.]. January 28, 2009.
[5] Liljegren, Karin, D.E.C. Marine AB. [Communications with K. Craik, Shell]. January 6, 2009.

Because ammonia slip occurs only for the main generators, ammonia emissions are presented in a separate calculation, not as part of Tables 2-1 and 2-2. Ammonia slip for each of the D399 engines is based on three factors: 10 ppm ammonia in the exhaust, 5,592 kg of exhaust per hour, and a molecular weight of the exhaust of 30.56 grams per gram-mole. The latter two factors are taken from the Caterpillar D399 Engine Data Sheet 5/95 at 100% load. Note that some calculation was performed from the Caterpillar data to develop the molecular weight and these details are shown in Appendix A. The quantity of ammonia emitted is calculated as follows:

Moles exhaust = (5,592 kg exhaust/hr)(1,000 g/kg)/(30.56 g/g-mole) = 182,984 g-mole/hr

NH_3 emission = (10 g-mole NH_3/1,000,000 g-mole exhaust)(182,984 g-mole/hr) = 1.83 g-mole/hr

NH_3 emission = (1.83 g-mole/hr)(17.03 g/g-mole)/(453.59 g/lb) = 0.0687 lb/hr

Thus each generator emits at most 0.0687 lb/hr when operating, but the ORR for the six generators when combined is for 71% total combined load, so total emissions for all six generators is (0.0687 lb/hr)(6)(0.71) = 0.293 lb/hr. Annual emissions of ammonia are based on 4,032 hours per year of operation and total 0.59 tons per year ((0.293 lb/hr)(4,032 hr/yr)/(2000 lb/ton) = 0.59 ton/yr).

2.1.2 Emergency Generator (FD-8)

The *Discoverer* will have one 130-hp emergency generator for use in powering basic drill ship utilities, which includes domestic and worker safety devices but excludes all drilling equipment. There are no planned uses of the emergency generator except for weekly exercising, which involves operation for up to 120 minutes at loads up to capacity.[6] The seasonal emissions from this weekly 120-minute exercise are estimated at 0.078 ton NO_x. Because these emissions are small, they are grouped with the generator emissions for impact evaluation.

2.1.3 Propulsion Engine (FD-7)

The *Discoverer* propulsion engine will be shut down by the time the vessel becomes an “OCS Source,” which is when it is “attached to the seabed and erected thereon and used for the purpose of exploring, developing or producing resources there from...” 40 CFR 55.2. As discussed in Section 3.2.1, the vessel is attached to and erected on the seabed only after the *Discoverer* is sufficiently anchored such that the vessel is secure and stable in a position to commence exploratory activity at a drilling location. The propulsion engine, therefore, will have no emissions during the time the drill ship is a stationary source.

2.1.4 MLC Air Compressors (FD-9, 10, and 11) and HPU Units (FD-12 and 13)

The remainder of the diesel engines are used only occasionally for specialized and intermittent tasks. The MLC air compressors (FD-9, 10, and 11) and hydraulic power units HPU (FD-12 and 13) are used for

[6] Wright, Alistair, Chief Engineer, Frontier *Discoverer*. [Communication with A. Wilson, Frontier Drilling]. January 21, 2009.

drilling the MLCs, which is the initial drilling activity lasting about six days. These engines would be operated between 50 and 100 percent capacity to evacuate the MLC. Shell requests ORRs equivalent to 63 days per season of capacity operation for each of these two source groups. The air compressors are to be new Tier 3 engines with OxyCat controls added to reduce particulate matter, volatile organic compounds, and carbon monoxide emissions, while the HPUs are existing engines with catalytic diesel particulate filters (CDPF) for control of oxidizable emissions (volatile organics, carbon monoxide, and hydrocarbon particulate matter).

2.1.5 Cranes (FD-14 and 15)

As shown in Figure 2-2, the *Discoverer* has two cranes mounted on pedestals that are used intermittently to move materials around the deck and to on-load supplies from the re-supply ship. The engine operating rates are highly variable, and depend on the load being moved. Shell proposes an ORR for the combined operation of the cranes equivalent to 63 days per season of capacity operation, to be demonstrated through tracking of fuel consumption. The crane engines have CDPFs for control of organic particulate matter, carbon monoxide, and volatile organics.

2.1.6 Cementing Units (FD-16, 17, and 18)

Three cementing units are used intermittently to fix casings in the hole and seal the drill hole when drilling is interrupted or ended. The cementing units force a slurry of cement and additives down the casing and into the annular space between the casing and the wall of the borehole when the drill pipe is pulled out of the hole, or for P&A'ing wells. The cement units are also used intermittently as high-pressure pumps for hydrostatically testing well equipment and drilling components, such as the wellhead connections, the blowout preventer, and other connections.

Because drilling cannot take place simultaneously, the generators will be operating only at low loads when cementing occurs. This decrease in generator emissions is not taken into account in the impact analysis herein. Shell requests an ORR equivalent to capacity operation for 27.8 percent of the day for the three cementing unit engines and the two logging units (discussed below) combined, to be demonstrated through tracking of fuel consumption. The cementing units are equipped with CDPFs for control of volatile organics, carbon monoxide, and organic particulate matter.

2.1.7 Logging Units (FD-19 and 20)

Two logging units, a winch and a generator, powered by diesel engines are used to gather information from the well after the drill stem is removed. When the logging units are operated, the cementing units would be off and the generators would be operating at low load. The logging units operate at variable and unpredictable loads. The logging units also have CDPFs for control of volatile organics, carbon monoxide, and organic particulate matter.

To simplify the impact analysis, we elected to evaluate the logging unit emissions using cementing unit engines. This is a conservative assumption because the logging unit engines are smaller and have lower emissions than the cementing unit engines.

Because the logging engines and the cementing unit engines cannot be used at the same time, Shell proposes to apply the same ORR to both the cementing and the logging units: the cementing units and logging units will operate no more than 27.8 percent of capacity operation of the cementing unit engines in any calendar day. In other words, the daily fuel consumption restriction on the cementing units is to include use of the logging units.

2.1.8 Boilers (FD-21 and 22)

The *Discoverer* has two diesel-fueled boilers that provide heat for domestic hot water and space heating. Typically, only one boiler operates at a time. However, because there could be times when both would operate, both are assumed to be operating at capacity in the impact assessment.

2.1.9 Waste Incinerator (FD-23)

Domestic and other non-hazardous materials are incinerated. This camp-style incinerator is a batch-charged unit capable of burning 125 kg/hr of solid trash or 1,000 lb of liquid sewage per day.[7] Its incineration capacity is limited to 3 MMBtu/hr (850 kW) of heat. Shell proposes incinerator ORRs based on the use of the HPU engines. The primary operation case is with both HPU engines operating, for which Shell proposes an incinerator ORR of 300 pounds of waste per day. With one HPU engine or no HPU engines running, Shell proposes ORRs of 800 and 1,300 pounds per day respectively. Impact assessments were performed for these two scenarios and are discussed further in Section 5.4.

2.1.10 Diesel Fuel Tanks

Ultra-low sulfur distillate fuel is the only fuel that will be used in the *Discoverer's* reciprocating engines and boilers. Because diesel has a very low vapor pressure, the tanks will have negligible vent emissions and are not listed as separate sources. Table 2-5 identifies fuel tank sizes and predicted VOC emissions based on EPA's TANKs emission estimation model.

[7] TeamTec Incinerators. *Type GS 500C specifications.* Fax. February 19, 2007.3.6

Table 2-5: *Discoverer* Diesel Fuel Tanks

EPA Source ID	*Discoverer* ID	Tank capacity (m^3)	Emissions (lb/yr)
FD-24	21P	538	8
FD-25	29P	267	4
FD-26	29S	267	4
FD-27	21S	179	2
FD-28	22S	150	2
FD-29	23S	150	2
FD-30	24S	135	2

2.2 Ice Management and Anchor Handling Fleet

The ice management and anchor handling fleet would consist of two ships: a primary icebreaker and an anchor handler/ice management ship. These ships would manage the ice, which involves deflecting or in extreme cases breaking up any ice floes that could affect the *Discoverer* when it is drilling, and to handle the *Discoverer* anchors during connection to and separation from the seafloor.

The ice floe frequency and intensity are unpredictable and could range from no ice to ice sufficiently dense so that the fleet has insufficient capacity, and the *Discoverer* would need to disconnect from its anchors and move off site. Ice statistics for 2003-2005 at the Sivulliq drill site during the proposed drilling season indicate ice would be found within 30 miles of the drill site 23 percent of the season and would require ice breaking 15 percent of the season.[8] Ice breaker operations in this application are based on the conservative assumption that ice is on location 38 percent of the season and that the fleet will be operating with the propulsion engines at 80% of capacity and all other engines at 100% of capacity during this time. For the remainder of the time, the ice management and anchor handling fleet would be either downwind of the *Discoverer* or beyond the 25-mile radius from the *Discoverer* in a warm stack mode (anchored and occupied).

When there is ice present at the drill site, ice disturbance will be limited to the minimum needed to permit drilling to continue. The most likely ice to be encountered will be first-year ice, and the ice management ships will be tasked to churn this up so that it will flow easily around and past the *Discoverer* without building up in front of it. This type of ice is fragmented by an icebreaker continually moving back and forth across the drift line, directly up-drift of the *Discoverer* and making turns at both ends.[9] Additional discussion of icebreaker activity and location is provided in Section 5.

[8] Craik, Keith, Arctic Wells Advisor, Shell International Exploration and Production Inc. [Communication with R. Steen, Air Sciences Inc.]. January 19, 2009. Supporting data are provided in Appendix L.

[9] Craik, Keith, Arctic Wells Advisor, Shell International Exploration and Production Inc. [Communication with R. Steen, Air Sciences Inc.]. February 10, 2009.

Occasionally there may be multi-year ice ridges that are expected to be managed at a much slower speed than used for first-year ice. Multi-year ice may be managed by riding up onto the ice so that the weight of the icebreaker on top of the ice cracks it. Although this is another emission scenario, the first-year ice is most common and is most efficiently managed at continuous high speed[10] which involves the highest continuous power production and represents the highest emissions.

There can also be ice buildup at the bow of the *Discoverer* that needs a nudge to slide past. In this event the anchor handler will pass close to the *Discoverer* bow and dislodge this ice with its propeller wash. An additional impact analysis was performed for this scenario and is discussed further in section 5.4.

Anchor handling involves placing the *Discoverer* anchors on the seabed in preparation for drilling and retrieving the anchors when the *Discoverer* is being moved off the well. Placement involves backing the handler up to the *Discoverer* under low power, connecting to the anchor line, reeling out the line, and setting the anchor at approximately 1,000 meters distance. This process is repeated for each anchor. The setting of each anchor consumes about 30 minutes and the entire process typically consumes no more than 18 hours. Anchor handler propulsion power during these 18 hours is either low or at idle due to the precision nature of setting anchors, spooling-out lines, and tensioning lines. An additional impact assessment was performed for this scenario and is discussed further in section 5.4.

The emission units of the icebreaker and anchor handler consist of the diesel engines for propulsion, general purpose generators and heaters, and an incinerator (see Appendix B). Short-term emissions from the ice management ships are calculated at maximum use of the emission units, which is 80 percent of capacity for the propulsion engines, and 100 percent of capacity for the remaining emission units. The long-term (seasonal) emissions are limited by ORRs on NOx and $PM_{2.5}$ emissions from the primary icebreaker and the anchor handler (see Table 2-3); emissions will be tracked based on emission factors derived from a stack test and fuel consumption for the actual ice breakers used.

Current plans call for the Vladimir Ignatjuk as the primary icebreaker. Because the primary ice breaker will be leased, however, it may change from year to year. The anchor handler will be one of two ships: the Tor Viking or a new ship Shell is constructing (referred to as Hull 247). These ships are smaller and have lower emissions than the primary ice breaker.

Because the primary ice breaker will be leased, Shell requests that the permit provide flexibility in selecting a primary ice breaker as long as predicted pollutant concentrations are equal to or less than those evaluated in this permit application. The ambient air quality impact of the primary ice breaker is defined herein by the ship with the lowest plume rise combined with a permit-restricted operation limit. NO_x and $PM_{2.5}$ are selected because these pollutants are most restrictive.

[10] Ibid. footnote 9.

The propulsion engine exhaust stacks of the eight ships listed below were modeled for plume rise (Appendix B, Page Discoverer 4). The Vladimir Ignatjuk plumes were the lowest (Table 5-4), so the impact analysis described in Sections 5 and 7 of this report is based on the permit-limited emissions from this stack with lowest plume rise. Concentrations from all other ships emitting at the same rate will have lower concentrations. Currently known ice management ships that fall within the range of ship characteristics evaluated in the dispersion modeling are listed in Table 2-6.

Table 2-6: Eligible Ice Management Ships

Ship Name	Owner
Vladimir Ignatjuk	Murmansk Shipping
Talagy	Smit
Odin	Viking
Nordica/Fennica	Finstaship
Tor	Viking
Balder	Viking
Vidor	Viking
Hull 247	Shell
Note: the Nordica and the Fennica are identical ships	

For purposes of the impact evaluation herein, the ice management vessel hourly energy consumption (MMBtu/hr) is estimated from maximum operation of all emission units on the ships. Compliance with the ORR emission limits will be based on an emission source test for the specific icebreakers used and the consequent development of a vessel-specific emission factor for NOx in pounds per gallon of fuel consumed. Using this emission factor, the seasonal total NOx emissions can be tracked from the gallons of fuel consumed by each ice management vessel.

Shell requests that EPA also authorize the use of icebreakers not listed in Table 2-6 as long as Shell demonstrates the substitute vessels generate pollutant concentrations equal to or less than those of the vessels assumed in this application. Shell will determine if a substitute icebreaker generates equal or lower concentrations by modeling its emissions and comparing predicted concentrations of PSD pollutants with concentrations identified in this application. Shell would demonstrate compliance with ORRs with the substitute icebreaker using the same monitoring, recordkeeping, and reporting requirements imposed on the permitted icebreaker.[11]

2.3 Oil Spill Response (OSR) Ships

The OSR fleet is expected to be used only in the unlikely event of an oil discharge to the water. The OSR fleet will typically be stationed between three and five kilometers downwind of the *Discoverer*. To

[11] This approach is analogous to modeling ships at refineries or other marine terminals. At a marine terminal, onshore facilities are modeled with great specificity. That is feasible because the physical and operational characteristics of the onshore facilities are usually well defined. In PSD permit applications, secondary sources such as the ships that bring crude oil to a refinery or take refined product away are also addressed in the impact modeling. Because there is no way of knowing which ships will call (some are known, but not all), applicants must evaluate a generic ship that approximates the size and characteristics of those expected. .

maintain a conservative approach, the OSR fleet was modeled two kilometers downwind of the *Discoverer*.

The OSR fleet is expected to consist of one offshore management/skimmer ship (currently the Arctic Endeavor Barge/Point Barrow Tug), three 34-foot work boats, and one 47-foot Rozema skimmer. It is possible that the *Nanuq* will be in the vicinity, but only as a berth for the OSR crew and occasional refueling of the *Discoverer* drilling equipment.

Two of the work boats will be used to tow containment booms while a third will act as a backup for crew changes and for re-fueling. The work boats and Rozema skimmer will remain on the deck of the management vessel and will only be in the water for training, drills, and response events. During training and normal routine operations, only two of the 34-foot work boats will be in operation at the same time.

The OSR fleet will perform daily training drills lasting up to eight hours per day when weather and seas permit, but will stay in the same area as the *Discoverer*, 3 or more km downwind. The exercise will normally consist of two work boats, towing an open apex boom diverting a water stream back to the Endeavor.[12] The Endeavor will have skimmers deployed and be simulating the recovery of oil downstream of the open apex. The Rozema could also participate in the skimming exercise. This is the configuration used to define maximum OSR training impacts. During this exercise, the small craft as well as the Endeavor will be moving at approximately 0.5 kts to skim the hypothetical training spill. With this slow speed and using the approximation that vehicle propulsion power is related to the square of the vehicle velocity,[13] the Artic Tug's propulsion power is estimated to be less than 10 percent from one engine (0.5 knots divided by 6 knots squared). The OSR *Nanuq* pilot estimates that the two small boats will be powered with both engines at approximately 50 percent.[14] It is assumed herein that the Rozema will also be powered at 50 percent capacity during the training exercise. If the *Nanuq* is used, it will be drifting, but staying in the vicinity of the OSR fleet, which would mean moving only to overcome the current. At a current of less than 1 knot, this would be at less than 10 percent power from one engine.

In addition, a tanker will normally be stationed beyond 25 miles from the fleet. The tanker would store fuel to refuel the fleet and the drill ship engines and, potentially, to store oil and water from the Endeavor Barge as it becomes full from possible cleanup operations. Emissions from the tanker are not considered with the offshore OSR fleet because it would be stationed beyond 25 miles and used only in emergencies. However, we address the tanker as a secondary source of emissions and model potential air quality impacts from its emissions in Section 8.6.

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[12] Merrell, Geoffrey T., Emergency Response Coordinator - Alaska Region, Shell Exploration & Production Co. [Communication with R. Steen, Air Sciences Inc.]. February 27, 2009.

[13] One form of Bernoulli's Equation: $P = k * (\text{velocity})^2$. With a vehicle maximum of 14 kts, the power to move the ship at 1 kt is 1/196 of full power or less than 1 percent of full power. Terminel, Michael, Alaska Operations Edison Chouest Offshore. [Communications with R. Steen, Air Sciences Inc.]. February 12, 2009.

[14] Seltz, Richard H., Alaska Simops Coordinator. [Communication with R. Steen, Air Sciences Inc.]. February 12, 2009.

2.4 Resupply Ship

The *Discoverer* is expected to be provisioned for the first few wells at the beginning of the season and will be re-provisioned at intervals of two to four weeks, for a maximum of eight re-provisionings. The supply ship is currently expected to be similar to the foreign-flagged *Jim Kilabuk*, if the drillship is resupplied out of Canada, or a similarly sized Jones Act compliant vessel, if resupplied out of Alaska. There will be no need for it to be within 25 miles of the *Discoverer* except for the time needed to approach, deliver, and leave the area. If it makes a delivery, it will attach to the *Discoverer* for less than 12 hours during which time one of its 292-hp generators will be operating at a low power level, assumed for this impact analysis to be at capacity, for ship utility powering. Its generator emissions while attached to the *Discoverer* are estimated (Tables 2-1 and 2-2) and its impacts are included in the impact analysis. In addition, the emissions from the resupply ship were also calculated for the period when the resupply ship is in transit to the site. Tables 2-1 and 2-2 show the emissions during the period when the resupply ship is in transit (within 25 kilometers of the *Discoverer*).

Although the *Jim Kilabuk* is representative, Shell contracts the use of the supply ships on a short-term basis and must allow for a range of acceptable supply ship generator sizes while continuing to operate without the ambient impact envelope presented in this application. Shell proposes to restrict the supply ship to a total of 7784 hp from all IC engines while also restricting the propulsion power to no more than 7200 hp. In this way, the generator capacity could be greater than 582 hp, but the propulsion engines could not be greater than 7200 hp. The ambient impacts during transit to and from the *Discoverer* would be equal or lesser than already demonstrated because the gross power limit would not change.

Under OCS regulations, the supply ship is part of the OCS source when it is attached to the *Discoverer*. Shell has proposed a 12-hour time restriction and the generator capacity limit of 292 hp but requests the flexibility to use the same energy consumption restriction of 3504 hp-hr per day while attached to the *Discoverer*, which is equivalent to the current limit of 292 hp for 12 hours. Using the assigned supply ship IC engine heat rate of 7000 Btu per hp-hr, and fuel heat value of 133,098 Btu per gallon, compliance with this energy restriction will be tracked through fuel usage and will be limited to approximately 184 gallons per day when part of the OCS source.

An alternative to this approach being considered by Shell for the Beaufort Sea Project is the use of an un-powered barge in place of a re-supply vessel. The barge would be delivered to the *Discoverer* by a tug and attached to the *Discoverer*. There are no stationary source implications of this change, since the barge would have no emission sources. The tug would have a power limitation of half or less than the Kilabuk, and thus could come and go even on the same day without an increase in emissions over the evaluated scenario. Because the barge can remain attached to the *Discoverer* for an unlimited time, it is likely that the tug would deliver and retrieve the barge on different days, further decreasing the relative impact when compared to the *Jim Kilabuk* scenario. The tug/barge option for re-supply has not been evaluated directly since its impacts would be less than the evaluated scenario for re-supply.

2.5 Cuttings/Mud Disposal

Any drilling operation creates a material consisting of the drill cuttings and mud-like materials used to mobilize the cuttings. In most cases these materials are simply deposited on the seafloor at the drill site pursuant to EPA's General NPDES Permit for the Beaufort Sea. However, in an effort to avoid potential environmental impacts of the exploration program, Shell is considering collecting these materials and removing them from the area to a separate disposal site. Because there is no room on the *Discoverer* to store the material, one concept currently being considered by Shell is the placement of an un-powered barge next to the *Discoverer* to be used as a repository for these materials until they can be taken out of the area.

The barge itself has no air quality implications since it has no generators or other fuel-burning equipment. Like other barges, it must be delivered to the site and removed from the site using a tug. The tug has emission units that have not been included in the emission inventory herein, and have not been evaluated. It is obvious, however, that in order for this technique to be used, the barge must be delivered before drilling begins and must be removed after drilling is ceased, so there can be no simultaneous operation of this tug with the major sources of the project, which are the drilling engines. In fact, it is likely one of the other tugs that is part of this project, either the OSR tug, or the potential tug used in re-supply, would be used for the mud barge. Thus, the scenario where a tug delivers or retrieves a mud barge would be a lower emitting and lower impact scenario than the base case evaluated herein.

2.6 Refueling

The diesel storage tanks aboard *Discoverer* may need replenishment if the *Discoverer* remains in one location for more than 40 continuous days. During this process, a refueling vessel would approach the *Discoverer* and connect a fuel line between the two ships. The refueling vessel will need to remain relatively stationary during this refueling process. To do this, the refueling vessel would undergo dynamic positioning (DP) adjacent to the *Discoverer* while fuel is transferred. Dynamic positioning is the technique of maintaining a ship's position using propulsion engines. The entire process of refueling could take up to eight hours. Section 5.4 provides a quantitative air quality impact analysis for the refueling process based on use of the *Nanuq* and the conservative assumption that its propulsion engines are operating at full power.

2.7 Onshore Support Facilities

The indirect activities associated with the *Discoverer* exploration activities are likely to include temporary use of support facilities in Deadhorse or Barrow, with possible minor activities in Kotzebue. The facilities could include storage facilities and aircraft hangers. Crew accommodations are expected to be in existing hotels but could include some temporary trailer camps. Equipment change-out is expected to be

performed by existing commercial means (airlines). Communications would be through existing communications center networks.[15]

Shell does not expect the *Discoverer* exploration activities to increase full-time population because *Discoverer* project employees who are not already permanent residents would likely leave the North Slope when off the vessel. Shell plans to lease its onshore facilities and does not plan to construct any new facilities. If there is any construction, it will likely be by a contractor and could be a storage building, the need of which will be determined by a local service contractor. Section 8.5 discusses the potential air quality impacts of any onshore development associated with the project.

2.8 Miscellaneous Emissions-related Topics

The SOI Beaufort exploration project entails use of the same equipment that was presented in Shell's Chukchi Sea exploration PSD permit application. During its review of Shell's *Revised Preconstruction Permit Application for Frontier Discoverer in Chukchi Sea, Alaska, beyond the 25-mile Alaska Seaward Boundary* (February 2009), EPA posed a number of questions related to emission estimates and related ambient air quality impacts[16]. In recognition of the similarity of the equipment used for these two exploration projects, we are addressing in this section several of the issues EPA noted for the Chukchi Sea project.

2.8.1 Fuel Used

Shell proposes to use diesel fuel with a sulfur content of 0.0015 percent or less to limit SO2 emissions from all fuel-burning sources in the project. This commitment to limit fuel sulfur content is among the ORRs listed in Table 2-3. Ultra-low sulfur diesel fuel is not currently available on the North Slope and would be barged in to make it available to the project. These fuel qualities are incorporated in the emission and impact assessments presented here. To date, Shell has not purchased ultra-low sulfur fuel for Alaska use, so the density and heat content can only be estimated from fuel recently purchased for other North Slope uses17, 18. These values are incorporated in to the emission calculations of Appendix A and B.

2.8.2 Miscellaneous Hydrocarbon Emissions

Shell does not plan to flow test wells, flare gas, or store liquid hydrocarbons recovered during well testing during its planned drilling campaign using the *Discoverer*. Therefore, no emissions from flaring or stored

[15] Pavia, Gene, Principal Consultant, UMIAQ. [Communication with R. Steen, Air Sciences Inc.]. January 22, 2009.

[16] EPA Comments, Attachment B, II.B.4.

[17] Skandinaviska Raffinaderi AB, SCANRAFF. *Vladimir Ignatjuk Certificate of Quality*. September 19, 2004.

[18] Keiser, Ronald, Domestic Fuels Manager, Shell Marine Products (U.S.) Company. [Communication with C. Tengco, Shell]. January 26, 2009.

crude oil tank vapors are included in Tables 2-1 and 2-2.[19] No well venting subsequent to the drilling operation is planned and is therefore not part of the project scope.

As part of Shell's Chukchi Sea PSD permit process, Shell on May 4, 2009 provided EPA a conservative estimate of the volatile organic compound (VOC) emissions from the Discoverer drilling cuttings while drilling. These VOC emissions were estimated at 128 pounds per drilling season. Shell anticipates that VOC emissions from drill cuttings in the Beaufort Sea would be comparable to those in the Chukchi Sea.

2.8.3 Relief Wells

The need to drill a relief well to control a blowout is highly unlikely, but possible. Relief well drilling would employ the same equipment that is used to drill in routine operation. Table 2-1 provides hourly emissions estimates for drilling activities by the *Discoverer* and would apply to drilling whether the well being drilled is a planned well or a relief well being drilled in response to a well control event. No emissions would be associated with the emergency deployment of the ship's Subsea Blowout Preventer (SSBOP).

We note that EPA guidelines indicate that allowable emissions should not include emissions that would occur only as a result of events outside of standard operating conditions. Appendix W to 40 CFR Part 51, Guidelines on Air Quality Models, instructs that emissions resulting from malfunctions should not be factored into allowable emissions:

> *Malfunctions which may result in excess emissions are not considered to be a normal operating condition. They generally should not be considered in determining allowable emissions.*

Emissions from emergency drilling operations, even more so than ordinary malfunctions, are highly unlikely events and should not be considered the "normal operating condition" of the drilling operation. Therefore, they are not to be factored into allowable emissions specified by permit.

Shell drilling plans, protocols, and procedures and the Minerals Management Service Application for the Permit to Drill detail drilling operation precautions to avoid blowouts during drilling operations. The likelihood that a well control event could occur during exploration drilling on the Alaska OCS and that a relief well would then be necessary to bring the well under control is approximately 1 in 6,000. The inclusion of emissions from such an unlikely event would incorrectly "skew" the project emissions data, so as to make it unrepresentative of "annual" emissions and inaccurate for anticipated operations.

Because emissions from drilling a relief well are so unlikely and are not reasonably foreseeable, Shell maintains that it is also not appropriate or practical to include such emissions in the air quality modeling for the *Discoverer*. In the highly unlikely event that, at some future time, the *Discoverer's* drilling operations were to cause a violation of an NAAQS or the PSD increment due to emissions produced

[19] Craik, Keith, Arctic Wells Advisor, Shell International Exploration and Production Inc. [Communication with R. Steen, Air Sciences Inc]. February 4, 2009.

during emergency relief well drilling at the end of a drilling season, it is acknowledged that the EPA would have discretion to take enforcement action against Shell for such a violation under the Agency's policy on "excess emissions" that result from, inter alia, malfunctions. See "State Implementation Plans: Policy Regarding Excess Emissions During Malfunctions, Startup, and Shutdown," Steven A. Herman, Assistant Administrator for Enforcement and Compliance (September 20, 1999) ("Herman Memorandum"). [20]

2.8.4 Diverters

A diverter is a mechanical device located beneath the drilling platform that protects the drill rig and personnel in the event of an influx to the well, which is extremely rare. The influx for which the diverter could be used could consist of fresh or salt water, or gas. The diverter is viewed by Shell in the same way as the SSBOP (subsurface blowout protector) and both will be in place at every drilling event. The MMS requires all rigs operating in OCS waters to use a diverter. As a rule, most offshore rigs have diverters whether or not they operate in OCS waters.

The diverter directs any formation fluids away from the rig in the event of an influx into the borehole. The diverter is used while drilling the shallow interval of the well before the SSBOP's are installed (the interval from the 30" casing shoe at approximately 350 feet, down to 20" casing shoe at approximately 1000 feet). The diverter does not shut the well in; it merely diverts the flow for discharge away from the rig until the gas dissipates or the hole bridges over. The diverter is used because at the shallow depths the formation strength is insufficient to withstand the potential pressure of a shut-in gas or gas/mud column in the annulus. The SSBOP's are installed after running the 20" casing because below the 20" casing the formation strength is sufficient to permit the well to be physically shut in using the SSBOP's.

The likelihood of encountering shallow gas in the interval noted above is quite small for the following reasons:

1) Shell has drilled wells nearby that have penetrated the same shallow formations and did not see shallow gas.

2) In accordance with MMS regulations, Shell has conducted shallow hazards seismic surveys to delineate possible shallow gas intervals and has selected locations to avoid any likely potential shallow gas sites.

3) Shell drills with a drilling fluid density that exceeds the anticipated formation fluid pressure.

4) Shell drills a smaller (12 ¼"-17 ½") pilot hole and uses formation evaluation tools to interpret in real time the possibility of a shallow gas flow environment. Drilling the smaller hole limits the

[20] This policy was reconfirmed in a memorandum issued by Eric Schaeffer, Director of the Office of Regulatory Enforcement, dated December 5, 2001, which clarified that the policy was intended to be applied prospectively to future SIP approvals. Although these guidance documents are designed to set out the standards under which the EPA will approve a SIP, they also provide the most applicable guidance to the EPA's policy regarding excess emissions for all permits, those issued pursuant to a SIP and those issued under federal regulations.

amount of gas that can enter the well bore and permits the use of the dynamic kill procedure to shut off the flow. The dynamic well control procedure utilizes kill mud, pumped at high rates to shut off the flow. The additional back pressure against the formation that shuts off the flow potential is the result of the frictional pressure drop in the annulus pumping at the high rates, facilitated by the smaller diameter pilot hole. In this manner, the pressure in the annulus can be adjusted to permit control to be regained without breaking down the formation.

5) Shell maintains a volume of heavy weight kill mud on hand that is immediately available to pump in the event of a formation fluid influx so that the appropriate hydrostatic head can be reestablished and influx can be shut off. The most likely scenario for a gas influx is when formation fluids are swabbed in while pulling the drill string out of the hole.

6) Shell has real-time drill string instrumentation that permits monitoring the bottom hole pressure so that the swabbing effect can be immediately be recognized and appropriate countermeasures taken. For these reasons the probability of gas to surface is quite small. From an industry standpoint, in the Gulf of Mexico, in the period 1992-2006, 15077 wells were drilled during which diverter use was documented 20 times, resulting in a probability of usage of 0.01%. Given the aforementioned precautions that will be taken in the Beaufort Sea exploration, the probability is likely substantially lower.

In summary, the diverter is a safety device that would be used only in the unexpected event of a sudden influx to the bore hole prior to installation of the SSBOP. There would be emissions if the influx consisted of hydrocarbon gases, but they are unplanned and not quantifiable.

2.8.5 Helicopter Support

Shell will use helicopters to transport personnel and miscellaneous supplies such as groceries, parts, tools, etc. between the drill site and the mainland. Shell anticipates approximately 11 round trips per week from Prudhoe Bay to the *Discoverer*. Typical combustion related emissions, including oxides of nitrogen and sulfur dioxide, carbon monoxide, and particulate matter would result from use of the helicopter. These emissions have not been quantified, but they are expected to be small due to the rapid travel time of the helicopter from shore to the drill site and the brief time on site when the engines are operating. In addition, any air quality impacts from these emissions would be negligible due to the large dispersion caused by the action of the helicopter rotor blades and the helicopter's brief operation in any given location.

SECTION 3

REGULATORY APPLICABILITY

The *Discoverer* is to be an "exploratory OCS source," under Section 55.2 of the Outer Continental Shelf Air Regulations in 40 CFR Part 55. Applicability of the OCS Air Regulations is triggered under Sections 55.3(b) and (c) because exploration will occur both within and beyond 25 miles of the Alaska seaward boundary. The federal and State of Alaska requirements identified in Sections 55.13 and 55.14 apply. The main substantive requirements from these sections are the Prevention of Significant Deterioration (PSD) permitting rules in 40 CFR 52.21 and 18 AAC 50. These are discussed further in Section 3.3 below.

From a regulatory perspective, the OCS Air Regulations apply to the *Discoverer* only when it is an "OCS Source." This application, therefore, describes the source, its emissions, and emission controls and operational restrictions only for the period the vessel is an OCS Source. This is discussed further in Section 3.2 below. The *Discoverer's* emissions are not regulated, and therefore not addressed in this application, when the vessel is not an OCS Source.

3.1 Additional Alaska requirements

3.1.1 Alaska-Only Rules

Within 25 miles of the Alaska seaward boundary, several Alaska-only rules apply. These are discussed below.

18 AAC 50.010: Supplements the federal ambient air quality standards with an 8-hour average ammonia standard of 2.1 mg/m^3 and a 30-minute average reduced sulfur compound standard of 50 µg/m^3 (neither to be exceeded more than once per year).

18 AAC 50.050: Limits visible emissions from an incinerator to 20 percent averaged over any six consecutive minutes, excluding condensed water vapor.

18 AAC 50.055: Emission standards for fuel-burning equipment:

> Visible Emissions: Not cause or allow visible emissions, excluding condensed water vapor, emitted from fuel-burning equipment to reduce visibility through the exhaust effluent more than 20 percent averaged over any six consecutive minutes.
>
> Particulate matter: Not cause or allow particulate matter emitted from fuel-burning equipment to exceed, per cubic foot of exhaust gas corrected to standard conditions and averaged over three hours, 0.05 grains.

Sulfur compound emissions: Not cause or allow sulfur compound emissions, expressed as sulfur dioxide, to exceed 500 ppm averaged over three hours.

The *Discoverer* emission units will meet the standards in 18 AAC 50.010, 50.050, and 50.055 through equipment design, add-on particulate controls, and use of ultra-low sulfur diesel fuel. A model evaluation of ammonia emissions from the generator SCR is presented in Section 7.4; that evaluation predicted concentrations that are less than one percent of Alaska'

18 AAC 50.070: Prohibits opacity of ship emission plumes from exceeding 20 percent when that plume is within three miles of the Alaskan coastline except under certain prescribed conditions. The *Discoverer* and associated fleet will comply with this standard by combusting only ultra-low sulfur diesel fuel.

18 AAC 50.080: Authorizes Alaska Department of Environmental Conservation to require a permit for industrial sources, fuel-burning equipment, or incinerators in areas of potential ice fog. Shell acknowledges that this regulation may apply to its operations within 25 miles of Alaska's seaward boundary. There has been no indication that ADEC intends to require such a permit.

The volatile liquid storage tank emission standard under 18 AAC 50.085 does not apply to the *Discoverer* storage tanks because diesel fuel has a vapor pressure less than 0.5 lb per square inch (50.990, 117)

3.1.2 Owner Requested Limit for Sulfuric Acid Mist Under 18 AAC 50.225s

Shell commits to combust only ultra low sulfur diesel (ULSD) fuel in all emission units on the *Discoverer* and vessels in the associated fleet. The allowable sulfur content for ULSD is 15 ppm (0.0015%). Using ULSD to fuel all combustion units results in a PTE for sulfuric acid mist emissions from the project of well below 1 ton per year. This includes associated fleet emissions, which must be taken into account in determining permit program applicability under the OCS regulations. Using fuel with higher sulfur content (e.g., 0.19%) could result in a PTE that exceeds the PSD significant emission rate for sulfuric acid mist. Shell, therefore, seeks to limit sulfuric acid mist PTE by making its commitment to use ULSD in associated fleet emission units enforceable. Because ADEC rules apply within 25 miles of the Alaska seaward boundary, ADEC's requirements for limiting PTE by obtaining an Owner Requested Limit (ORL) apply. The ORL provision in 18 AAC 50.225(b) lists nine elements of an ORL request. In this case, item (b)(7) does not apply. This request, therefore, responds to the following 8 required elements:

1. A completed stationary source identification form.

   A completed ADEC Stationary Source Identification Form is provided in Appendix K.

2. A list of all emission units at the stationary source.

   A list of all project-related emission units is provided Table 2-1 of the application.

3. A calculation of the stationary source's actual emissions and potential to emit air pollutants.

Sulfuric acid mist PTE from the entire fleet (the stationary source plus the associated fleet), assuming use of fuel with 0.19% sulfur content in associated fleet emission units is 13.52 tons per year. Sulfuric acid mist PTE from the stationary source (the *Discoverer*) is 0.21 tpy. Estimated actual emissions of sulfuric acid mist from the entire fleet (the stationary source plus the associated fleet) using ULSD are 0.35 tons per year. These values are calculated by first determining if an emissions unit is controlled with SCR. If so, 100% of the SO2 emissions identified in the application is assumed to convert to H2SO4 mist; if not, only 5% is assumed to convert. Next, the ratio of molecular weights (98.08/64.08) is used to convert mass of SO2 to mass of H2SO4 mist.

4. A description of the proposed limit, including for each air pollutant a calculation of the effect the limit will have on the stationary source's potential to emit and the allowable emissions.

The permittee may not combust any liquid fuel with sulfur content greater than 0.0015 percent by weight in any emission unit on any vessel in the associated fleet.

5. A description of a verifiable method to attain and maintain the limit, including monitoring and recordkeeping requirements.

Before mobilizing the *Discoverer* for the first time at the beginning of a drilling season, determine the sulfur content in each fuel oil storage tank on the vessels comprising the associated fleet. Obtain representative fuel samples using one of the methods in 40 CFR § 80.330(b) and determine fuel sulfur content using ASTM D 5453-08b.

Thereafter, determine and record the sulfur content upon receiving each fuel shipment by either analyzing a representative sample for sulfur content by the procedures cited above, or obtaining a single certification of sulfur content for each shipment of fuel from the fuel supplier based on an analysis of the fuel, provided that the certification indicates that the sulfur content was determined using ASTM Method D 5453-08b.

6. Citation to the requirement that the person seeks to avoid, including an explanation of why the requirement would apply in the absence of the limit and how the limit allows the person to avoid the requirement.

The requested limit will avoid applicability of ADEC's PSD rule, in 18 AAC 50.306, for emissions of sulfuric acid mist. Although Shell is committing to use ULSD and will therefore bring only ULSD to the project, for operations within 25 miles of the Alaska seaward boundary an enforceable limit on H2SO4 emissions from the associated fleet is necessary to ensure that project PTE does not trigger PSD applicability for H2SO4. If fuel with higher sulfur content (e.g.

0.19% sulfur) were used, the project PTE would exceed the PSD significant emission rate of 10 tpy for H2SO4.

The limit makes Shell's commitment to combust only ULSD in associated fleet emission units enforceable, which in turn allows PTE calculations for sulfuric acid mist emissions from the associated fleet to assume the use of 0.0015% sulfur fuel. As a result, the associated fleet's PTE for H2SO4 is 0.35 tons per year, which is well below the PSD applicability trigger for H2SO4.

8. A statement that the owner or operator of the stationary source will be able to comply with the limit.

ULSD is an available fuel, so Shell will be able to obtain it. In addition, the PSD permit authorizing the project will also require use of ULSD as BACT for SO2 from the *Discoverer* emission units and will limit SO2 PTE for the associated fleet by requiring use of ULSD.

9. A certification, bearing the signature of the person requesting the limit, that states: "Based on information and belief formed after reasonable inquiry, I certify that the statements and information in this request are true, accurate, and complete.

The required certification is provided on the ADEC Stationary Source Identification Form in Appendix K..

3.2 Other Part 55 requirements

Because the *Discoverer* will conduct exploratory activities within the 25-mile Alaska seaward boundary, Sections 55.4, and 55.5 of the OCS Air Regulations also apply. Section 55.4 requires Shell to submit a Notice of Intent to permit. Shell submitted a Notice of Intent to permit to EPA on January 2, 2009. In response, EPA issued a "proposed rule – consistency update" in the March 3, 2009 Federal Register (Vol. 74, pp. 9180–9185) to update the OCS Air Regulations' list of Alaska rules incorporated by reference. Section 55.5 requires the "corresponding onshore area" (COA) to be determined. For the Beaufort Sea, the COA is the Northern Alaska Intrastate Air Quality Control Region and the permitting rules for this area (the Alaska rules identified in EPA's recent consistency update) apply to exploration within the 25-mile Alaska seaward boundary.

3.2.1 When is the *Discoverer* an "OCS Source"?

Vessels are OCS Sources "only when it they are: (1) Permanently or temporarily attached to the seabed and erected thereon and used for the purpose of exploring, developing or producing resources therefrom, within the meaning of Section 4(a)(1) of OCSLA (43 U.S.C. §1331 *et seq.*); or (2) Physically attached to an OCS facility, in which case only the stationary sources aspects of the vessels will be regulated." 40 CFR 55.2 (definition of OCS Source). To be an OCS Source, therefore, the *Discoverer* must be "attached" to the seabed *and* "erected" on the seabed *and*, at the least, positioned for exploratory drilling. Shell believes it is clear that this is the case only after the *Discoverer* is sufficiently anchored such that the

vessel is secure and stable in a position to commence exploratory activity at a drilling location. Until that time, the vessel is still operating as a mobile source, moving across the sea surface. Only when it is sufficiently stable to conduct operations on a well or at a well location does the *Discoverer* become stationary, changing its status from a mobile sea-going vessel to a stationary drill platform. Similarly, the *Discoverer* would cease to be an OCS Source when the anchor removal process is commenced in preparation for moving the vessel, i.e., when the first anchor is removed. A supporting legal analysis discussing how courts have applied the OCS Source definition is provided in Appendix I.

Descriptions of typical anchor setting and anchor retrieval processes for the *Discoverer*, as well as the emergency anchor disconnection process, are provided below.

Setting of Anchors: Anchors are set using an anchor handling vessel. The anchor and associated equipment (the anchoring assembly) is placed, or carried, on the anchor handler. The free end of the mooring line is passed from the drillship to the anchor handler, where the mooring line is connected to the anchoring assembly. The line and assembly are then transported to the location of the anchor setting point, where the anchor is placed on the seabed. The anchor is lowered to the seabed using a pennant line. Once the anchor is placed at the appropriate location on the seabed the anchor wire is pulled, using a winch on the drillship until a pre-described tension is achieved. This tension is held (the anchor allowed to soak) for a pre-described amount of time. The tension and the soak time are based on location-specific criteria. Once complete, the tension is locked into the system using a break on the winch mooring line drum. This process is repeated in a pattern of anchors that are run in opposite directions. The tension and position of the mooring lines are adjusted as subsequent lines are run to ensure that no line is over-tensioned. If a single anchor at a specified location is not able to hold with the necessary tension then a second anchor is attached in series (called a piggyback) to increase the holding power. Finally, once there are enough lines out to control the position of the ship with the mooring lines, the vessel is put into position and mooring line tensions are adjusted to allow operations to be undertaken on the well or at the well location, as determined by the on-site company representative. If all the lines are not yet out, anchors are run as described above and the various tensions of the mooring lines adjusted accordingly.

Retrieval of Anchors: Anchors are retrieved from the seabed by the anchor handling vessel. Initially, the tension in a single mooring line is released by the. Next, the anchor retrieval is accomplished by pulling the anchor to the surface using the buoyed pennant line that is attached to the anchor or by using a “chase” line from the drillship. Once the anchor is pulled to the surface and the associated equipment is removed from the anchor, the mooring line is spooled back onto the drums onboard the drillship. This spooling occurs while the anchor handling vessel holds tension on the line to ensure that the wire is retrieved in an orderly manner. This process is repeated in a pattern of anchors that are run in opposite directions. The anchor tension in all lines is adjusted as the process progresses to ensure that the overall tension is not overloaded on one or more lines.

Emergency or Contingency Disconnection of Anchors: As part of the ice management process for operations in Alaska, there is the ability to quickly disconnect the mooring lines from the anchors by activating the Rig Anchor Releases (RARs). The RARs are considered the primary emergency disconnect method. If emergency disconnect is necessary, the RARs are activated one at a time and the lines spooled back onto the vessel. This leaves the anchors on seabed to be retrieved later by the anchor handler, using the process described above. As a backup, a secondary emergency disconnect option is available. If necessary, the break on the mooring winches can be released allowing the onboard lines to "spool off" if ice pushes the drillship off location. This secondary option is designed to be used only in an extreme emergency situation, if necessary to protect the people onboard the vessel, because the lines are left on bottom and are likely to either be damaged or tangled.

3.3 Applicability of PSD permitting requirements

3.3.1 Potential emissions

"Potential emissions" are used to determine applicability of Prevention of Significant Deterioration (PSD) air quality permitting rules. Under the OCS Air Regulations, potential emissions are:

> the maximum emissions of a pollutant from an OCS source operating at its design capacity. Any physical or operational limitation on the capacity of a source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as a limit on the design capacity of the source if the limitation is federally enforceable. Pursuant to section 328 of the Act, emissions from vessels servicing or associated with an OCS source shall be considered direct emissions from such a source while at the source, and while enroute to or from the source when within 25 miles of the source, and shall be included in the "potential to emit" for an OCS source.

40 CFR 55.2. The definitions of "potential to emit" (PTE) in federal and state PSD regulations similarly take federally enforceable limits on capacity to emit into account in calculating potential emissions. 40 CFR 52.21(b)(4); 18 AAC 50.040(h)(4)(B) (citing AS 46.14.990, which cites 40 CFR 51.166(b)). ENVIRON has calculated potential emissions from the OCS Source after it exists as authorized under the permit this application seeks. In other words, the calculations take into account all of the physical or operational limitations on the OCS Source proposed in this application, because the permit will make all of those limitations, including those that will be assumed voluntarily, federally enforceable.

For this type of source, PSD is triggered if the source has potential emissions exceeding 250 tons per year of any regulated pollutant. As shown in Table 3-1, that is the case here because potential emissions of NOx and CO exceed the threshold. The next step in the applicability process is to compare potential emissions to the "significant emission rates" (SERs) to determine whether additional analysis for a particular pollutant is required. Table 3-1 shows that potential emissions of NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOCs from the *Discoverer* and its associated fleet combined each exceed the corresponding SER. Therefore, this application includes Best Available Control Technology (BACT) analyses for *Discoverer* emission units, and a source impact analysis, addressing emissions from the *Discoverer* and its

associated fleet for NO_x, CO, PM, PM_{10} , $PM_{2.5}$, and VOC emissions. At EPA's request, PTE calculations that exclude any limits requested by Shell are provided in Appendix H.[21]

Table 3-1: Potential Emissions and Significant Emission Rates

Pollutant	Significant Emission Rate Threshold [1] (tpy)	*Discoverer* Emissions (tpy)	*Discoverer* and Fleet Emissions (tpy)
Nitrogen Dioxide (NO_x)	40	51	1,371
Carbon Monoxide (CO)	100	10	464
Sulfur Dioxide (SO_2)	40	0.2	2
Particulate Matter PM)	25	5	81
Particulate Matter (PM_{10})	15	4	65
Particulate Matter ($PM_{2.5}$)	10	4	57
Ozone (Volatile Organics)	40	6	96
Lead	0.6	0.006	0.111
Fluorides	3		Negligible
Sulfuric Acid Mist	7	0.2	0.35
Hydrogen sulfide	10		Negligible
Total reduce Sulfides	10		Negligible
Reduced Sulfur Compounds	10		Negligible
Municipal Waste Combustor Organics	3.5E-6		<0.033 x 10-6
Municipal Waste Combustor Metals	15		<0.12
Municipal Waste Combustor Acid Gases	40		<4
Municipal Solid Waste Landfill Emissions	50		0

[1] 40 CFR Section 52.21 (b)(23)

3.3.2 Summary of PSD requirements

The main substantive requirements of the PSD permitting rules in 40 CFR 52.21 and 18 AAC 50 (which for the most part reference the federal rules) are summarized below, noting which application section addresses the requirement (section references are to 40 CFR 52.21):

> *Section (j) Control Technology Review:* Addressed in application Section 4. Includes a best available control technology (BACT) review of all permitted emission units for regulated pollutants with the potential to be emitted in significant amounts. NSPS applicability and NESHAPs applicability are addressed in 3.4, below.

[21] The calculations include consideration of BACT for *Discoverer* emission units because it is required regardless of applicant proposed restrictions and include the 168 day limit on drilling because that is believed to be a physical limitation on drilling in the Arctic Ocean.

Section (k) Source Impact Analysis: Addressed in application Section 5. Requires demonstration that the source will not cause or contribute to a violation of NAAQS or PSD increment.

Section (m) Air Quality Analysis: Addressed in application Section 6. Review of baseline concentrations of regulated NSR pollutants with the potential to be emitted in significant amounts.

Section (o) Additional Impact Analysis: Addressed in application Section 8. Impact analysis of impairment to visibility, soils, and vegetation.

Section (p) Sources Impacting Federal Class I Areas: Requirements relating to impacts on designated "Class I" areas. Shell claims exemption from these requirements because nearest Class I area, Denali National Park, is approximately 750 kilometers (465 miles) from the Beaufort Sea – well beyond the distance at which the proposed source could have any impact at Denali. In addition to the substantial distance, the Brooks Range lies between the Beaufort Sea and Denali, presenting an insurmountable barrier to sea level emissions.

3.3.3 PSD baselines

Shell recognizes that EPA Region 10 has asserted a position assuming the existence of an Air Quality Control Region in the OCS in a July 2, 2009 internal memorandum and implemented further in the Statement of Basis for the proposed Shell Chukchi Sea permit (Section 5.2.2 on pp. 72-73). Shell believes that the position enumerated in the September 11, 2009 letter from M. Cohen, Stoel Rives, to B. Harnett, EPA OAQPS (copied to Region 10), is legally sound, and understands that the Agency has not yet issued a formal response.

3.4 Applicability of other requirements

3.4.1 NSPS

Under the OCS Air Regulations, New Source Performance Standards apply to OCS Sources in the same manner as in the COA. 40 CFR 55.13 (c). Candidate source types for NSPS applicability (40 CFR 60) are the fuel tanks (subparts Ka and Kb), the incinerator (subpart CCCC), the boilers (subpart Dc), and the internal combustion engines (subpart IIII).

NSPS Subpart Ka applies to petroleum liquid storage tanks with a capacity of greater than 420,000 gallons; this is well above the capacity of the largest *Discoverer* tank (21P -142,140 gallons). NSPS Subpart Kb applies to petroleum liquids tanks manufactured after July 1984. All *Discoverer* tanks were manufactured before 1984, and therefore none of the petroleum liquid storage tanks are affected sources.

The incinerator (FD-23) meets the definition of a commercial or industrial solid waste incinerator (CISWI) and was manufactured after November 30, 1999, and is therefore potentially affected by NSPS 40 CFR part 60 subpart CCCC.. Because the incinerator qualifies as a small (capacity less than 35 tons per day) Municipal Solid Waste (MSW) incinerator, it is exempt from subpart CCCC requirements except for notification and record-keeping (§60.2020(c)(2)). An exemption request is attached as Appendix G. Its applicable NSPS requirements will consist of the attached initial notification to the EPA administrator and quarterly record-keeping of the waste material and fuel burned.

NSPS subpart Dc is applicable to boilers equal to or greater than 10 MMBtu/hr design capacity. Because the two *Discoverer* boilers are both under 10 MMBtu/hr, they are exempt.

All diesel engines, except the MLC compressor engines and the logging winch engine, were manufactured prior to July 11, 2005, and therefore are exempt from NSPS subpart IIII. The MLC compressor engines (FD-9, 10, and 11) and the logging winch engine (FD-19) are new engines to which NSPS subpart IIII applies. At a size of less than 10 liters per cylinder, the operator is to operate the engine to meet the manufacturer's Tier 3 emission limits, which translates to applying good maintenance practices (GMP). These engines will be certified to meet the Tier-3 standards and Shell will implement GMP.

3.4.2 NESHAPs

National standards for hazardous air pollutants (HAPs) apply to an OCS Source only if they are rationally related to ambient air quality standard compliance. 40 CFR 55.13 (e). It's not clear that any federal HAP standard meets this criterion, but in the interest of completeness, an analysis of potentially applicable HAP standards is provided below. It's worth noting that if the proposal was directly subject to these standards, it would not be a major HAP source. The *Discoverer's* total potential hazardous air pollutant (HAP) emissions, including the fleets (Appendix B, Page 13), are less than the 10 tons per year single HAP, and 25 tons per year combined HAPs emission major source threshold, and therefore the *Discoverer* is categorized as an area source of HAPs per § 63.2 (40 CFR 63, subpart A - National Emission Standards for Hazardous Air Pollutants – General Provisions – Definitions).

3.4.3 Compression Ignition (CI) Reciprocating Internal Combustion Engines (RICE)

CI RICE associated with the *Discoverer* are potentially subject to 40 CFR 63, subpart ZZZZ (National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines). Subpart ZZZZ does not apply to RICE with site-rated horsepower less than 500 hp (§63.6590). Therefore FD-8 and FD-12 through 20 are not subject to subpart ZZZZ.[22]

[22] EPA proposed an amendment to subpart ZZZZ on March 5, 2009 that would extend applicability to RICE with less than 500 hp site rating located at area HAP sources. This amendment to the rule has not been finalized.

All of the other engines associated with *Discoverer*, except for FD-9 through FD-11 and FD-19 were constructed before June 12, 2006, and are therefore not subject to the requirements of 40 CFR 63 subparts ZZZZ and A, and initial notification pursuant to subpart ZZZZ is not required (§ 63.6590 (b) (3)). FD-9 through FD-11 commenced (or will commence) construction after June 12, 2006, and are therefore defined as a new RICE located at an area source of HAPs (§ 63.6590 (a) (2) (iii)). These new RICE sources (FD-9 through FD-11 and FD-19) are not subject to the requirements of subpart ZZZZ, pursuant to § 63.6590 (c)), but must meet the applicable 40 CFR part 60 subpart IIII NSPS requirements as described above, and no notifications pursuant to subpart ZZZZ are required.

3.4.4 Commercial and Industrial Solid Waste Incinerator (CISWI)

HAP emission standards for non-hazardous waste combustors are addressed in NSPS and are not regulated under the 40 CFR part 61 or part 63 NESHAPS regulations (Section 129 (h) (2) of the 1990 Clean Air Act Amendments). Emission unit FD-23 is a CISWI subject to NSPS under 40 CFR 60, subpart CCCC, but is exempt from the requirements of this subpart, except for notification and recordkeeping (§ 60.2020 (c) (2)) (see discussion, above).

3.4.5 Boilers

Emission units FD-21 and FD-22 are utility boilers on the *Discoverer*. These boilers are potentially subject to the 40 CFR 63, subpart DDDDD - National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters. However, because this subpart is only applicable to boilers located at major HAP sources (§ 63.7485), emission units FD-21 and FD-22 are not subject to any NESHAP standard at this time.

3.4.6 Title VI

Under the PSD rules, only a substance that is identified in Title VI and also is subject to a standard under Title VI is a “regulated NSR pollutant” 40 CFR 52.21(b)(50)(iii); 18AAC 50.040(h)(4)(c)(i)/18 AAC 50.990(91)/40 CFR 51.166(b)(49)(iii).

40 CFR Part 82, the rules for Title VI of the Clean Air Act of 1990, addresses the use, production, import, export and disposition of chemicals related to the depletion of stratospheric ozone. Regulated ozone-depleting substances (“ODS”) are listed in Appendices A and B to Part 82 and consist primarily of chlorofluorocarbons, halons, carbon tetrachloride, methyl chloroform, and hydrocholorofluorocarbons. These substances were historically used primarily in heat pump units (freezers, refrigerators, air conditioners, dehumidifiers, coolers, etc.), fire suppression systems, and as cleaning solvents. Most production of ODS was phased out by 1996, but they could still be in use in some older equipment and materials.

Assuming that the requirements under Title VI for management of ODS are considered “standards” for purposes of the definition of “regulated NSR pollutant,” EPA’s long-standing policy is that potential

emissions of ODS are deemed “significant” if they exceed 100 tons per year. See Letter from John S. Seitz, Director, USEPA Office of Air Quality Planning and Standards to Kevin Tubbs, American Standard (March 19, 1998).

The *Discoverer* and associated vessels may have some ODS in refrigeration equipment, fire suppression systems, or as small amounts of unused cleaning solvents. No maintenance of refrigeration equipment or use of fire suppression that could result in emissions to the atmosphere is planned during offshore operations. Any cleaning that involves ODS would use only small amounts of solvent, on the order of pounds and not tons. The potentials to emit from any of these activities will be de minimus, and would certainly not approach the threshold of significance in the PSD rules.

SECTION 4

EMISSION CONTROL TECHNOLOGY REVIEW

4.1 Best Available Control Technology (BACT) Overview

Table 3-1 indicates that emissions from the *Discoverer* and its associated support vessels exceed the Significant Emission Rates established for NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC. The PSD rules require a BACT analysis to be performed for each emission unit on the *Discoverer* that emits these pollutants. 40 CFR 52.21 (j) (2); 18 AAC 50.306, 50.040 (h) (8).

BACT is defined in the PSD regulations as:

"... an emission limitation based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any proposed major stationary source ... which [is determined to be achievable], on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs" [40 CFR 52.21(b)(12); 18 AAC 50.040 (b) (4)].

In a 1987 memorandum, EPA provided guidance on the "top-down" methodology for determining BACT. The top-down process involves the identification of all applicable control technologies according to control effectiveness. Evaluation begins with the "top," or most stringent, control alternative. If the most stringent option is shown to be technically or economically infeasible or if environmental impacts are severe enough to preclude its use, then it is eliminated from consideration and the next most stringent control technology is similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by technical or economic considerations, energy impacts, or environmental impacts. The top control alternative that is not eliminated in this process becomes the proposed BACT basis.

This top-down BACT analysis process can be considered to contain five basic steps described below (from the EPA's Draft New Source Review Workshop Manual, 1990).[23]

- Identify all available control technologies.
- Eliminate technically infeasible options.
- Rank remaining technologies by control effectiveness.
- Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.
- Select BACT.

[23] U.S. EPA. *New Source Review Workshop Manual Prevention of Significant Deterioration and Nonattainment Area Permitting*. Draft, October 1990.

Shell applied EPA's top-down methodology to groups of similar emission units on the *Discoverer*. For example, there are six large diesel generators that are identical, so individual BACT analyses are not warranted. Similarly, there are small diesel engines can be grouped. In addition, the CO and VOC BACT analyses are grouped together because these two pollutants are generally controlled by the same technology.

Also, for the sake of this BACT analysis, we treat PM, PM_{10}, and $PM_{2.5}$ the same. All emissions associated with the stationary source are products of combustion – either from combustion of diesel or waste material. Although information on the particle size distribution is limited, most of the particulate matter would be expected to be very fine ($PM_{2.5}$). Consequently, this BACT analysis application does not distinguish between PM, $PM_{2.5}$ and PM_{10}. Because PM does not include the condensable fraction as do PM_{10} and $PM_{2.5}$, and because the project filterable particulate matter emissions are expected to be fine, PM emissions would be lower than PM_{10} and $PM_{2.5}$ emissions and any particulate matter controls would be less cost effective for PM than for PM_{10} and $PM_{2.5}$. Hence, while for brevity this section will refer only to PM, we intend the discussion to apply to PM, PM_{10}, and $PM_{2.5}$.

Table 4-1 identifies the emission unit categories and summarizes the results of Shell's BACT analysis. Additional detail is provided in the following sections.

Table 4-1: Source Categories, Proposed BACT

Source Category	PM	NO_x	SO_2	CO/VOC
Diesel Generators (1,325 hp)	OxyCat	SCR	ULSD	OxyCat
Small Diesel Engines (<500 hp)	CDPF	GCP	ULSD	CDPF
Diesel Compressors (540 hp)	OxyCat	Tier 3	ULSD	OxyCat
Boilers	GCP	GCP	ULSD	GCP
Incinerator	GCP	GCP	ULSD	GCP

SCR: selective catalytic reduction
OxyCat: oxidation catalyst
CDPF: catalytic diesel particulate filter
GCP: good combustion practices
Tier: 3 EPA Non-Road Engine Tier 3 Emission Standards per 40 CFR 89.112
ULSD: Ultra-low sulfur distillate fuel (15 ppm sulfur content)

Good Combustion Practices for the incinerator, small diesel engines, and boilers will consist of:

- Personnel (operators) will be trained for signs of improper operation, including visible plumes, and instructed to report these to the maintenance specialist,
- There will be at least one full-time equipment maintenance specialist on board at all times during drilling activities,
- There will be a weekly inspection of all the emission units by the maintenance specialist – for proper general operation,
- The scheduled maintenance procedures recommended by manufacturer will be followed, a copy of which will be available on the *Discoverer*,

- A maintenance manual provided by the manufacturer will be available for each emission unit on the *Discoverer*

While the Beaufort Project is being permitted as a new stationary source, Shell notes that the *Discoverer*, and all of the emission units on the *Discoverer*, except for the MLC compressors and the logging units, are existing units, purchased and regularly used for years prior to this application. To this extent execution of an OCS exploratory drilling operation is substantively different than *de novo* construction of the land-based industrial sources frequently addressed by the PSD permit process.

Comments on the initial proposed Chukchi Sea PSD permit suggested that Shell must evaluate the construction of an entirely new drill ship in order to comply with federal BACT requirements. Shell prepared a legal analysis responding to this assertion for inclusion in the Chukchi Sea permit record. A copy of the memo, titled, *Absence of Justification for Source Redefinition in BACT Analysis*, is provided in Appendix M. Although prepared for the Chukchi project, the legal analysis applies equally to the Beaufort project to explain why BACT requirements do not require Shell to evaluate construction of an entirely new drill ship for this application.

4.2 Main Generators

There are six identical large generator engines that are the primary power source on the *Discoverer*.

4.2.1 NO_x BACT Analyses

Step 1 – Identify all available control technologies.

There are two sources of nitrogen that when oxidized result in NO_x emissions – nitrogen in the fuel and nitrogen in the combustion air. Oxidation fixation of atmospheric nitrogen is known as thermal NO_x. The production of thermal NO_x is a function of combustion flame temperature, with increased thermal NOx formation as flame temperature increases.

The available NO_x control technologies for combustion can be characterized by the following two categories: combustion control and post-combustion exhaust treatment. In combustion control, thermal NO_x is reduced by lowering the peak combustion temperature. Post-combustion exhaust treatment relies on the removal of NO_x from the exhaust stream through adsorption or reduction. Available NO_x control technologies for the *Discoverer's* emission units were determined by searching the EPA RACT/BACT/LAER Clearinghouse (RBLC) and the California Air Resources Board Statewide Best Available Control Technology Clearinghouse (CA-BACT). The search conditions and a summary of the resulting control technologies are provided in Table 4-2.

Section 4.2.1 discusses the results for the main diesel generators. Subsequent sections will refer to the other information shown in Table 4-2. The complete database downloads are provided in Appendix C. For the RBLC, only those determinations made after January 1, 1999 were downloaded because older determinations are typically less stringent.

The available NO_x combustion control technologies for main generator diesel engines identified in the RBLC and CA-BACT are injection timing retard (ITR), intake air cooling (AC), high injection pressure (HIP), low NO_x design (LND), Tier 2 or 3 level controls, water injection (WI), and good combustion

Table 4-2: Available NO_x Control Technologies

Source Category	Clearinghouse	Search Conditions	Control Technologies
Diesel IC Engines (>500 hp) Applicable to: Main Generators MLC Compressor Engines	RBLC	Process Code = 17.110	None, AC, HIP, ITR, LND, SCR, TIER 2/3, WI
	CA-BACT	I.C. Engines - CI, Non-Emergency (>500 hp)	None, AC, SCR, ITR
Diesel IC Engines (≤500 hp) Applicable to: HPU Engines, Deck Cranes, Cemeting Units, Logging Winches	RBLC	Process Code = 17.210	None, AC, ITR, LND
	CA-BACT	I.C. Engines - CI, Non-Emergency (≤500 hp)	None, AC, ITR, WI*
Boiler (≤100 MMBtu/hr) Applicable to: Heater Boilers	RBLC	Process Code = 13.220	None, LNB, FGR
	CA-BACT	Boilers – Oil-Fired (≤100 MMBtu)	No determinations
Incinerator	RBLC	Process Description = Incinerator; Fuel = Solid Waste	None, SNCR
	CA-BACT		No determinations

*Unit was never installed.

CI: Compression Ignition

Process Code Key:

17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

13.220 - Commercial/Institutional-Sized Boilers/Furnaces (≤100 million BTU/H); Distillate Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

Control Technology Key:

AC:	Intake Air Cooling
FGR:	Flue Gas Recirculation
HIP:	High Injection Pressure
ITR:	Injection Timing Retard
LNB:	Low NO_x Burners
LND:	Low NO_x Design
SCR:	Selective Catalytic Reduction
SNCR:	Selective Non-Catalytic Reduction
TIER 2/3:	EPA Non-Road Engine Emission Standards per 40 CFR 89.112
WI:	Water Injection
None:	No specific technology listed or good combustion practices

practices. The RBLC and CA-BACT also list lean burn, air-to-fuel ratio control, turbocharger, clean fuel, and preventative maintenance as part of the NO_x control description; these technologies or work practices are not specific to NO_x reduction and are therefore not discussed further.[24]

ITR reduces NO_x emissions in reciprocating engines by delaying the injection of fuel in the engine from when the chamber is at its smallest to a time when the compression chamber is expanding. The larger volume in the compression chamber lowers peak combustion temperature, thus reducing thermal NO_x formation. Lower peak combustion temperature can also be achieved with charge air coolers (AC), common to turbo-charged engines, which reduce the intake manifold temperature. The combination of ITR and AC may reduce NO_x by 10 to 50 percent (up to 40 percent from ITR and an additional 10 percent from AC).[25]

Cooling the flame with ITR and/or AC reduces NO_x at the expense of incomplete combustion, resulting in the formation of PM, VOC, and CO emissions and reduced fuel economy.[26] The fuel economy penalty can be reduced by increasing injection pressure. High injection pressure (HIP) can accomplish better fuel atomization which leads to better combustion and reduced PM emissions. ITR also has a negative impact by contamination of lube oil with soot which increases engine wear.[27]

In WI systems, water acts as an inert gas and also absorbs heat in the process of evaporation. Both effects cause a decrease in the peak combustion temperature, thus reducing thermal NO_x formation by up to 50 percent.[28] The main disadvantage of WI is the large amount of extremely pure water required. In general, reduction of NO_x by one percent requires one percent of water in the water-fuel system.[29] In other words, achieving a 50 percent NOx reduction requires injecting the engine with as much water as fuel. Another issue with the introduction of water in the combustion chamber is the potential for liquid droplets to contact the cylinder surface. In this case, there would be an immediate disintegration of the lubrication oil film, damaging the engine. Cold temperature environments (such as the Arctic Ocean) are also problematic for WI systems due to the potential for freezing.

The RBLC also lists low NO_x design (LND) for several engines, but does not describe the actual NO_x combustion control technology. It is assumed that these determinations are referring to specific combustion chamber designs which provide good mixing of fuel and air before the start of combustion.

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24 Turbocharged engines with after- or inter-cooling can increase fuel efficiency, but it is the air intake cooling that provides the actual NO_x control. Clean fuels with low nitrogen contents do reduce NO_x produced from fuel-bound nitrogen. However, the amount of NO_x produced from the fuel-bound nitrogen in distillate fuel oil constitutes only a small fraction of the total NO_x. Lean burn, air-to-fuel ratio control, and preventative maintenance are more related to engine performance than NO_x control.

25 Khair, Magdi K. DieselNet Technology Guide. *Engine Design for NO_x Control.* May 2002.

26 DieselNet Technology Guide. *Engine Design for Low Emissions.* March 2003.

27 Ibid. footnote 26.

28 Genesis Engineering Inc. & Levelton Engineering Ltd. *Non-Road Diesel Emissions Reduction Study*. October 14, 2003.

29 Ibid. footnote 26.

These designs are intrinsic to the particular model of engine associated with each RBLC determination for LND.

Although not listed in the RBLC or CA-BACT, exhaust gas recirculation (EGR) is a new diesel engine NO_x combustion control technology which is becoming commercially available. In October 2002, several heavy-duty engine manufacturers introduced their new EPA-certified engines equipped with EGR systems.[30] EGR is a method by which a portion of the engine's exhaust gas is returned to its combustion chambers via the inlet system in order to reduce thermal NO_x formation. In general, the most important factor contributing to the NO_x reduction effect of EGR is the decrease in the peak combustion temperature caused by the heat adsorption and oxygen reduction effects of the returned inert exhaust gas. The NO_x emission benefit of EGR comes at a cost: increased PM, HC, and CO emissions, a fuel economy penalty, and potential engine wear and durability issues.[31] EGR demonstration tests have shown NO_x reductions from EGR of 40 to 50 percent.[32]

Shell also identified several other alternatives including engine replacement and the installation of cam shaft cylinder reengineering kits for certain older engines.

Shell considered achievement of emission reductions by implementing these engine modifications in combination with add-on NOx controls (e.g., SCR). D.E.C. Marine, an SCR device vendor, indicated that engine modifications made to reduce NOx emissions tend to increase fuel consumption, reduce exhaust gas temperature, and increase particulate and hydrocarbon emissions. These are negative side-effects that hamper the effectiveness of add-on NOx control devices. Therefore, NOx emissions-reducing engine modifications are not recommended to be implemented in combination with add-on controls and the combination is, accordingly, not listed as an available control technology option.

The only post-combustion exhaust treatment control technology listed in the RBLC and CA-BACT for diesel engines is Selective Catalytic Reduction (SCR). SCR systems use ammonia or urea to selectively reduce NO_x to elemental nitrogen and water. SCR injects ammonia or urea into the exhaust upstream of a catalyst bed. The operating temperature for various catalysts are 175°C to 250°C for platinum catalysts, 300°C to 450°C for vanadium catalysts, and 350°C to 600°C for zeolite catalysts.[33] SCR systems are commonly used on stationary sources,[34] as they require a fixed ammonia or urea tank in a containment area, a fixed catalyst bed and injection system, and a fixed NO_x measurement and control system. Several of the *Discoverer* engines are portable, so it is relevant to note that there are no SCR

30 Khair, Magdi K. DieselNet Technology Guide. *Exhaust Gas Recirculation.* November 2006.
31 Ibid. footnote 30.
32 Ibid. footnote 30.
33 Ibid. footnote 28.
34 U.S. EPA. Office of Transportation and Air Quality. *Clean Construction USA, Retrofit Strategies.* September 28, 2007.

determinations in the RBLC or CA-BACT for engines listed as portable units.[35] An SCR system can achieve approximately 90 percent NO_x reduction.[36]

Shell also examined new emerging technologies including NOx adsorbers and Lean NOx Catalyst or Hydrocarbon-SCR systems. Because superior SCR technology was selected for the main generators, these emerging technologies are discussed in more detail for the smaller engines, for which SCR was not considered feasible, in Section 4.3.

Step 2 – Eliminate technically infeasible options.

As discussed earlier, the available control technologies for the *Discoverer's* six diesel generators (FD-1 through FD-6 – 1,325 hp Caterpillar D399 Marine Generator Sets) are ITR, AC, HIP, LND, Tier 2 or 3 level controls, WI, EGR, and SCR. LND, Tier 2 or 3 level controls, EGR, and WI are considered technically infeasible. LND and Tier 2 or 3 level controls are intrinsic to the original engine design and are not part of the Caterpillar D399 design. EGR is not available for these older model engines. WI is considered technically infeasible due to the cold climate in which these generators will be operated, the potential engine retrofit incompatibility, the excessive pure water requirements and limited available ship space for storing the water, and the potential engine damage risk associated with this technology.

ITR, AC, and HIP and engine replacement are considered technically feasible for this generator model. SCR is also considered technically feasible because the engines are stationary on the vessel deck and there is adequate room to install the SCR devices.

Step 3 – Rank remaining technologies by control effectiveness.

The technically feasible control technologies for Generators FD-1 through FD-6 are ranked by control effectiveness as follows:

- Engine Replacement with SCR – 95% control
- SCR – 90 percent control
- ITR, AC, and/or HIP – 10 to 50 percent control
- Good combustion practices

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

Replacement with a new engine of similar size would require the engine to meet the Tier 2 emission standard for off-road engines of 6.4 g/kW-hr or 4.77 grams per horse-power hour (g/hp-hr).[37] Assuming

[35] RBLC ID MS-0086 is incorrectly listed as a portable unit. This engine was a temporary unit that Chevron Products Company rented for nine months for use at a single location (i.e., stationary unit). It was then removed from the site. Brown, Carla. Mississippi Department of Environmental Quality. [Communication with D. Steen, Air Sciences Inc.]. February 9, 2009.

[36] Ibid. footnote 28.

[37] There is no Tier 3 standard for engines of this size and Tier 4 does not become effective until 2011.

SCR would result in 95% control (the high end of expected performance identified in AP-42) the new engine would emit NOx at the rate of 0.32 g/kW-hr. Emissions from each engine would be lowered by 0.56 tons or 3.37 tons for all 6 engines when compared with just SCR applied to the existing engines as guaranteed by D.E.C. Marine AB (D.E.C. Marine guarantees 0.5 g/kW-hr).

The capital cost for each engine replacement is estimated by Shell at $365,000 for an annualized cost rate of $45,001. The cost/benefit ratio is then $80,359 per ton of NOx removed when compared against SCR on the existing engines. This cost is considered too high to be required as BACT and therefore, engine replacement is not considered BACT.

The next most effective feasible NO_x control option is SCR. Shell proposes to apply this control technology to Generators FD-1 through FD-6. Shell acknowledges that there is ammonia slip associated with SCR.

Step 5 – Select NOx BACT for the Diesel Generators.

Shell proposes to employ SCR technology to achieve 0.5 gram/kW-hr. D.E.C. Marine AB, the supplier to several other vessels applying SCR, indicates that this is the highest efficiency control available for the *Discoverer's* diesel-fired generators.[38] Ammonia slip will be minimized through the use of a digital controller system to regulate reagent (urea or aqueous ammonia) delivery to the SCR based on engine load, which is strongly correlated to NOx emission rate. The load/reagent injection algorithm is checked via periodic (hourly) NOx monitoring.

We note that 0.5 g/kW-hr is an extremely low NOx emission factor. The three most recent permits issued by the Alaska DEC for diesel engine generators used the following emission factors:

- Nixon Fork Mine, Issued 8/13/2009 included a permit for an engine generator operating at 11.1 g/kW-hr
- The Naknek Power Plant, Issued 3/31/2009 included a permit for an engine generator with an emission rate of 26.0 g/kW-hr
- The Liberty Offshore Oil Project (BP), Issued 12/19/2008 included a permit for an engine generator with an emission rate of 6.3 g/kW-hr.

The recent Tier 4 emission limits for non-road engines that will not take effect until 2011 will only require that engines meet an emission rate of 3.5 g/kW-hr. EPA's emission factor reference document indicates uncontrolled diesel engines have an emission rate of 14.6 g/kW-hr and that SCR technology can control 80% to 95% of NOx emissions. Even at 95% control, the emission factor for NOx would be 0.729 g/kW-

[38] Ibid. footnote 1.

hr. Thus the quoted emission factor for the current project reflects a 97% control over the current AP-42 emission factor for SCR-controlled engines.

Despite this advanced performance, the manufacturer has indicated that under ideal conditions, including steady loads and mild ambient temperatures, the engines may actually perform at an emission rate as low as 0.1 g/kW-hr. However, they are only willing to guarantee emissions of 0.5 g/kW-hr. Shell believes 0.5 g/kW-hr is BACT for these engines. While lower levels might be attained under some conditions, such low levels cannot be continuously attained and do not reflect BACT.

4.2.2 Particulate Matter BACT Analyses

This section addresses BACT for particulate matter. As initially discussed early in Section 4.1, this BACT analysis applies to PM, PM_{10}, and $PM_{2.5}$ even though (for brevity) the text refers only to PM.

Step 1 – Identify all available control technologies.

Diesel PM is a complex mixture of compounds formed through a number of different mechanisms. PM is comprised of the soluble organic fraction (SOF), the insoluble (solid) fraction, and the sulfate fraction. Fuel and lube oil contribute to the SOF fraction. The insoluble fraction is primarily dry carbonaceous soot from “too-rich-to-burn” fuel combustion. The sulfate fraction is produced from the sulfur in diesel fuel. This fraction can only be controlled by limiting fuel sulfur content.

The available PM control technologies for the *Discoverer's* engines, boilers, and incinerator were determined from searches performed on the RBLC and the CA-BACT. The search conditions and a summary of the resulting control technologies are provided in Table 4-3. This section discusses the results for the main diesel generators. Subsequent sections will refer to the other information shown in Table 4-3. The complete downloads are provided in Appendix C. For the RBLC, only determinations made after Jan. 1, 1999 were downloaded.

The available PM combustion control technologies for diesel engines identified in the RBLC and CA-BACT and shown in Table 4-3 are LSF, oxidation catalyst (OxyCat), diesel particulate filter (DPF), Tier 2 or 3 level controls, and closed crankcase ventilation (CCV). Although not listed in the RBLC or CA-BACT, the combination of OxyCat and DPF referred to as catalytic diesel particulate filter (CDPF) is also an available control technology for PM reduction. Engine replacement was also evaluated.

LSF reduces the sulfate PM fraction by limiting the amount of sulfur in the fuel that is available for sulfate formation. An OxyCat removes the SOF of PM through catalytic oxidation of the combustible organic matter resulting in an overall PM control efficiency of 50 percent.[39] A DPF removes the insoluble (solid) fraction of PM (soot) by filtration with an overall PM control efficiency of 40 to 50 percent.[40,41] CDPFs

[39] Ibid. footnote 2.

[40] Khair, Magdi K. DieselNet Technology Guide. *Engine Design for PM Control.* May 2002.

Table 4-3: Available PM Control Technologies

Source Category	Clearinghouse	Search Conditions	Control Technologies
Diesel IC Engines (>500 hp) Applicable to: Main Generators MLC Compressor Engines	RBLC	Process Code = 17.110	None, LSF, CCV, Tier 2/3
	CA-BACT	I.C. Engines - CI, Non-Emergency (>500 hp)	None, OxyCat, LSF, CCV, DPF
Diesel IC Engines (≤500 hp) Applicable to: HPU Engines, Deck Cranes, Cemeting Units, Logging Winches	RBLC	Process Code = 17.210	None, LSF, CCV
	CA-BACT	I.C. Engines - CI, Non-Emergency (≤500 hp)	None, LSF, CCV
Boiler (≤100 MMBtu/hr) Applicable to: Heater Boilers	RBLC	Process Code = 13.220	None
	CA-BACT	Boilers – Oil Fired (≤100 MMBtu)	No determinations
Incinerator	RBLC	Process Description = Incinerator; Fuel = Solid Waste	None, ESP
	CA-BACT		No determinations

CI: Compression Ignition.

Process Code Key:

17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

13.220 - Commercial/Institutional-Size Boilers/Furnaces (≤100 million BTU/H); Distillate Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

Control Technology Key:

- DPF: Diesel Particulate Filter
- LSF: Low Sulfur Fuel
- OxyCat: Oxidation Catalyst
- CCV: Closed Crankcase Ventilation
- TIER 2/3: EPA Non-Road Engine Emission Standards per 40 CFR 89.112
- None: No specific technology listed or good combustion practices

remove both the SOF and the insoluble fraction of PM with an overall PM control efficiency of 85 percent.[42]

The crankcase of a combustion engine accumulates gases and oil mist called blowby that leak into the crankcase from the combustion chamber and other sources. The blowby gases must be vented from the crankcase to prevent damage. Due to the fact that blowby gas contains PM, which is 100 percent SOF,[43]

[41] Majewski, Addy W. DieselNet Technology Guide. *Diesel Particulate Filters.* July 2001.

[42] California EPA. Air Resource Board. *Verification Procedure - Currently Verified, CleanAIR Systems PERMIT*. January 26, 2009. http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

[43] Jaaskelainen, Hannu. DieselNet Technology Guide. *Crankcase Ventilation.* January 2009.

it should be handled such that it does not contribute to PM emissions. The CCV system was developed to remove blowby from the engine and to prevent those vapors from being expelled into the atmosphere. The CCV system does this by directing the blowby back to the intake manifold, so it can be combusted. All of the reciprocating engines on the *Discoverer* will be equipped with a closed circuit crankcase ventilation system to control PM emissions from crankcase ventilation.

Regardless of the technology applied to achieve BACT, EPA regulations require that the BACT is no less stringent than an applicable NSPS emission rate. As discussed above in the NO_x BACT analysis, EPA has promulgated exhaust emission standards for non-road engines under 40 CFR 89.112 in 1998. Engines designed to meet Tier 2 or 3 PM emission standards typically employ a combination of low PM emitting engine designs and DPF or CDPF.[44] The overall PM control for Tier 3 engines is 85 percent.[45] The NSPS PM emission standards applicable to the 540 hp MLC compressor engines is provided in Table 4-4.

Table 4-4: EPA Tier 1-3 Non-Road Diesel Engine PM Emission Standards

Engine Power	Tier	Year	PM g/kWh (g/bhp-hr)
225 ≤ kW < 450	Tier 1	1996	0.54 (0.4)
(300 ≤ hp < 600)	Tier 2	2001	0.2 (0.15)
	Tier 3	2006	0.2 (0.15)
450 ≤ kW < 560	Tier 1	1996	0.54 (0.4)
(600 ≤ hp < 750)	Tier 2	2002	0.2 (0.15)
	Tier 3	2006	0.2 (0.15)
kW ≥ 560	Tier 1	2000	0.54 (0.4)
(hp ≥ 750)	Tier 2	2006	0.2 (0.15)

Step 2 – Eliminate technically infeasible options.

As discussed above, the available control technologies for the *Discoverer's* main generator engines are LSF, OxyCat, DPF, CDPF, Tier 2 level controls, and PCV. Tier 2 level controls and PCV are intrinsic to the original engine design. Therefore, other than the consideration of engine replacement, these control technologies are only considered technically feasibility if they are already a part of the design of the *Discoverer's* diesel engines. For the main generators, these technologies are not intrinsic to the existing engines. LSF, OxyCat, DPF and CDPF are considered technically feasible for the *Discoverer* generators.

The use of CDPF on these engines is difficult and may be infeasible because these filters add back pressure on the engines which will cause the SCR system to fail. We have, nonetheless, carried this technology to the next step in the evaluation.

[44] Ibid. footnote 40.

[45] The Tier 3 PM emission standard for large non-road engines is 0.2 g/kWh or 0.15 g/hp-hr. The base case is considered to be approximately 1 g/hp-hr.

Step 3 – Rank remaining technologies by control effectiveness.

The technically feasible control technologies for the *Discoverer's* diesel engines are ranked by control effectiveness as follows:

- Engine replacement with CDPF or OxyCat
- CDPF – 85 percent control (technically feasible for all engines except Caterpillar D399 with SCR);
- OxyCat – 50 percent control,
- DPF – 40 to 50 percent control,
- Good combustion practices.

ULSD, even lower in emission than LSF, is included in all the above technologies.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

Similar to the calculation made above for NOx, engine replacement was evaluated for particulate matter, but the cost per ton for engine replacement is even higher because particulate matter mass emissions are much lower. For example, even if the new engine had no particulate matter emissions, the reduction would be only 0.4 t/y per engine. With the annual cost of $45,001 to replace the engine, cost/benefit calculations show over $110,000 per ton of particulate matter removed. This cost is considered too high to be required as BACT and therefore, engine replacement is not considered BACT for PM with or without additional add-on controls.

For the *Discoverer's* six diesel generators (FD-1 through FD-6 – 1,325 hp Caterpillar D399 Marine Generator Set), the CDPF is commercially infeasible. The potential reduction in emissions is very small because emissions of particulate matter are very small with the OxyCat control. Each engine emits only 0.4 tons per year of PM. The use of CDPF as an alternative to OxyCat, if it were feasible, would reduce PM emissions by only 0.28 tons/year. The cost benefit for CDPF would be from $22,000 to $27,000 per ton of PM removed. This cost is considered too high to be required as BACT and therefore, CDPF is not considered BACT. Appendix C provides more calculation details.

Step 5 – Select PM BACT for the Diesel Generators.

Shell proposes that BACT for the main diesel generators (FD-1 through FD-6) be the use of ULSD as the only fuel, the installation of closed crankcase ventilation and the addition of an OxyCat control system to the exhaust.

4.2.3 SO_2 BACT Analysis

Step 1 – Identify all available control technologies.

Combusting fuels containing sulfur produces SO_2 emissions. Available SO_2 control technologies for the *Discoverer's* engines, boilers, and incinerator fall into two categories: combustion of low sulfur fuels and post-combustion exhaust treatment (generically referred to as flue gas desulfurization). Post-combustion exhaust treatment relies on the removal of SO_2 from the exhaust stream through wet or dry adsorption.

The available SO_2 control technologies for the *Discoverer's* engines, boilers, and incinerator were determined based on searches performed on the RBLC and CA-BACT. The search conditions and a summary of the resulting control technologies are provided in Table 4-5. The complete downloads are provided in Appendix C. For the RBLC, only those determinations made after January 1, 1999 were downloaded.

Table 4-5: Available SO_2 Control Technologies

Source Category	Clearinghouse	Search Conditions	Control Technologies
Diesel IC Engines (>500 hp) Applicable to: Main Generators MLC Compressor Engines	RBLC	Process Code = 17.110	None, LSF
	CA-BACT	I.C. Engines - CI, Non-Emergency (>500 hp)	None, LSF
Diesel IC Engines (≤500 hp) Applicable to: HPU Engines, Deck Cranes, Cemeting Units, Logging Winches	RBLC	Process Code = 17.210	None, LSF
	CA-BACT	I.C. Engines - CI, Non-Emergency (≤500 hp)	None, LSF
Boiler (≤100 MMBtu/hr) Applicable to: Heater Boilers	RBLC	Process Code = 13.220	None, LSF
	CA-BACT	Boilers – Oil Fired (≤100 MMBtu)	No determinations
Incinerator	RBLC	Process Description = Incinerator; Fuel = Solid Waste	None, LSF, SDS
	CA-BACT		No determinations

CI: Compression Ignition

Process Code Key:

17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

13.220 - Commercial/Institutional-Size Boilers/Furnaces (≤100 million BTU/H); Distillate Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

Control Technology Key:

LSF: Low Sulfur Fuel (defined as ≤0.1 weight percent sulfur for the purpose of this analysis)

SDS: Semi-Dry Scrubber

None: No specific technology listed

The available SO_2 control technology for diesel engines identified in the RBLC and CA-BACT is the use of Low Sulfur Fuel (LSF). For the purpose of this analysis, LSF is considered to be 0.1 percent sulfur by weight or less. Fuel sulfur contents listed in the RBLC and CA-BACT determinations ranged from ≤0.0015 to ≤0.5 weight percent. The most prevalent fuel sulfur contents listed for the diesel engines and diesel-fired boilers were ≤0.05 and ≤0.15 weight percent, respectively.

Step 2 – Eliminate technically infeasible options.

As discussed above, the available control technology for the *Discoverer's* diesel engines and diesel-fired boilers is LSF. LSF is considered technically feasible for these diesel combustion units.

None of the BACT databases reviewed specified flue gas desulfurization (FGD) as BACT for engines in the type and size class of the main generators. This supports the conclusion that FGD is not economically feasible when substantial sulfur dioxide emission control can be achieved through limitations on fuel sulfur content. The cost of FGD is not feasible when considered in relation to the additional emission reduction FGD provides after LSF utilization is implemented. Additionally, FGD involves installing scrubber chambers and reagent (e.g. wet or dry $CaCO_3$) and reactant (e.g., $CaSO_3$) storage vessels and transport systems. The space requirements and other technical considerations (e.g., freeze-up) related to this equipment make FGD technically infeasible as BACT on drill ship emission units.

Step 3 – Rank remaining technologies by control effectiveness.

The technically feasible control technologies for the *Discoverer's* diesel engines and diesel-fired boilers are ranked by control effectiveness as follows:

- Ultra-low sulfur fuel: ≤0.0015 weight percent sulfur (15 ppm)
- Low sulfur diesel: ≤0.05 weight percent sulfur
- Non-low sulfur diesel fuels: >0.05 weight percent sulfur

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The top control option from Step 3 is proposed as BACT, so additional analyses are not warranted.

Step 5 – Select SO_2 BACT for the Diesel Engines and Boilers.

Shell proposes the exclusive use of ultra-low sulfur diesel, which is the lowest sulfur diesel fuel available, as BACT for the *Discoverer's* diesel engines and diesel-fired boilers.

4.2.4 CO/VOC BACT Analysis

With few exceptions, technology used to control CO emissions from combustion sources, including internal combustion engines, also provides collateral control of volatile organic compound (VOC) emissions. Accordingly, the following analysis addresses CO and VOC control in combination, with exceptions noted.

Step 1 – Identify all available control technologies.

The available CO and VOC control technologies for the *Discoverer's* engines, boilers, and incinerator were determined from searches performed on the RBLC and the CA-BACT. The search conditions and a summary of the resulting control technologies are provided in Table 4-6. The complete downloads are provided in Appendix C. For the RBLC, only those determinations made after January 1, 1999 were downloaded. Shell notes that internal combustion engine crankcase ventilation gases contain some VOC. Closed circuit crankcase ventilation (CCV) reduces emissions from crankcase blow-by and is included on all engines.

Table 4-6: Available CO/VOC Control Technologies

Source Category	Clearinghouse	Search Conditions	Control Technologies
Diesel IC Engines (>500 hp) Applicable to: Main Generators MLC Compressor Engines	RBLC CA-BACT	Process Code = 17.110 I.C. Engines - CI, Non-Emergency (>500 hp)	None, OxyCat, Tier 2/3 None, OxyCat
Diesel IC Engines (≤500 hp) Applicable to: HPU Engines, Deck Cranes, Cemeting Units, Logging Winches	RBLC CA-BACT	Process Code = 17.210 I.C. Engines - CI, Non-Emergency (≤500 hp)	Good Combustion Practices None, OxyCat
Boiler (≤100 MMBtu/hr) Applicable to: Heater Boilers	RBLC CA-BACT	Process Code = 13.220 Boilers – Oil Fired (≤100 MMBtu)	Good Combustion Practices Good Combustion Practices
Incinerator	RBLC CA-BACT	Process Description = Incinerator; Fuel = Solid Waste	Good Combustion Practices No determinations

CI: Compression Ignition

Process Code Key:

17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

13.220 - Commercial/Institutional-Size Boilers/Furnaces (≤100 million BTU/H); Distillate Fuel Oil (ASTM #1, 2, includes kerosene, aviation, diesel fuel).

Control Technology Key:

OxyCat: Oxidation Catalyst

TIER 2/3: EPA Non-Road Engine Emission Standards per 40 CFR 89.112

None: No specific technology listed or good combustion practices

The available CO/VOC combustion control technologies for the generator engines identified in the RBLC and CA-BACT are OxyCat and Tier 2 level controls available only through engine replacement. OxyCat reduces CO/VOC emission through catalytic oxidation of these combustible gases, resulting in an overall CO control efficiency of 80% and VOC emission control efficiency of approximately 70%.[46] Engines designed to meet Tier 2 emission standards typically employ a combination of advanced combustion technology and catalytic oxidation. However, new Tier 2 engines are only required to meet a standard of 3.5 g/kW-hr, before the addition of any controls. The manufacturer's specifications for the existing main generators on the *Discoverer* already meet this specification, so it is unclear that any CO or VOC reduction would be achieved by engine replacement. Although not listed in the RBLC or CA-BACT, CDPF reduces CO and VOC emissions through catalytic oxidation with an overall control efficiency of 80% and 90%, respectively.[47]

Step 2 – Eliminate technically infeasible options.

As discussed above, the available control technologies for the *Discoverer's* diesel engines are OxyCat and CDPF. OxyCat and CDPF are both considered technically feasible for the main generator engines, but as noted above, the use of CDPF on the main generators equipped with SCR would produce unacceptable back-pressure.

Step 3 – Rank remaining technologies by control effectiveness.

The technically feasible control technologies for the *Discoverer's* diesel engines are ranked by control effectiveness as follows:

- CDPF – 80 percent control (technically feasible for all engines),
- OxyCat – 80/70 percent control for CO/VOC, respectively,
- Good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

For the *Discoverer's* six diesel generators (FD-1 through FD-6 – 1,325 hp Caterpillar D399 Marine Generator Set), the top control option (CDPF) is technically infeasible because of unacceptably high back-pressure. Even if it were feasible, it provides the same level of CO control and only slightly better VOC control as the next control option (OxyCat). Considering the total capital cost of CDPF of $640,000 for six units, as shown in Appendix C, the economic impact of CDPF does not justify the marginal environmental benefit. CDPF is considered not to be cost-effective.

[46] Ibid. footnote 1.
[47] Ibid. footnote 55.

Step 5 – Select CO/VOC BACT for the Diesel Engines.

For the main diesel generators Shell proposes OxyCat and CCV as BACT for CO and VOC.

4.3 Smaller Diesel Engines

The small diesel engines associated with the proposed source can be divided into five categories:

- Air compressors and hydraulic power units
- Cranes
- Cementing Units
- Logging Units
- Diesel Generators on the Supply Ship

This section provides information and operational details for each group of engines.

MLC Air Compressors and HPU (FD-9, 10, 11, 12, and 13)

Table 4-7 identifies the MLC air compressor engine size, make and model numbers. As stated above, these engines will be designed to meet new Tier 3 engine regulations, the most stringent emissions standards for commercially available engines of this size.

Table 4-7. MLC Air Compressor Tier 3 Engines

Unit	Manufacturer	Model No	Size (hp)	Load %	Operating factor (days per year)
FD-9	Caterpillar	C-15	540	50 to 100	63
FD-10	Caterpillar	C-15	540	50 to 100	63
FD-11	Caterpillar	C-15	540	50 to 100	63

Table 4-8 identifies the HPU engine sizes, make and model numbers. The HPUs are existing engines with catalytic diesel particulate filters (CDPF) for control of VOCs, CO and PM. The engines were built in 1978 and 1979.

Table 4-8. Hydraulic Power Units

Unit	Manufacturer	Model No	Size (hp)	Load %	Operating factor (days per year)
FD-12	Detroit	8V71	250	50 to 100	63
FD-13	Detroit	8V71	250	50 to 100	63

The MLC equipment is temporary equipment that is loaded onto the drill ship for the MLC drilling operation that occurs at the beginning of the well drilling program. The two hydraulic power units (HPUs) and the three air compressor units (ACUs) are each powered by diesel engines. These units have been designed to be portable so they can be removed from the drill ship at any time, should the deck space be required for other equipment or materials. However, operationally, the preference is to have these units available on board the drill ship to minimize time required to set up the units for a second MLC operation if so required, as well as to reduce the potential of damage or corrosion that might occur if they are stored on the deck of an anchor handling supply vessel. The air compressors are quite large (20 ft x 7.3 ft w x 8 ft h each), and as a result there is a limited number of locations that will allow easy access for operations and maintenance. The area chosen was the port forward casing racks near the drill floor.

Operationally, the HPUs need to be located as close to well center as possible to reduce the length of the umbilical hose that is required to supply the power fluid to the MLC bit. In 2007, the chosen location to store and operate the HPUs was the top of the BOP 'garage'. Although limited on space to layout the HPUs and the hose reel, the proximity to and straight line access to the drill floor was an advantage. Each HPU is approximately 12 ft x 7 ft w x 8 ft h.

Cranes (FD-14 and 15)

The *Discoverer* has two cranes mounted on pedestals that are used intermittently to move materials around the deck and to on-load supplies from the re-supply vessel. The engine operating rates are highly variable, and depend on the load being moved. The crane engines have CDPFs for control of soluble organic fraction and solid particulate matter, carbon monoxide, and volatile organics. The crane engines were built in 1974. A summary of the crane engines are shown in Table 4-9.

Table 4-9. Crane engine sizes, make and model numbers..

Unit	Manufacturer	Model No	Size (hp)	Load %	Operating factor (days per year)
FD-14	Caterpillar	D343	365	variable	63
FD-15	Caterpillar	D343	365	variable	

Cement Units (FD-16, 17, and 18)

Three cementing units are used intermittently to fix casings in the hole and seal the drill hole when drilling is interrupted or ended. The cementing units are equipped with CDPFs for control of volatile organics, carbon monoxide, and organic particulate matter. Table 4-10 below identifies the cementing unit engine characteristics.

Table 4-10. Cementing Units

Unit	Manufacturer	Model No	Size (hp)	Load %	Operating factor (days per year)
FD-16	Detroit	8V-71N	335	Low	168
FD-17	Detroit	8V-71N	335	Low	168
FD-18	GM	3-71	147	Low	168

Logging Units (FD-19 and 20)

The Logging winch unit and electrical power generator are powered by diesel engines. The logging equipment is used to gather information from the well after the drill stem is removed. When the logging equipment is operated, the cementing units would be off and the drilling generators would be operating at low load. The logging units operate at variable and unpredictable loads. The logging units also have CDPFs for control of volatile organics, carbon monoxide, and organic and solid particulate matter.

The electrical generator has a Tier 2 MMG35 generator engine (35 hp). The load for the generator varies depending on the type of operation and is summarized as follows, but the generators are very lightly loaded most of the time.

- Data Acquisition systems – Steady load ~5-10KW
- Lights – Varying load 0 – 3 KW.
- Heating – Varying load 0 – 20 KW

The logging winch unit (Caterpillar C7, 250 hp) meets the Tier 3 engine standard. The loads on the winch unit also vary and are summarized as follows:

- <5% during rig-up, rig-down, and when stopped in a well.
- Negative while descending into the well. While the tools are moving downward the engine is acting as a brake on the hydraulic system.
- ~5-15% of full power while logging the well dependent on tension and logging speed.
- 20-100% when retrieving the tools after logging, with the power need dependent on tension and well depth. With the power level dropping constantly as tension drops due cable retrieval. During this phase the load goes to zero every time the winch is stopped.

A logging job does not proceed smoothly through the four phases described above in a progression. During decent the winch is reversed several times to check tension, to clear obstructions, and to run repeat section. During retrieval the winch is often stopped when an obstruction is encountered or a wrap is missed.

A summary of the logging unit engine characteristics are shown in Table 4-11. Only one John Deere unit is required. Either unit 3248 or 3285 will be sent to the rig prior to the start of the drilling season. Both John Deere units were built in 2005 and the Caterpillar unit was built in 2008.

Table 4-11. Logging Units (Generators and Winch Units) model year

Unit	Manufacturer	Model No	Size (hp)	Load %	Operating factor (days per year)
3248	John Deere	PE4020TF270D	35	Light and variable	168
3285	John Deere	PE4020TF270D	35	Light and variable	168
1723	Caterpillar	C7	250	Light and variable	168

Supply Ship Diesel Generators (FD-31)

If the supply ship is attached to the *Discoverer* when it is an OCS Source, the engines on the supply ship become part of the stationary source and subject to BACT. Only one of two identical utility generators on board the supply ship will operate when the supply ship is attached to the *Discoverer*. The utility generator engines are both Caterpillar D3406 engines. Because of their infrequent connection to the *Discoverer* (only 96 hours per year) annual emissions from these engines are very small, so the cost of any proposed control measure is very high when compared with the potential emission reduction.

4.3.1 NOx BACT Analysis

NO_X is generated when combustion temperatures are high enough for the nitrogen in the combustion air or bound in the fuel to combine with oxygen to form NO. Depending upon conditions, some portion of the NO will react to form NO_2.

Step 1 – Identify all available control technologies.

There are a variety of options available for controlling NO_X emissions from combustion sources. Some options involve combustion controls that reduce NO_X formation, while others utilize add-on control devices to remove NO_X after it is formed. NOx reduction approaches that do not involve the application of a control technology were also considered.

Cam Shaft Cylinder Reengineering Kit

The Clean Cam Technology Systems (CCTS) technology consists of engine-specific retrofit components, including a proprietary cam shaft. It reduces NOx emissions by increasing the volume of residual exhaust gas that remains in the combustion chamber after the power stroke. These residual exhaust gases absorb heat and reduce the peak combustion temperature, which results in lower NOx emissions. The heat absorption by the residual exhaust gases occurs within the camshaft to reduce NOx and does not lower the exhaust temperature. The injection timing can be advanced on some engines to maximize PM emission reductions, or it can be varied to achieve the desired balance of NOx versus PM reductions.

The technology has been certified through the California Air Resources Board's (CARB's) Equipment and Process Certification Program.

Exhaust Gas Recirculation (EGR)

Exhaust gas recirculation reduces NOx emissions from diesel engines by re-circulating exhaust gases back to the turbocharger or, in the case of naturally aspirated engines, to the intake manifold. The temperature of the re-circulated gases is typically lowered with an intercooler. The cooled exhaust gases have a higher heat capacity than air and contain less oxygen thereby lowering NOx formation. Both low and high pressure EGR systems exist, but the low-pressure EGR is the most suitable for retrofit applications because it does not require engine modifications.[48]

Ignition Timing Retard (ITR)

Retarding the ignition timing delays the start of fuel injection to later in the power cycle, which increases the volume of the combustion chamber and reduces the residence time of the combustion products, thereby reducing the magnitude and duration of peak temperatures. This, in turn, has the potential for reduced NOx formation.

Engine Replacement

Engine replacement is not a control technology *per se*, but replacing an existing engine with a new engine of more current design that emits NOx at a lower rate can result in lower emissions. To be a feasible alternative, the replacement engine would have to be capable of performing the duties required of the existing engine under the same operational conditions.

New replacement engines would be manufactured to meet Federal Tier 3 emission standards. The State of California imposes more stringent emission regulations than the Federal standards. Several of the references in this evaluation also include reference to the work by the California Air Resources Board (CARB). The CARB has created a voluntary Portable Engine Registration Program (PERP), which allows owners and operators to register their portable engines/equipment and operate them throughout the state without obtaining permits from local air districts. The current registration requirements for 2009 and 2010 are as follows:

- Engines rated 50 to 75 bhp: Interim Tier 4.
- Engines rated 75 to 750 bhp: Tier 3.
- Engines rated over 750 bhp and over: Tier 2.

Air Pollution Control Districts (APCDs) and Air Quality Management Districts (AQMDs) in California use this program when permitting portable engines including engines that are skid mounted for offshore

[48] Stationary Diesel Engines in the Northeast: An Initial Assessment of the Regional Population, Control Technology Options and Air Quality Policy Issues, Northeast States for Coordinated Air Use Management, June 2003.tionary

platforms and drilling operations. For example, the Santa Barbara County APCD, which has offshore platforms in its jurisdiction, considers the CARB Portable Engine Registration Program as BACT, and does not require additional controls for engines associated with those sources.[49]

Selective Catalytic Reduction (SCR)

Selective catalytic reduction (SCR) systems are widely used technologies for controlling NO_X emissions from combustion sources. In the SCR process, ammonia or urea is mixed with the exhaust from a combustion device, and the NO_X reacts with the ammonia to form nitrogen and water. The mixture is passed through a catalyst bed, which allows the reduction reaction to proceed at lower temperatures than it would otherwise occur.

NOx Adsorber

Under this technology, NOx is adsorbed by a chemical, typically a barium salt, or other elemental salt. The adsorbent is coated onto a honeycomb monolith or onto the inside surface of the exhaust duct. Once the catalyst is saturated, the NOx adsorbers must be regenerated. Regeneration requires heat and storage of chemical (e.g. potassium) which results in KNO3.

Lean NOx Catalyst (LNC) or Hydrocarbon-SCR (HC SCR)

Lean NOx catalysts (LNC), also known as hydrocarbon-SCR (HC-SCR) systems, use an advanced catalyst to capture and store NOx. The catalyst is regenerated during short periods when excess hydrocarbon (HC) in the exhaust removes the stored NOx and reduces it to nitrogen and water. The HC in the exhaust can be either unburned fuel ("native") from the engine, or additional fuel added to the exhaust gases through injection. This system has the advantage that no additional reductant, such as the ammonia or urea required for an SCR system, is necessary. Emissions of excess HC reductant (i.e., "slip") is addressed by a DPF (Diesel Particulate Filter) or a DOC (Diesel Oxidation Catalyst) located downstream of the system. Similar to SCR systems, LNC systems operate best at consistent high loads, and are not amenable to long periods of engine idle.

Summary of Potential Control Alternatives

Based on literature and database searches the following alternatives are possible for controlling NO_X emissions from compression ignition engines less than 600 hp:

- Cam Shaft Cylinder Reengineering Kit
- Exhaust Gas Recirculation (EGR)
- Ignition Timing Retard (ITR)

[49] Personal conversation with Terry Snyder of the Santa Barbara County Air Pollution Control District on November 17, 2009

- Engine Replacement
- Selective Catalytic Reduction (SCR)
- NOx Adsorber
- Lean NOx Catalyst (LNC) or Hydrocarbon-SCR (HC-SCR)

Table 4-12 provides a summary of the BACT Control Options for each of the engine groups considered here.

Table 4-12. Summary of NOx BACT Analysis for Small Engines

Engine:		MLC Comp.	HPU	Cranes	Large Cement	Small Cement	Large Logging	Small Logging	Supply Ship Gen.
Model:		Cat. C15	DD 8V71	Cat D343	DD 8V71	GM 3-71	Cat C7	Deere	Cat 3406
Size:		540 hp	250 hp	365hp	335 hp	147 hp	250 hp	35 hp	292 hp
Quantity:		3	2	2	2	1	1	1	2
Option									
Replace	Included?	No	No	No	No	No	No	No	No
	Cost/ton?		$8,671	$25,790	$44,744	$44,740		$54,576	$36,224
SCR	Included?	No	No	No	No	No	No	No	No
	Feasible?	No	No	No	No	No	No	No	No
	Cost/ton?								
NOx Adsorber	Included?	No	No	No	No	No	No	No	No
	Feasible?	No	No	No	No	No	No	No	No
	Cost/ton?	$36,896							
Lean NOx Cat	Included?	No	No	No	No	No	No	No	No
	Feasible?	No	No	No	No	No	No	No	No
	Cost/ton?								
Clean Cam	Included?	Yes	No	No	No	No	Yes	Yes	No
	Feasible?		Yes	No	Yes	No			No
	Cost/ton?		$16,202		$12,206				
EGR	Included?	Yes	No	No	No	No	Yes	Yes	No
	Feasible?		No	No	No	No			No
	Cost/ton?								
ITR	Included?	Yes	No	No	No	No	Yes	Yes	No
	Feasible?		No	No	No	No			No
	Cost/ton?								

"Included" means the technology is currently installed or proposed to be installed.

Step 2 – Eliminate technically infeasible options.

In this section, the control alternatives presented in the previous section are evaluated for technical feasibility as applied to the proposed engines under the proposed operational conditions.

Cam Shaft Cylinder Reengineering Kit

The CCTS retrofit kit is designed for older (pre-MY2000) Detroit Diesel Corporation two-stroke engines, model series 71 and 92. It is commercially available and has been installed on engines used in oil well

drilling. The manufacturer also indicates that they are moving more towards marine applications and the product has been tested on a U.S. Navy ship. This product can be used with existing California diesel fuel, and testing is underway for the use with ULSD. This product was also tested in Alaska, and the manufacturer found that the system performs adequately under the cold climate when using regular diesel fuel.[50] However, the CCTS retrofit kits are not available for the Caterpillar engines, and so are considered technically infeasible for all engines except the two HPU engines and the two larger Cementing unit engines.

Exhaust Gas Recirculation (EGR)

It is not technically feasible to retrofit the HPU units, the cement units, the cranes and the supply ship generator with exhaust gas recirculation (EGR) systems. The HPU and cementing units are older two-stoke engines which are not amenable to these modifications because the engines intake through the block and vent through the valves. The cranes and the supply ship generators are older Caterpillar engines and EGR is not available for these engines. The remaining engines, the MLC compressors and the logging unit engines, are all newer and incorporate EGR in the low NOx design of the engine. Accordingly, adding EGR is considered infeasible for all engines.

Ignition Timing Retard (ITR)

The extent to which the fuel injection can be retarded to reduce NOx emissions varies for each engine, as ITR can increase exhaust temperatures, which may adversely impact exhaust valve life and turbocharger performance, and extreme levels of ITR may result in combustion instability and a loss of power. In addition, the Brake-specific fuel consumption increases. While the maximum power output of the engine is reduced, this reduction is generally minor. In addition, emissions of hydrocarbons will increase.[51] This increase can be more than offset with a combined use of a diesel particulate filter. The newer engines, however, are not amenable to ITR because these engines have already been optimized as part of the low NOx design. In effect, they incorporate the benefits of ITR in the low NOx design of the engine. The older engines do not have electronic fuel injection systems. Electronic controls are used to sense ambient conditions and engine operation to maximize performance and minimize emissions over a wide range of conditions, such as the transient operation of the engine and extreme ambient temperatures.[52] Due to the loss of power and the lack of electronic controls, this technology would have little, if any, benefit if applied to the HPU units, the cement units, the cranes or the supply ship generators. Accordingly, ITR is considered infeasible for all engines.

[50] Personal communication with Clean Cam Technology Systems manufacturer. November, 2009

[51] Proposed Determination of Reasonably Available Control Technology and Best Available Control Technology for Stationary Spark-Ignited Combustion Engines, California Air Resources Board, April, 2001

[52] Final Regulatory Support Document: Control of Emissions from New Marine Compression-Ignited Engines at or Above 30 Liters per Cylinder, USEPA, EPA420-R-03-004, January 2003.

It should be noted all engines on this rig including Cement Units are mechanically injected making it more difficult to adjust the engines under ambient conditions found in the Arctic. It should be pointed out that HC and DPM will increase if only ITR is applied to these engines. ITR and AC reduce NOx at the expense of incomplete combustion; this increases PM, VOC, and CO emissions, reduced fuel economy, and contaminates the lube oil with soot. Furthermore, as previously discussed, Engines FD-12 through FD-20 will be equipped with CDPF controls to reduce PM and CO emissions. Without electronic fuel injection systems, it would be difficult to achieve the level of control identified for this technology. Due to these energy and environmental considerations, ITR is not considered further.

Engine Replacement

Because Tier 3 is the most stringent non-road emission standards for engines rated between 75 and 750 brake horsepower-hours, operating with Tier 3 engines would be another emission reduction strategy. The three MLC air compressor engines and the Logging wireline unit engines are all Tier 3 and therefore are not candidates for engine replacement. To replace the cement unit engines with newer Tier 3 engines would require replacing the entire cementing skid unit. This in turn would require more deck space and a complete re-install. New Tier 3 engines are larger and will not fit in the existing skid frame. Engine replacement is not considered for the newer engines (the compressor engines and the larger logging unit) because these engines are already Tier 3 and there would be no benefit from replacing with a new unit. Engine replacement is evaluated for the other engines.

Selective Catalytic Reduction (SCR)

While SCR is proposed for the main generator sets, several issues have been identified with applying SCR to the smaller air compressor engines, HPUs and other smaller CI engines. The six Caterpillar D399 generator sets (1,325 hp each) provide the primary systems power for drilling and ship utilities and are operational at varying load levels throughout the drilling process. Under normal operating conditions, no more than five engines will operate at one time, leaving one as a spare. For these generators, Shell plans to utilize ~42 percent concentration urea, which corresponds to salt out temperature of approx 40 °F and an exhaust stream temperature to be maintained at 300 to 400°C. For these larger engines, it may be easier to maintain these temperatures due to their operating profile. However, the smaller engines operate on a more intermittent basis with a wide range of loads. The figures above show that the engines are located on deck where space is extremely limited.

The following analysis addresses the application of SCR to these smaller engines:

- The dynamic loading of the smaller engines (short-term load swings of up to 50 percent) can be expected when these engines are operated. These changing load demands will cause the SCR system to be ineffective at scrubbing NOx emissions from the exhaust gases, because the engines may not be sufficiently loaded to achieve exhaust temperatures necessary for optimal

performance of the catalyst. It is estimated that NOx reduction may be as little as 20 percent at exhaust temperatures below 400°F (204 °C)[53].

- These engines will be operating under cold climate conditions in the Arctic, and the fact that they are all located on the topsides deck of the rig severely reduces their ability to maintain effectively high temperatures.
- Urea concentration is directly correlated to salt out temperature. For smaller engines with lower exhaust temperatures, the urea concentration would logically need to increase to get the same NOx emissions reduction as compared to the larger generator engines. If urea was used on deck in the Arctic, it would be extremely difficult to keep the temperatures high enough to stay in solution. If the salt was allowed to precipitate out, there would be a continuous build up of salt on the SCR catalyst and a corresponding increase in engine backpressure, which ultimately could lead to catastrophic damage to the engine. A Catalyst vendor indicated a concern with exposing the catalysts to arctic temperatures without additional insulation and heat tracers.[54]
- Due to the characteristics described in items 1 to 3 above, there is potential for catalyst fouling and disintegration.
- Ammonia slip can occur when catalyst temperatures are not in the optimal range for the reaction or when too much ammonia is injected into the process. As the temperature range of these smaller diesel engines are lower than that of larger generator diesel sets (such as the D399 Gensets), the effectiveness will be significantly diminished.
- Space on the ship is extremely limited. In addition to retrofitting the engines with the SCR equipment, additional space is required onboard to store the reductant. Also, the logging winch unit is designed to be a space efficient portable system. Due to increasing well depths the unit has been upgraded from 128 HP Detroit Diesel 4-71N non-tiered engine to a 250 HP Caterpillar C7 Tier 3 engine in the same space. The addition of turbochargers, charge air coolers, and larger silencers left no room for a SCR without a total redesign. Space is extremely limited for all the other smaller engines as well. Furthermore, taking additional deck space for storage of reductants and other equipment would compromise the maneuverability during drilling operations. Each compressor engine would need to be retrofitted with the Catalyst and each engine would require the SCR injection system which measures approximately 5.5 ft x 3.5 ft. There is virtually no additional space that would accommodate these requirements.
- The supply of urea for an SCR system to support the MLC Compressor engines would require a 1000 gallon storage tank. The urea would need to be purchased in 700 gallon quantities. Basically the urea flow rate is 1.1 gallons per hour. A 1000 gallon tank would allow for 900 hours of operation or 37 days at full load. Because one would not want to run the tank dry, one must replenish the tank at least once during the 63 day operating period. Further the space requirements for the storage tank (6.5 ft x 4.0 ft) are problematic.

SCR technology, therefore, does not represent BACT for the MLC compressor engines and other smaller engines. This conclusion is based primarily on the lack of space required for retrofitting the engines with SCR catalysts and injection systems. Furthermore, additional issues related to the operation of these systems in Arctic conditions raised issues with operation of the catalysts in cold temperatures without additional insulation and heat tracers. Finally, even if sufficient space were available, the cost-effectiveness would be at the upper end of the acceptable cost-effectiveness for NOx technologies.

[53] Gaitley, J., The Operation of Selective Catalytic Reduction systems on Mobile Offshore Drilling Units, Transocean, September 9m 2009.

[54] Personal conversation with Jeremy Harris of Johnson Matthey on November 24, 2009.

NOx Adsorber

Applications of this technology have successfully achieved Tier 2, Bin 5 NOx emissions levels on light duty vehicles using 15 ppmv sulfur fuel. However we are not aware of any marine applications for this technology. At this time, Johnson Matthey is just starting to look at this technology for stationary applications.[55] Accordingly, this technology is not commercially available for stationary applications, particularly in a marine environment. Additionally, there may be a need for a second adsorber so that regeneration can occur while the second adsorber is placed into operation. Finally, additional storage would be required for chemicals. The second adsorber plus storage for chemicals would require additional space onboard the *Discoverer*.

There are no vendors that market this technology for stationary applications, particularly marine applications. NOx adsorber technology is not commercially available for the MLC engines and other smaller engines and therefore does not represent BACT for these engines

Lean NOx Catalysts (LNC) or Hydrocarbon-SCR (HC SCR)

While the Lean NOx Catalyst systems have performed well in some retrofit applications it has been primarily used in on-road diesel applications. The technology has been used in off-road applications to comply with EPA Tier 1 requirements on engines of 100 hp or greater. It has also been installed on backhoes, graders, wheel loaders and back-up generators. However we are not aware of any marine applications at this time. Typical reductions for offroad diesel equipment have ranged from 10% to 25%.[56]

There have been very few stationary applications of the Cleaire Lean NOx technology and while there are no currently known technical reasons the technology would not work, representatives of the company indicated their technology would be more of a demonstration project for this application. Additionally, the application would require an increase in the tail pipe run to approximately a 36 to 48 inch exhaust and would be subject to cooling which would reduce the effectiveness of the systems. Furthermore the lack of available space and the need for technical support during the demonstration of this technology in this application would be difficult to overcome. Cleaire representatives indicated it would not recommend the Longview system as commercial for this application.[57]

Neither the Lean NOx Catalysts (LNC) nor the HC SCR technology are commercially available for the MLC engines and other smaller engines and therefore do not represent BACT for these engines. Neither of these systems offers the same performance as ammonia-based SCR systems. Depending on the system, a post-injection system may need to be supplemented by a separate fuel injection system. The potential NOx reductions range from 30% to 50%.

[55] Personal communication with Jack Carroll of Johnson Matthey on November 9, 2009
[56] WRAP Offroad Diesel Retrofit Guidance Document, Volume 2-Section IV, Emissions Advantage, LLC, November 18,2005
[57] Personal Communication with Tom Swenson of Cleaire on November 19, 2009

Summary of Alternatives Determined to be Technically Feasible

The following is a list of the technically feasible NO_X control technologies and possible combinations:

- Cam Shaft Cylinder Reengineering Kit for the HPU and larger cementing units only.
- Replacement of engines associated with cementing units and HPU, cranes, and logging generator.

Step 3 – Rank remaining technologies by control effectiveness.

This section describes the remaining technologies in more detail and ranks them by effectiveness.

Cam Shaft Cylinder Reengineering Kit

The manufacturer states that Version I of the CCTS retrofit kit, which are applicable to use on some of the HPUs and Cementing Unit engines, can achieve emission reductions of no greater than 1.0 g/bhp-hr of hydrocarbons, 8.5 g/bhp-hr of carbon monoxide, 5.8 g/bhp-hr of nitrogen oxides and 0.16 g/bhp-hr of diesel particulate matter. These claims have been verified by emission testing. However, there is a possible fuel penalty of up to 12 percent depending on the rebuild configuration due to the installation of the Cam Shaft Cylinder Reengineering Kit.

Ranking of Remaining Alternatives by Effectiveness

The remaining technologically feasible control technologies ranked in decreasing order of effectiveness are:

- Engine Replacement
- Camshaft Cylinder Reengineering Kit

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The cost and cost-effectiveness (in dollars per ton of pollutant reduced) of the various technologies is discussed in this section. Control technology costs are based on both information received from technology vendors and from published reports on the technologies.

Cam Shaft Cylinder Reengineering Kit

The cost of the CCTS retrofit kit varies by the size of the engine, but is generally small. However, the cost of the kits is not the major cost of the engine rebuild. The major cost is associated with providing the technicians and mechanics to the site to extract the engine and ship it to and from the *Discoverer* and the

engine shop. The cost of the actual kits varies between $4800 and $7500 for a 400hp engine, and between $4000 and $6100 for a 275hp engine. However, Shell estimates the additional cost for shipping and logistics to be $50,000. According to the manufacturer, using this product does not affect the OEM engine warranty.[58] The retrofit is usually done by shipping the engines to the CCTS manufacturer or by shipping both the engines and the kit to a local shop. In addition to the capital costs, there are costs associated with increased fuel usage. The annualized cost for the CAM kit for the HPU engines is $16,202 per ton of NOx. For the Cementing unit engine, the annualized cost is $12,206 per ton of NOx. CCTS cost effectiveness calculations for HPU engines and the Cementing unit engine are provided in Appendix C, Table C-1.

The Cam Shaft Cylinder Reengineering Kit is commercially available for certain DDC diesel engines and the emission reduction levels have been tested and verified. This technology is potentially applicable to the two HPU engines and two of three cementing unit engines onboard the *Discoverer*, but there are problems associated with its application on the *Discoverer*. The fuel penalty could potentially increase emissions of some pollutants and the *Discoverer* would need to be taken out of service while this engine retrofit is being performed. This technology is not considered BACT for the current application due to the minimal reduction in NOx emissions from these small and infrequently used engines.

Engine Replacement

Engine replacement has not been evaluated for cost for the new Tier 3 engines because replacement would not result in any lower emissions.

Replacing engines is in some cases a simple option, but for some applications the entire unit must be replaced. Replacing the engine is referred to as repowering; replacing the entire unit is referred to as replacement. For example, repowering the cement unit engines with newer Tier 3 engines would require replacing the entire cementing skid unit. This in turn would require more deck space and a complete re-install. The newer engines are larger with larger transmissions and will not fit in the existing skid frame. Shell estimates the cost to replace the cementing units to exceed 1.6 million dollars to replace all three engines. The two larger cementing units would cost $656,059 each, while the smaller unit would cost $287,882. The cost-effectiveness for this option would be $44,700 per ton of NOx for the cementing engines.[59]

While the HPU units can be repowered, additional effort would be required to attach all the necessary hydraulic lines and other associated equipment. To replace the HPU units with newer Tier 3 engines would cost $100,000 for each of the two Detroit 8V71 engines.[60] The cost-effectiveness for this option

[58] ARB study: http://www.arb.ca.gov/diesel/documents/rrpapp9.pdf

[59] Proposed Requirements for Stationary Diesel In-Use Agricultural Engines, Appendix F, Economic Analysis Methodology, Diesel Engine Costs, Page 3, September 6, 2006

[60] Proposed Requirements for Stationary Diesel In-Use Agricultural Engines, Appendix F, Economic Analysis Methodology, Diesel Engine Costs, Page 3, September 6, 2006

would be $8,700 per ton of NOx reduced. Overall NOx reductions would be 1.4 tons per year per engine or a total of 2.8 tons for both HPU engines.

Replacing the crane engines would be even less cost-effective. Smith Power Products provided a cost estimate of $65,000 each to replace the crane engines. Shell further estimates an additional $35,000 would be necessary for each engine for shipping and labor to perform the engine replacement. The net result is of $25,800 per ton of NOx reduced. Overall NOx reductions would be 0.48 tons per year for each engine or a total of 0.96 tons total for both cranes.

The current logging generator is Tier 2. A Tier 3 engine is available at a cost of $20,000 to 25,000. Based on annual NOx emissions of less than 0.05 tons, the cost per ton of NOx removed is over $55,000 if achieved through repowering.

Replacing the engine on the supply ship with a Tier 3 unit would not result in significant emissions reduction because the supply ship is only attached to the *Discoverer* for 96 hours per year. The net emission reduction is only 0.17 tons per year of NOx. The cost of a new engine is estimated at $50,000 with an annualized cost of $6,165. The cost effectiveness for repowering exceeds $36,000 per ton of NOx.

Cost effectiveness calculations for these engine replacements are provided in Appendix C, Table C-2. In conclusion, none of the engine replacement options evaluated are less than $8,000 per ton of NOx removed. Given the very small quantity of NOx that would be eliminated by these engine replacements, engine replacement is not cost-effective and therefore not BACT.

Selective Catalytic Reduction (SCR)

SCR has been eliminated on the basis of technical feasibility, but some cost analysis was provided as additional support for the conclusion that SCR is not appropriate for BACT. The cost effectiveness of applying SCR has been calculated by EPA in its Cost-Effectiveness of Reducing Particulate Matter and Nitrogen Oxides Emissions from Heavy-Duty Non-road Diesel Engines through Retrofits . The cost-effectiveness for non-road equipment was calculated ranging from approximately $7,400 to $19,000 per ton of NOx reduced. For non-road engines the potential NOx reduction was an average of 70 percent. These estimates are based on typical operating conditions for each piece of equipment including generator sets, cranes and excavators. As expected, the cost-effectiveness for NOx was higher for earlier models. However, the cost-effectiveness for older engines (pre-2000) was significantly reduced. This is consistent with calculations of the cost-effectiveness for retrofitting the C-15 compressor engines (engine specifications attached). Based on the costs quoted by Johnson Matthey, the cost-effectiveness for retrofitting SCR for the compressor engines was calculated at $37,000 per ton of NOx reduced. As a further example a 1998 crane engine retrofitted with SCR has a cost-effectiveness of $15,100. SCR cost effectiveness calculations for the compressor engines are provided in Appendix C, Table C-3. The crane

engines on the *Discoverer* were built in 1974. Discussions with the State of Alaska permitting engineers indicates that the State of Alaska has not made BACT decisions with such a high cost-effectiveness for onshore or offshore engines.

Step 5 – Select NOx BACT for the Small Diesel Engines.

Based on the analysis presented in this section, Shell proposes that BACT for NO_X emissions from small diesel engines be:

- Mud Line Cellar Air Compressors – 3 g/hp-hr achieved through Tier 3 engines.
- Hydraulic Power Units – 9.8 g/hp-hr achieved through good combustion
- Crane Engines – 7.7 g/hp-hr achieved through good combustion
- Large Cementing Units – 11.72 g/hp-hr achieved through good combustion
- Small Cementing Units – 11.72 g/hp-hr achieved through good combustion
- Large Logging Units – 3 g/hp-hr achieved through a Tier 3 engine
- Small Logging Units – 5.6 g/hp-hr achieved through a Tier 2 engine
- Supply Ship Generator – 14 g/hp-hr achieved through good combustion

4.3.2 Exhaust Particulate Matter BACT Analysis

Diesel particulate matter (PM) is a complex mixture of compounds which are formed through a number of different mechanisms. PM is comprised of the soluble organic fraction (SOF), the insoluble (solid) fraction, and the sulfate fraction. Fuel and lube oil contribute to the SOF fraction. The insoluble fraction is primarily dry carbonaceous soot from “too-rich-to-burn” fuel combustion. The sulfate fraction is produced from the sulfur in diesel fuel. This fraction can only be controlled by limiting fuel sulfur content.

In this discussion, we refer to PM generically. Virtually all the diesel PM is PM10, and most of the PM_{10} is assumed to be $PM_{2.5}$.

Step 1 – Identify all available control technologies.

The available PM control technologies for the *Discoverer’s* engines, boilers, and incinerator were determined from searches performed on the RBLC and the CA-BACT, as well as a review of other available technologies.

PM emissions from diesel engines can be reduced with combustion controls that prevent the formation of PM and add-on controls that capture it. Because a portion of the sulfur contained in combusted fuels becomes sulfates, which are particles, PM emissions can also be reduced by reducing the sulfur content of the fuel.

Regardless of the technology applied to achieve BACT, the control option must result in an emission rate no less stringent than the applicable NSPS emission rate, if any NSPS standard for that pollutant is applicable to the source. As discussed above in the NOx BACT analysis, EPA has promulgated exhaust emission standards for non-road engines under 40 CFR 89.112 in 1998. Engines designed to meet Tier 2 or 3 PM emission standards typically employ a combination of low PM emitting engine designs and DPF or CDPF.[61] The overall PM control for Tier 3 engines is 85 percent.[62]

Good Combustion Practices, Low Sulfur Fuel (LSF), and Crankcase Ventilation Controls

The concept of applying combustion controls to minimize PM10 emissions includes adequate fuel residence time in the combustion zone, proper fuel-air mixing, and combustion temperature control to ensure the maximum amount of fuel is combusted. Optimization of these factors to reduce PM formation can result in an increase in the NOx emissions. Thus, engines are generally designed to balance control mechanisms to achieve the lowest possible emissions of all pollutants.

LSF reduces the sulfate PM fraction by limiting the amount of sulfur in the fuel that is available for sulfate formation.

The crankcase of a combustion engine accumulates gases and oil mist called blowby that leak into the crankcase from the combustion chamber and other sources. The blowby gases must be vented from the crankcase to prevent damage. Due to the fact that blowby gas contains PM, which is 100 percent SOF,[63] it should be handled such that it does not contribute to PM emissions. The CCV system was developed to remove blowby from the engine and to prevent those vapors from being expelled into the atmosphere. The CCV system does this by directing the blowby back to the intake manifold, so it can be combusted.

Systems used to control combustion for the purpose of limiting all pollutants and ensuring efficient engine operation are employed on all modern diesel engines, and will be employed on all diesel engines at the source. Furthermore, all diesel engines at the source will burn ultra low sulfur diesel (ULSD) fuel, and be equipped with a closed circuit crankcase ventilation system to control PM emissions from crankcase ventilation. Because these control technologies and approaches will be employed, they will be discussed no further in this analysis, and are considered part of the baseline BACT determination.

Engine Replacement

Engine replacement would entail removal of the existing engine in favor of a Tier 3 engine.

Oxidation Catalyst (OxyCat)

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61 Caterpillar brochure. *Cat® C15 for Fleet and Line Haul Performance, ACERT™ Technology for 2007*.

62 The Tier 3 PM emission standard for large non-road engines is 0.2 g/kWh or 0.15 g/hp-hr. The base case is considered to be approximately 1 g/hp-hr.

63 Jaaskelainen, Hannu. DieselNet Technology Guide. *Crankcase Ventilation.* January 2009.

An OxyCat removes the SOF of PM through catalytic oxidation of the combustible organic matter resulting in an overall PM control efficiency of 20-50 percent.[64]

Diesel Particulate Filter (DPF)

A DPF removes the insoluble (solid) fraction of PM (soot) by filtration with an overall PM control efficiency of 40 to 50 percent.[65, 66]

Catalytic Diesel Particulate Filter (CDPF)

CDPFs remove both the SOF and the insoluble fraction of PM with an overall PM control efficiency of 85 percent.[67]

Table 4-13 summarizes the available control technologies and the BACT process.

Table 4-13. Summary of PM BACT Analysis for Small Engines

Engine:		MLC Comp.	HPU	Cranes	Large Cement	Small Cement	Large Logging	Small Logging	Supply Ship Gen.
Model:		Cat. C15	DD 8V71	Cat D343	DD 8V71	GM 3-71	Cat C7	Deere	Cat 3406
Size:		540 hp	250 hp	365hp	335 hp	147 hp	250 hp	35 hp	292 hp
Quantity:		3	2	2	2	1	1	1	2
Option									
Replace	Included?	No	No	No	No	No	No	No	No
	Cost/ton?		$53,278	$576,997	$220,716	$220,716		$509,374	$455,728
CDPF	Included?	No	Yes	Yes	Yes	Yes	No	Yes	No
	Feasible?	Yes					Yes		Yes
	Cost/ton?	$41,883					$90,467		$186,720
OxyCat	Included?	No					No		No
	Feasible?	Yes					Yes		Yes
	Cost/ton?	$32,139					$55,233		$113,999
DPF	Included?	Yes					Yes		No
	Feasible?								Yes
	Cost/ton?								$227,999

"Included" means the technology is currently installed or proposed to be installed.

Step 2 – Eliminate technically infeasible options.

Engine Replacement

[64] Holmström, Per. D.E.C. Marine AB. [Communication with R. Steen, Air Sciences Inc.]. February 9, 2009.

[65] Khair, Magdi K. DieselNet Technology Guide. *Engine Design for PM Control.* May 2002.

[66] Majewski, Addy W. DieselNet Technology Guide. *Diesel Particulate Filters.* July 2001.

[67] California EPA. Air Resource Board. *Verification Procedure - Currently Verified, CleanAIR Systems PERMIT*. January 26, 2009. http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Tier 2 or 3 level controls and PCV are intrinsic to the original engine design. Therefore, replacing an engine with one employing these control technologies is considered technically infeasible if they are already a part of the design of the diesel engines. The three MLC compressor (540 hp Caterpillar C-15) engines and the large logging (260 hp Cat C7) engine are already Tier 3 engines. As indicated in the NOx BACT analysis, replacing an existing engine with a new Tier 3 engine is only practical (and, therefore, technically feasible) for the HPU (250 hp DD 8V71) engines, the crane (365 hp Cat D343) engines, the cementing units (powered by 335 hp DD 8V71 and 147 hp GM 3-71 engines), the logging winch (36 kW John Deere) engine and the supply ship generator (Cat. 292 hp D3406 engine).

Oxidation Catalyst (OxyCat)

OxyCats are considered technically feasible for all diesel engines and compressors.

Diesel Particulate Filter (DPF)

DPFs are considered technically feasible for all diesel engines and compressors. It should be noted that DPF technology is already incorporated in Tier 3 engines.

Catalytic Diesel Particulate Filter (CDPF)

CDPFs are considered technically feasible for all small diesel engines and compressors.

Step 3 – Rank remaining technologies by control effectiveness.

Engine Replacement

As stated in the previous section, the only units for which replacement with a Tier 3 unit is technically feasible are the HPU engines, the crane engines, the cementing units (the entire unit, not just the engine, would be replaced), the logging winch engine and the supply ship generator. The expected PM emission reduction associated with each replacement is as follows:

- HPU Compressor Engines (2 X 250 hp DD 8V71) – 0.46 tons per year (tpy), equivalent to a 88 percent reduction
- Crane Engines (2 X 365 hp Cat D343) – 0.043 tpy, equivalent to a 58 percent reduction
- Cementing Units (powered by 2 X 335 hp DD 8V71 and 1 X 147 hp GM 3-71 engines) – 0.89 tpy, equivalent to a 92 percent reduction
- Logging Winch Engine (1 X 36 kW John Deere) – 0.0048 tpy, equivalent to a 50 percent reduction.
- Supply ship Engine Generator (1 X 292 hp Cat. D3406) – 0.01 tpy, equivalent to a 89% reduction

Oxidation Catalyst (OxyCat)

An OxyCat removes the SOF of PM through catalytic oxidation of the combustible organic matter resulting in an overall PM control efficiency of 20-50 percent.[68]

Diesel Particulate Filter (DPF)

A DPF removes the insoluble (solid) fraction of PM (soot) by filtration with an overall PM control efficiency of 40 to 50 percent.[69, 70]

Catalytic Diesel Particulate Filter (CDPF)

CDPFs remove both the SOF and the insoluble fraction of PM with an overall PM control efficiency of 85 percent.[71]

Ranking of Remaining Alternatives by Effectiveness

The remaining technologically feasible control technologies ranked in decreasing order of effectiveness are:

- Engine Replacement (50 – 95 percent reduction, depending on engine)
- CDPF (85 percent reduction)
- OxyCat (20 - 50 percent reduction)
- DPF (40 – 50 percent reduction)

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

Engine Replacement

The cost effectiveness of replacing existing engines or units with Tier 3 equivalents varies depending upon the engine or unit. Cost effectiveness calculations for these engine replacements are provided in Appendix C, Table C-2. The cost effectiveness associated with each replacement is as follows:

- HPU Compressor Engines (2 X 250 hp DD 8V71) – $53,300/ton PM
- Crane Engines (2 X 365 hp Cat D343) – $577,000/ton PM
- Cementing Units (powered by 2 X 335 hp DD 8V71 and 1 X 147 hp GM 3-71 engines) – $221,000/ton PM
- Logging Winch Engine (1 X 36 kW John Deere) – $509,000/ton PM
- Supply Ship Engine Generator (1 X 292 hp Cat. D3406) - $456,000/ton PM

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68 Holmström, Per. D.E.C. Marine AB. [Communication with R. Steen, Air Sciences Inc.]. February 9, 2009.

69 Khair, Magdi K. DieselNet Technology Guide. *Engine Design for PM Control.* May 2002.

70 Majewski, Addy W. DieselNet Technology Guide. *Diesel Particulate Filters.* July 2001.

71 California EPA. Air Resource Board. *Verification Procedure - Currently Verified, CleanAIR Systems PERMIT*. January 26, 2009. http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Although replacing engines or units with Tier 3 equivalents is technically feasible for some engines, and would result in PM emission reductions, the emission reductions are small compared to the expense of the engine replacement. Engine replacement is not a cost-effective PM control strategy.

Catalytic Diesel Particulate Filter (CDPF)

Shell proposes to install CDPF on all small diesel engines and diesel compressors that are not already Tier 3 engines (i.e., the 549 hp MLC compressor engines and the 250 hp logging engines) except for the supply ship generator. Cost effectiveness calculations for the addition of CDPF to the MLC Compressors engines, the 250 hp logging engine and the supply ship generator are provided in Appendix C, Table C-4.

- MLC Compressor Engines (3 X 540 hp Cat. C15) - $41,900/ton PM
- Logging Generator Engine (1 X 250 hp Cat C7) - $90,000/ton PM
- Supply Ship Engine Generator (1 X 292 hp Cat D3406) - $187,000/ton PM

Although addition of CDPF to the Tier 3 engines or the supply ship is technically feasible, and would result in PM emission reductions, the reductions are small compared to the expense of the CDPF addition, thus, CDPF addition is not a cost-effective PM control strategy.

Oxidation Catalyst (OxyCat)

Because a more stringent PM control technologies (CDPF) has been proposed as BACT for all small diesel engines and diesel compressors except the Tier 3 engines and the supply ship, no cost-effectiveness analysis was developed for OxyCat for any of the engines except the Tier 3 and Supply ship. These cost effectiveness analyses are provided in Appendix C, Table C-5.

- MLC Compressor Engines (3 X 540 hp Cat. C15) - $32,100/ton PM
- Logging Generator Engine (1 X 250 hp Cat C7) - $55,200/ton PM
- Supply Ship Engine Generator (1 X 292 hp Cat D3406) - $114,000/ton PM

Although addition of OxyCat to the Tier 3 engines and supply ship is technically feasible, and would result in PM emission reductions, the reductions are small compared to the expense of the OxyCat addition, thus, OxyCat addition is not a cost-effective PM control strategy.

Diesel Particulate Filter (DPF)

Because a more stringent PM control technologies (Tier 3 engines or CDPF) has been proposed as BACT for all small diesel engines and diesel compressors except the supply ship, no cost-effectiveness analysis was developed for DPF for any of the engines except the Supply ship. This cost effectiveness analysis is provided in Appendix C, Table C-6.

- Supply Ship Engine Generator (1 X 292 hp Cat D3406) - $228,000/ton PM

Although addition of DPF to the supply ship is technically feasible, and would result in PM emission reductions, the reductions are small compared to the expense of the DPF addition, thus, DPF addition is not a cost-effective PM control strategy.

Step 5 – Select Particulate Matter BACT for the Small Diesel Engines.

Based on the analysis presented in this section, Shell proposes that BACT for PM emissions from small diesel engines and diesel compressor be as follows:

- Mud Line Cellar Air Compressors – 0.082 g/hp-hr, achieved using the existing Tier 3 engines.
- Hydraulic Power Units – 0.19 g/hp-hr, achieved using CDPF
- Crane Engines – 0.053 g/hp-hr, achieved using CDPF
- Cementing Units – 0.29 g/hp-hr, achieved using CDPF
- Logging Unit – 0.15 g/hp-hr, achieved using the existing Tier 3 engine.
- Logging Winch Unit – 0.067 g/hp-hr, achieved using CDPF
- Supply Ship Engine Generator – 0.98 g/hp-hr, achieved through good combustion

4.3.3 SO_2 BACT Analysis

The discussion under Section 4.2.3 concerning the use of Ultra-Low Sulfur Diesel fuel in all engines applies equally for the small engines. BACT is the use of ULSD in these engines.

4.3.4 CO/VOC BACT Analysis

With few exceptions, technology used to control of CO emissions from combustion sources, including internal combustion engines, also provides collateral control of volatile organic compound (VOC) emissions. Accordingly, the following analysis addresses CO and VOC control in combination, with exceptions noted.

Step 1 – Identify all available control technologies.

As discussed earlier, the available CO and VOC control technologies for the *Discoverer's* engines, boilers, and incinerator were determined from searches performed on the RBLC and the CA-BACT and the resulting control technologies were previously provided in Table 4-6.

The available CO/VOC combustion control technologies for the generator engines identified in the RBLC and CA-BACT are OxyCat and Tier 2 level controls available only through engine replacement. Although not listed in the RBLC or CA-BACT, CDPF reduces CO and VOC emissions through catalytic oxidation with an overall control efficiency of 80% and 90%, respectively.[72] We have added engine replacement to the list of evaluated control technologies.

[72] Ibid. footnote 55.

Step 2 – Eliminate technically infeasible options.

As discussed above, the available control technologies for the *Discoverer's* small diesel engines are engine replacement, OxyCat and CDPF. Engine replacement, OxyCat and CDPF are all considered technically feasible for the small engines

Step 3 – Rank remaining technologies by control effectiveness.

The technically feasible control technologies for the *Discoverer's* diesel engines are ranked by control effectiveness as follows:

- Engine Replacement
- CDPF – 90 percent control for the smallest engines, but for the larger MLC Compressor engine and the logging winch engine control is only 80percent (technically feasible for all engines),
- OxyCat – 80/70 percent control for CO/VOC, respectively, (but only 47percent for the MLC Compressor Engines)
- Good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

Engine Replacement

Engine replacement has not been evaluated for cost for the new Tier 3 engines because replacement would not result in any lower emissions.

The cost for replacement of the cementing units has been estimated by Shell to exceed 1.6 million dollars to replace all three engines. The two larger cementing units would cost $656,059 each, while the smaller unit would cost $287,882. The cost-effectiveness for this option would be over $1,000,000 per ton of CO for the larger cementing engines and $138,500 per ton of CO for the smaller unit.[73]

To replace the HPU units with newer Tier 3 engines would cost $100,000 for each of the two Detroit 8V71 engines.[74] The cost-effectiveness for this option would be $155,700 per ton of CO reduced. Overall CO reductions would be 0.08 tons per year per engine or a total of 0.16 tons for both HPU engines.

Replacing the crane engines would not be cost effective. The Tier 3 emission standard for CO for these engines is actually higher than the emission factor from the current engines.

[73] Proposed Requirements for Stationary Diesel In-Use Agricultural Engines, Appendix F, Economic Analysis Methodology, Diesel Engine Costs, Page 3, September 6, 2006

[74] Proposed Requirements for Stationary Diesel In-Use Agricultural Engines, Appendix F, Economic Analysis Methodology, Diesel Engine Costs, Page 3, September 6, 2006

The current logging generator is Tier 2. A Tier 3 engine is available at a cost of $20,000 to 25,000 but it does not have lower CO emissions than the Tier 2 engine, thus there is no CO emission reduction for engine replacement.

Replacing the engine on the supply ship with a Tier 3 unit would not result in significant emissions reduction because the supply ship is only attached to the *Discoverer* for at most 96 hours per year. The net emission reduction is only 0.01 tons per year of CO. The cost of a new engine is estimated at $50,000 with an annualized cost of $6,165. The cost effectiveness for repowering exceeds $530,000 per ton of CO. All cost effectiveness calculations for these engine replacements are provided in Appendix C, Table C-2.

In conclusion, none of the engine replacement options evaluated are less than $100,000 per ton of CO removed. Given the very small quantity of CO that would be eliminated by these engine replacements, engine replacement is not cost-effective and therefore not BACT.

Catalytic Diesel Particulate Filter (CDPF)

As indicated for particulate matter above, Shell proposes to install CDPF on all small diesel engines and diesel compressors that are not already Tier 3 engines (i.e., the 540 hp MLC compressor engines and the 250 hp logging engines) except for the supply ship generator. Cost effectiveness calculations for the addition of CDPF to the MLC Compressors engines, the 250 hp logging engine and the supply ship generator are provided in Appendix C, Tables C7-C9.

- MLC Compressor Engines (3 X 540 hp Cat. C15) - $9,848/ton CO
- Logging Generator Engine (1 X 250 hp Cat C7) - $3,329/ton CO
- Supply Ship Engine Generator (1 X 292 hp Cat D3406) - $98,000/ton CO

Although addition of CDPF the supply ship is technically feasible, and would result in CO emission reductions, the reductions are small compared to the expense of the CDPF addition, thus, CDPF addition is not a cost-effective CO control strategy for the supply ship. Application of CDPF is cost-effective for the logging generator engine.

Oxidation Catalyst (OxyCat)

Because a more stringent CO control technologies (CDPF) has been proposed as BACT for all small diesel engines and diesel compressors except the Tier 3 engines and the supply ship, no cost-effectiveness analysis was developed for OxyCat for any of the engines except the Tier 3 and Supply ship. These cost effectiveness analyses are provided in Appendix C, Tables C10-C12.

- MLC Compressor Engines (3 X 540 hp Cat. C15) - $4,323/ton CO
- Logging Generator Engine (1 X 250 hp Cat C7) - $2,123/ton CO
- Supply Ship Engine Generator (1 X 292 hp Cat D3406) - $23,750/ton CO

OxyCat is cost-effective for each of these small engines. However, it is not certain which vessel will be used as a supply ship so amortizing the costs over multiple years is not appropriate for the supply ship.

Step 5 – Select CO/VOC BACT for the Small Diesel Engines.

Shell proposes that Oxycat technology is BACT for CO/VOC emissions from the MLC Compressor Engines and CDPF is BACT for CO/VOC emissions from the Tier 3 Logging Winch engine.

4.4 Boilers

4.4.1 NOx BACT Analysis

There are two 8 MMBtu/hr Clayton 200 boilers (FD-21 and FD-22) on the *Discoverer* that provide general heat. Only one boiler operates at a time; the second serves as a backup.

Step 1 – Identify all available control technologies.

Table 4-2 identifies the BACT alternatives for boilers. The available NOx combustion control technologies for diesel-fired boilers less than or equal to 100 MMBtu/hr identified in the RBLC and CA-BACT are LNB, FGR, and good combustion practices. LNB combustion systems reduce thermal NOx formation by reducing the peak combustion temperature relative to conventional burners. LNB designs are specific to the manufacturer. FGR reduces NOx emissions by recirculating a portion of the boiler flue gas into the main combustion chamber. This process reduces the peak combustion temperature and lowers the percentage of oxygen in the combustion air/flue gas mixture, thus retarding the formation of thermal NOx. There were no instances of add-on NOX emission abatement technologies indicated in the BACT database entries reviewed for boilers in the subject size class. Good combustion practices for NOx control essentially require maintenance of proper air to fuel ratios for efficient combustion.

Step 2 – Eliminate technically infeasible options.

As discussed in Section 4.1.2, the available control technologies for these boilers are LNB, FGR, and good combustion practices. LNB are considered technically infeasible because LNBs for this model boiler are only available for natural gas and propane fuels.[75] The FGR option available for the Clayton 200 diesel boiler is provided as a package during the original installation. Clayton Industries (the manufacturer) does not know of any cases where FGR has been retrofitted on an existing unit purchased without FGR, as in the case of the *Discoverer's* boilers.[76]

Within the BACT databases reviewed, there were no determinations that specified installation of SCR on diesel boilers under 100 MMBtu/hr capacity. This implies that SCR is not BACT for this diesel boiler category. This control technology has never been required (or installed to Shell's knowledge) on utility

[75] Clayton Industries brochure. *Advanced Low NO_x Technology*. http://www.claytonindustries.com. August 2007.
[76] Services Department. Clayton Industries. [Communication with D. Steen, Air Sciences Inc.]. February 11, 2009.

boilers of this small size on exploration vessels. More importantly, the boilers are located adjacent to the engine room which is being expanded to accommodate SCR on the generators. There is no deck space for additional SCR units beyond those proposed for the generators. Thus, SCR is considered technically infeasible for the two small boilers.

Step 3 – Rank remaining technologies by control effectiveness.

The only technically feasible NOx control option for the two boilers (FD-21 and FD-22) is good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The top control option from Step 3 is proposed as BACT, thus this step is not required.

Step 5 – Select NOx BACT for the Diesel-Fired Boilers.

Shell proposes good combustion practice as BACT for the *Discoverer's* diesel-fired boilers. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions.

4.4.2 Particulate Matter BACT Analysis

This section addresses BACT for particulate matter. As initially discussed early in Section 4.1, this BACT analysis applies to PM, PM_{10}, and $PM_{2.5}$ even though (for brevity) the text refers only to PM.

Step 1 – Identify all available control technologies.

As shown in Table 4-3, there are no PM control technologies listed in the RBLC and CA-BACT for diesel-fired boilers less than or equal to 100 MMBtu/hr.

Step 2 – Eliminate technically infeasible options.

It is extremely rate to apply fabric filters and electrostatic precipitators to diesel-fueled combustion equipment because particulate matter emissions and collection efficiencies are low. In a fabric filter, flue gas is passed through a tightly woven or felted fabric, causing particulate matter in the flue gas to be collected on the fabric and the resulting collected particulate (called cake) by sieving and other mechanisms. Most of the particle collection is performed by the filter cake itself. Fabric filters may be in the form of sheets, cartridges, or bags, with a number of the individual fabric filter units housed together in a group.

PM10 and PM2.5 emissions consist of two fractions: filterable and condensable. Due to the relatively high proportion of condensable particulate matter emissions (approximately 72% condensable according

to AP-42), the majority of combustion particulate matter will not be collected by a fabric filter treating the flue gas. Also, due to the low particulate concentration, a cake will be slow to form resulting in poor collection efficiency. The low collection efficiency for diesel fueled units, the requirement for cooling of gas streams to capture the condensable component, and the small particle size all make implementing baghouse control on diesel-fueled engines and boilers ineffective.

In an ESP, exhaust gas is introduced into an electric field that imparts a charge on the suspended particulate. The charged particulate then migrates to the charged plates where it is collected within the electrostatic precipitator (ESP). The low particulate concentration from diesel fuel combustion would not allow significant charge buildup on the particles, resulting in poor migration to the collecting plates. Based on this issue, ESPs are considered technically infeasible.

Therefore, good combustion practices and the combustion of clean diesel fuel is the only available control technology for consideration in this analysis. The only available PM control technology for these boilers is good combustion practices.

Step 3 – Rank remaining technologies by control effectiveness.

The only technically feasible control technologies for the two boilers (FD-21 and FD-22) is good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The top control option from Step 3 is proposed as BACT, thus this step is not required.

Step 5 – Select PM BACT for the Diesel-Fired Boilers.

Shell proposes good combustion practice as BACT for the *Discoverer's* boilers. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions.

4.4.3 SO_2 BACT Analysis

The discussion under Section 4.2.3 concerning the use of Ultra-Low Sulfur Diesel fuel in all engines applies equally for the boilers. BACT for SO_2 emissions from the boilers is the use of ULSD.

4.4.4 CO/VOC BACT Analysis

Step 1 – Identify all available control technologies.

There are no CO or VOC control technologies listed in the RBLC and CA-BACT for diesel-fired boilers less than or equal to 100 MMBtu/hr. Therefore, good combustion practices and the combustion of clean diesel fuel is the only available control technology for consideration in this analysis.

Step 2 – Eliminate technically infeasible options.

The only available CO control technology for these boilers is good combustion practices.

Step 3 – Rank remaining technologies by control effectiveness.

The only technically feasible control technologies for the two boilers (FD-21 and FD-22) is good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The top control option from Step 3 is proposed as BACT. Further analysis is not required.

Step 5 – Select CO/VOC BACT for the Diesel-Fired Boilers.

Shell proposes good combustion practice as BACT for *Discoverer's* boilers. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions.

4.5 Incinerator

4.5.1 NOx BACT Analysis

Step 1 – Identify all available control technologies.

The available NO_x combustion control technologies for waste incinerators identified in the RBLC and CA-BACT are SNCR and good combustion practices (shown in Table 4-2, above). The SNCR process involves injecting either ammonia or urea into the firebox of the incinerator, at a location where the flue gas is between 1,600°F and 2,100°F, to react with the NO_x formed in the combustion process. The resulting products of the chemical reaction are residual NOx, elemental nitrogen, carbon dioxide, water, and emissions of un-reacted ammonia. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions

Step 2 – Eliminate technically infeasible options.

The available control technologies for the *Discoverer's* 276 lb/hr TeamTec/GS500C incinerator (FD-22) are SNCR and good combustion practices. SNCR is considered technically infeasible for this incinerator. The *Discoverer's* incinerator is very small in comparison to the incinerator listed in the RBLC with SNCR (575 tons per day; 48,000 lb/hr). Based on communication with TeamTec, the manufacturer, they are not aware of any control technologies that have been installed on this model of incinerator for control of any of the pollutants.[77] Shell is not aware of any control technology installations on this or similar-sized incinerators.

Step 3 – Rank remaining technologies by control effectiveness.

The only technically feasible control technology for the incinerator FD-23 is good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The top control option from Step 3 is proposed as BACT, thus this step is not required.

Step 5 – Select NOx BACT for the Incinerator.

Shell proposes good combustion practice as BACT for the *Discoverer's* incinerator. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions.

4.5.2 Particulate Matter BACT Analysis

Step 1 – Identify all available control technologies.

The available PM control technologies for incinerators identified in the RBLC and CA-BACT, and shown in Table 4-3, are electrostatic precipitators (ESP) and good combustion practices. An ESP uses electrostatic charges to move particulates from a gas stream onto a collection surface. The electric field is created through electrodes that are maintained at a high voltage.

Shell retained G1 Development LLC to assist Shell staff in evaluating particulate matter control options for the incinerator. The review process considered technical feasibility and identified capital costs for a wide range of technologies, but narrowed the review to the four most promising options: dry and wet ESPs, venture scrubber technologies, and a ceramic filter. Table 4-14 summarizes the technologies, issues, and capital costs associated with each of these technologies.

Step 2 – Eliminate technically infeasible options.

[77] Bulien, Ole. TeamTec Marine Products. [Communication with K. Lewis, Air Sciences Inc.]. February 11, 2009.

The available control technologies for the *Discoverer's* incinerator (FD-22 – 276 lb/hr TeamTec/GS500C) are ESPs, scrubbers, ceramic filters, and good combustion practices. There are a number of significant feasibility issues with each of the technologies. Among the primary concerns for the scrubbers is available space for the scrubber body and duct work. Additional concerns for the wet technologies is freezing, the availability of water, and icing and fogging of the Discoverer's work area. Ultimately, G1 determined that the ceramic filter technology was the preferred technology because of space considerations, Arctic weather conditions, and superior collection efficiency. However, all four technologies are carried through the cost effectiveness assessment.

Step 3 – Rank remaining technologies by control effectiveness.

G1 determined that each of the technologies could achieve 90% control of PM over that achieved with good combustion practices.

Table 4-14. Incinerator Control Technology Alternatives

Property	Technologies for Effective PM_{10} and $PM_{2.5}$ Control			
	Ceramic Fiber Baghouse	**Dry Electrostatic Precipitator**	**Venturi**	**Wet Electrostatic Precipitator**
Brief description	High temperature fibrous particulate filtering	High voltage wires driving particles to collector	Gas water quenched to saturation followed by high differential pressure drop water/air contact	Gas water quenched to saturation followed by high voltage wires driving particles to collector
Applied to incinerator control	Yes - land - and at least one ship incinerator	Yes - land	Yes - land	Yes - land
Nominal pressure drop, inches water column	7 to 14	2	7 to 8 (higher required if significant fine particles < 1 micron)	2
Design	Simple	Complex	Simple	Complex
Collection efficiency	90% +	75% at quoted size (90%+ for larger sizes)	90% for particles > 1 micron (Lower for < 1 micron)	75% at quoted size (90%+ for larger sizes)
Budgetary equipment capital costs, FOB factory	$230,000	$420,000	$150,000	$175,000
Capital Includes	Ceramic fiber baghouse flange to flange with 75 mm mineral wool insulation/trace heating and controls	Dry electrostatic precipitator flange to flange with shop insulation, power supply and controls	Venturi, separator, pumps, valves, and control system	Wet electrostatic precipitator flange to flange with power supply and ESP voltage controller
Solids discharge	Dry	Dry	Solids/water slurry	Solids/water slurry
Scrubber Size (not including separate vessels)	12.5 ft depth X 21.2 ft width X 15.6 ft height (including access platforms, ladder, inlet manifold, and discharge chutes)	11.5 ft depth X 16.8 ft width X 19.1 ft height (not including high voltage bus and inlet/outlet duct manifolds or access platforms)	1.7 ft diameter X 3.5 ft long (not including the in line separator)	4.5 ft depth X 4.5 ft width X 16.8 ft height (not including high voltage bus, inlet/outlet duct manifolds, access platforms)

Table 4-14. Incinerator Control Technology Alternatives

Property	Technologies for Effective PM_{10} and $PM_{2.5}$ Control			
	Ceramic Fiber Baghouse	**Dry Electrostatic Precipitator**	**Venturi**	**Wet Electrostatic Precipitator**
Other significant vessel/space requirements	Compressed air receiver for reverse pulsing/cleaning and discharge conveyer and/or drums	High voltage transformer	In line separator (could be integrated with stack) and pump	High voltage transformer, tank and pump
Gas cooling requirements	No	No	Yes to saturated water temperature (50 to 70 Deg C)	Yes to saturated water temperature (50 to 70 Deg C)
Air discharge characteristics	Hot and dry	Hot and dry	Saturated with water and possible icing issues	Saturated with water and possible icing issues
Solid particle issues	Potential problems with sticky particles	Potential problems with sticky particles	None known	None known
Maintenance	Change bags every 3 years (Expected bag life = 3-5 years) (System monitored via phone link by factory)	Initial tuning and fine tuning after 2 weeks operation (System monitored via phone link by factory) and annual inspection/cleaning	None expected	Initial tuning
Corrosion	Maintaining hot avoids corrosion issues	Maintaining hot avoids corrosion issues	Metallurgy upgrades and/or water treating required	Metallurgy upgrades and/or water treating required
Utilities				
Electricity	240 volt/1 amp for control power and reverse pulse switching	480 volt/3 Phase/60 Hz at MCC Electricity for 9.5 KW transformer and controls, 120 Volt, 15 amp at the operator interface location	2 KW control power	480 Volts/3 Phase - 2.5 KW for ESP and controls

Table 4-14. Incinerator Control Technology Alternatives

Property	Technologies for Effective PM_{10} and $PM_{2.5}$ Control			
	Ceramic Fiber Baghouse	**Dry Electrostatic Precipitator**	**Venturi**	**Wet Electrostatic Precipitator**
	Heat tracing of baghouse exterior (assumed required): 12.8 KW	Heat tracing of Insulators and hoppers (assumed required): 13.0 KW	Heat tracing required - estimate not supplied	Heat tracing required - estimate not supplied
	Rotary valves (if required): 0.4 KW + 3.5 KW for heat tracing	Hopper vibrators (assumed required): 0.6 KW	Pump: 3.7 KW	2 Pumps: 7.5 KW
	4.5 m U-tube conveyer (if required): 5.5 KW	Screw conveyer (if required): 2.7 KW		
Nominal water requirements, gpm	0	0	4 (3.5 evaporates for cooling) can be seawater but requires metallurgy upgrade	4 (3.5 evaporates for cooling) can be seawater but requires metallurgy upgrade
Water discharge rate, gpm	0	0	0.5 - could be lowered by concentrating solids in discharge with hydroclones, rotary vacuum filtration, etc	0.5 - could be lowered by concentrating solids in discharge with hydroclones, rotary vacuum filtration, etc
Other utility requirements	Dry compressed air at 90 psig (15 cubic meters per hour)	Dry compressed air at 80 psig (10 cubic meters per hour)		Dry air at >3 inches water column (340 cubic meters per hour for 2 insulator boxes)
Vendor Used for Data	Glosfume	McGill	Croll-Reynolds Fisher-Klosterman	Beltran
Assumptions				
Teamtec Incinerator Max Flowrate, acm/hr	12,000	12,000	12,000	12,000

Table 4-14. Incinerator Control Technology Alternatives

Property	Technologies for Effective PM_{10} and $PM_{2.5}$ Control			
	Ceramic Fiber Baghouse	Dry Electrostatic Precipitator	Venturi	Wet Electrostatic Precipitator
Teamtec Incinerator Max Outlet Temperature, Deg C	350	350	350	350
Incinerator Emissions, lb/hr PM_{10}	1.13	1.13	1.13	1.13
Incinerator Emissions, lb/hr $PM_{2.5}$	0.97	0.97	0.97	0.97

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

Despite technical feasibility concerns, all the post-control emission control options were evaluated in a cost-effectiveness analysis and were determined to exceed commonly accepted cost-effectiveness criteria. Simplified cost-effectiveness calculation for a wet scrubber (the low cost and low performance option) and a ceramic filter (the higher cost and higher performance option) are provided in Appendix C. These tables indicate that a ceramic filter achieving 99% control of the estimated 0.53 tons of PM10 emissions from the incinerator would cost $46,000 per annual ton removed – even if the life of the filter is assumed to be 20 years. Similarly, the annual cost of PM10 control is $150,000 per ton based on 20 years and 90% control efficiency.

Both the low and high end of control options exceed commonly accepted cost effectiveness criteria.

Step 5 – Select PM BACT for the Incinerator.

Shell proposes good combustion practice as BACT for *Discoverer's* incinerator. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions.

4.5.3 SO_2 BACT Analysis

Step 1 – Identify all available control technologies.

For the *Discoverer's* incinerator, SO_2 is produced from the combustion of the diesel fuel used to heat the furnace and the combustion of sulfur in the solid waste. The RBLC and CA-BACT listed LSF and Semi-Dry Scrubber (SDS) as the available control technologies for waste incinerators. In an SDS, particles of an alkaline sorbent are injected into a flue gas and SO_2 is adsorbed producing a solid by-product.

Step 2 – Eliminate technically infeasible options.

As discussed above, the available control technologies for the *Discoverer's* incinerator are LSF and SDS. SDS is considered technically infeasible for this incinerator. The *Discoverer's* incinerator is very small in comparison to the incinerator listed in the RBLC with SDS (350 tons per day; 29,000 lb/hr). TeamTec, the incinerator manufacturer, are not aware of any control technologies that have been installed on this model of incinerator for control of any of the pollutants.[78] Shell is not aware of any control technology installations on this or similar-sized incinerators. As noted above, FGD involves installation of scrubber chambers and reagent (e.g. wet or dry $CaCO_3$) and reactant (e.g., $CaSO_3$) storage vessels and transport systems. The space requirements and other technical considerations (e.g., freeze-up) related to this equipment make FGD technically infeasible as BACT on drill ship emission units.

[78] Ibid. footnote 77.

LSF is considered technically feasible.

Step 3 – Rank remaining technologies by control effectiveness.

The technically feasible control technologies for the *Discoverer's* incinerator are ranked by control effectiveness as follows:

- Ultra-low sulfur fuel – ≤0.0015 weight percent sulfur
- Non-low sulfur fuel

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

As noted in the discussion of PM BACT, there are significant technical feasibility concerns with respect to dry and wet scrubbers on the Discoverer. However, the PM BACT analysis determined that the scrubbers were not cost effective. Because anticipated uncontrolled SO_2 emissions are lower than uncontrolled PM emissions, scrubbers would be even less cost effective for SO_2 control.

Step 5 – Select SO_2BACT for the Incinerator.

To minimize SO_2 production from the diesel used to heat the furnace, Shell proposes the exclusive use of ultra-low sulfur diesel, which is the lowest sulfur diesel fuel available, as BACT for the *Discoverer's* incinerator.

4.5.4 CO/VOC BACT Analysis

Step 1 – Identify all available control technologies.

There are no CO or VOC control technologies listed in the RBLC and CA-BACT for waste incinerators. Therefore, good combustion practices and the combustion of clean diesel fuel is the only available control technology for consideration in this analysis.

Step 2 – Eliminate technically infeasible options.

As discussed in Section 4.1.5, the only available control technology for the *Discoverer's* incinerator is good combustion practices.

Step 3 – Rank remaining technologies by control effectiveness.

The only technically feasible control technologies for the incinerator FD-23 is good combustion practices.

Step 4 – Evaluate the most effective control based on a case-by-case consideration of energy, environmental, and economic impacts.

The top control option from Step 3 is proposed as BACT. Further analysis is not required.

Step 5 – Select CO/VOC BACT for the Incinerator.

Shell proposes good combustion practice as BACT for *Discoverer's* incinerator. Good combustion practices require operating and maintaining the equipment according to the manufacturer's recommendations to maximize fuel efficiency and minimize emissions.

4.6 CO_2

Except for the October 30, 2009 reporting rule requiring certain sources with greenhouse gas (GHG) emissions over 25,000 tons per year to report their GHG emissions, Shell recognizes that the EPA is still considering whether and how to regulate CO2 under the Clean Air Act and that in the future the agency may establish by rule or policy a requirement that major sources perform a BACT analysis for CO2 emissions. EPA's current policy on GHG emissions under the PSD program is outlined in a December 18, 2008 memo by then-Administrator Stephen Johnson, titled, EPA's Interpretation of Regulations that Determine Pollutants Covered by Federal Prevention of Significant Deterioration (PSD) Permit Program. The memo concludes that GHGs, including CO2, are not currently regulated under the federal PSD program. EPA is in the process of reconsidering this position, but the 2008 Johnson memo remains in effect. BACT for CO2, therefore, is not currently required by the PSD program. At this time, Shell believes it is premature to address projected CO2 emissions in this application for purposes of possible control. However, the efficiency measures that Shell is incorporating in to the project (e.g., good combustion and maintenance practices, vessel management, etc….) will minimize CO2 emissions.

ENVIRON has analyzed emissions of carbon dioxide from the Discoverer and its associated fleet. Annual emissions of carbon dioxide from the Discoverer alone are estimated to be approximately 22,500 tons/year. Potential annual emissions of carbon dioxide from the Discoverer and its associated fleet are estimated to be approximately 94,000 tons/year. These estimates are based on a generic diesel fuel and refuse combustion CO_2 emission factors obtained from AP-42.

4.7 Drilling Mud De-gassing

In its May 4, 2009 submission to EPA, Shell provided a conservative estimate of the volatile organic compound (VOC) emissions from the Discoverer drilling cuttings while drilling. As noted above, these VOC emissions were estimated at 128 pounds per drilling season; this emission rate is expected to be similar in the Beaufort Sea lease blocks. Although this is a small emission, total VOC emissions are significant from the Discoverer and BACT analyses are required for all VOC source units on the Discoverer. Due to the very low emissions, cost for emission control of this source would be well above that which is considered cost-effective, but an analysis demonstrating this is provided here.

Drilling mud is used during the drilling process to lubricate and carry away heat from the bit and transport drill cuttings. During the drilling process and when the drill bit is passing through a hydrocarbon zone,

trapped hydrocarbons in the drilled material will be carried to the surface (to the deck of the Discoverer) with the mud. Once the mud reaches the surface it is exposed to the atmosphere and is directed to the "ditch", then the shakers, and then the mud pit.

All of these have free surfaces and most trapped gas, which could be volatile hydrocarbons or water vapor or CO_2, flashes out of the mud to the atmosphere, at all of these locations. There are no covers in place to capture or control this minor hydrocarbon volume as part of normal drilling. The open surfaces are used for inspection of the mud returning from the drill bit. There is a system, known as a "gas buster" or mud gas separator, and the mud is temporarily routed to the gas buster when a certain minimum level of hydrocarbons are encountered during normal operations. This system handles mud containing normal levels of volatile hydrocarbons but is designed to withstand any unexpected surge in hydrocarbons, as a safety precaution from ignition / explosion on or in the drillship, and is capable of exhausting away from the drillship large volumes of gas. The exhaust is a 10 inch diameter pipe that vents at the top of the derrick, away from workers. The gas buster is only used for mud containing volatile hydrocarbons which would include emergency/unexpected situations and is not designed to handle the abrasion from the flowing mud that would occur from continuous use as part of a gas collection device.

To control all VOC emissions from mud degassing, the mud-handling system would need to be redesigned to collect gas from both the trench / shaker / mud pit and the gas buster, depending which route the mud was directed to, and the associated gas collection system would need to handle large volumes of gas, over 500 ft^3/min, associated with emergency and unexpected releases. But the gas collection system would normally process only minute amounts of gas, i.e., emissions at a rate of 128 lb. per season. With such a variable flow rate and the need to handle high flow rates under emergency and explosive situations, condensers, absorbers and rerouting to the incinerators (the air intakes of on-board combustion devices) would be technologically infeasible. The only control devices capable of such service are flares, as corroborated by a literature research of other exploration drilling operations.

Approximate costs for a flare are provided below using information from an EPA control cost manual,[79] Section 3.2, “VOC Destruction Controls,” Chapter 1.6. This manual provides the cost for a small (2 inch nozzle) flare which would be considerably smaller than the 10 inch one needed for the Discoverer gas buster. Therefore the costs should be well below those for the Discoverer. This 2 inch nozzle flare cost is for on-land application, and not a salt environment. Additionally, costs for equipment, installation, operation and maintenance are substantially higher for ships than on land. The annualized 2 inch nozzle flare cost as of 2002 is listed as $61,800 per year (Table 2.13). At 100 percent control efficiency, this flare would oxidize 128 lb of VOC, which equates to a cost efficiency of approximately $1 million per ton of VOC removed, well above a level of cost effectiveness. Even if the control costs are in error by a factor of 10, the cost effectiveness would still be unacceptable.

79 *EPA Air Pollution Control Cost Manual, Sixth Edition, EPA 450-02-001,* January 2002

SECTION 5

SIGNIFICANT IMPACT ANALYSIS

The Prevention of Significant Deterioration regulations require assurance that predicted concentrations attributable to a proposed project will not threaten compliance with PSD increments or National Ambient Air Quality Standards (NAAQS). The analysis detailed in this document demonstrates that the *Discoverer* will be in compliance with PSD increments, NAAQS, and Alaska Ambient Air Quality Standards (AAAQS) at all Beaufort Sea locations where Shell proposes exploration drilling.

This Section addresses the methods used to assess air quality impacts from the *Discoverer* and its associated fleets for demonstration of compliance with the NAAQS and AAAQS and the PSD increments listed in Table 5-1. The NAAQS and AAAQS are the same for the criteria pollutants (NO_2, PM_{10}, $PM_{2.5}$, SO_2, and CO), but the AAAQS also include an ambient standard for ammonia (NH_3). The modeling is performed according to Appendix W of Part 51 (Guideline on Air Quality Models). ENVIRON has applied conservative screening dispersion modeling for this analysis. Although the EPA AERMOD model is the current EPA-recommended model for regulatory applications, it does not allow modeling with a conservative screening meteorological data set. Accordingly, the ISC-PRIME model, an earlier model recommended by EPA, is used with EPA screening meteorology and EPA-recommended persistence factors for converting one-hour maximum concentrations to other averaging periods.

Table 5-1: Summary of Applicable Standards

Pollutant	Averaging Time	NAAQS/ AAAQS [1] ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)
Nitrogen Dioxide (NO_2)	Annual	100	25
Particulate Matter (PM_{10})	24-hour	150	30
	Annual[2]	50	17
Particulate Matter ($PM_{2.5}$)	24-hour	35	Not Established
	Annual	15	Not Established
Sulfur Dioxide (SO_2)	3-hour	1,300	512
	24-hour	365	91
	Annual	80	20
Carbon Monoxide (CO)	1-hour	40,000	None
	8-hour	10,000	None
Ammonia (NH_3)	8-hour	2,100[2]	None

[1] National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards
[2] Alaska only

5.1 Overview of Modeling Approach

5.1.1 Model Selection

Because representative meteorological data meeting the EPA Region 10's dispersion modeling requirements are not available for the Beaufort Sea OCS locations, the most recent version (04269) of the ISC-PRIME dispersion model was used. The ISC-PRIME model is a U.S. EPA-approved, steady-state, multiple-source, Gaussian plume model. It offers a screening mode; it can characterize sources which are substantially affected by building wake effects, such as the source units on the *Discoverer*; it resolves concentrations in a three-dimensional receptor grid; and it allows for consideration of the actual spatial distribution of sources, all of which are important in this analysis. The sources in this analysis are distributed over a wide area, and the model is capable of characterizing this spatial distribution.

5.1.2 Worst-Case Meteorological Data

The dispersion model is used with screening meteorology (meteorological assumptions that result in concentrations equal to or higher than those to be expected). An ISC-PRIME compatible meteorological data set was generated using the SCREEN3 model's array of possible wind speed and stability combinations. As shown in Table 5-2, the screening meteorological data contain all possible wind speeds for all of the dispersion categories listed in the U.S. EPA's SCREEN3 Model User's Guide (EPA-454/B-95-004). This meteorological data are considered to contain the theoretical worst-case dispersion conditions regardless of whether these conditions will actually occur at the project locations. The *Discoverer* will have its bow pointing into the wind when it is drilling as described in Section 5.6. Thus, the combinations of speed and stability are applied from a single wind direction; in our modeling, we depict this with winds blowing from the east to the west. This configuration also aligns sources so that maximum overlapping concentrations will be obtained.

Table 5-2: Wind Speed and Stability Class Combinations Used for Screening Modeling

	Wind Speed (m/sec)												
Stability	1	1.5	2	2.5	3	3.5	4	4.5	5	8	10	15	20
A	*	*	*	*	*								
B	*	*	*	*	*	*	*	*	*				
C	*	*	*	*	*	*	*	*	*	*	*		
D	*	*	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*				
F	*	*	*	*	*	*	*						

Consistent with guidance provided in the SCREEN3 Model User's Guide for mixing heights, the mixing heights used for neutral and unstable conditions (Classes A-D) are based on an estimate of the mechanically-driven mixing height. The mechanical mixing height for these conditions equals 320 times

the wind speed. For stable conditions (Classes E-F), the mixing height is set equal to 10,000 meters to represent unlimited mixing.

Section 3.4 of EPA's Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised (EPA-454/R-92-019, October 1992) document allows the use of measured ambient temperatures in lieu of a default temperature value of 293°K. Per EPA Region 10's recommendation, the ambient temperatures for the screening meteorological data are based on the long-term average temperature at Barrow, Alaska. Based on data from the Western Regional Climate Center,[80] from 1949 to 2007, the average daily high and low temperatures at Barrow were 15.7°F and 4.9°F, respectively. Thus, the average of these two values, 10.3°F (261.1°K), was utilized in the screening meteorological data set.

5.1.3 Persistence Factors

The model in screening mode produces one-hour maximum concentrations. These screening one-hour concentrations generated by the model are converted to longer-term concentrations by using multipliers (i.e., worst-case persistence factors) specified by EPA Region 10. To obtain the estimated maximum concentration for 3-hour, 8-hour, 24-hour, and annual averaging times, the 1-hour average model output is multiplied by the worst-case persistence factor values provided in Table 5-3.

Table 5-3: Worst-Case Persistence Factors

Averaging Period	Persistence Factor [1]
3-hour	1.0
8-hour	0.9
24-hour	0.6
Annual	0.1

[1] Worst-case factors from EPA's Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised (EPA-454/R-92-019, October 1992) document.

5.1.4 Volume Source Characterization of Supporting Fleets

Following the modeling approach used in Shell's *Discoverer* Chukchi Sea Permit Application Revised, the following characterization of the support fleets is utilized in the modeling analysis of the *Discoverer* in the Beaufort Sea OCS.

The ice management and OSR fleets are characterized in the air quality impact analysis using an elevated line source (series of adjacent volume sources) at the nearest edge of anticipated activity to the *Discoverer*. Consistent with the ISC User's Guide, a series of volume sources was used to simulate line sources (see Table 1-6 of the ISC User's Guide, EPA-454/B-95-003b). This configuration is a worst-case

[80] Western Region Climate Center. *Climatological data for Barrow, Alaska*. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak0546

scenario because, in reality, the ice management fleet will be breaking up ice at and beyond (e.g., farther away from the *Discoverer*) the nearest edge of anticipated ice management activity. The line source characterization is designed to simulate the effect of mobile source plumes that rise and form an elevated layer of emissions that is then advected downwind toward the *Discoverer*. This design simulates the effect of ice management fleet under its highest emitting scenario, which is a continual churning one-year ice drifting toward the *Discoverer*.

Volume sources in all versions of the ISC3 Model are defined by 4 parameters:

- An emission rate,
- A release height (called an "effected emission height"),
- An initial horizontal dimension called the initial sigma-Y, and
- An initial vertical dimension called the initial sigma-Z.

Determination of Effective Emission Heights for Volume Sources

According to Section 1.2 in the User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II - Description of Model Algorithms (EPA-454/95-003b, September 1995), the effective release height should be based on the height of the emissions including any plume rise for buoyancy of the emissions. The plume heights for the fleet emissions are estimated using SCREEN3, which accounts for the mechanical and buoyant lift from the ship's stacks.[81] As provided in Section 2.12, Shell has compiled a list of potential ships which could be used for ice management and anchor handling activities. The stack characteristics of the main propulsion engines for each ship are used with the SCREEN3 algorithms to define the plume height for the ice management fleet emissions (in ISC-PRIME) as shown in Appendix B. Building downwash information related to these sources is also provided in Appendix B.

Note that some of the ice management ships have horizontal stacks which are modeled in accordance with Alaska DEC's recommendations. Alaska DEC's recommended adjustments provide for the retention of buoyancy while addressing the impediment to the vertical momentum of the release. The following procedure was utilized to model horizontally emitting stacks:

- Set the actual stack velocity (V_{actual}), in meters per second, to an adjusted stack exit velocity ($V_{adjusted}$) of 0.001 meter per second.

[81] SCREEN3 is an alternate EPA-approved screening model that uses the same plume rise equations as ISCST3 but also provides a printout of plume rise calculations.

- To conserve volumetric flow, determine an adjusted stack diameter ($D_{adjusted}$) by adjusting the actual stack inside diameter (D_{actual}), in meters, to account for buoyancy of the plume by using the following Equation 1:

$$D_{adjusted} = 31.6(D_{actual})(V_{actual})^{0.5} \quad (1)$$

The adjusted parameters, $V_{adjusted}$ and $D_{adjusted}$, were used in the modeling analysis.

These source characteristics and building dimension information were used as inputs to SCREEN3 to obtain an estimate of final plume rise. The plume height for each of the ships was defined based on the plume rise calculated by SCREEN3 for the combination of 20 meters per second, and D stability. Appendix E provides the SCREEN3 output for each of the ice management ships.

The ice management fleet will operate upwind of the *Discoverer*. The final plume rise for each ship was chosen to represent the height of the volume sources for ISC-PRIME. Because the plumes achieve final plume height under D stability and 20 m/s in a very short distance (within 500 meters) downwind of the ship, the final plume height is used.

In reality, the support ships will typically be located much farther away than 1,000 meters from the *Discoverer*. Based on the data highlighted in Table 5-4, the lowest final plume rise for the primary and secondary ice management ships is 25.22 meters (based on worst-case final plume rise from the Vladimir Ignatjuk) and is used to define the volume source release heights for the ice management fleet in ISC-PRIME.

Determination of the Volume Sources Spacing and Dimensions

For each ship, the elevated line source is divided into a series of volume sources and each volume source is assigned an initial height and initial dimensions following Section 1.2 in the User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume II - Description of Model Algorithms (EPA-454/95-003b dated September 1995) (see Table 1.6).

The line source for the primary icebreaker and anchor handler/ice management ship is comprised of a series of adjacent volume sources that have a horizontal dimension on the order of 100 meters (roughly the length of the ice management ships).

The OSR fleet includes work boats and the main ship. The work boats are comprised of two 34-foot boats and one 47-foot boat. The spacing and lateral dimensions of these work boat volume sources were calculated by taking the average length of the three boats. The work boats were spaced approximately 11.6 meters apart with a horizontal dimension of approximately 5.4 meters. The main ship volume sources were assigned spacing and lateral dimensions based on the 300-foot *Nanuq*. The spacing is approximately 91 meters with a horizontal dimension of approximately 42 meters.

Table 5-4: Summary of SCREEN3 Output for Plume Rise

	Minimum Plume Rise from SCREEN3								
Downwind Distance(m)	OSR Small	OSR Main	Fennica/ Nordica	Vladimir Ignatjuk	Talagy	Tor Viking II	Odin Viking II	Balder Viking	Vidar Viking
100	3.38	15.37	32.02	**24.43**	25.98	28.97	28.97	28.97	28.97
200	3.38	15.76	32.1	**24.58**	26.19	29.02	29	29.02	29.02
300	3.38	16.37	32.22	**24.82**	26.53	29.07	29.01	29.07	29.07
400	3.38	17.17	32.39	**25.15**	26.99	29.07	29.01	29.07	29.07
500 (final)	3.38	17.55	32.51	**25.22**	27.44	29.07	29.01	29.07	29.07

Initial dispersion for volume sources is characterized by two parameters, σ_y (sigma Y) and σ_z (sigma Z). For the ice management and anchor handling fleet, the sigma Y value for each volume source is determined by dividing the physical horizontal dimension of the volume, 100 meters, by 2.15 as recommended in the ISC User's Guide. The sigma Y value for each volume of the work boat OSR fleet is 11.6 meters, divided by 2.15. The sigma Y value for each volume of the main ship OSR fleet is 91 meters, divided by 2.15. Thus, the sigma Y values for the OSR fleet work boats, main ship, and ice management fleet used as input to the ISC-PRIME model are 5.4, 42.3, and 46.5 meters, respectively.

Table 1-6 from the ISC User's Guide details methods for selecting values of sigma Z. For cases where the emission source is elevated but on or adjacent to a building, sigma Z is calculated by dividing the height of the building by 2.15. Table 5-5 depicts calculated sigma Z values for each of the ships used in the current analysis.

A listing of the assumed locations and source characteristics for the primary and secondary ice management ships and the OSR fleet is provided in Appendix B.

Table 5-5: Initial Sigma Z Values from SCREEN3

Source Name	SCREEN3 Model ID	Minimum Sigma Z
OSR Workboats	OILSPL3	1.42
OSR Large Vessels	*NANUQ*	6.38
Fennica/Nordica	FENNICA2	12.76
Vladimir Ignatjuk	VLADIGN2	9.214
Talagy	TALAGY	9.214
Tor Viking II	TOR_H	11.34
Odin Viking II	ODIN_H	11.34
Balder Viking	BALD_H	11.34
Vidar Viking	VIDAR_H	11.34

5.1.5 Merging Stacks

EPA screening procedures allow that sources that emit the same pollutant from several stacks with similar parameters that are within about 100 meters of each other may be analyzed by treating all of the emissions as coming from a single representative stack.[82] Several sources on the *Discoverer* are located adjacent to each other, and merging the stacks for modeling purposes is appropriate because of similarities in source size and location. For these, single-source stack parameters are used.

5.1.6 Plume Downwash

Given the configuration of the stacks and structures on the *Discoverer*, plumes may be down-washed and pulled into the buildings' wake region. For this analysis, the building downwash parameters used in ISC-PRIME are calculated using the Building Profile Input Program (BPIP) version (Version 04274). The building height and location information used in the BPIP analysis are provided in Appendix B.

5.1.7 Ambient Air Boundary and Receptors

Most stationary sources governed by the PSD permit process have a physical plant site with established property lines. The facility owner may control access to the plant site. In such circumstances, compliance with ambient air quality standards and PSD increments is demonstrated only off-site (referred to as ambient air).

Although Shell has purchased the lease rights to certain areas of the Arctic Ocean and is in the process of receiving authorization for exploration from the Minerals Management Service, Shell does not own the waters surrounding its "plant site." Nonetheless, there are substantive safety and security bases for excluding the public from the immediate vicinity of the drill ship while conducting exploratory drilling. The United States Coast Guard routinely establishes safety zones in other parts of the country, and is expected to grant such a zone for Arctic drill sites. Because a safety zone has yet to be formally approved by the Coast Guard for Shell's Beaufort Sea exploration, this analysis is based on the assumption that "ambient air" (where air quality standards must be met) begins immediately adjacent to the hull of the *Discoverer*. This section identifies locations where pollutant concentrations are calculated (i.e., receptors).

A comprehensive series of receptors was defined to ensure capture of the peak concentrations while at the same time capturing the extent of the impact from the Project. Because only a single wind direction was evaluated (the worst case wind direction as described above in section 5.1.2) the receptors are arranged in a series of grids covering an area much larger in the east-west direction than in the north-

[82] Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised (EPA-454/R-92-019, October 1992

south direction. In all, 16,530 receptors were used in the modeling of the Project; Table 5-6 summarizes how these receptors were arranged to provide both broad geographic coverage and detail in locations most apt to experience the highest concentrations. Note that a coordinate system was used with the drill hole itself as the origin (coordinate 0,0) of the system. All receptors used to evaluate the Project were referenced based on distance in meters from the drill hole. Note that this receptor grid is identical to the receptor grid used in the modeling for Shell's Chukchi Sea permit application.

Table 5-6: Receptors Used in the ISC3Prime Modeling of the Project

Receptor Grid	Description	Spacing
Hull Receptors	Receptors placed directly adjacent to the Hull of both the *Discoverer* and the Kilabuk.	10 meters
Close Receptor Grid	Receptors covering a square area 1000 meters on a side with the *Discoverer* in the center.	25 meters
Large Grid Receptors	Receptors covering a rectangular area 13 km by 9.5 km, with the *Discoverer* off center.	100 meters
Extended Receptors	Three E-W horizontal lines of receptors spaced 15 meters apart, running from the *Discoverer* out to a distance of 50 kilometers downwind.	25 m

Receptor locations used in the modeling are depicted in Figures 5-1 through 5-3.

Figure 5-1: Source and Receptor Locations – Large Area View

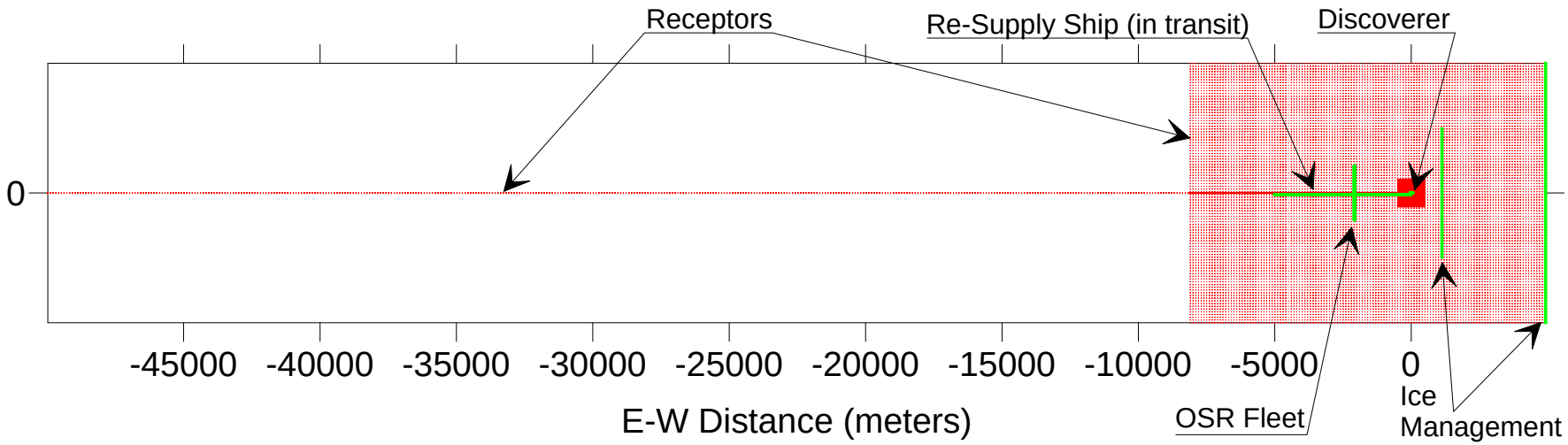


Figure 5-2: Source and Receptor Locations – Intermediate Area View

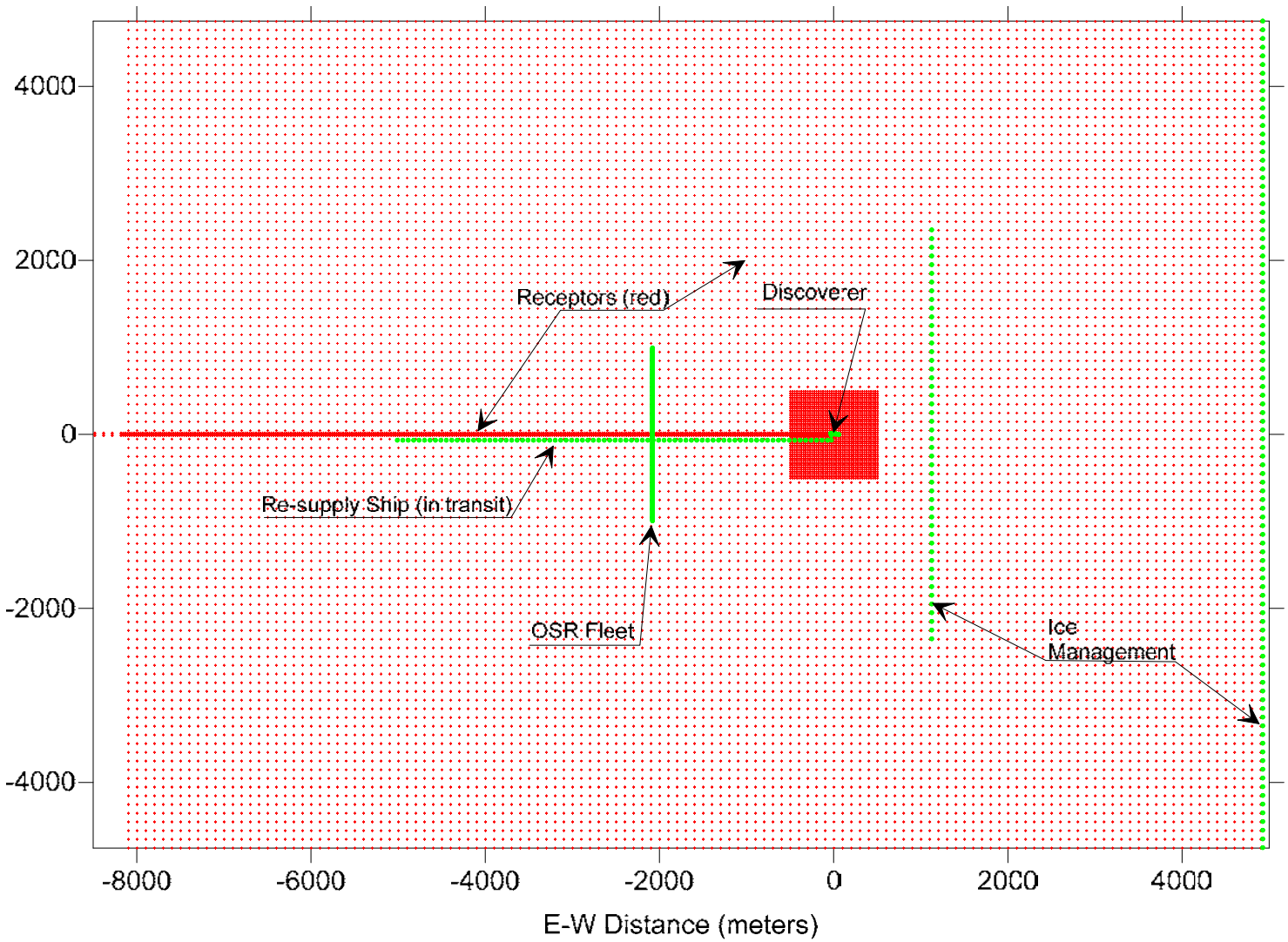
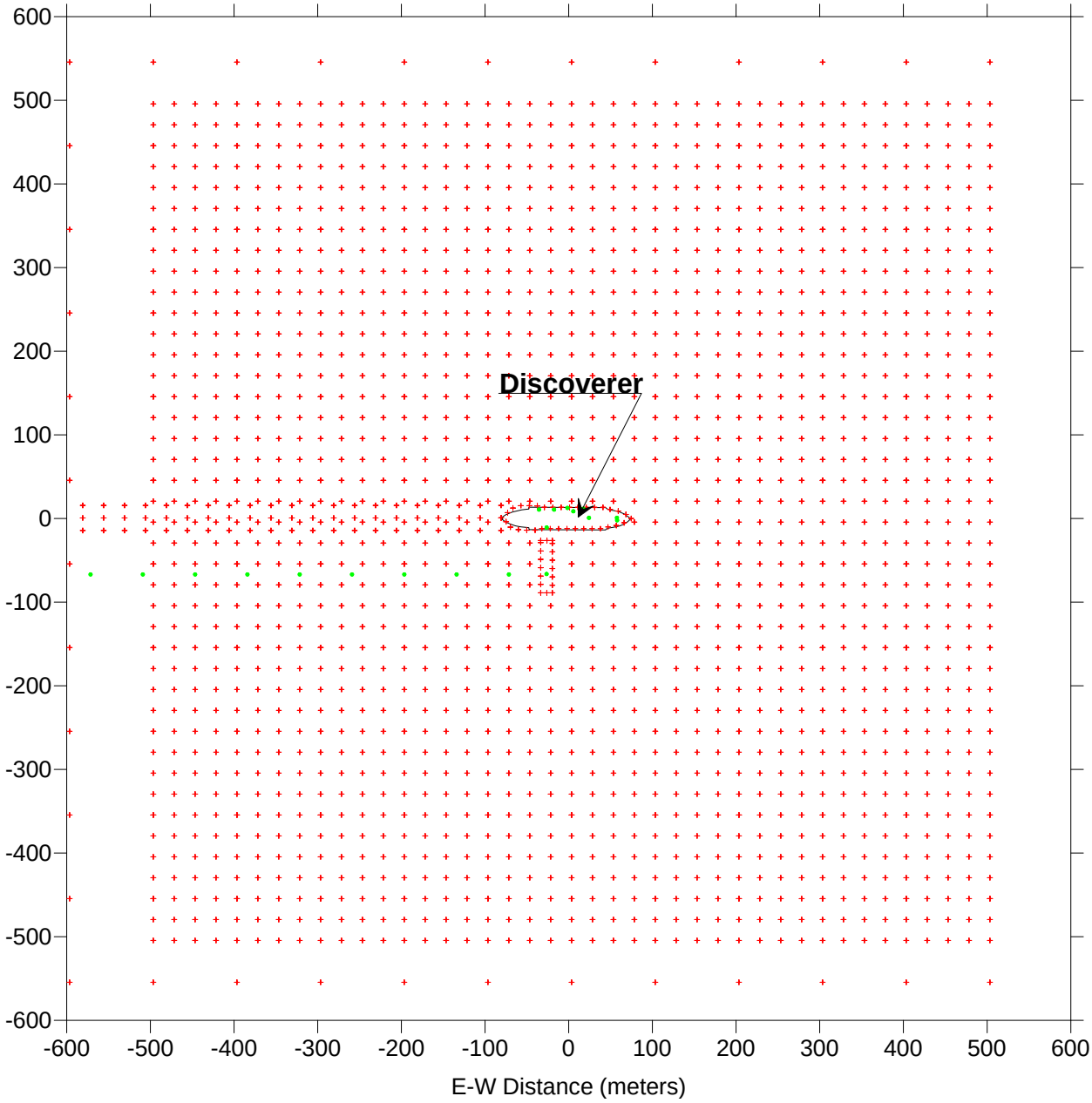


Figure 5-3: Source and Receptor Locations – Close-up View



5.2 Model Simulation of Emission Units

5.2.1 *Discoverer*

The *Discoverer* will have its bow pointing into the wind when it is drilling. This is accomplished through a mechanical drive that rotates the ring that forms the anchor tie relative to the hull and is for the purpose of minimizing ice buildup on the *Discoverer's* hull during drilling. In the modeling analysis, the wind is blowing from the east towards the bow of the *Discoverer*.

Emission release characteristics of the *Discoverer* emission units and a plan view of the *Discoverer* emission unit configuration are provided in Appendix B. Stack parameters listed for *Discoverer* sources are representative of a 100 percent load.

5.2.2 Support Fleet – Base Operating Scenario

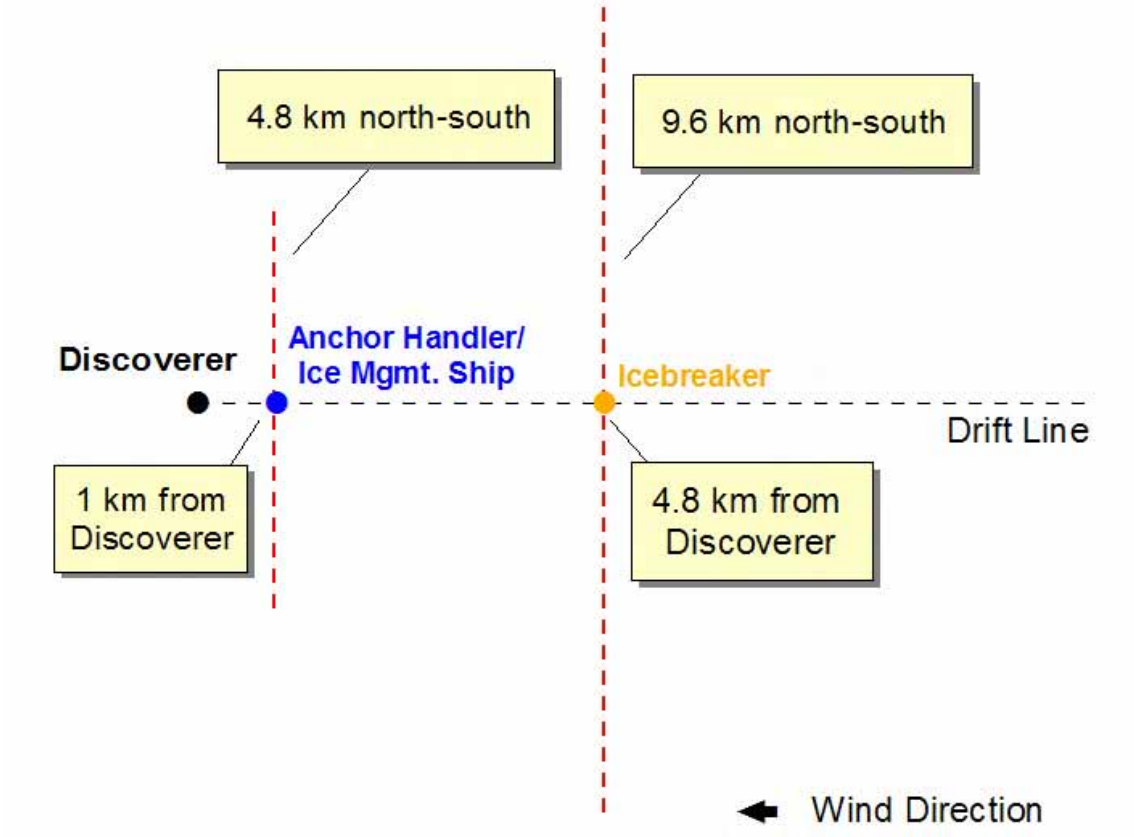
This section identifies typical operation of the ice management fleet and the oil spill recovery vessels. Additional, occasional operating scenarios of short duration (such as refueling, resupplying, etc) are discussed in Section 5.3.

Shell requests authorization to lease and operate any of the ice management ships identified in Table 2-6. To ensure that worst-case air quality impacts are identified, our modeling evaluates the ships with the highest emissions and worst dispersion characteristics. In the future, other icebreakers may also be available for lease. In that case, Shell requests that the permit allow for a demonstration that pollutant concentrations attributable to those proposed ships are equal to or less than those evaluated in this application. Shell believes that this demonstration would not require reopening of the permit, but acknowledges this may require concurrence from EPA Region 10.[83]

Ice breaker and anchor handler/ice management ship emissions are modeled as line sources at the closest distance to the *Discoverer* at which the ships will normally operate. When there is ice to be broken, the primary ice breaker is normally positioned from 3 miles (4.8 km) to 12 miles upwind of the *Discoverer* on the drift line (Figure 5-4). The width of the swath will be about 3 miles (4.8 km) to either side of the drift line. The anchor handler/ice management ship will be located from the anchor buoy pattern to 6 miles up-drift from the *Discoverer*, moving laterally 1.5 miles to either side of the drift line and in a similar movement pattern. The actual vessel distances will be determined by the ice floe speed, size, thickness, and character, and wind forecast.

[83] Even this approach is more stringent than the typical permit application for a marine terminal, where onshore facilities are well defined but the ships that call there are unknown.

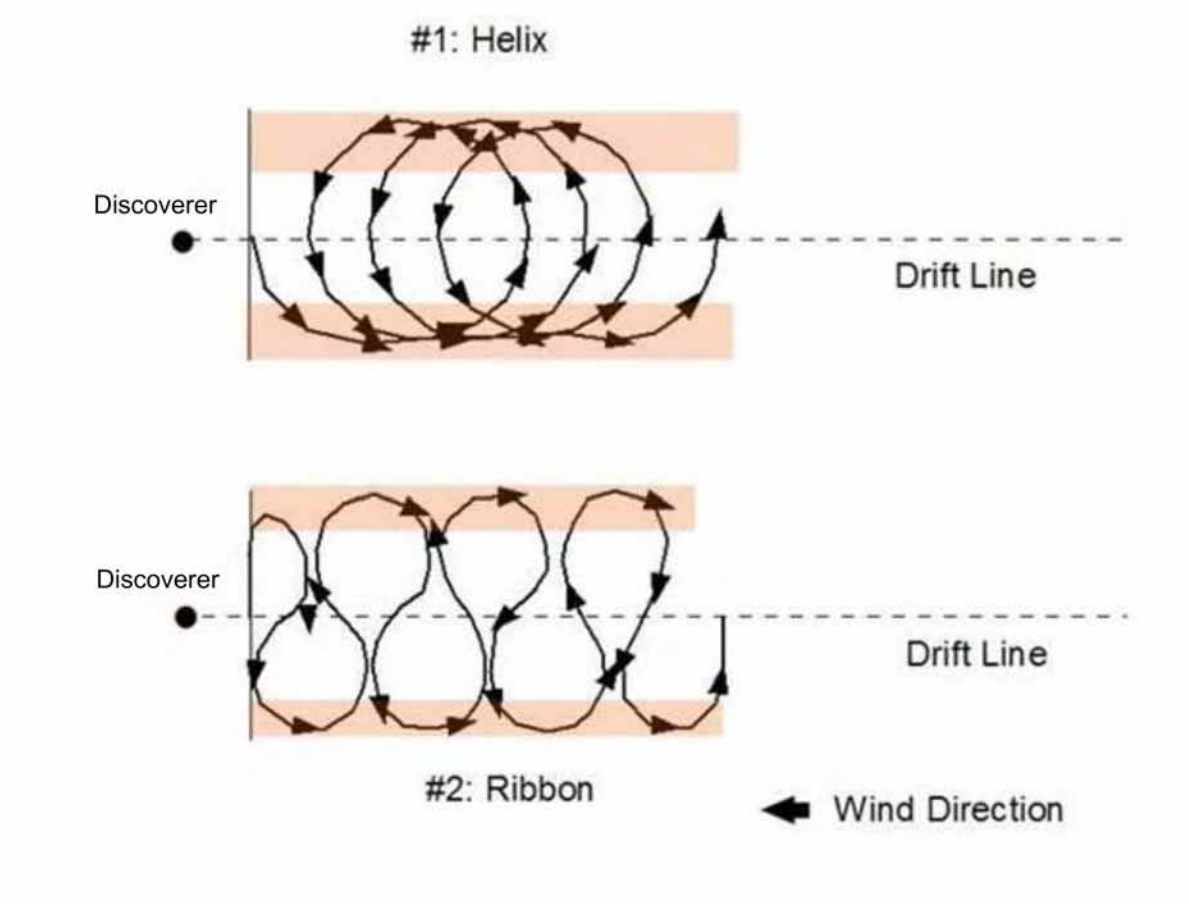
Figure 5-4: Primary Ice Breaker and Anchor Handler Locations for Breaking One-Year Ice



For modeling purposes, the icebreaker emissions are placed on a "north-south" line 3 miles (4.8 km) upwind of the *Discoverer* and spanning 3 miles (4.8 km) on each side of the drift line. The nearest edge of activity for the anchor handler/ice management ship is assumed to be one km upwind of the *Discoverer* and spanning a line 1.5 miles (2.4 km) on either side of the drift line.

The pattern of movement for the icebreaker follows either a spiraling pattern or a folded pattern with sharp turns. Figure 5-5 shows typical patterns of icebreaker movement during ice management activity. The shaded areas indicate the turning areas for the icebreakers. It will be noted that the icebreakers spend the greatest percentage of their time in the shaded areas, so the largest quantity of emissions would be expected in these zones. However, for the purposes of a conservative modeling approach, the emissions have been uniformly distributed along a line from north to south (represented by the vertical line on the left side of the patterns in Figure 5-5).

Figure 5-5: Typical Movement Patterns for Ice Breakers



The OSR fleet in the Beaufort will consist of one offshore management/skimmer ship (currently the Arctic Endeavor Barge/Point Barrow Tug), two 34-foot work boats, and one 47-foot Rozema skimmer. It is possible that the *Nanuq* will be in the vicinity, only as a berth for the OSR crew. The two work boats will be used to tow containment booms while the other vessels will act as backup for crew changes and for re-fueling.

Typically, the OSR fleet will be operating several miles downwind from the *Discoverer.* For modeling purposes, however, the OSR fleet is assumed to be operating three km directly downwind of the *Discoverer*. The only planned activity for the OSR fleet is training on a daily (or less frequent) schedule, with an exercise lasting up to eight hours per day. The emissions from these exercises are modeled at the closest normal distance of 3 km downwind. The training is expected to be contained within a 2-mile area, to be modeled as a 2-km line source. The ice management and OSR fleets are modeled as a series of elevated line sources as described in more detail in the next section.

The analysis of the emissions from the re-supply ship is based on a generic ship of the size expected to serve the exploration effort. The supply ship emissions are explicitly modeled both in transit and at the

Discoverer. The re-supply ship generally ties to the drill ship stern first with a 50-foot standoff when on-loading/off-loading. For this modeling analysis, it is assumed that the re-supply ship is continuously located 12 hours per day near the *Discoverer* for 32 days per drilling season. In reality, the re-supply ship is expected to visit the *Discoverer* only a few days per season for 12 hours per visit. These emissions are allowed to be down-washed in the wake of the *Discoverer*, just as the *Discoverer* source units emissions will be to some degree.

Details on the specific values used as model input parameters for the fleet emission sources are provided in Appendix B.

5.2.3 Emissions and Impacts as a Function of Load

Ambient air quality concentrations from combustion sources depend on both the emission rate and the dispersion of the emissions from the stack. This permit application is based on maximum emissions from all sources, after taking into consideration proposed emission controls and ORRs. It is appropriate to evaluate whether operating an engine at a lower rate has a higher impact than operating the engine at its maximum rate because it is possible the lower stack exhaust volumetric flow rate will more than offset the reduced emission rate.

We evaluated predicted pollutant concentrations attributable to five of the larger diesel engines operating at three different loads. Although these engines do not cause the largest local concentrations, they are representative of different models of diesels and therefore should be representative of the smaller engines also. Also, in comparison to the other engines associated with the project, these engines have the most complete partial load emissions data set.

The propulsion engines for four ice management and anchor handler ships were modeled at three loads: 35, 57, and 80 percent load; and the *Discoverer* generator engines were modeled at 50, 75, and 100 percent load. Each load has a separate emission factor and set of stack parameters, provided in Appendix B. Tables 5-7 and 5-8 provide the emissions and predicted concentrations of NO_x and PM_{10}, respectively, at the three loads. These tables demonstrate that maximum load causes the highest emissions and concentrations.

Table 5-7: NO_x Emissions and Concentrations at Three Loads

Load (% of capacity)	Engine	NO_x Emissions (g/s normalized)	NO_x Concentration ($\mu g/m^3$)
80	Vladimir Ignatjuk - Wärtsilä / 9ZL	1.000	65.5
57		0.818	45.4
35		0.354	22.4
80	Fennica/Nordica - Wärtsilä / 16V32	1.000	49.2
57		0.690	34.0
35		0.508	25.0
80	Tor Viking II – MaK 8M32C	1.000	44.9
57		0.374	17.8
35		0.189	9.2
100	*Discoverer* – Caterpillar D399	1.000	32.4
75		0.771	30.0
50		0.545	25.4

Table 5-8: PM_{10} Emissions and Concentrations at Three Loads

Load (% of capacity)	Engine	PM_{10} Emissions (g/s normalized)	PM_{10} Concentration ($\mu g/m^3$)
100	*Discoverer* – Caterpillar D399	1.000	32.4
75		0.533	20.7
50		0.315	14.7

5.3 Significant Impact Assessment of Base Operating Scenario

The PSD program limits degradation of air quality to specific incremental increases (termed PSD increments) that depend on land classification. Class I areas include certain national parks and certain wilderness areas. PSD allows very little air quality degradation in Class I areas. The nearest Class I area (Denali National Park) is located more than 750 km (465 miles) from the Project on the Beaufort Sea OCS. At this distance, it is inconceivable that the Project would have a significant impact. Furthermore, the Brooks Range represents a substantial barrier to air flow from the Arctic to Denali. Notification of Shell's intention to permit exploration was provided to Federal Land Managers of these Class I areas and no indication of concern was received.

Most areas in the United States, including the North Slope, are classified as Class II. Although it is not clear that the OCS beyond three miles from the shoreline has a designated air quality control region, this application assumes the area may be considered Class II.

EPA's 1990 Draft New Source Review Workshop Manual prescribes phased air quality impact analysis: a preliminary analysis (referred to in the NSR Manual as a Significant Impact Analysis) and, if required, a full impact analysis. The preliminary analysis estimates ambient concentrations resulting from the

proposed project for pollutants that trigger PSD review. If the ambient concentrations from the preliminary analysis are greater than the PSD Significant Impact Levels (SILs), then a full impact assessment is required.

Application of the modeling approach described in Section 5.1 to the operating scenarios described in Section 5.2 produced predicted concentrations attributable to the proposed Project that are summarized in Table 5-9. This table indicates predicted maximum concentrations of NO_2 and 24-hour average PM_{10} exceed the Class II SILs and require a full impact analysis. CO and SO_2 concentrations, however, are not significant and do not warrant further evaluation.

Table 5-9: Summary of Modeling Results and Significant Impact Levels

Pollutant	Averaging Time	Peak Model Concentration (µg/m^3)	Distance to Peak Concentration Point[1] (m)	SIL[2] (µg/m^3)	Maximum Distance Exceeding SIL (Defines SIA[4]) (kilometers)
NO_2	Annual	19.1	2281	1	50.0
PM_{10}	24-hour	19.4	2406	5	42.0
	Annual	1.1	81	1	0.1
$PM_{2.5}$	24-hour	18.2	2406	NA[3]	NA[3]
	Annual	1.1	81	NA[3]	NA[3]
SO_2	3-hour	24.4	81	25	Not significant
	24-hour	1.3	81	5	Not significant
	Annual	0.1	81	1	Not significant
CO	1-hour	611.7	5,097	2,000	Not significant
	8-hour	358.0	4,897	500	Not significant

[1]Measured from Drill Hole, not from ship hull
[2]SIL Significant Impact Level
[3]NA not applicable
[4]SIA – significant Impact Area – a pollutant-specific radius from the source with concentrations exceeding SILs

5.4 Other Operating Scenarios

There are several operating scenarios for which source locations and emissions would differ from that of normal drilling operation. In comparison to the normal operating scenario described in Section 5.3, these scenarios are expected to be infrequent and have lower emissions. Nonetheless, these scenarios are discussed and results of modeling of these scenarios are presented in the following sections. Because these scenarios are relatively short in duration, the air quality analyses were restricted to short term averaging periods only. A brief summary of all other operating scenarios is provided in Table 5-10.

Table 5-10: Summary of all Other Operating Scenarios.

Scenario Name	Analysis Performed	Description
Bow Washing	Quantitative	The anchor handler approaches the *Discoverer* and oscillates back and forth in an effort to create waves that will knock ice accumulation off of the *Discoverer*'s bow. A quantitative analysis of Bow Washing was selected because emissions from the Anchor Handler operating near the *Discoverer* can be realistically quantified and modeled for potential air quality impacts.
Anchor Setting and Retrieval	Quantitative	The anchor handler travels to each of the eight anchor locations while many of the *Discoverer*'s sources are not in operation since drilling will not be performed during anchor setting and retrieval. A quantitative analysis was selected for Anchor Setting and Retrieval because emissions from the Anchor Handler operating within the eight anchor locations can be realistically quantified and modeled for potential air quality impacts.
Discoverer 15° Rotation	Qualitative	During normal operation, the *Discoverer* pivots along the drill in order to keep the bow facing the wind. The period it takes for the ship to realign itself with respect to the wind is less than an hour. A qualitative analysis for possible 15° rotation of the *Discoverer* with respect to wind direction was selected because the periods in which the *Discoverer* will not face directly into the wind will be brief less than an hour.
Ice Breaker and Anchor Handler Re-Supply	Quantitative	Either the primary ice breaker or the anchor handler will occasionally approach the *Discoverer* to switch personnel or to gather supplies. Two additional modeling analyses were performed; one for primary ice breaker re-supply and one for anchor handler re-supply. A quantitative analysis for Ice Breaker and Anchor Handler Re-Supply was selected because emissions from the re-supplying ship traveling to and from the *Discoverer* and the idling period next to the *Discoverer* can be realistically quantified and modeled for potential air quality impacts.
Nanuq Refueling	Quantitative	The *Nanuq* approaches and connects a fuel line to the *Discoverer* to transfer fuel. To maintain its position, the *Nanuq* undergoes dynamic positioning, in which it uses its propulsion engines to counteract any movement caused by water flow. A quantitative analysis for *Nanuq* Refueling was selected because emissions from the *Nanuq* during the refueling process can be realistically quantified and modeled for potential air quality impacts.
Alternative Incinerator Use Options	Quantitative	The ORRs on the *Discoverer*'s incinerator depend on the 24-hour operation of the HPU engines. The base operation case has both of the two HPU engines running. Alternatively, one or no HPU engine could be running with a corresponding greater incinerator limit. These two alternative scenarios were modeled for potential air quality impacts. A quantitative analysis for Alternative Incinerator Use Options was selected because these alternative configurations only change emission rates from existing sources that can be realistically modeled for potential air quality impacts.

Scenario Name	Analysis Performed	Description
Other Potential Scenarios	Quantitative	Other potential scenarios refers to situations in which either the anchor handler or the primary ice breaker would come closer to the *Discoverer* for ice breaking operations. A total of six possible ice management fleet configurations were modeled in this analysis. A qualitative analysis was selected because each of these six scenarios involve only the movement of either the anchor handler or primary ice breaker which can be realistically modeled for potential air quality impacts.
Warehouse Modeling	Quantitative	A quantitative analysis for the onshore facility was selected to show compliance with NAAQS and PSD increments. This scenario looks at the potential air quality impact from an onshore facility. The warehouse modeling shows compliance with all NAAQS and does not exceed any PSD increments. This analysis is provided is Section 8.5.
Tanker Modeling	Quantitative	A quantitative analysis for the Tanker was selected to show compliance with NAAQS and PSD increments. The Tanker operates beyond 25 miles of the *Discoverer*. The Tanker modeling shows compliance with all NAAQS and does not exceed any PSD increment. This analysis is provided in Section 8.6.

5.4.1 Bow Washing

Despite the activity of the ice management fleet, over time some ice still accumulates along the bow. When this occurs, the anchor handler would come to the side of the bow of the *Discoverer* and move back and forth in an effort to create waves from the propeller action on the anchor handler. These waves gently break the ice formation on the *Discoverer* bow and allow it to flow past the *Discoverer*. It is estimated to take approximately 30 minutes for the anchor handler to perform this task, but to maintain a conservative analysis one hour of activity was modeled. Because this operation is considered to be precision work the anchor handler would operate at a significantly reduced power setting. The emissions during this hour were calculated by assuming the main engines of the anchor handler would operate at a maximum of 20% load. However, to simulate worst-case conditions, the generators and heaters/boilers on the anchor handler are assumed to be operating at 100% power and the anchor handler incinerator is also assumed to be operating at its maximum feed rate of 154 lb/hr. Total emissions from the anchor handler for this scenario are summarized in Table 5-11 below.

Table 5-11: Anchor Handler Emissions While Bow Washing.

Anchor Handler			**(lb/hr)**		
Description	**Capacity**	**PM_{10}**	**$PM_{2.5}$**	**SO2**	**CO**
AH ICE Engines	20%	2.6	2.6	0.08	52.9
AH Boiler	100%	0.1	0.1	0.01	0.2
AH Incinerator	100%	1.0	0.7	0.2	22.7
Anchor Handler Total	-	3.8	3.4	0.3	75.8

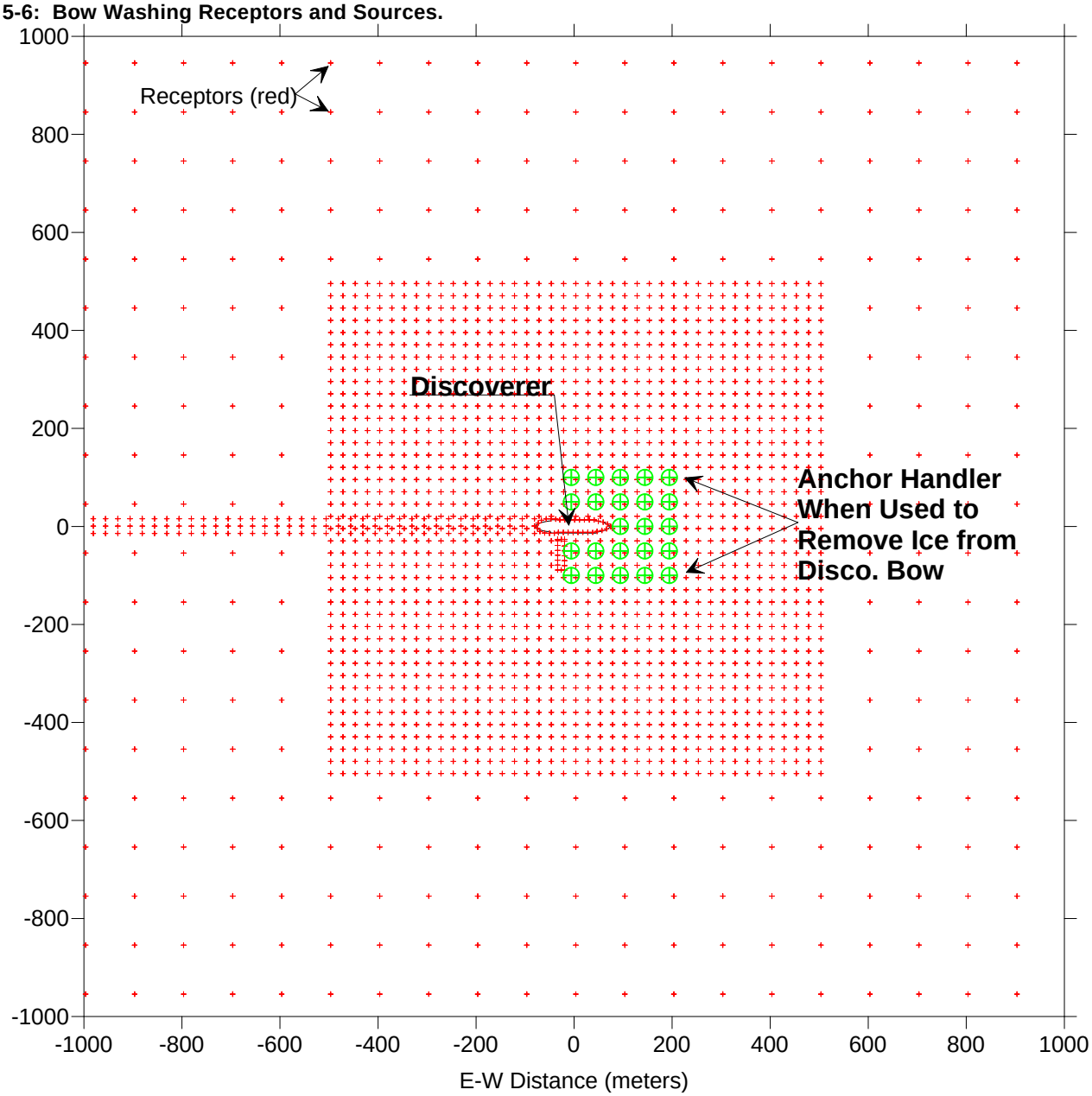
To model this scenario, 23 volume sources were placed around the bow of the *Discoverer* (Figure 5-6). The volume sources' emission rates were based upon one hour of operation in a given day at the

reduced power rate discussed above. The anchor handler is assumed to resume its normal ice breaking operation for the remaining 23 hours of the day. The results of the bow washing scenario are summarized in Table 5-12.

Table 5-12: Bow washing Results

Pollutant	Averaging Period	Class II Significance Level (SIL) ($\mu g/m^3$)	Maximum Predicted Concentration ($\mu g/m^3$)	Distance Exceeding SIL (km)
PM_{10}	24-hour	5	19.8	41.8
$PM_{2.5}$	24-hour	None	18.5	NA
SO_2	24-hour	5	1.3	0
	3-hour	25	24.8	0
CO	8-hour	500	376.1	0
	1-hour	2000	789.5	0

Figure 5-6: Bow Washing Receptors and Sources.



5.4.2 Anchor Setting and Retrieval

Shell's Chukchi Sea permit application assumed that the *Discoverer* is a stationary source subject to PSD review when the first of its anchors is attached to the sea floor. Consequently, the Chukchi Sea permit application evaluated air quality impacts associated with the setting and retrieving the anchors.

As explained in Section 3.2.1, Shell believes it is clear that the Discoverer becomes a stationary source (an “OCS Source”) only after it is sufficiently anchored such that the vessel is secure and stable in a position to commence exploratory activity at a drilling location. With this interpretation, no analysis of anchor setting or retrieval would be warranted. In the event that EPA disagrees with Shell's

interpretation, this application includes an analysis of anchor handling that is consistent with the Chukchi Sea permit application analysis.

In order to drill effectively, the *Discoverer* must be properly anchored. The *Discoverer* uses eight anchors to maintain its position while drilling. The setting and retrieval of these anchors is to be done by the anchor handler. Emissions during this time, like the bow washing, are calculated by assuming the main engines of the anchor handler would operate at a maximum of 20% load, but to simulate worst-case conditions, the generators, and heaters/boilers on the anchor handler are assumed to be operating at 100% power and the anchor handler incinerator is also assumed to be operating at its maximum feed rate of 154 lb/hr. During anchor deployment and retrieval, many of the emission units on *Discoverer* will not be operating because drilling would not be taking place.

The anchor setting and retrieval processes each consume no more than 18 hours. During this time, the anchor handler will travel to each anchor location to either set or retrieve the anchor. To model this, 1004 volume sources were placed in a circle around the *Discoverer* with a radius equal to the anchoring distance as seen in Figure 5-7. These volume sources' emission rates reflect 18 hours of operation in a given day. The anchor handler is assumed to be in normal ice management mode for the remaining 6 hours of the day. The anchor handler emissions are summarized in Table 5-13 below.

Table 5-13: Anchor Handler Emissions for Anchor Setting/Retrieval Scenario

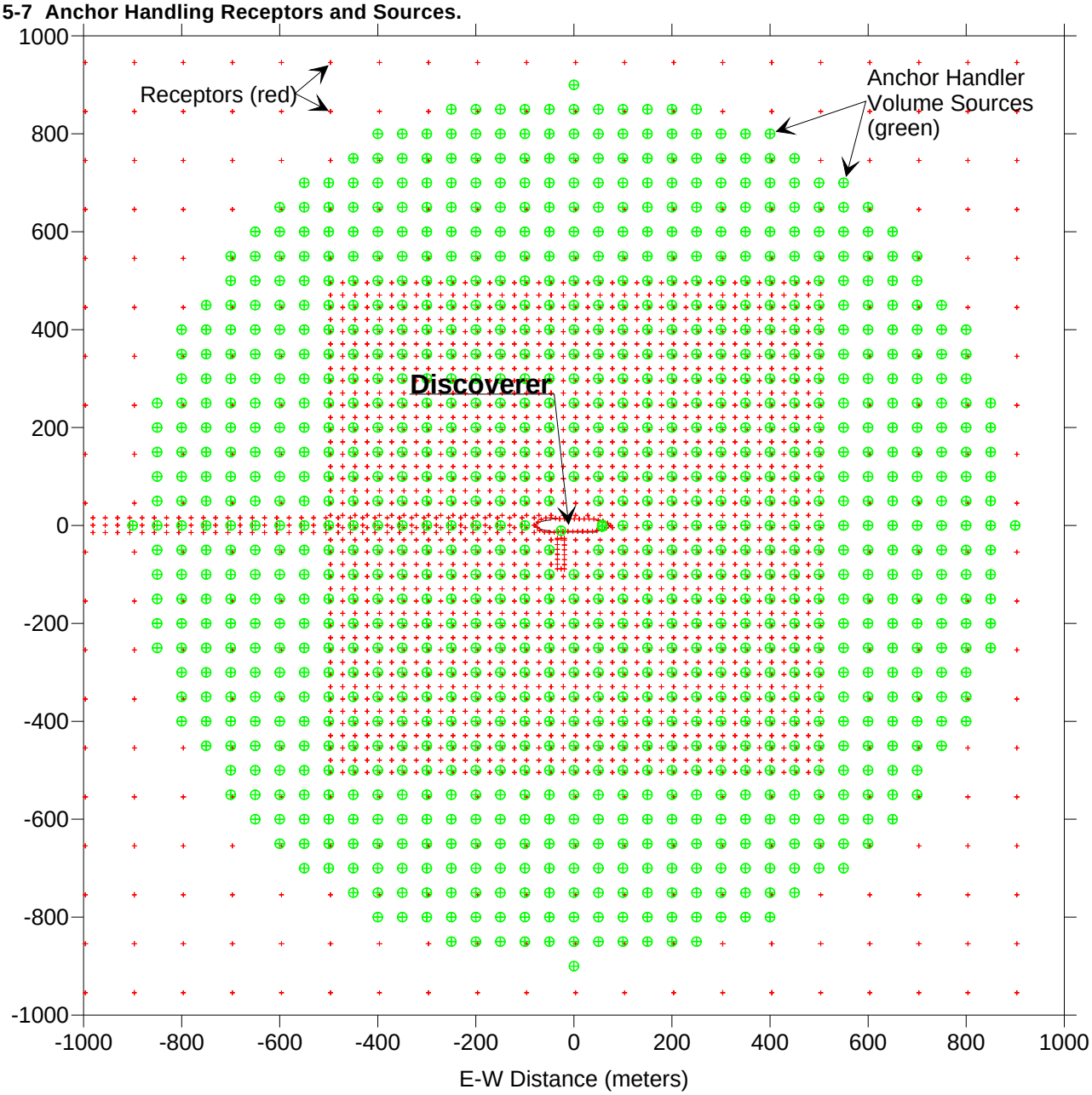
Anchor Handler			**(lb/hr)**		
Description	**Capacity**	**PM_{10}**	**$PM_{2.5}$**	**SO2**	**CO**
AH ICE Engines	20%	2.6	2.6	0.08	52.9
AH Boiler	100%	0.1	0.1	0.01	0.2
AH Incinerator	100%	1.0	0.7	0.2	22.7
Anchor Handler Total	-	3.8	3.4	0.3	75.8

The results from the Anchor Setting and Retrieval scenario are summarized in Table 5-14 below.

Table 5-14: Anchor Setting and Retrieval Results

Pollutant	**Averaging Period**	**Class II Significance Level (SIL) ($\mu g/m^3$)**	**Maximum Predicted Concentration ($\mu g/m^3$)**	**Distance Exceeding SIL (km)**
PM_{10}	24-hour	5	19.6	37.5
$PM_{2.5}$	24-hour	None	18.3	NA
SO_2	24-hour	5	1.3	0
	3-hour	25	24.4	0
CO	8-hour	500	363.9	0
	1-hour	2000	619.7	0

Figure 5-7 Anchor Handling Receptors and Sources.



5.4.3 *Discoverer* 15º Rotation

The air quality modeling analysis for the *Discoverer* emission sources assumed the ship will always be oriented with the bow into the wind. This is critical for operation of the *Discoverer* because wind is the mechanism for movement of ice in the arctic and it is important that the *Discoverer's* bow be facing into the ice flow. For this reason, a turret, a large circular ring to which the eight anchor wires are attached, has been installed in the hull of the *Discoverer*. The turret maintains a fixed position over the well; however the hull of the *Discoverer* is free to rotate around the turret to orient the bow into the wind. The wind and ice direction is constantly monitored and adjustments are made to orient the ship's bow into the

wind. This rotation is performed by hydraulic jacks that are electrically powered by generators already included in the emission inventory. The propulsion engine is not used to rotate the ship. As a result of these adjustments in orientation angle, the ship is always expected to be within 15 degrees of the wind direction and the time period taken to realign the ship with respect to the wind will be less than an hour, so that periods when the ship is at an angle with respect to the wind will be brief and is ignored in the air quality modeling.

5.4.4 Ice Breaker and Anchor Handler Re-supply

On occasion the ice breaker fleet may need additional supplies, personnel, or medical assistance from the *Discoverer*. This would require either the anchor handler or primary icebreaker to approach the *Discoverer*, dock for a short while, and then travel back to normal ice breaking locations. Two additional air quality impact analyses were developed for this scenario: one for anchor handler re-supply and another for primary ice breaker re-supply.

During these scenarios, the ship in transit would not be breaking ice and thus would operate at a reduced power setting much like the bow washing and anchor setting/retrieval scenarios. The emissions during this time were calculated by assuming the main engines of the ship would operate at a maximum of 20% load, but to simulate worst-case conditions, the ship's generators and heaters/boilers are assumed to be operating at 100% power and the ship's incinerator is also assumed to be operating at its maximum feed rate of 154 lb/hr.

For the anchor handler re-supply case, it was estimated that the anchor handler would take approximately 15 minutes to travel from its typical location to the *Discoverer*. It would then remain next to the *Discoverer* for approximately 30 minutes. After the transfer is complete, the anchor handler would then travel an additional 15 minutes back to resume normal ice breaking duties.

To model the anchor handler's transit, a series of 22 volume sources (spaced 50 meters apart) were placed from the center of the anchor handler's normal location to alongside the *Discoverer* as shown in Figure 5-8. The center of the anchor handler's normal location was selected to simulate worst case operations. An additional volume source was placed directly alongside the *Discoverer* to represent the stationary loading/unloading. Emission rates for each volume source were calculated based on the amount of time to be spent in each location. As such, the volume source directly next to the *Discoverer* has a much greater emission rate than the others since it the anchor handler would be idling here for an estimated 30 minutes.

The results from the Anchor Handler Re-Supply scenario are summarized in Table 5-15.

Table 5-15: Anchor Handler Re-Supply Results

Pollutant	Averaging Period	Class II Significance Level (SIL) (µg/m^3)	Maximum Predicted Concentration (µg/m^3)	Distance Exceeding SIL (km)
PM_{10}	24-hour	5	18.9	40.6
$PM_{2.5}$	24-hour	None	18.5	NA
SO_2	24-hour	5	1.3	0
	3-hour	25	25.0	0
CO	8-hour	500	373.0	0
	1-hour	2000	1227.1	0

During primary ice breaker re-supply, it was estimated that the primary ice breaker would take approximately 45 minutes to travel from its typical location to the *Discoverer*. Like in the anchor handler re-supply case, it would then dock for approximately 30 minutes. After the transfer is complete, the primary ice breaker would travel an additional 45 minutes back to resume normal ice breaking duties.

To model the primary ice breaker's transit, a series of 99 volume source (spaced 50 meters apart) were placed from the center of the primary ice breaker's typical location to alongside the *Discoverer* as shown in Figure 5-9. Like in the anchor handler re-supply, the center of the primary ice breaker's normal location was selected to simulate worst case operations. An additional volume source was placed directly alongside the *Discoverer* to represent the stationary loading/unloading. The emission rate for each volume source was calculated based on the amount of time to be spent in each location.

The results from the Ice Breaker Re-Supply scenario are summarized in Table 5-16 below.

Table 5-16: Ice Breaker Re-Supply Peak Results.

Pollutant	Averaging Period	Class II Significance Level (SIL) (µg/m^3)	Maximum Predicted Concentration (µg/m^3)	Distance Exceeding SIL (km)
PM_{10}	24-hour	5	20.7	40.9
$PM_{2.5}$	24-hour	None	19.2	NA
SO_2	24-hour	5	1.3	0
	3-hour	25	24.6	0
CO	8-hour	500	381.3	0
	1-hour	2000	733.5	0

Figure 5-8: Anchor Handler Re-Supply Receptors and Sources.

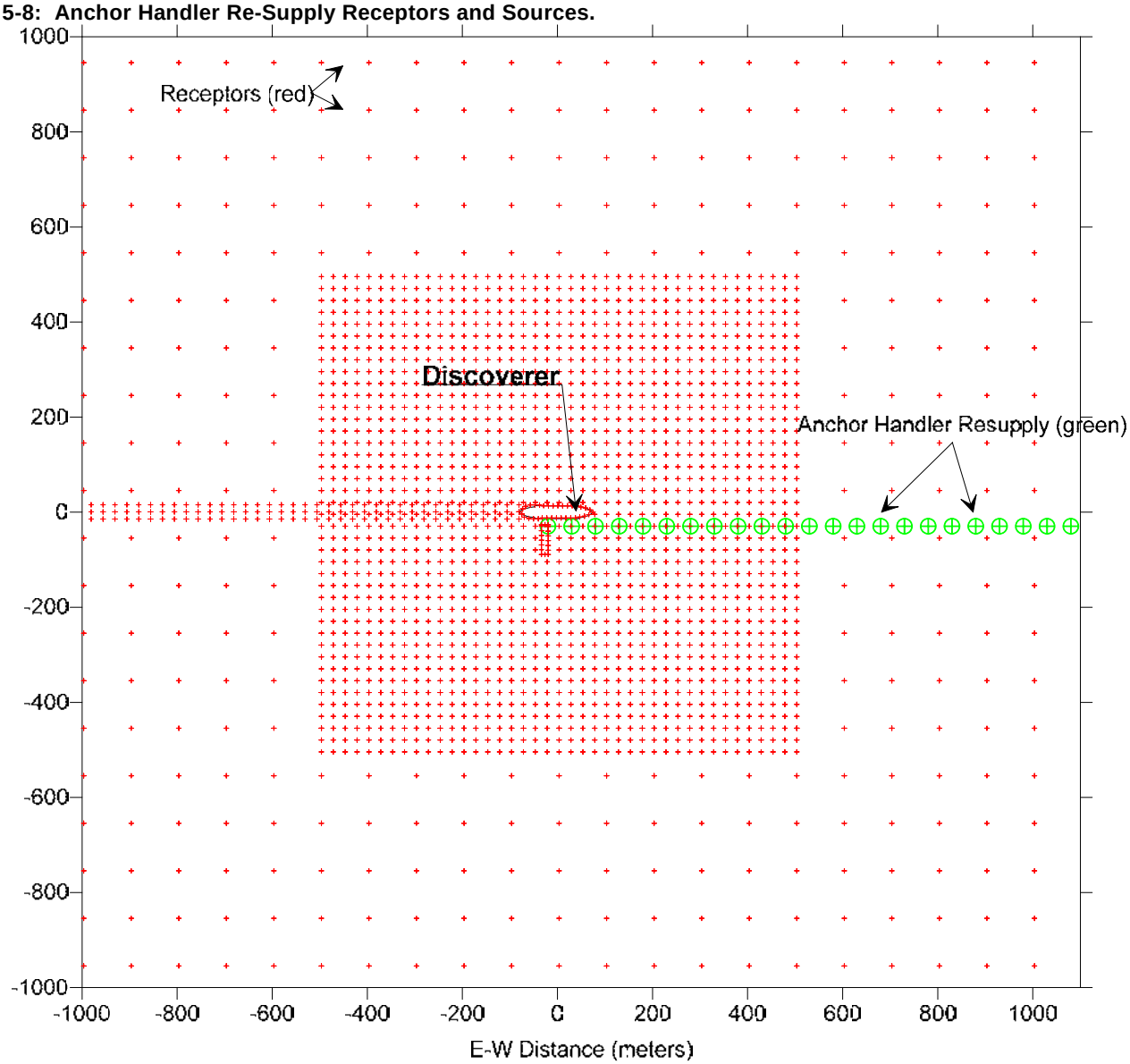
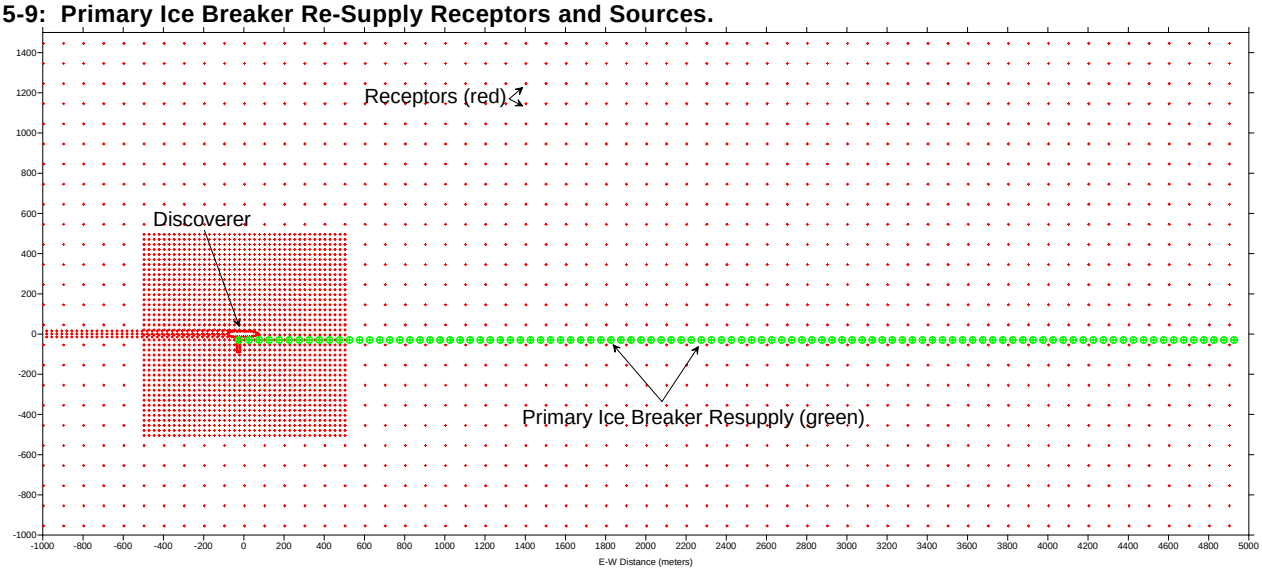


Figure 5-9: Primary Ice Breaker Re-Supply Receptors and Sources.



5.4.5 *Nanuq* Refueling

As mentioned in Section 2, occasionally during the course of normal operations the *Discoverer* will require additional fuel. During this refueling process, a vessel will approach and connect a fuel line to the *Discoverer*. While any vessel could potentially perform this task, it is most likely that it will performed by the oil spill recovery main ship – the *Nanuq*.

The process of refueling could take up to eight hours. During this time, the *Nanuq* will dynamically position next to the rear of the *Discoverer* as to not interrupt the fuel line. Dynamic positioning requires that the *Nanuq* operate its propulsion engines in an effort to counteract movement caused by water flow. For this scenario, it was conservatively assumed that the *Nanuq* would operate at normal power for the entire duration of the refueling process.

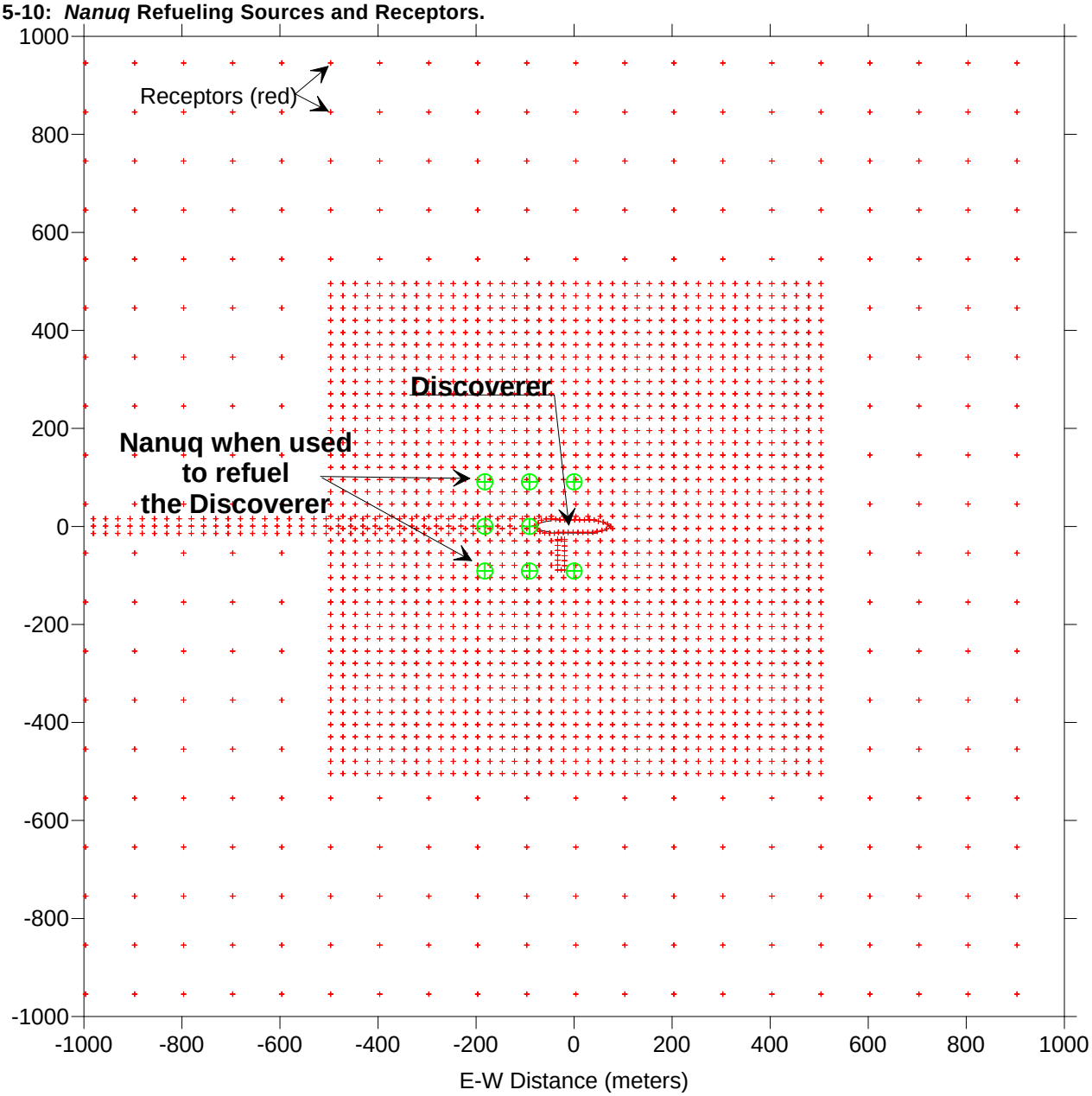
During the refueling process, the *Nanuq* could position itself in a number of places near the rear of the ship. To account for both this location flexibility and potential movement while dynamically positioning, the *Nanuq* was modeled as a series of 8 volume sources flanking the rear of the *Discoverer* as depicted in Figure 5-10.

The results from the *Nanuq* Refueling scenario are summarized in Table 5-17.

Table 5-17: *Nanuq* Refueling Results.

Pollutant	Averaging Period	Class II Significance Level (SIL) ($\mu g/m^3$)	Maximum Predicted Concentration ($\mu g/m^3$)	Distance Exceeding SIL (km)
PM_{10}	24-hour	5	20.7	42.2
$PM_{2.5}$	24-hour	None	19.1	NA
SO_2	24-hour	5	1.3	0
	3-hour	25	24.4	0
CO	8-hour	500	457.5	0
	1-hour	2000	653.4	0

Figure 5-10: *Nanuq* Refueling Sources and Receptors.



5.4.6 Alternative Incinerator Use Options

As discussed in Section 2, the ORR's for the *Discoverer's* incinerator vary depending on usage of the HPU engines. The base operating scenario (Section 5.3) is considered to be maximum HPU engine operation, which corresponds to a 300 lb waste/day limit on the incinerator. Shell proposes two additional incinerator use options reflecting reduced use of the HPU engines: 1) when only one HPU engine is operating, incinerator feed would be limited to 800 lb waste/day; 2) when neither HPU engine is operating, incinerator feed would be limited to 1300 lb waste/day.

A quantitative air quality impact analysis has been performed for these two alternate incinerator configurations. The incinerator's maximum operational capacity is 276 lb waste/hour. Because of this, the primary operating scenario reflects the worst case scenario for all 1-hour averaging periods. This is because for 1-hour averaging periods, the max 1-hour emissions from both the incinerator and the HPU engines have been considered. For this reason, additional air quality impact analyses for alternate incinerator configurations need to only to be performed for a 24-hour averaging period (the 8-hour averaging period for CO and the 3-hour averaging period for SO_2 in the primary operating scenario use maximum 1-hour emission rates for the incinerator).

The only differences between these alternate incinerator configurations and the base case are emissions from the HPU engines and the incinerator. The results from these two alternate configurations are displayed in Table 5-18 and Table 5-19 below.

Table 5-18: One HPU Engine with 800 lb/day Incinerator Limit Significant Impact Area Distances.

Pollutant	Averaging Period	Class II Significance Level (SIL) ($\mu g/m^3$)	Maximum Predicted Concentration ($\mu g/m^3$)	Distance Exceeding SIL (km)
PM_{10}	24-hour	5	19.4	42
$PM_{2.5}$	24-hour	None	18.1	NA
SO_2	24-hour	5	2.2	0

Table 5-19: No HPU Engines with 1300 lb/day Incinerator Limit Significant Impact Area Distances.

Pollutant	Averaging Period	Class II Significance Level (SIL) ($\mu g/m^3$)	Maximum Predicted Concentration ($\mu g/m^3$)	Distance Exceeding SIL (km)
PM_{10}	24-hour	5	19.4	41.9
$PM_{2.5}$	24-hour	None	18.1	NA
SO_2	24-hour	5	3.2	0

5.4.7 Other Potential Scenarios

In addition to the known but infrequent operating scenarios discussed above, Shell anticipates there would be situations where the ice management vessels would need to move to different positions with respect to the *Discoverer*. In some cases, the ice breaker and anchor handler may need to come significantly closer to the *Discoverer* than under normal operation.

These scenarios are analyzed and provided to avoid unnecessary restrictions on associated fleet location. This application analyzes the worst-case operating conditions for associated fleet vessels. For instance, for ice breakers worst-case emissions occur when they are being used to break ice.

The vessels have no other duties that would produce comparable emissions to the worst-case scenarios modeled, nor is there any other operational condition under which associated fleet vessels would be operating at full load during periods when they might be closer to the *Discoverer* than under normal operation. If more proximate operation is required under the circumstances, it would be under low power sufficient to simply propel the vessel. The following scenarios are provided to provide a further technical basis for the conclusion that such other potential scenarios do not present potential impact above the worst-case impacts modeled.

In order to demonstrate compliance with ambient standards during these scenarios, air quality impact analyses have been performed for a total of six additional ice breaker fleet configurations.

The six additional ice management vessel operating arrangements were designed to represent situations when either the anchor handler or the primary ice breaker operates closer to the *Discoverer* than under normal operations. Scenarios one through three simulate occasions when the anchor handler operates closer to the *Discoverer*, while four through six simulate occasions when the primary ice breaker would operate closer to the *Discoverer*. The three cases for each ship represent different distances upwind from the *Discoverer*:

- Scenarios one and four depict a ship operating directly to the side of the *Discoverer*.
- Scenarios two and five depict operations 100 meters upwind of the *Discoverer*.
- Scenarios three and six depict operations 500 meters upwind of the *Discoverer*.

The results of these scenarios are summarized in Table 5-20. Figures 5-12 and 5-13 depict source and receptor locations for each scenario scenario.

Table 5-20: Peak Concentrations for Other Potential Scenarios.

Scenario	Pollutant	Averaging Period	Class II Significance Level (SIL) ($\mu g/m^3$)	Maximum Predicted Concentration ($\mu g/m^3$)	Distance Exceeding SIL (km)
1	PM_{10}	24-hour	5	19.5	42.2
	$PM_{2.5}$	24-hour	None	18.2	NA
	SO_2	24-hour	5	1.3	0
		3-hour	25	24.4	0
	CO	8-hour	500	358.1	0
		1-hour	2000	613.4	0
2	PM_{10}	24-hour	5	19.5	42.2
	$PM_{2.5}$	24-hour	None	18.2	NA
	SO_2	24-hour	5	1.3	0
		3-hour	25	24.4	0
	CO	8-hour	500	357.9	0
		1-hour	2000	613.1	0
3	PM_{10}	24-hour	5	19.5	42.1
	$PM_{2.5}$	24-hour	None	18.2	NA
	SO_2	24-hour	5	1.3	0
		3-hour	25	24.4	0
	CO	8-hour	500	356.9	0
		1-hour	2000	612.1	0
4	PM_{10}	24-hour	5	20.1	43.0
	$PM_{2.5}$	24-hour	None	18.8	NA
	SO_2	24-hour	5	1.3	0
		3-hour	25	24.4	0
	CO	8-hour	500	358.6	0
		1-hour	2000	614.0	0
5	PM_{10}	24-hour	5	20.1	43.0
	$PM_{2.5}$	24-hour	None	18.8	NA
	SO_2	24-hour	5	1.3	0
		3-hour	25	24.4	0
	CO	8-hour	500	358.6	0
		1-hour	2000	613.9	0
6	PM_{10}	24-hour	5	20.1	42.9
	$PM_{2.5}$	24-hour	None	18.7	NA
	SO_2	24-hour	5	1.3	0
		3-hour	25	24.4	0
	CO	8-hour	500	358.2	0
		1-hour	2000	613.5	0

Figure 5-12: Scenarios 1-3 Receptors and Sources.

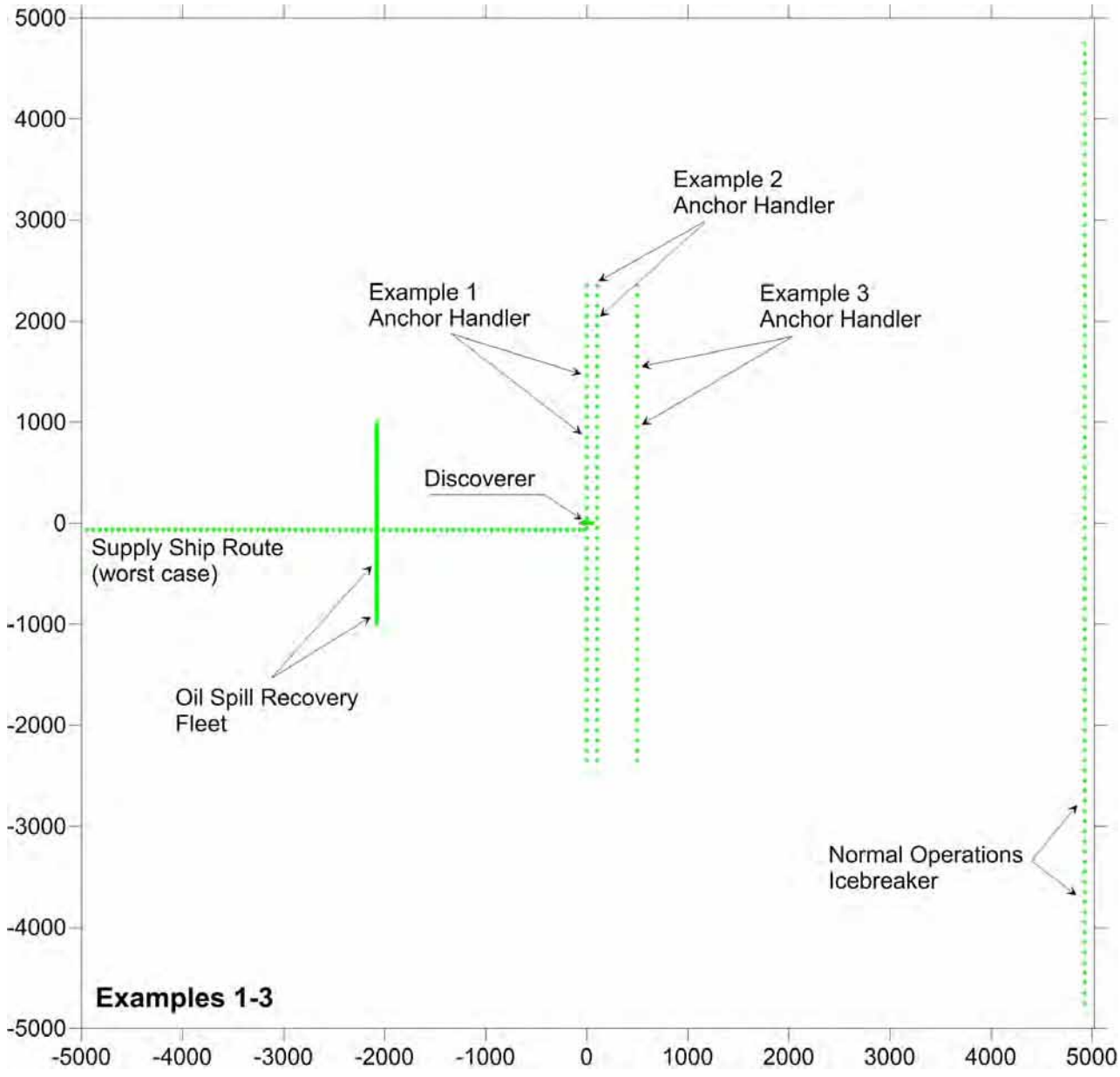
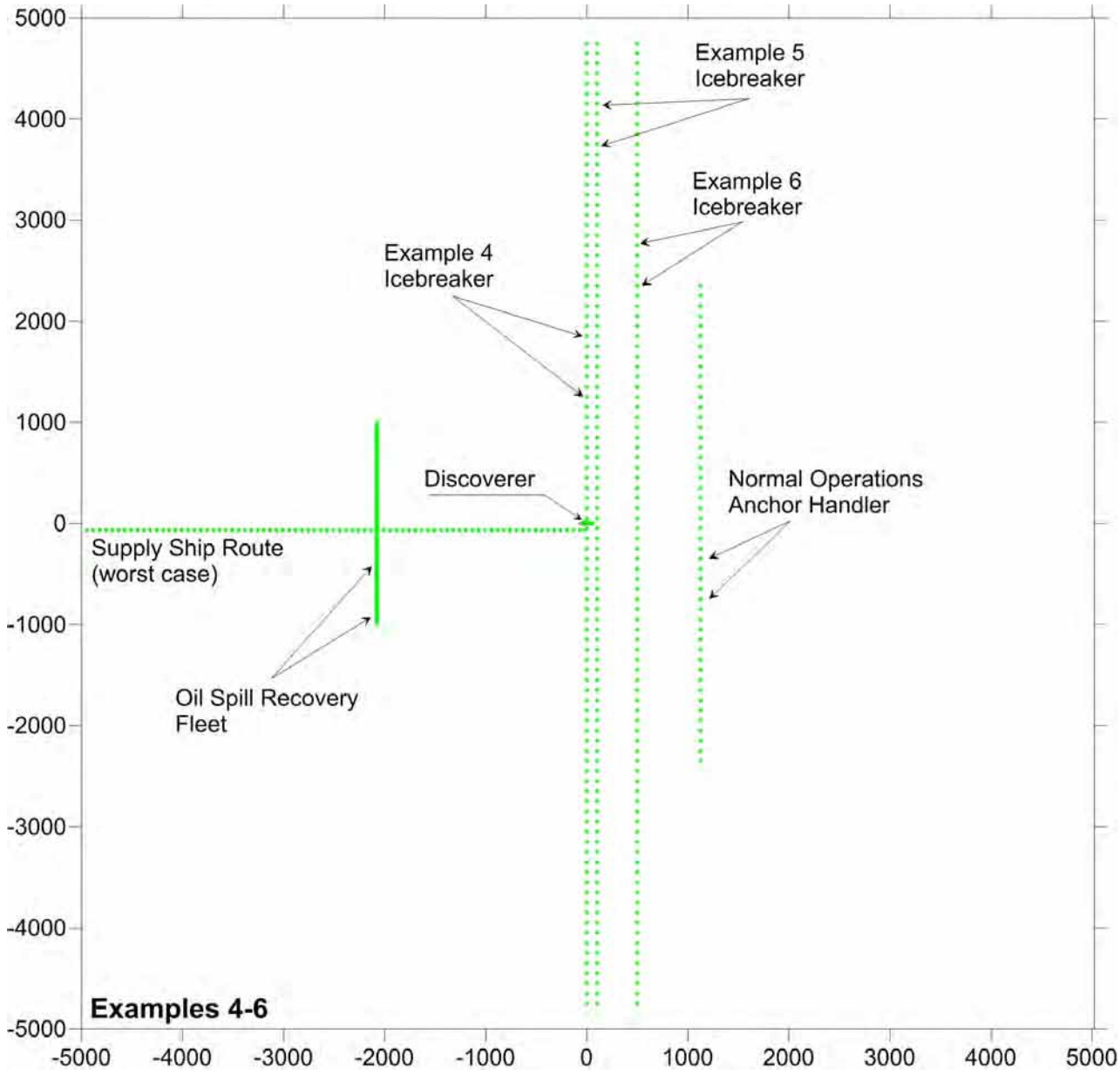


Figure 5-13: Scenarios 4-6 Receptors and Sources.



5.5 Summary of Maximum Short-term Concentrations

Table 5-21 identifies the maximum short-term concentrations attributable to the range of possible operating scenarios discussed in sections 5.3 and 5.4 and the distance to the point where predicted concentrations no longer exceed the SILs. The maximum annual concentrations remain as presented in Table 5-9. Table 5-21 indicates that only 24-hour PM_{10} concentrations exceed the SIL and warrant a Full Impact Analysis. As discussed in Section 5.3, predicted annual NO_2 concentrations also exceed the SIL and warrant a Full Impact Analyses. Cumulative 24-hour PM_{10} and annual NO_2 concentrations are addressed in Chapter 7.

Table 5-21: Maximum Predicted Short-term Concentrations From all Operating Scenarios

Pollutant	Averaging Period	SIL (µg/m^3)	Maximum Concentration Scenario	Maximum Predicted Concentration (µg/m3)	Maximum SIL Distance Scenario	Maximum Distance Exceeding SIL (km)
PM_{10}	24-hour	5	Ice Breaker Re-Supply	20.7	Ice breaker Scenario 4	43.0
$PM_{2.5}$	24-hour	None	Ice Breaker Re-Supply	19.2	N/A	N/A
SO_2	24-hour	5	Alternate Incinerator Configuration 2	3.2	N/A	N/A
	3-hour	25	Anchor Handler Re-Supply	25.0	N/A	N/A
CO	8-hour	500	*Nanuq* Refuel	457.5	N/A	N/A
	1-hour	2000	Anchor Handler Re-Supply	1227.1	N/A	N/A

SECTION 6

BACKGROUND CONCENTRATIONS

PSD regulations generally require consideration of background (existing) air quality when a full impact analysis is required for a pollutant subject to PSD review. This section discusses when consideration of background is not required, options for characterizing background air quality and, specifically whether existing ambient air quality data are adequate or whether preconstruction ambient air quality monitoring is required. The discussion is complicated by the fact that PSD rules and guidance are oriented towards analyzing proposed industrial sources based on land, not in an extremely remote offshore location.

6.1 When may analysis of background air quality not be required?

Under the PSD rules, collection of preconstruction background monitoring data may be required unless: (1) predicted concentrations attributable to the new source are less than the values in a list of Significant Monitoring Concentrations (SMCs); (2) existing concentrations in the area affected by the new source are less than the SMCs; or (3) no final SMC has been promulgated for a particular pollutant. 40 CFR 52.21(i)(5); 18 ACC 50.040 (H)(7).[84] Each of these three exemption criteria is discussed below.

6.1.1 Are concentrations attributable to the Project below specified SMCs?

The PSD rules are not clear as to where one should apply the SMCs for a source operating in the OCS. Shell is aware that ConocoPhillips Alaska Inc. (CPAI) has formally requested from EPA's Office of Air Quality Planning and Standards a determination that, under Section 328 of the Clean Air Act and EPA's implementing regulations, a proposed source in the OCS subject to PSD review need only demonstrate that its emissions will not cause an exceedance of the applicable PSD increment at impacted onshore locations and that neither "ambient air" nor any applicable air quality planning area extends offshore to the drillship for purposes of PSD compliance. Shell agrees with CPAI's analysis, but understanding that Region 10 has taken a different position, is providing analysis to also demonstrate compliance at the ambient air boundary. If at some point in the future CPAI's position is accepted or affirmed, Shell will seek revisions as may be appropriate.

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[84] The SMCs are listed in 40 CFR 52.21(i)(5)(i); 18 ACC 50.040 (H)(7). They are:
Carbon monoxide—575 µg/m^3 , 8-hour average;
Nitrogen dioxide—14 µg/m^3 , annual average;
Particulate matter—10 µg/m^3 of PM–10, 24-hour average;
Sulfur dioxide—13 µg/m^3 , 24-hour average;
Ozone— No de minimis air quality level is provided for ozone. However, any net emissions increase of 100 tons per year or more of volatile organic compounds or nitrogen oxides subject to PSD would be required to perform an ambient impact analysis, including the gathering of ambient air quality data.
Lead—0.1 µg/m^3 , 3-month average;
Fluorides—0.25 µg/m^3 , 24-hour average;
Total reduced sulfur—10 µg/m^3, 1-hour average;
Hydrogen sulfide—0.2 µg/m^3, 1-hour average;
Reduced sulfur compounds—10 µg/m^3, 1-hour average.

To provide complete information, Table 6-1 shows model-predicted maximum concentrations attributable to the *Discoverer* and associated fleet on both land and off-shore. The table shows that the model-predicted concentration of CO is below the SMC for CO both on land and off-shore, so there is clearly no requirement to consider background CO concentrations in a full impact analysis (none is required anyway). Predicted concentrations of PM_{10} and NO_2 are above the SMC in both scenarios, so this exemption criterion is not applicable for those pollutants. Predicted concentrations of SO_2 are above the SMC off-shore, but below the SMC on land. Applying the SMC to land, background SO_2 concentrations need not be included in the analysis.

Table 6-1: Comparison of Model-Predicted Maximum Concentrations with SMCs

Pollutant	Averaging Time	Maximum Concentration on land (μg/m^3)	Maximum Concentration Off-shore (μg/m^3)	SMC (μg/m^3)
NO_2	Annual	17.0	19.7	14
CO	8-hour	355.4	458	575
PM10	24-hour	18.4	20.7	10
SO2	24-hour	1.0	25	13

Because Project potential VOC emissions do not exceed 100 tons per year, there is no requirement to document background ozone concentrations or conduct an ozone impact analysis. However, an assessment potential ozone impacts attributable to the project is still provided in Section 8.4.

6.1.2 Do concentrations exceed SMCs in the area the Project would affect?

Under the second exemption criterion, an application does not have to include an analysis of background ambient air quality if existing concentrations in the area affected by the new source are less than the SMCs. As discussed further below, there is no available existing ambient concentration data in the off-shore area – conducting an ambient air quality monitoring program in the Arctic Ocean would be extremely difficult, if not impossible. This leaves two approaches for estimating existing off-shore concentrations: predicting background concentrations through modeling or analyzing existing scientific measurements from monitors located as close as possible to the area or similar areas (other high latitude locations). ENVIRON concludes that both approaches confirm the common sense assessment that existing pollutant concentrations in the remote off-shore location in which the Project will operate are very low.

EPA guidance allows use of a screening technique or refined model to estimate existing ambient concentrations for comparison with the SMCs, and advises agency consultation before selecting a model. EPA Draft New Source Review Workshop Manual, Oct 1990 (NSR Manual), pp. C.16-18. In consultation with EPA, ENVIRON determined that ISC-PRIME was appropriate for evaluating OCS sources for the

significant impact analysis and the full impact analysis. ENVIRON also applied ISC-PRIME to estimate background concentrations attributable to existing industrial sources at the off-shore Project area. These model predictions, presented in Table 6-2, show that existing background concentrations in the area affected by the Project are well below corresponding SMCs.

Table 6-2: Comparison of Model-predicted Off-shore Concentrations with SMCs

Pollutant	Averaging Time	Modeled-predicted Concentration ($\mu g/m^3$)	SMC ($\mu g/m^3$)
NO_2	Annual	0.17	14
PM_{10}	24-hour	1.2	10
$PM_{2.5}$	24-hour	1.2	Not established
SO_2	24-hour	1.38	13

Under the second exemption criteria, therefore, modeled off-shore concentrations indicate that there is no requirement for this application to consider background concentrations for NO_2, PM_{10}, or SO_2 in the full impact analysis. The ISC-PRIME-predicted existing concentration for $PM_{2.5}$ is similarly very low (1.2 $\mu g/m^3$), but EPA has not yet established a $PM_{2.5}$ SMC with which to compare this value (see Section 6.2.3 below).

Furthermore, as discussed in Section 6.2.1, the most relevant measured NO_2 and SO_2 concentrations on the North Slope are equal to or less than their respective SMCs.

6.1.3 Have SMCs been promulgated for each relevant pollutant?

Under the third exemption criterion, an application does not have to include an analysis of background ambient air quality if the pollutant is not in the list of SMCs in the PSD rules. Of the pollutants emitted by the project at rates exceeding the Significant Emission Rates, SMCs have been promulgated for all except $PM_{2.5}$. An ambient monitoring threshold for $PM_{2.5}$ has been proposed but not promulgated. Because $PM_{2.5}$ is not listed in 40 CFR 52.21(i)(5)(i); 18ACC 50.040 (h)(7), this application need not contain an analysis of background ambient $PM_{2.5}$ concentrations.

Reflecting the staged implementation of the PM2.5 standard around the country, Alaska has not yet adopted the PM2.5 standard and does not require modeling of PM2.5 or PM2.5 monitoring at this time. If Alaska regulations govern within 28 miles of the shoreline, then PM2.5 monitoring would not be required for the Beaufort permit application at this time.

6.2 If background are included, what are appropriate values to apply?

For the reasons described in subsection 6.1, Shell believes there is ample basis for EPA to conclude that this application is not required to contain an analysis of background ambient concentrations in any required full impact analysis. However, in the interest of providing a complete application, and in the

event EPA declines to apply the 40 CFR 52.21(i)(5); 18ACC 50.040 (h)(7) exemptions, Section 7 of the application provides impact analyses that incorporate background concentrations. This subsection describes the basis for the background values ENVIRON used in those analyses.

6.2.1 What background data are available?

If background data are included in an analysis, the preference is for data gathered over a year that is representative of the year preceding the application. Data collected within the prior three years is also generally acceptable, and the permitting authority has the discretion to allow an analysis based on four months of data. When the source being permitted is isolated (as are the OCS lease blocks), alternate sources of representative background data may be used in lieu of actual monitoring in the project area.

EPA guidance states that if the location of a proposed source is not affected by other major stationary point sources, available monitoring data may be used to assess existing ambient concentrations. Table 6-2 clearly indicates that existing onshore industrial sources have a small effect on air quality at the lease blocks, as predicted concentrations are all less than the SILs (let alone SMCs). While it's preferable to use data collected within the area of concern, the possibility of using measured concentrations from representative "regional" sites may be acceptable. NSR Manual, p. C.18. Similarly, EPA's Guideline on Air Quality Models (Appendix W to Part 51, paragraph 8.2.2) identifies two options for isolated sources: collect air quality data in the vicinity of the source or rely on regional monitoring data. Given the remote, off-shore project location and lack of ambient data from that location, on-site data are not available. While onshore measurements of gaseous pollutants may be acceptable (though conservative) to apply to offshore source locations, ENVIRON attempted to find other sources of data for PM10 and PM2.5 to better represent offshore conditions.

<u>Scientific Monitoring Data</u>

ENVIRON conducted a search for existing scientific measurement programs that could provide data on background pollutant concentrations in the off-shore environment. We did not locate, nor are we aware of, any off-shore background monitoring data from the Arctic that meets PSD monitoring guidelines – likely due to extreme conditions which would make such monitoring virtually impossible. We were particularly interested in PM_{10} and $PM_{2.5}$ data because we expect onshore measurements of these pollutants to be least representative of off-shore background concentrations. Although we discovered and examined voluminous data from extensive studies in lower latitude locations in the Western South Pacific (near Australia), it is not clear that observations near tropical conditions would apply in the Arctic Ocean. Furthermore, PM information from those studies was not in size categories that enabled an evaluation of $PM_{2.5}$ concentrations.

ENVIRON also obtained a scientific paper that analyzed air quality data at a monitor in Sevettijarvi, an isolated location in northern Finland, during an 18 month period from December 1992 to July 5, 1994. The estimate of PM2.5 concentrations due to the Arctic and Norwegian Sea were obtained through a

back trajectory analysis. The paper reported only an average over the whole sampling period (1.9 µg/m3), but also identified the standard deviation. Three standard deviations above the average value results in a maximum (99.7 percentile) PM2.5 value of 5.7 µg/m^3 with trajectories from the sea:

$$\text{Max } PM_{2.5} = \mu + 3\sigma = 1943\frac{ng}{m^3} + 3 \times 1266\frac{ng}{m^3} = 5.741\frac{\mu g}{m^3}$$

Chemical analysis of the data revealed that salt and sulfates were the primary components of $PM_{2.5}$.

Researchers at McMurdo station in Antarctica implemented particulate monitoring Hut Point during two periods between 1995 and 1997. The study applied chemical mass balance (CMB) receptor modeling to achieve source apportionment results. Average PM_{10} concentration was found to be 3.4 µg/m^3 and was dominated by crustal material (dirt) and sea salt. By definition, $PM_{2.5}$ concentrations would be lower than PM_{10} values recorded at this site.

Finally, there are a number of background monitoring stations established at Class I areas in the United States and US territories. The purpose of these so-called IMPROVE stations is to monitor air quality related values, including visibility, in relatively pristine national parks and wilderness areas. Most of these sites are located inland and, while representative of inland regional air quality, they are not representative of ocean locations.

The IMPROVE station that we judged most likely to provide in-sight into Arctic conditions was located at Simeonoff, Alaska, an island in the upper Aleutian chain. This station measured PM_{10} and $PM_{2.5}$ from September 2001 through December 2004. Although aerial photographs indicate it, too, may be influenced by local dust events, it provides an indication of background $PM_{2.5}$ and PM_{10} concentrations in a relatively pristine near-shore environment. Table 6-3 summarizes three years of data from Simeonoff. The statistics most relevant to NAAQS compliance demonstrations are the 98th percentile 24-hour $PM_{2.5}$ concentration and the maximum 2nd highest 24-hour PM_{10} concentration.

Table 6-3: Summary of Simeonoff IMPROVE Station Observations (µg/m^3)

	$PM_{2.5}$	PM_{10}
Number Records	363	365
Min	0.33	0.95
Max	16.41	26.50
Average	2.95	7.38
Standard Deviation	2.12	4.97
98th Percentile	9.34	21.9

In summary, scientific measurements indicate a background $PM_{2.5}$ concentration ranging from 3.4 to 9.3 µg/m^3, with the latter observation occurring on an island that may be subject to dust effects.

<u>North Slope Onshore Data</u>

ENVIRON also reviewed the available data from onshore ambient air quality monitoring stations on the North Slope. Because there are emissions sources onshore, including stationary industrial sources, mobile sources such as trucks and all-terrain vehicles, and wind-blown dust, ENVIRON expects onshore data to show significantly higher pollutant concentrations than would be recorded if off-shore monitoring was feasible. The onshore data, therefore, provides very conservative background values.

ENVIRON obtained from the Alaska Department of Environmental Conservation (ADEC) historical ambient air quality monitoring data for a number of British Petroleum Exploration (Alaska), Inc., (BPX) monitoring stations and two Conoco Phillips Alaska, Inc. (CPAI) monitoring stations on the North Slope. Two additional monitoring stations on the North Slope in Barrow and Wainwright were identified. The Barrow station is a governmental research station run by the United States Department of Commerce, National Oceanic and Atmospheric Administration.[85] The Wainwright station is a private station operated by CPAI, which has a cost sharing arrangement in place with Shell. Figure 6-1 displays the locations of these stations.

Table 6-4 lists the nine current and historical ambient monitoring stations located on the North Slope, the station operating history, parameters measured at each station, and comments on the quality of the data. Table 6-4 documents a long record of ambient air quality monitoring and confirms that ADEC has reviewed and accepted much of the data for permitting purposes. The most recent data comes from stations closest to the Camden Bay lease blocks that are the focus of this application. BPX recently operated four monitoring stations at Liberty and Prudhoe Bay. Most of the data from these stations has been reviewed and endorsed by ADEC for permitting use, including NOx and SO2 monitoring data from BP's Liberty site from February 2007 through January 2008. ADEC has also approved NOx, SO2, and ozone monitoring data for 2007 from BP's monitoring stations at A-Pad and CCP. A formal review of BPX monitoring data for 2007 was conducted by an ADEC contractor and is documented in Appendix J.

Table 6-5 provides a tabulation of the maximum measured concentrations at each monitoring station. Although BPX monitoring stations at Prudhoe Bay sites are on shore and near substantial industrial development, they are closest to Shell lease blocks that are the subject of this application and may therefore be most representative.

[85] http://www.esrl.noaa.gov/gmd/obop/brw/

Figure 6-1: Ambient Monitoring Stations on the North Slope

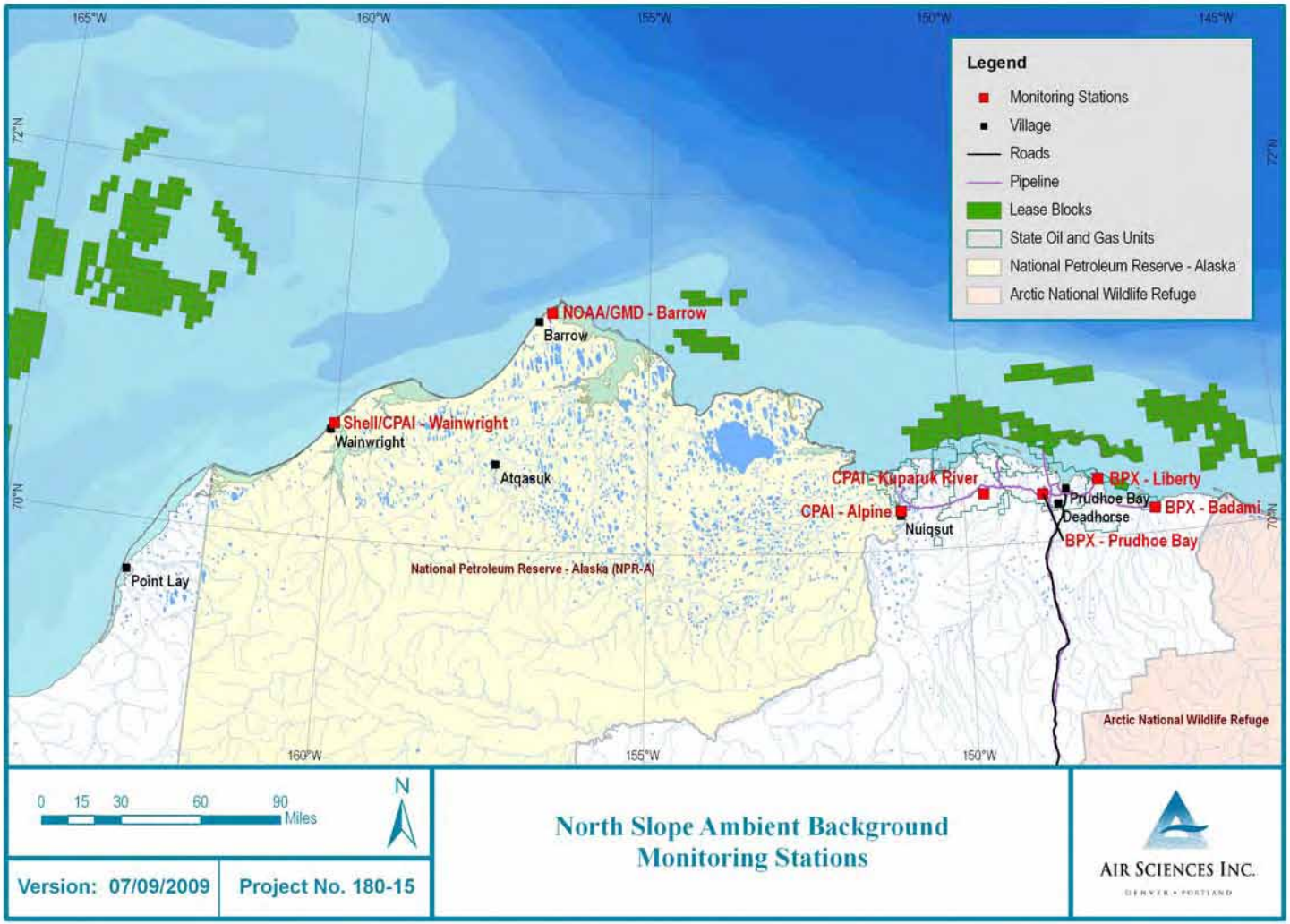


Table 6-4: Ambient Monitoring Stations on the North Slope

Company Location	Station	Station Operating History	Data Publicly Available [4]	Measured Parameters						Comments/Quality Assessment
				CO	NO_x	O_3	PM_{10}	$PM_{2.5}$	SO_2	
BPX - Badami	ANSER	1999	1999		X	X	X		X	ADEC has approved the use of this data for permitting purposes.
BPX - Liberty	Liberty	02/2007 - 01/2008	02/2007 - 01/2008	X	X				X	ADEC has approved the use of this data for permitting purposes.
BPX - Prudhoe Bay	A Pad	1986-Present [1]	2004 - 2007		X	X			X	BPX withdrew their request to have their 2003 - 2005 Prudhoe Bay data reviewed by ADEC due to equipment problems and inadequate data capture. ADEC has completed data reviews for 2006 and 2007. According to ADEC, the pollutant capture rates (all pollutants) for the fourth quarter of 2006 do not meet EPA's requirement of 80%. For 2007, the PM_{10} sample data does not meet the 80% data capture requirement in the fourth quarter, but all other air quality parameters were found to meet PSD data quality criteria.
BPX - Prudhoe Bay	CCP	1986-Present [1]	2004 - 2007		X	X	X		X	
BPX - Prudhoe Bay	GC1	1991-2004	2004		X	X				
CPAI - Alpine	Nuiqust	1999 - Present	2003 - 2005		X	X [3]	X		X	Data at Nuiqsut is being gathered for informational purposes only. ADEC has not reviewed this data. The 2003, 2004, 2005 data provided by ADEC appears to meet EPA requirements (except Q1 of 2003).
CPAI - Kuparuk River	DS1F	06/2001 - 06/2002	06/2001 - 06/2002	X	X	X	X		X	ADEC has approved the use of this data for permitting purposes.
NOAA/GMD - Barrow	Barrow	1973 - 2006	2003 - 2005			X				Data has not been reviewed by EPA or ADEC.
Shell/CPAI - Wainwright	Wainwright	11/2008 - Present	11/2008 - Present	X	X	X	X	X	X	For the Shell Chukchi Sea Exploratory Drilling Program, EPA has approved the use of six months of data for permitting purposes.

[3] Ozone monitoring at CPAI - Alpine began in 2004.

Table 6-5: Maximum Monitored Concentrations at Stations on the North Slope

Company/Location	Station	Data Dates	Maximum Measured Concentrations (ug/m^3)							
			PM_{10}		NO_2	CO		SO_2		
			24-Hour	Annual	Annual	1-Hour	8-Hour	3-Hour	24-Hour	Annual
BPX - Badami	ANSER	1999	7.9	1.8	3.0	---	---	9.8	7.2	2.6
BPX - Liberty	Liberty	02/2007 - 01/2008	---	---	11.3	1,749	1,097	41.6	13.0	2.6
BPX - Prudhoe Bay	A Pad	2006, 2007	---	---	10.5	---	---	41.6	33.8	2.1
BPX - Prudhoe Bay	CCP	2006, 2007	55.1	7.5	19.7	---	---	28.6	23.4	2.2
CPAI - Alpine	Nuiqust	2003, 2004, 2005	54.0 [a]	6.9 [a]	17.3	---	---	18.2	7.8	0.2
CPAI - Kuparuk River	DS1F	06/2001 - 06/2002	60	6	6	1,100	600	36	16	0
Shell/CPAI - Wainwright [b]	Wainwright	11/2008 – 8/2009	114	4.0	1.9	1,051	949	18	10.5	0

a. Local emissions sources such as blowing dust from nearby river channels elevate ambient PM_{10} concentrations at Nuiqsut which is not representative of remote offshore locations; PM_{10} data presented is from the most recent annual report available to Alaska DEC (Station Year 6: March 2004 - April 2005) and does not include hours associated with naturally occurring forest fires and wind blown dust events.

b. The maximum monthly data are provided as the annual average concentrations from this station until a year's worth of data are available at the station.

Maximum annual NOx values at BPX stations have ranged from 10 to 20 µg/m^3; the maximum concentration at the monitoring station nearest the lease areas is 11.3 µg/m^3 (from Liberty). This value is less than the SMC, affirming the earlier model-based conclusion that NO2 concentrations on land are less than the SMCs. All measured values are less than the NOx increment of 25 µg/m^3 and far below the ambient air quality standard of 100 µg/m^3.

Maximum 24-hour SO2 concentrations at BPX monitoring stations range from 13 to 34 µg/m^3. The maximum concentration at the monitoring station nearest the lease areas is 13 µg/m^3 (from Liberty). This value equals the SMC. All measured values are less than the SO2 increments and far below SO2 ambient air quality standards.

Although we cite maximum observations, the Guideline on Air Quality Models is very clear (at 8.2.2) that both annual and short-term background concentrations are to be determined by averaging data from the time periods of interest:

> "Determine the mean background concentration at each monitor by excluding values when the source in question is impacting the monitor. The mean annual background is the average of the annual concentrations so determined at each monitor."
>
> "Concentrations for meteorological conditions of concern, at monitors not impacted by the source in question, should be averaged for each separate averaging time to determine the average background value."

Consequently, estimates of background concentrations applicable offshore that rely on maximum onshore data are very conservative.

Given Badami's isolation, PM10 measurements from 1999 may still be representative of current conditions. More recent measurements are available from ConocoPhillips monitoring stations at Alpine and Kuparuk and from BPX (CCP, Prudhoe Bay). Each station reports low annual concentrations concentrations (7.5 µg/m^3 or less) but relatively higher short-term values (54-60 µg/m^3); occasionally, even higher concentrations are observed during fires or extreme windblown dust events. Maximum 24-hour PM_{10} concentrations exceed the SMC, but are still below ambient standards. Comparisons with PSD increment are inappropriate because most of the PM_{10} is presumed to be crustal material (soil) that would also have been present in the baseline.

<u>Monitoring data collected by Shell</u>

Shell has partnered with ConocoPhillips to monitor air quality at Wainwright. An interim station has been operating fall 2008; a permanent monitoring station became operational mid-September 2009. Both the interim and the new stations measure NOx, SO2, CO, PM_{10}, $PM_{2.5}$, ozone, and meteorological parameters.

Because Wainwright is an isolated shoreline village, one might expect that air quality measurements would be representative of background conditions. However, the village relies on oil for heat and

electricity, and numerous all terrain vehicles and road vehicles stir up dust that affect the monitoring stations. The interim station was located at the intersection of two unpaved roads that lead to the airport and the landfill; it is clear that suspended dust from these roads and the unpaved nearby runway contribute to PM_{10} and $PM_{2.5}$ concentrations measured at this station. The new monitoring station is less affected by traffic, but is still adjacent to a road leading to the village landfill. It is also affected by windblown dust, resuspended dust from roads and the airstrip, and from village combustion.

Recognizing that resuspended dust is an issue, consideration of Wainwright data is still warranted. EPA's analysis of the Wainwright particulate matter data, considering only the effects of high wind and recent precipitation, is that reasonable estimates of 24-hour average and annual average PM_{10} concentrations at offshore locations are 91 and 15 µg/m^3, respectively.[86] EPA's analysis determined that reasonable estimates of 24-hour average and annual average $PM_{2.5}$ concentrations at offshore locations are 11 and 2.8 µg/m^3, respectively. We believe both 24-hour average concentrations (but especially PM_{10}) are very conservative representations of offshore particulate matter concentrations.

In addition to the Wainwright monitoring, Shell devoted several months to evaluating options for background air quality in support of the Beaufort Sea air permit application. Shell considered stations at Nuiqsuit, Barter Island, Reindeer Island, Badami and other locations. However, there are numerous logistical considerations that preclude monitoring at offshore locations, including availability of electric power, access for maintenance, concerns about ice overrun in winter months, and even damage by polar bears.

After considerable time and effort, Shell elected to establish an ambient air quality monitoring station at Badami to measure NO2, $PM_{2.5}$, and meteorological parameters and to establish a meteorological station on Reindeer Island. The Badami location is isolated from industrial sources, but may still measure higher particulate matter concentrations than at sea. Data collection began in mid-August 2009. Consequently, the data are representative of the proposed exploration period (July through December).

On December 22, 2009, Shell's air quality and meteorology monitoring contractor, AECOM, submitted to EPA a report that report summarized quality assurance measures, performance criteria, and measurement results for the first four months of station operation.[87] Shell proposes that the highest 24-hour $PM_{2.5}$ concentration measured at Badami (8 µg/m^3) is a conservative representation of 24-hour average offshore background $PM_{2.5}$ background concentrations and that the period average $PM_{2.5}$ concentration measured at Badami (2 µg/m^3) is a conservative representation of annual average offshore background $PM_{2.5}$ background concentrations.

[86] USEPA Region 10, 2010. Statement of Basis for Proposed Outer Continental Shelf Prevention of Significant Deterioration Permit No. R10OCS/PSD-AK-09-01.

[87] AECOM 2009. Badami Ambient Air Quality and Meteorological Monitoring Station August 15, 2009 through December 15, 2009 Data Summary Report

The Badami monitoring station also monitors ambient concentrations of oxides of nitrogen. The average concentration from mid-August through December 15 is less than 0.001 ppmv (less than 2 ug/m3). This is considerably lower than the conservative background concentration of 11.3 µg/m^3 measured at BP Liberty and reported in the September 30 Beaufort Sea application.

We continue to believe that shore-side monitoring overstates off-shore conditions, but intend to apply the Badami $PM_{2.5}$ measurements to conservatively represent background $PM_{2.5}$ concentrations in the project area. Despite its conservatism, we will continue to rely on the BP Liberty data for background NO_2 concentrations in the Beaufort Sea exploration area.

6.2.2 Conclusion

As part of a 2008 air quality permitting process for the BP Exploration Alaska, Inc. Liberty Development Project, ADEC assessed available air quality monitoring data for use as background concentrations to be added to model results for comparison with ambient air quality standards. ADEC reviewed new monitoring conducted by BP in 2007-2008 for the proposed development as well as some supplemental data for pollutants not measured at the Liberty Development. Given the recent nature of these data, the recent decision by Alaska to determine these data as representative of regional background values, and the relative proximity to Shell's Beaufort Sea lease areas, Shell proposes to use these same values for regional background values for the Beaufort exploration project. Table 6-6 identifies the proposed background values for the Beaufort exploration effort.

Table 6-6: Conservative Estimates of Background Concentrations

Pollutant	Averaging Time	Measured Concentration (µg/m^3)	Data Source[88]
NO_2	Annual	11.3	BPX Liberty 2/07-1/08
PM_{10}	24-hour	55.1	BPX Prudhoe Bay 07
	Annual	7.5	BPX Prudhoe Bay 07
SO_2	3-hour	41.6	BPX Liberty 2/07-1/08
	24-hour	13.0	BPX Liberty 2/07-1/08
	Annual	2.6	BPX Liberty 2/07-1/08

As discussed above, it is not clear that PSD regulations require consideration of background $PM_{2.5}$ concentrations at this time. However, in the event it is determined that $PM_{2.5}$ monitoring is required, Shell proposes to apply 24-hour and annual average concentrations of 8 and 2 µg/m^3, respectively.

For the reasons discussed above, we have significant reservations with using onshore monitoring data to reflect off-shore conditions. It is extremely conservative to apply onshore background measurements to off-shore locations because distance tends to dilute concentrations attributable to onshore sources.

[88] From BP Liberty Technical Analysis Report, Final November 22, 2008, ADEC, except PM10, which is from BPX CCP monitoring site, Prudhoe Bay.

Furthermore, it is very conservative to add these measured values to model predicted cumulative concentrations because contributions from the industrial sources should already be accounted for in the measured values. Despite the very conservative nature of this process, the background values in Table 6-6 are added to cumulative model predictions in the NAAQS compliance demonstration included in Section 7.

SECTION 7

FULL IMPACT ANALYSIS

Dispersion modeling of Project emissions revealed maximum annual NO_2 and 24-hour PM_{10} concentrations that were greater than the respective SILs. Consequently, a full impact analysis is required for NO_2 and PM_{10}. The use of ultra-low sulfur diesel for all sources now results in maximum concentrations of SO_2 that are equal to or less than the SILs for any averaging period. However, to maintain consistency with previous submissions, a full impact analysis for SO2 is still contained within this section. Although there are no SILs established for $PM_{2.5}$, there is a NAAQS for $PM_{2.5}$, and this section includes a $PM_{2.5}$ NAAQS compliance analysis.

The first step in the full impact analysis is to determine the extent of the Significant Impact Area (SIA) of the proposed project. Initially, the SIA is determined for each averaging time for a particular pollutant. The final SIA for that pollutant is the largest area for each of the various averaging times. According to the EPA's Draft New Source Review Workshop Manual (EPA, 1990), the SIA is a circular area with a radius extending from the source to: (1) the most distant point where approved dispersion modeling predicts a significant ambient impact will occur, or (2) a modeling receptor distance of 50 km, whichever is less. Therefore, a SIA cannot be greater than 50 km for any pollutant.

The full impact analysis expands the significant impact analysis by considering emissions from the proposed project, other sources in the SIA, and sources outside the SIA that could cause significant concentrations in the SIA. The full impact analysis is used to demonstrate compliance with NAAQS and PSD increments. The source inventory for the cumulative NAAQS analysis includes all nearby sources that have potential significant concentrations within the proposed source SIA, while the source inventory for the cumulative PSD increment analysis is limited to actual increment-affecting sources (new sources and changes to existing sources that have occurred since the applicable increment baseline date).

Calculated Concentration for Comparison with PSD Increments	=	Model-predicted Concentration from Project Potential Emissions	+	Model-predicted Concentration from Increment Consuming Regional Sources at <u>Actual</u> Emission Rates

For comparison with ambient standards, the calculated concentration is:

Calculated Concentration for Comparison with Ambient Standards	=	Model-predicted Concentration from Project Potential Emissions	+	Model-predicted Concentration from All Regional Sources at <u>Potential</u> Emission Rates	+	Regional Background Concentration

Thus, it is necessary to determine two sets of regional concentrations for each pollutant and averaging time: 1) a concentration based on actual emission rates for increment consuming sources only, and 2) a concentration based on potential emission rates from all sources, whether increment consuming or not. As a practical matter, it was not possible to readily determine which sources had actual emissions that consume increment; therefore, all sources were assumed to consume increment. Therefore, the actual emissions from all sources were modeled to determine the regional source contribution for PSD increment comparison.

There is no air quality control region established for the OCS beyond the Alaska seaward boundary. Consequently, we assume that none of the increment has been consumed beyond the seaward boundary. The Beaufort coastline nearest to the Shell project (the Coastal Onshore Area) is part of Alaska's Northern Alaska Intrastate Air Quality Control Region (40 CFR 81.246). This region is designated as attainment or unclassifiable for all criteria pollutants, including ozone (40 CFR part 81.302).

In a letter dated September 4, 2009, EPA deemed the May 2009 Beaufort Sea application incomplete. Among other requests, EPA requested that Shell address baseline dates, baseline areas, trigger dates, and baseline concentrations consistent with a July 2, 2009 draft memorandum prepared by EPA Region 10. That memorandum determined that the Northern Alaska Intrastate Air Quality Control Region (which includes the Corresponding On-Shore Area) extends to sea 25 miles beyond Alaska's seaward boundary. The memorandum also asserts that the same region applies from that point seaward. Consequently, Region 10 determined that the Northern Alaska Baseline dates and increment consumption apply equally within and beyond 28 miles from the shoreline. In EPA's interpretation, the onshore baseline dates also apply to the OCS lease blocks where Shell proposes to conduct exploration. These dates are:

NO2: February 8, 1988
SO2: June 1, 1979
PM10: November 13, 1978

As discussed in Section 7, ENVIRON has determined that existing onshore sources have an insignificant impact at the maximum cumulative impact receptors for the Project and we have demonstrated increment compliance regardless of location. While acknowledging EPA's position, we do not believe that the Region's assertion of an AQCR in the OCS has any substantive effect on the analysis presented in this application.

7.1 Existing Industrial Sources of Emissions

Shell proposed stationary source would be located on the OCS at locations ranging from 3 to approximately 37 miles from shore. The minimum distance between a Shell lease block and an existing industrial facility is approximately 23 miles (BP's Badami facility). Consequently, there are no onshore industrial sources that can be considered "close" to the exploration activity but some are still close enough to warrant consideration in the full impact analysis.

Emissions for regional industrial sources were obtained by accessing data collected by the Alaska Department of Environmental Conservation (ADEC). The ADEC maintains several databases of information which assisted in this effort:

- Annual Title V reporting emission inventory for all major and synthetic minor sources in the North Slope area is available on-line at https://myalaska.state.ak.us/deca/air/airtoolsweb/EmissionInventory.aspx

  This included several hundred sources and provided actual emissions for each source. The most recent year with populated data was 2005, so the actual emission inventory is reflective of emissions during 2005. There are no more recent emission inventories of actual emissions available.

- ADEC provides on-line reference to all construction and Title V permits which provide information on emission restrictions and other limits on the potential emissions for sources. The permit information is available at http://www.dec.state.ak.us/air/ap/perlist.htm

The combination of these two on-line references allowed a preliminary NOx, PM10 and SO2 emission inventory to be prepared for emission sources on the North Slope. ENVIRON also met with ADEC and examined ADEC's files to obtain more detailed information on many of the sources, and to fill in data gaps for those sources with incomplete information or conflicting information in the on-line data. ADEC also provided computer files for many previous North Slope air quality modeling analyses. These computer files were an essential source of information about many of the emission sources. Appendix F provides the details of the emission inventory generated from all of these sources of information. We believe this is the most complete emission inventory for the North Slope currently available.

Only annual emissions are available in ADEC's emission inventory. However, in consultation with ADEC and EPA staff, several analyses were performed to evaluate the cumulative impact of regional short term emissions and those associated with the Project.

As discussed further below, the full impact assessment included regional emission sources within 100 kilometers of any of the proposed Shell permit blocks. Table 7-1 identifies those onshore regional sources.

7.2 Cumulative Impact Modeling Methodology

7.2.1 Receptor Grid

Because the SIA is limited to the screening model range of 50 kilometers, the impact of onshore industrial sources need only be evaluated for at those receptors within 50 kilometers of the proposed source. The nearby sources are similarly subject to the same 50 kilometer model limitation, so shore-based facilities

that are more than 50 kilometers from any of the receptors of interest are not evaluated in the modeling. The end result of these two 50 kilometer restrictions is that nearby sources more than 100 kilometers from the lease blocks do not need to be evaluated.

Because this application requests authorization for exploration at many possible locations, it is necessary to define zones of influence, or areas from each lease block where existing onshore sources need to be included.

Figure 7-1 shows (as orange squares) the location of the specific lease blocks that are addressed in this permit application. The red dots in Figure 7-1 identify onshore industrial facilities. Also shown in Figure 7-1 are 100 kilometer and 50 kilometer radii from the lease blocks being considered in the current application.

Figure 7-1 indicates that many sources are included in the 100 kilometer radius from the proposed permit blocks, but only one facility (BP's Badami facility) is within 50 kilometers of Shell's lease blocks. All of the sources included in 100 kilometer radius were included in the current evaluation. However, a 50 kilometer radius from a regional industrial source does not include all the receptors within a 50 kilometer radius of the proposed permit blocks. For example, Figure 7-2 shows a 50 kilometer radius drawn from the Northstar facility and the shaded area depicts the overlap where receptors could potentially be within 50 kilometers of any of the lease blocks and at the same time within 50 kilometers of the Northstar facility. Only receptors within this overlap were considered in the impact assessment.

Table 7-1: Regional Sources of Emission Included

BP Badami Facility
BP Base Operations Center
BP Central Compressor Plant
BP Central Gas Facility
BP Endicott Production Facility
BP Endicott Liberty Expansion
BP Flow Station #1
BP Flow Station #2
BP Flow Station #3
BP Gathering Center #1
BP Gathering Center #2
BP Gathering Center #3
BP Lisburne Production Center
BP Northstar Production Facility
BP Central Power Station
BP Prudhoe Bay Operations Center / Main Construction Camp
BP Seawater Injection Plant East
BP Seawater Treatment Plant
BP Transportable Drilling Rigs
Alyeska TAPS Pump Station 01
Deadhorse Soil Remediation Unit
Haliburton Deadhorse Facility
TDX Deadhorse Power Plant

Figure 7-1: 100 and 50 kilometer Radii from Shell Proposed Permit Blocks

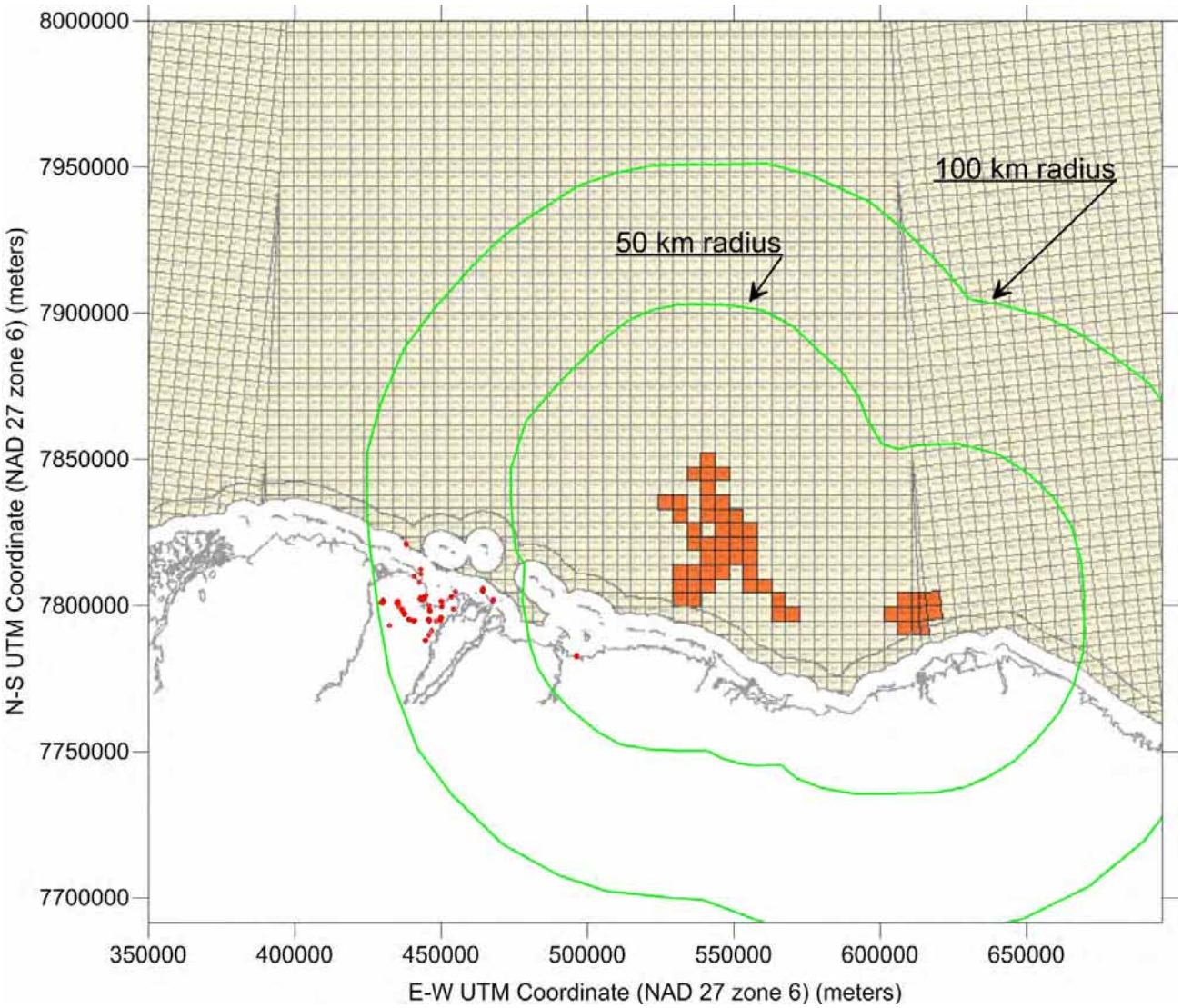
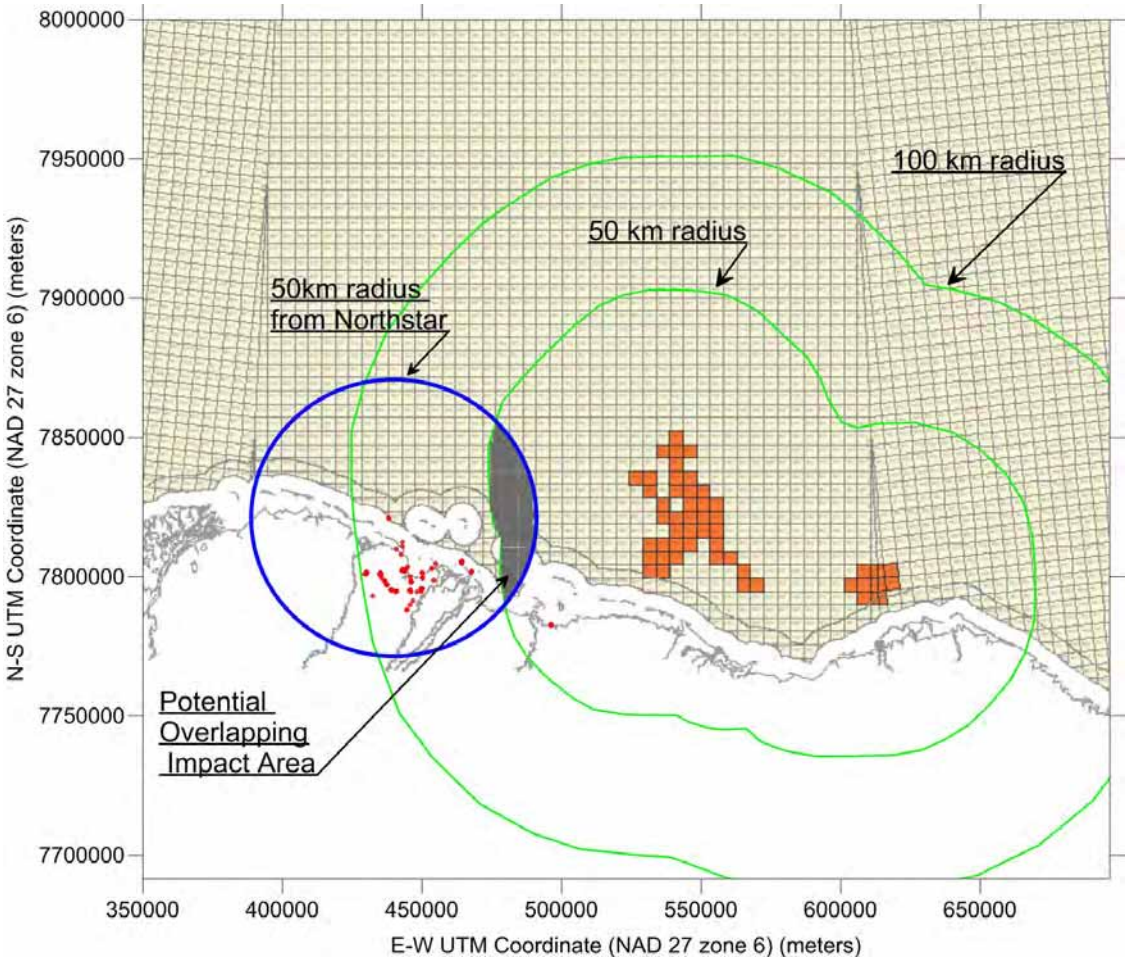


Figure 7-2: Example Illustrating Overlap Area for Northstar Emission Sources.



7.2.2 Modeling of Existing Onshore Facilities

Actual and potential emissions from existing onshore industrial sources were modeled to determine concentrations at each receptor depicted in Figure 7-3.[89] The receptor spacing for this analysis was one kilometer and a total of 24,096 receptors were evaluated.

Unlike the modeling of the Project emission units, the modeling for the regional sources was based on actual shore-base meteorological data obtained from ADEC. A recent permit application filed with the ADEC for the re-start of the Badami facility included five years of meteorological data for the period from 1991 through 1995. These data were already processed in an ISCPRIME format and were used without modification from the ADEC files. Figure 7-4 is a wind rose depicting the relative frequencies of different wind speeds and wind directions. Note that the directions depicted in Figure 7-4 are the direction from which the wind is coming.

[89] There are approximately 25 receptors in each of the small blue squares in Figure 7-3.

Figure 7-3: Receptors within 50 km of the Proposed Shell Permit Blocks

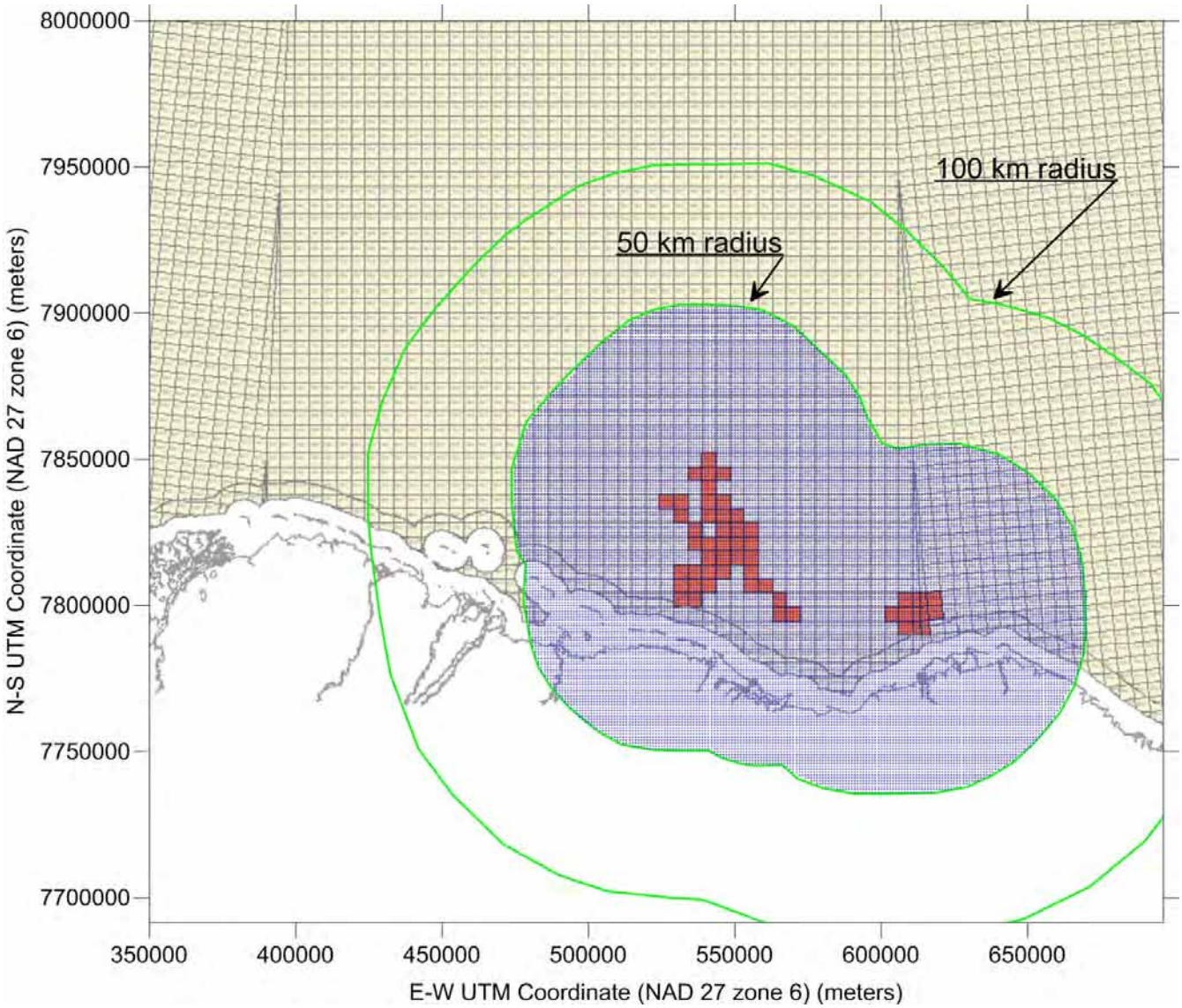
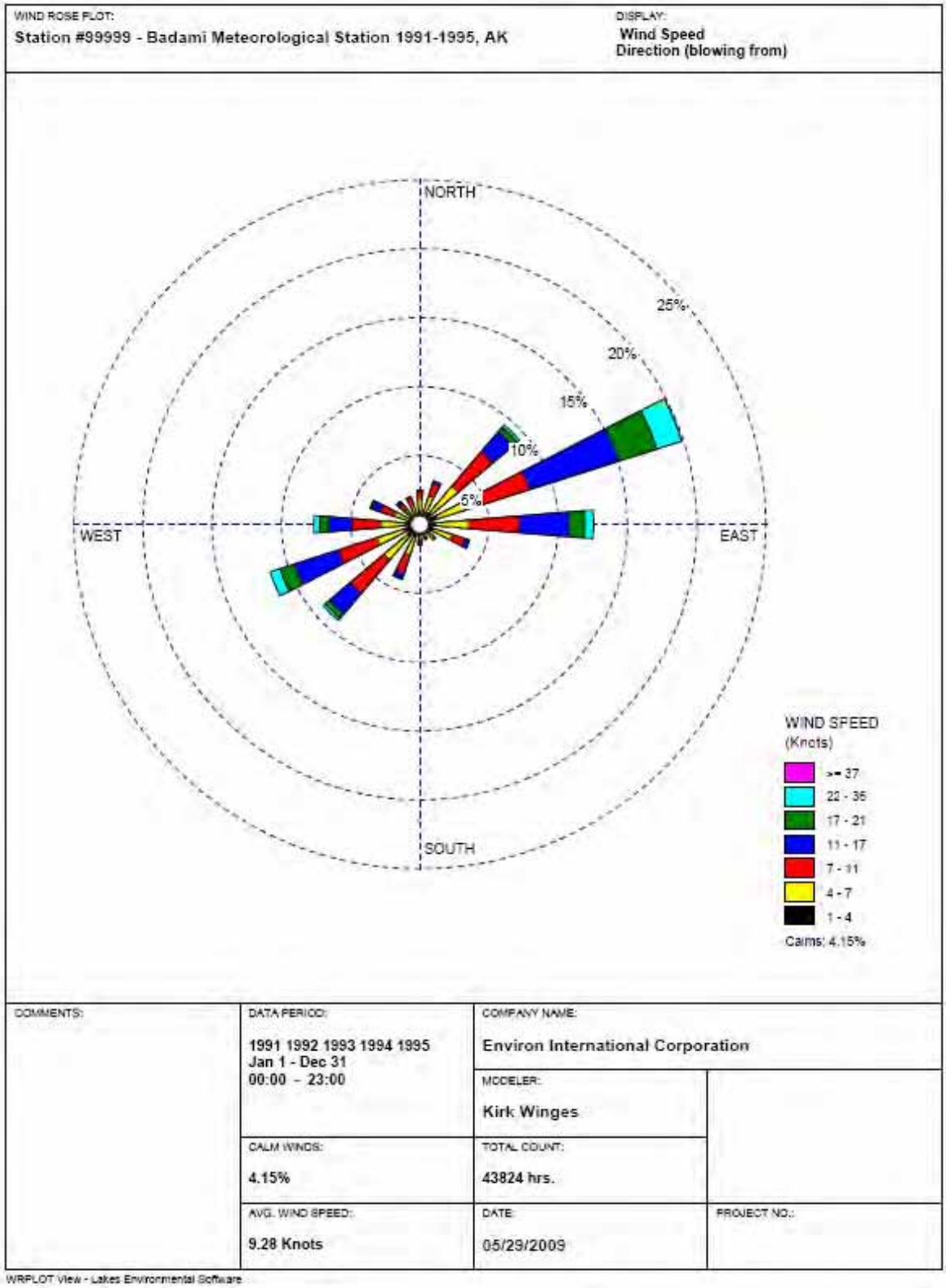


Figure 7-4: Wind Rose for Badami Meteorological data 1991-1995



7.2.3 Short Term Regional Source Impacts

Every three years, ADEC inventories actual annual emissions. However, ADEC does not compile inventories of actual short term emissions, and potential short term emissions are also unavailable for many of the facilities located within 100km of the Shell lease blocks. In the absence of actual and potential short term emission data for regional facilities, three additional analyses were performed to evaluate cumulative short term air quality concentrations. All three analyses clearly demonstrate that short term emissions from regional facilities will not significantly contribute to cumulative concentrations where the Project impacts exceed the SILs.

7.2.3.1 NOx: SO2/PM10 Emissions Comparison

Facility-wide potential emissions for NOx, SO2, and PM10 can be found within Title 5 permits for many facilities in Alaska. Table 7-2 displays a summary of these potential emissions for each facility within 100km of the Shell lease blocks.

Table 7-2: Potential Emissions for Regional Facilities.

		Facility Wide Emissions (tons/year)		
Company	**Facility**	**NO_x**	**SO_2**	**PM_{10}**
BP	Badami	277.9	66.6	11.6
BP	Base Operations Center	1165	171	37
BP	Central Compressor Plant	14238	147	347
BP	Central Gas Facility	10968	125	305
BP	Endicott Production Facility[1]	3594	539	63
BP	Flow Station #1	2872	35	84
BP	Flow Station #2	3663	83	91
BP	Flow Station #3	4235	42	100
BP	Gathering Center #1	4912	48	107
BP	Gathering Center #2	2370	38	84
BP	Gathering Center #3	2873	33	69
BP	Lisburne Production Center	2241	263	57
BP	Northstar Production Facility	562	56.5	331
BP	PBU Central Power Station	6110	63	150
BP	Prudhoe Bay Operations Center	231	51.5	45.8
BP	Seawater Injection Plant East	2175	20	42
BP	Seawater Treatment Plant	395	28	35
BP	Transportable Drilling Rigs	1386.7	145.6	56.7
Alyeska	TAPS Pump Station 001	773	39	122
Alaska Interstate Construction	Deadhorse Soil Remediation Unit	107	162.8	13.5
Haliburton	Deadhorse Facility	249	1.5	2.3
TDX	Deadhorse Power Plant	246	9	17
Total		65644	2168	2171

[1] Endicott Production Facility emissions include the Liberty Expansion.

This table highlights the extent to which NO_x emissions outweigh PM_{10} and SO_2 emissions for these facilities. While these facilities have potential annual emissions exceeding 65,000 tons of NO_x, potential SO2 and PM10 emissions total about 2,200 tons each. This analysis demonstrates that the focus of regional modeling should be on NO_x, not on other pollutants.

7.2.3.2 Significant Impact Area Analysis

A significant impact area analysis was performed for two facilities for which short term PM_{10} and SO_2 data are readily available. The facilities chosen for this analysis were the Endicott Facility (with the Liberty Expansion included) and the Northstar Production Facility. Of the regional facilities for which short term data are available, Endicott had the highest short term SO_2 emissions while Northstar had the highest short term PM_{10} emissions so Endicott and Northstar were selected to evaluate SO2 and PM10, respectively. Note that Endicott also has the highest annual potential SO_2 emissions while Northstar is the second largest source of annual potential PM_{10} emissions.

The results of the significant impact area analysis are summarized in Table 7-3 below.

Table 7-3: Significant Impact Area for Short Term PM_{10} and SO_2.

Facility	Pollutant	Averaging Period	SIL ($\mu g/m^3$)	Distance Exceeding SIL (km)
Endicott	SO_2	24-hour	5	11.4
		3-hour	25	1.6
Northstar	PM_{10}	24-hour	5	0.9

Because Endicott and Northstar are each at least 75 km from the nearest Shell lease block, the SO2 concentrations attributable to Endicott and the PM10 concentration attributable to Northstar would be less than the SIL at a 50 km radius of a Project location. Consequently, this analysis indicates that short term regional emissions of PM_{10} and SO_2 have an insignificant effect on cumulative concentrations with the Project. The significant impact area would be even smaller with consideration of actual emissions, which are the basis for increment analysis.

7.2.3.3 Q/D Analysis

With EPA endorsement, the Q/D analysis has been used in Alaska for more than a decade to quantitatively evaluate whether a source's emissions of a particular pollutant will impact an area a certain distance away. If the quotient of emissions (Q, expressed in tons per year) divided by Distance (D, expressed in kilometers) is less than 20, the source's contribution to distant concentrations is deemed insignificant.

Table 7-4 indicates the maximum PM_{10} and SO_2 Q/D for the regional facilities within 100km of the Shell lease blocks were 3.79 and 7.64, respectively. Because both quotients are under 20, the Q/D analysis

demonstrates that short term regional emissions of PM10 and SO2 do not contribute significantly to cumulative concentrations near Shell lease blocks.

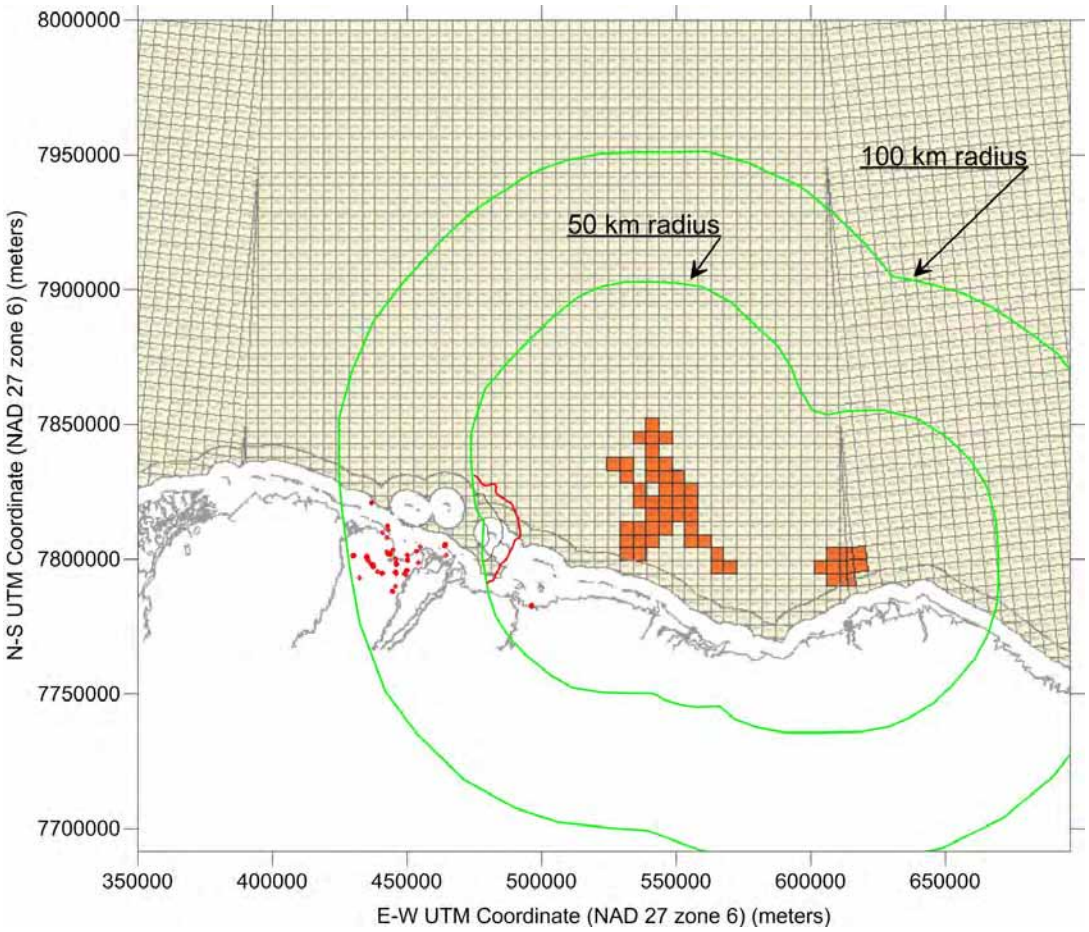
Table 7-4: Q/D Calculations

Company	Facility	PM10 Q (t/y)	SO2 Q (t/y)	Distance (km)	Q/D PM10 ST	Q/D SO2 ST
BP	Badami	11.6	66.6	46.14	0.25	1.44
BP	Base Operations Center	37	171	99.84	0.37	1.71
BP	Central Compressor Plant	347	147	91.45	3.79	1.61
BP	Central Gas Facility	305	125	92.17	3.31	1.36
BP	Endicott Production Facility	63	539	70.51	0.89	7.64
BP	Flow Station #1	84	35	89.91	0.93	0.39
BP	Flow Station #2	91	83	85.22	1.07	0.97
BP	Flow Station #3	100	42	95.04	1.05	0.44
BP	Gathering Center #1	107	48	100.07	1.07	0.48
BP	Gathering Center #2	84	38	105.06	0.80	0.36
BP	Gathering Center #3	69	33	98.12	0.70	0.34
BP	Lisburne Production Center	57	263	80.31	0.71	3.27
BP	Northstar Production Facility	331	56.5	99.18	3.34	0.57
BP	PBU Central Power Station	150	63	98.22	1.53	0.64
BP	Prudhoe Bay Operations Center	45.8	51.5	87.12	0.53	0.59
BP	Seawater Injection Plant East	42	20	90.34	0.46	0.22
BP	Seawater Treatment Plant	35	28	92.39	0.38	0.30
BP	Transportable Drilling Rigs	8.1	20.8	98.25	0.08	0.21
Alyeska	TAPS Pump Station 001	122	39	96.90	1.26	0.40
Alaska Interstate Construction	Deadhorse Soil Remediation Unit	13.5	162.8	91.05	0.15	1.79
Haliburton	Deadhorse Facility	2.3	1.5	86.67	0.03	0.02
TDX	Deadhorse Power Plant	17	9	92.60	0.18	0.10
	Maximum Q/D				3.79	7.64

7.2.4 Annual Regional Source Impacts

Annual actual and potential emissions from regional onshore industrial facilities were modeled using five years of actual meteorological data from BP's Badami station. Figure 7-5 summarizes the annual NOx concentrations resulting from actual emissions from regional sources listed in Table 7-1. The small red line on the western part of the 50 km radius from the proposed Shell permit block area is the one ug/m3 annual NOx isopleth resulting from actual NOx emissions from regional onshore industrial sources. Thus, the only portion of the 50 kilometer radius with significant regional source actual NOx concentrations is the area between the red line and the 50 km radius of the Shell lease blocks. All other areas in the 50 kilometer radius area have an insignificant impact on the Project significant impact area and are assumed to have zero concentrations.

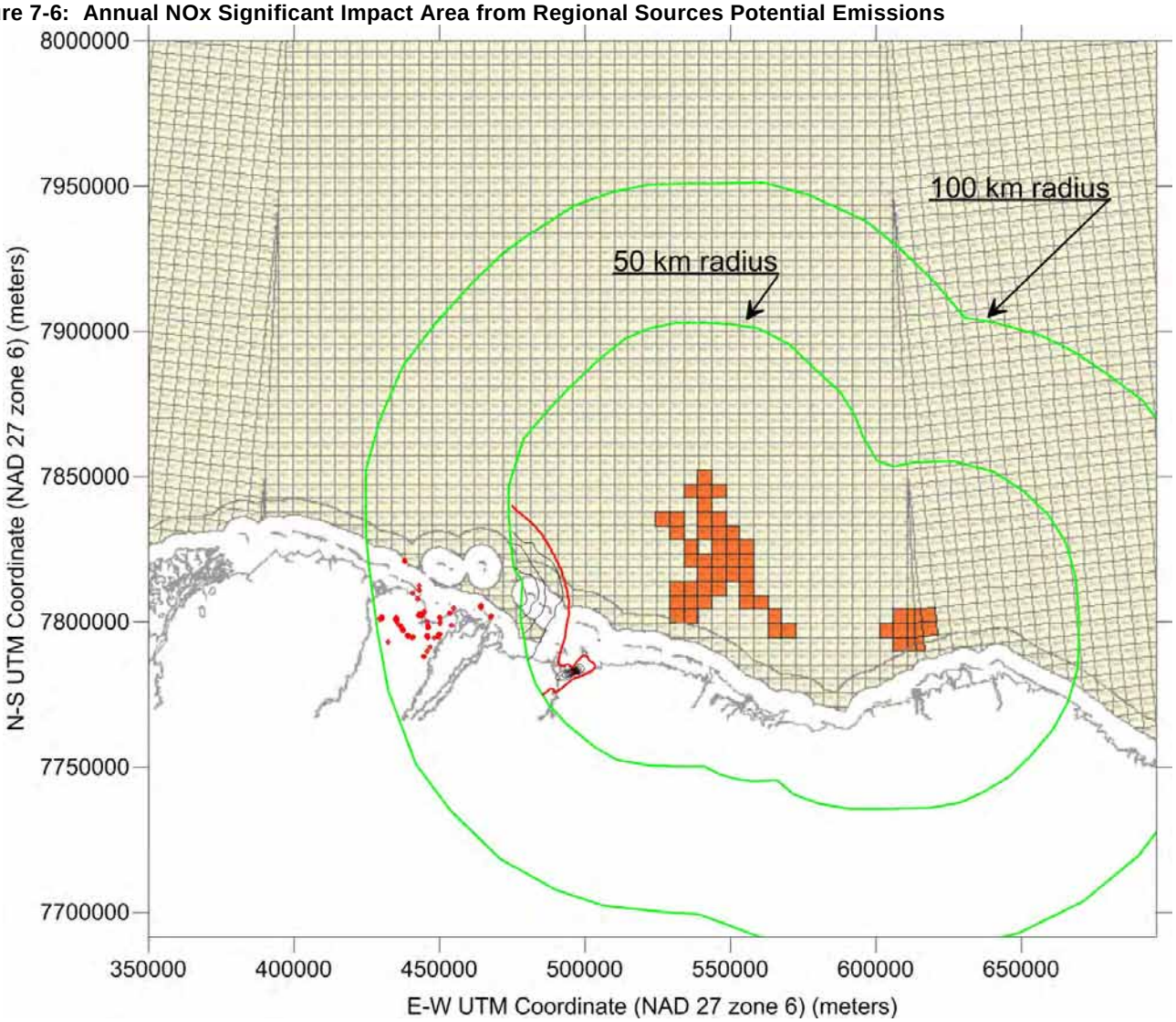
Figure 7-5: Annual NOx Significant Impact Area from Regional Sources Actual Emissions



Modeling of potential emissions from onshore facilities was conducted to evaluate cumulative concentrations for purposes of comparison with the NAAQS. Figure 7-6 is similar to Figure 7-5, but presents the one ug/m3 annual NOx isopleth resulting from potential NOx emissions from regional onshore industrial sources.

As was the case for the actual concentrations, the significant potential concentrations, delimited by the red line in Figure 7-6, is confined to the western portion of the 50 kilometer radius from the Shell lease blocks. The area defined by the red line, however, is somewhat larger for the potential emissions than for the actual emissions. Concentrations at all receptors outside of the one ug/m3 isopleth have an insignificant impact on the Project significant impact area and are assumed to have zero concentrations.

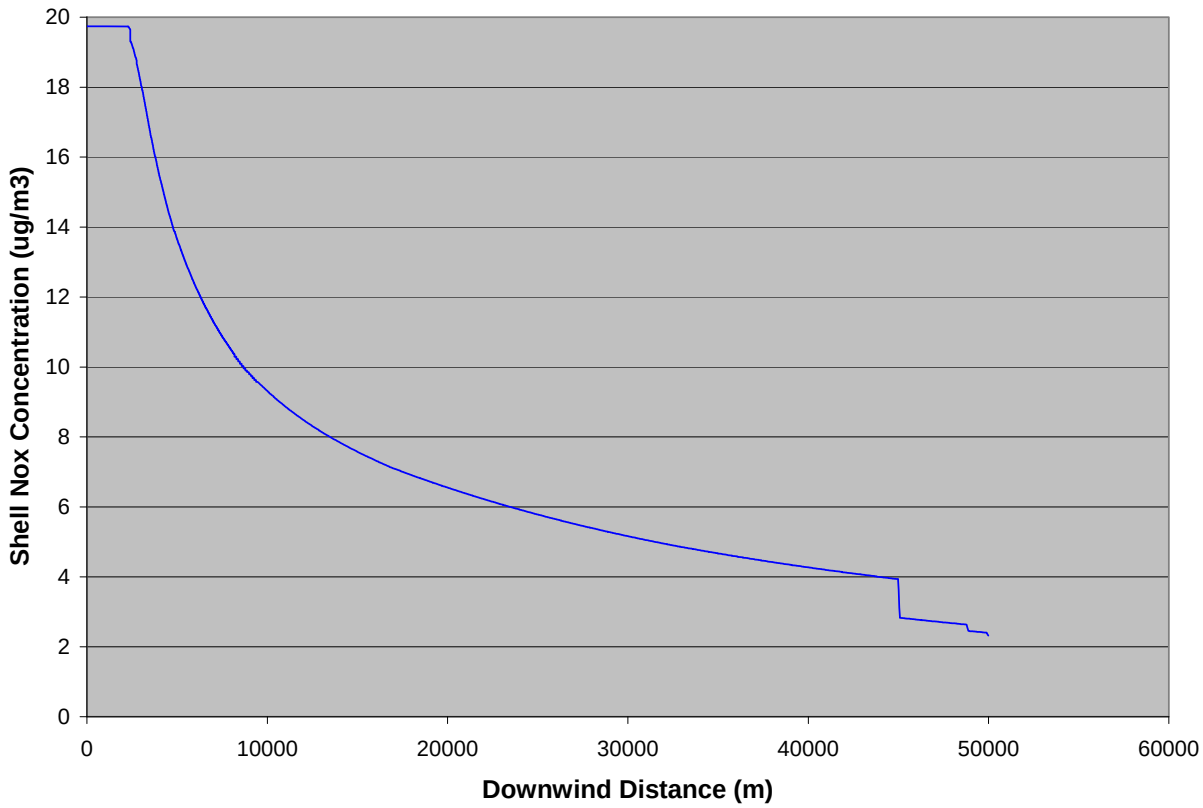
Figure 7-6: Annual NOx Significant Impact Area from Regional Sources Potential Emissions



7.2.5 Adding Project and Regional Source Contributions

In the modeling of regional source impacts, the receptors were fixed locations. In contrast, receptors evaluated for the *Discoverer* and associated fleet were fixed only with respect to the drill hole; as we evaluated all the lease blocks under consideration, these receptors moved with the drill hole. To determine the Project contribution at each of the fixed receptors, a plot was made of the Project contribution as a function of distance from the drill hole. Figure 7-7 is an example of such a plot.

Figure 7-7: Plot of Project NOx Concentrations as a Function of Downwind Distance from Drill Site



The figure is created from the model results for the Project alone as follows:

1. All 16,530 calculated concentrations attributable to the Project alone are imported to a spreadsheet and the distance from the drill site to each receptor computed.

2. The results are then sorted by distance from the drill site in ascending order

3. For each receptor, the maximum concentration is determined for the group of receptors starting with this receptor and including all receptors further from the drill site.

The last step is necessary because some receptors will be off the plume centerline, so that even though they are closer to the drill site, they may have lower concentrations. The intent of the plot is to ensure that the maximum concentration is determined for any receptor at that distance or farther from the drill site.

The values in Figure 7-7 can then be used as a “look-up” table defining maximum Project impact as a function of distance between receptor and drill site. In the subsequent analyses where the Project contribution is to be determined at specific receptor locations, the minimum distance between that

receptor and any of the proposed Shell permit blocks is determined, and the Project contribution is determined from the look-up table.

7.3 Comparison with PSD Increments and Ambient Standards

Calculated cumulative concentrations are compared with PSD increments in Table 7-5. Note that all the regional source contributions to annual concentrations at the receptor with the highest cumulative concentration are zero. For each of the 24,096 receptors in the regional modeling, a regional concentration was calculated. As noted in section 7.2, the Project contribution was determined for each receptor based on the distance between the receptor and the nearest lease block area and that contribution was added to the concentration attributable to regional sources at that receptor. However, at all receptors, the cumulative concentrations were less than the peak Project contribution alone, which occurs only 80 meters downwind of the drill site. This can be confirmed by examination of Figures 7-5 and 7-7. The peak NOx concentration from regional actual emissions is just over 2 µg/m^3 while the Project contribution at 40-50 kilometers is less than 4 µg/m^3. The total (6 µg/m^3) is far below the peak value for the shell sources alone of 17.3 µg/m^3. All values in Table 7-5 comply with the PSD Increments.

Table 7-5: Comparison of Maximum Cumulative Concentrations with PSD Increments

Pollutant	Averaging Time	PSD Class II Increment (µg/m^3)	Project Contribution At Peak Receptor (µg/m^3)	Regional Source Contribution at Peak Receptor (µg/m^3)	Peak Total Concentration (µg/m^3)
Nitrogen Dioxide (NO_2)	Annual	25	19.7	0	19.7
Particulate Matter (PM_{10})	24-hour	30	20.7	N/A	20.7
	Annual	17	1.1	0	1.1
Sulfur Dioxide (SO_2)	3-hour	512	25.0	N/A	25.0
	24-hour	91	3.2	N/A	3.2
	Annual	20	0.1	0	0.1

Table 7-6 compares cumulative concentrations with ambient air quality standards. Similar to the discussion of Table 7-5, entries of zero for regional contributions implies that peak concentrations occur close to the drill ship. Table 7-6 indicates cumulative concentrations of all criteria pollutants comply with NAAQS.

Finally, it is worth noting that use of screening meteorological data to evaluate the Project overstates the potential cumulative concentrations. On those days when winds carry emissions from onshore facilities toward the Project area, the wind will also carry Project emissions away from the onshore facilities. The conservative application of screening meteorology in this application, however, assumes that winds are carrying Project emissions toward to the onshore sources at the same time that winds are carrying

onshore source emissions toward the Project. This is physically impossible. Consequently, cumulative concentrations are overstated.

Table 7-6: Comparison of Maximum Cumulative Concentrations with NAAQS

Pollutant	Averaging Time	NAAQS/ AAAQS [1] ($\mu g/m^3$)	Project Contribution At Peak Receptor ($\mu g/m^3$)	Regional Source Contribution at Peak Receptor ($\mu g/m^3$)	Background Concen. ($\mu g/m^3$)	Total Concen. ($\mu g/m^3$)
NO_2	Annual	100	19.7	0	11.3	31.0
PM_{10}	24-hour	150	20.7	N/A	55.1	75.8
	Annual	50	1.1	0	7.5	8.6
$PM_{2.5}$	24-hour	35	19.2	N/A	8.0	27.2
	Annual	15	1.1	0	2.0	3.1
SO_2	3-hour	1,300	25.0	N/A	41.6	66.6
	24-hour	365	3.2	N/A	13.0	16.2
	Annual	80	.01	3.38	2.6	6.0
CO	1-hour	40,000	1227.1	N/A	1,750	2977.1
	8-hour	10,000	457.5	N/A	1,070	1527.5

[1] National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards.

All electronic modeling files and associated with emissions and model calculations are provided in the compact disc attached to the back cover of this document.

7.4 Compliance with Alaska Ammonia and Hydrogen Sulfide Ambient Standards

In addition to the criteria pollutant ambient standards listed in Table 7-6, Alaska has established ambient air quality standards for reduced sulfur compounds (18 AAC 50.010) and ammonia. The Alaska ambient standard for reduced sulfur compounds (RSCs) is 50 $\mu g/m^3$ on a 30-minute basis. The only sources of sulfur emissions will be from the sulfur in the diesel fuel used on the *Discoverer* and its associated fleet, and incinerator operations. Because all the fuel is ultra-low sulfur diesel, and the processes using the diesel fuel are oxidation processes, the emissions of RSCs will be negligible from these sources.

Alaska's ambient air quality standard for ammonia is 2,100 $\mu g/m^3$ (8-hour average). The only substantive source of ammonia emissions is ammonia slip from the SCR applied to the six main engines on the *Discoverer*. A model evaluation of these ammonia emissions determined a peak 1-hour concentration of 2.4 $\mu g/m^3$, well below the 2100 $\mu g/m^3$ ambient standard for 8-hour concentrations. Background of ammonia should be near zero in the Beaufort Sea, so it can be safely concluded that the Alaska standard for ammonia will not be exceeded under any circumstances.

7.5 Source Contribution Analyses at Maximum Impact Location

During EPA's review of the air permit application for Shell's Chukchi Sea exploration effort, EPA asked that Shell provide a breakdown of individual source contributions. A source contribution analysis for 24-hour average PM_{10} and annual average NO_2 is provided in Table 7-7. These pollutants and averaging times are presented because these are the highest impacts relative to the applicable ambient standards. Maximum impacts for annual NO_2 are driven by poorer dispersing engines (HPU engines and cementing units) on the *Discoverer* while 24-hour PM_{10} impacts are dominated by the incinerator on the *Discoverer*.

Table 7-7: Source Contributions at Peak Receptors

Source Description	Model Source ID	Impact Contribution (%) [1,2]	
		Annual NO_2	24-Hour PM_{10}
Stack #1: Six Main Drill Engines	MAINENGS	2	10
Stack #2: Two Air Compressors	COMPENGS	3	5
Stack #3: Two HPU Engines	HPPENGS	7	6
Stack #4: Three Cementing Units	CEMENT	10	4
Stack #5a: One Crane Engine (port)	CRANE_PT	2	0
Stack #5b: One Crane Engine (starbd)	CRANE_SB	3	2
Stack #6: Two Heat Boilers	HEATBOIL	4	8
Stack #7 Two Logging Winches	LOGWNCH	0	0
Stack #8: One Incinerator	INCIN_D	0	2
Re-supply Ship (Docked)	KILABUK	0	5
Re-supply Ship (In Transit)	RST_01-80	0	7
Oil Spill Response Ships	OILSPL01-40	57	23
Ice Management (Secondary)	BRK_B01-48	2	11
Ice Management (Primary)	BRK_A01-96	9	18
	Total >	100	100

[1] Maximum impact occurs adjacent to the hull of the *Discoverer*.
[2] Totals may not add up to exactly 100 due to rounding.

7.6 Impacts from the Ice Management and Anchor Handler Fleet

During EPA's review of the air permit application for Shell's Chukchi Sea exploration effort, EPA asked that Shell provide a table showing the maximum concentration impacts from both the primary and the secondary ice management ships and its locations. In anticipation of a similar request for the Beaufort Sea exploration effort, we address that request here.

Given that predicted concentrations from all source operations comply with ambient standards, concentrations from each of the ice management ships individually also comply with the ambient standards. The maximum predicted concentrations from the primary ice management fleet and secondary ice management fleet are provided in Table 7-8 and 7-9, respectively; predicted concentrations are well below the PSD increment and NAAQS.

Table 7-8: Maximum Concentrations from Primary Ice Management Ship

Pollutant	Averaging Period	Peak Concentration ($\mu g/m^3$)[1]	PSD Increment ($\mu g/m^3$)	Exceed Increment?[2]	Background Concentration ($\mu g/m^3$)	Background + Peak Concentration ($\mu g/m^3$)[3]	NAAQS ($\mu g/m^3$)	Exceed NAAQS?
NO_2	Annual	3.3	25	No	11.3	14.6	100	No
PM_{10}	Annual	0.2	17	No	1.8	2.0	50	No
	24-hour	6.3	30	No	7.9	14.2	150	No
$PM_{2.5}$	Annual	0.2	-	-	2	2.2	15	No
	24-hour	5.5	-	-	8	13.5	35	No
SO_2	Annual	0.003	20	No	2.7	2.7	80	No
	24-hour	0.1	91	No	13	13.1	365	No
	3-hour	0.1	512	No	36.4	36.5	1300	No
CO	8-hour	33.6	-	-	1,070	1103.6	10,000	No
	1-hour	37.4	-	-	1,750	1787.4	40,000	No

[1] For short-term impacts assume 24 hour/day operations (adjustment = 1) for annual impacts assume 64 days per drilling season (adjustment = 64 days/365 days).
[2] Impacts without background concentrations are compared to the PSD increments.
[3] Impacts including background concentrations are compared to the NAAQS and AAAQS.

Table 7-9: Maximum Concentrations from Anchor Handler

Pollutant	Averaging Period	Peak Concentration ($\mu g/m^3$)[1]	PSD Increment ($\mu g/m^3$)	Exceed Increment?[2]	Background Concentration ($\mu g/m^3$)	Background + Peak Concentration ($\mu g/m^3$)	NAAQS/ AAAQS ($\mu g/m^3$)[3]	Exceed NAAQS?
NO_2	Annual	0.6	25	No	11.3	11.9	100	No
PM_{10}	Annual	0.1	17	No	1.8	1.9	50	No
	24-hour	3.2	30	No	7.9	11.1	150	No
$PM_{2.5}$	Annual	0.1	-	-	2	2.1	15	No
	24-hour	3.1	-	-	8	11.1	35	No
SO_2	Annual	0.007	20	No	2.7	2.7	80	No
	24-hour	0.1	91	No	13	13.1	365	No
	3-hour	0.2	512	No	36.4	36.6	1300	No
CO	8-hour	96.3	-	-	1,070	1166.3	10,000	No
	1-hour	107.0	-	-	1,750	1857.0	40,000	No

[1] For short-term impacts assume 24 hour/day operations (adjustment = 1) for annual impacts assume 64 days per drilling season (adjustment = 64 days/365 days).
[2] Impacts without background concentrations are compared to the PSD increments.
[3] Impacts including background concentrations are compared to the NAAQS and AAAQS.

SECTION 8

ADDITIONAL IMPACT ANALYSES

In addition to the NAAQS and PSD increment analyses, PSD applicants must also address the impact from the proposed project on associated growth, soils and vegetation of significant commercial value impacts, and visibility impairment. 40 CFR 52.21(o); 18 AAC 50.306, 50.040 (h) (13). This section also evaluates the proposed project's impact on ozone concentrations.

8.1 Growth Analysis

Section 2.6 addresses onshore facilities and activities associated with the Project. Because of the seasonal and temporary nature of the exploratory drilling program, and the absence of any permanent improvements offshore or onshore, Shell expects that its exploration program will have an insignificant impact on industrial, commercial, and residential growth of nearby coastal communities. The emissions presented for the project already include all anticipated emissions, including those from support activities (e.g., resupply ships, ice management fleet, etc.). There will be no substantial increase in community growth needed to support the exploratory drilling program. Therefore, it is not anticipated that the project will result a significant increase in air emissions associated with growth.

8.2 Effects on Soils and Vegetation

According to the EPA's Draft New Source Review Workshop Manual (EPA, 1990[90]), the analysis of air pollutant impacts on soils and vegetation is to focus on vegetation having significant commercial or recreational value.

Alaska's North Slope is divided into three eco-regions: Arctic Coastal Plain, Arctic Foothills, and Brooks Range. Information for each eco-region is derived from the Circumpolar Arctic Vegetation Map CAVM Team (2003[91]), DOI (2008[92]and Gallant et al. (1995[93]). A 50 km buffer around the Shell lease blocks (Figure 8-1) includes portions of the 50,000 km^2 Arctic Coastal Plain, the northernmost eco-region in Alaska. The Coastal Plain is bounded on the west and north by the Chukchi and Beaufort seas and extends east nearly to the U.S.-Canada border. The region is underlain by thick permafrost, up to 660 m deep (at Prudhoe Bay). Permafrost-related surface features, such as pingos, ice-wedge polygons, oriented lakes, peat ridges, and frost boils, are common. The major vegetation communities on the Arctic Coastal Plain are: nontussock sedge, dwarf-shrub, moss tundra; tussock-sedge, dwarf-shrub, moss

[90] New Source Review Workshop Manual Draft (October, 1990), http://www.epa.gov/air/nsr/publications.html.

[91] CAVM Team. 2003. Circumpolar Arcticv Vegetation Map. Scale 1:7,500,000. Conservation of Arctic Flora and Fauna (CAFF) Map No. 1. U.S. Fish and Wildlife Service, Anchorage, Alaska.

[92] Department of Interior, Fish and Wildlife Service, Wildlife Response to Environmental Arctic Change, Section 2 North Slope Ecoregions and Climate Scenarios. 2008.

[93] Gallant, A.L., Binnian, E.F., and Shasby, M.B. 1995. Ecoregions of Alaska: U.S. Geological Survey Professional Paper 1567, 73p., 2 sheets, scale 1:500,000.

tundra; sedge/grass, moss wetland; and sedge, moss, dwarf-shrub wetland (DOI 1998[94], ADNR 2006[95], AART 1999[96], NOAA 2005[97]).

Several types of tundra are found in the Beaufort Sea area. These include wet sedge tundra, found in drained lake basins, swales, and floodplains; and tussock tundra and sedge-dryas tundra found on ridges. Low willow thickets, dwarf birch, various heath species, and herbs and lichens also grow in the area (Table 4.1; CEC 1997[98]; ADF&G 2006[99], AGC 2008[100], ADNR 2009[101], DOI 2008[102]). Plant species of the tundra are few, their growth is minimal, and most of their biomass is concentrated in the root system. They often reproduce by division because of the short growing season (ADF&G 2006[103]). Trees are generally absent because of the impermeable permafrost layer and thin soils. The short period of thawing during the summer and persistence of permafrost near the surface limit diversity of plant and animal species. Despite the low precipitation, much of the area remains marshy throughout the summer (Truett and Johnson 2000[104], NRC 2003[105], McCabe et al. 1992[106]).

Consultation with local residents (providing local ecological knowledge), federal, state, and North Slope representatives, the Alaska Center for the Environment, and University of Alaska Fairbanks, School of Natural Resource and Agricultural Sciences faculty has resulted in the identification of a no terrestrial soil and vegetation resources, and no aquatic sediment and vegetation resources that have significant recreation and or commercial value across the North Slope. A few minor terrestrial vegetation resources

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[94] Department of Interior, Bureau of Land Management. 1998. "Northeast National Petroleum Reserve-Alaska, Final Integrated Activity Plan/Environmental Impact Statement, Volume 1" prepared in cooperation with the Minerals Management Service, August, 1998.

[95] Alaska Department of Natural Resource, Office of Project Management and Permitting, Conditional Right-of-Way lease Application - Eastern North Slope Oil and Gas Pipelines, Environmental Report (February 2, 2006)

[96] Alaska Area Response Team, North Slope Subarea Contingency Plan For Oil and Hazardous Substance Discharges/Releases, A Subarea Plan of the Unified Plan for the State of Alaska, Sensitive Area Section (December 1999), http://www.akrrt.org/NSplan/nstoc.shtml

[97] National Ocean and Atmospheric Administration, National Ocean Service, Office of Response and Restoration, Environmental Sensitivity Index for the North Slope (2005), http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY(entry_subtopic_topic)=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=759&subtopic_id(entry_subtopic_topic)=8&topic_id(entry_subtopic_topic)=1

[98] Commission for Environmental Cooperation. 1997. Ecological Regions of North America Toward a Common Perspective. http://www.epa.gov/wed/pages/ecoregions/na_eco.htm#CEC%201997

[99] ADF&G Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife Conservation Strategy (April 2006), http://www.sf.adfg.state.ak.us/statewide/ngplan/NG_outline.cfm

[100] Alaska Geobotany Center, Institute of Arctic Biology, University of Alaska Fairbanks. 2008. Alaska Geobotanical Atlas. http://www.arcticatlas.org/

[101] Alaska Department of Natural Resources, Division of Oil and Gas, Proposed Beaufort Sea Areawide Oil and Gas Lease Sale, Preliminary Finding of the Director (April 2, 2009)

[102] Beaufort Sea and Chukchi Sea Planning Areas Oil and Gas lease Sales 209, 212, 217, 221 Draft Environmental Impact Statement (MMS 2008-0055). U.S. Department of Interior Minerals Management Service, Alaska OCS Region (November 2008).

[103] ADF&G Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife Conservation Strategy (April 2006), http://www.sf.adfg.state.ak.us/statewide/ngplan/NG_outline.cfm

[104] Truett, J.C. and Johnson, S.R. (Editors) 2000. The Natural History of an Arctic Oil Field : Development and the Biota. 422 pages.

[105] National Research Council. 2003. Cumulative environmental effects of oil and gas activities on Alaska's North Slope. The National Academies Press, Washington D.C.

[106] T. R. McCabe, B. Griffith, N. E. Walsh, and D. D. Young, editors. 1992. Terrestrial Research: 1002 Area - Arctic NWR Interim Report 1988 - 1990. U.S. Fish Wildlife Service, Anchorage, Alaska. 432 pp.

have been identified with limited commercial value include: berries and roots, in close proximity to coastal communities, which may be used to make tea for tourist markets, and peat, which is abundant in some areas, however not commercially viable to export at this time. Northern Alaska (north of the Brooks Range) has less mineral occurrences than other areas of Alaska. Phosphate beds and clay deposits are locally mixed with by soil horizons, and exposed along river beds across the North Slope, however the remoteness of the deposits combined with the absence of a viable market presently limits their significant commercial value at this time (Szumigala et al. 2009[107]). There are no tree forests on the North Slope, and hence there is no forestry industry. There are no golf courses or other comparable outdoor recreation facilities on the North Slope that might have a dependence on grasses and vegetation. Recreational lawns and gardens are very rare with reports of a few residents experimenting with potatoes and flowers during the short arctic growing season. Commercial hunting and guiding is limited across the coastal North Slope, with indirect dependence on terrestrial vegetation that hunted animals depend upon (e.g. caribou eat sedge grass and lichen) (Garner et al. 1986[108]). Recreational wilderness guiding is also limited across the North Slope, and these experiences include appreciation of the polar Arctic tundra ubiquitous across the region.

Our review of published literature and consultation with federal, state, and North Slope Borough agency representatives, conservation groups, and University of Alaska faculty, supports our conclusion that there are no reported or known commercial or recreational terrestrial agricultural or aquatic sediments and vegetation across the Alaska Arctic that has significant commercial or recreational value[109], hence an analysis of the impact on terrestrial or aquatic soils and vegetation resources is not required.

We also note, however, that EPA developed the NAAQS for pollutants considered harmful to public health and the environment. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. The secondary NAAQS represent levels below which most types of soils and vegetation are unaffected by criteria pollutants. As summarized in Section 7.3, the Project worst-case predicted cumulative concentrations of criteria pollutants are predicted to be lower than NAAQS (both primary and secondary standards.

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[107] Szumigala, D.J. and Hughes, R.A. Annual Alaska Mineral Industry Report 2009. Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, Information Circular 57, Special Report 64.

[108] Garner, G. W., and P. E. Reynolds. 1986. Final report - baseline study of the fish, wildlife, and their habitats. Arctic National Wildlife Refuge Coastal Plain Resource Assessment. (several volumes). U.S. Department of Interior, Fish and Wildlife Service, Anchorage, Alaska.

[109] Records of Communication have been prepared capturing consultation with representative of the U.S. Department of Interior's Minerals Management Service, Bureau of Land Management, and Fish and Wildlife Service (including Arctic National Wildlife Refuge); State of Alaska Departments of Fish and Game, Natural Resources (Divisions of Oil and Gas, Mining, Land, and Water, Geological and Geophysical Surveys, Parks and Outdoor Recreation, Coastal and Ocean Management); North Slope Borough Departments of Wildlife and Planning and Community Services; University of Alaska faculty; and the Alaska Center for the Environment documenting that there are no known or reported commercial or recreational soil and vegetation resources that have significant commercial or recreation value across the North Slope.

A recent PSD permit application for "Restarting the BP Badami Development Facility" (February 2005[110]) included surveys of soils and vegetation in the vicinity of the BP Badami facility. It was concluded that impacts below the NAAQS would not have an adverse impact on any soils and vegetation in this area and Alaska DEC concurred with these conclusions[111]. These conclusions also apply to the Project because cumulative concentrations identified in Section 7 are also below the NAAQS.

8.3 Visibility Analysis

8.3.1 Visible Plumes

Visibility impacts can be in the form of visible plumes ("plume blight") or a general, area-wide reduction in visibility ("regional haze"). Neither the EPA nor the state of Alaska have established visibility thresholds for Class II areas, and the exploratory program is located offshore where any coherent plumes will be broken up and dispersed over large areas over water. In addition, there are no visibility or other special protection areas in Alaska (18 AAC 50.025) located near the Project.

Visible plumes usually result from fine particulate matter emissions. The PM emissions from the *Discoverer* will be minimized through the use of oxidation catalysts and CDPFs on all on the diesel engines. It is possible that these engines will emit a visible plume during cold startup and these could last for several minutes. With the tailpipe control technology, these plumes should disappear quickly. There are expected to be visible plumes in the near-field from emissions from the ice management and anchor handling fleet activity. However, given the mobile nature of these sources, plumes would be expected to be more coherent near the ice management and anchor handling ships, and then the plumes would disperse and be broken up by movement of the ships and ambient winds.

The CAA established two types of national air quality standards, primary and secondary. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. Permitting authorities located in EPA Region 10 have previously utilized the secondary ambient air quality standards to evaluate Class II visibility issues.[112] Following that precedent, visibility impacts to attributable to the Project are considered acceptable because the predicted concentrations are below the secondary NAAQS for all pollutants.

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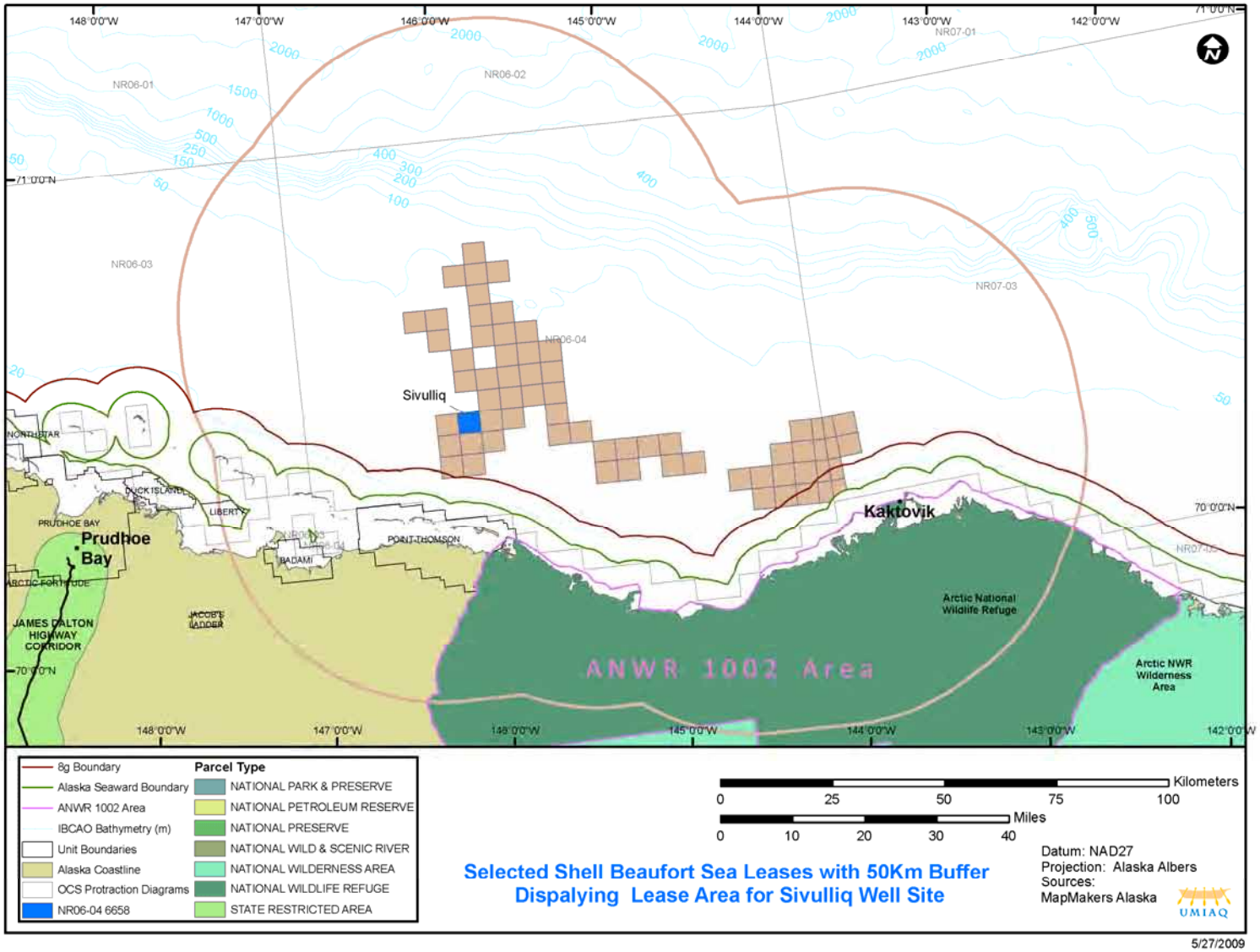
[110] Alaska Department of Environmental Conservation (ADEC) 2005. BP Exploration (Alaska) Inc., Badami Development Facility Air Quality Operating Permit No. AQ0417TVP01 Revision 2: August 19, 2005.

[111] Schuler, Alan, Alaska Department of Environmental Conservation [Technical memorandum to Alaska DEC file]. *Review of Badami Restart Ambient Assessment.* May 13, 2005.

[112] Coburg Power, L.L.C. *Prevention of Significant Deterioration Permit Application – Coburg Power Generating Plant, Coburg, Oregon. Submitted to Lane Regional Air Pollution Authority*. February 2002.

Figure 8-1: 50-km Radius Around Beaufort Lease Areas



8.3.2 Ice Fog

The capacity of air to carry water vapor is limited by its temperature. Air in contact with water often becomes saturated (carrying the maximum amount of water vapor). If the air subsequently cools due to contact with a cooler surface, mixing with cooler air, or (quite commonly) as the sun sets, the capacity of the air decreases and moisture will condense to form fog (a cloud). Freezing fog occurs when liquid fog droplets freeze to tiny particles in the air. Ice fog occurs when droplets have frozen into tiny crystals of ice in mid air which generally requires very cold temperatures (e.g., -30 deg F).

Table 8-1 provides freezing fog statistics from the most recent 5-years of National Climatic Data Center (NCDC) Integrated Surface Hourly (ISH) data from Deadhorse, Alaska. Three or more days of naturally occurring freezing fog is typical during colder months. It is only in July that the average is less than two days per month. Thus, freezing fog is a condition that a vessel should expect in nearly any month, including during most of the proposed drilling season of July through December. Any commercial Arctic vessel should be equipped to operate in the naturally-occurring fog.

The stacks (boilers, generators, incinerators) on the *Discoverer* and its associated fleets emit hot combustion gases with high moisture contents. However, unlike cooling towers with massive volumes of emitted moist air, these plume volumes are small, and mix and disperse quickly; although there will be some condensation and perhaps some fog near the exhaust tips, these disperse rapidly and are unlikely to reach the water surface unless fog is already present. During colder weather conditions, Project emission unit stacks will not produce a significant additional source of moisture which would lead fog formation beyond what already occurs in the Beaufort Sea.

Table 8-1. Number of Days with Freezing Fog at Deadhorse, Alaska

Month	2004	2005	2006	2007	2008	Max.	Min.	Average
January	2	6	5	2	0	6	0	3
February	1	6	6	9	2	9	1	5
March	7	7	1	3	0	7	0	4
April	7	5	2	10	4	10	2	6
May	8	17	12	12	6	17	6	11
June	6	5	1	4	2	6	1	4
July *	0	2	0	0	0	2	0	0
August *	1	3	1	3	1	3	1	2
September *	1	2	7	3	4	7	1	3
October *	6	7	7	3	7	7	3	6
November *	10	2	7	7	4	10	2	6
December	3	3	5	4	4	5	3	4

* The Project drilling season is from July through December, but depends on ice conditions.

8.4 Ozone Analysis

Ozone is an air pollutant formed through complex chemical reactions of nitrogen oxide (NOx) and volatile organic compound (VOC) emissions during periods of conducive weather conditions. Ozone is more readily formed when it is sunny and hot and the air is stagnant. Conversely, ozone production is more limited when it is cloudy, cool, rainy, and windy. For these reasons, ozone concentrations are generally the highest during the summer. The majority of tropospheric ozone formation occurs when nitrogen oxides (NOx), carbon monoxide (CO) and volatile organic compounds (VOCs), react in the atmosphere in the presence of sunlight. NOx, CO, and VOCs are called ozone precursors. The chemical reactions involved in tropospheric ozone formation are a series of complex cycles in which carbon monoxide and VOCs are oxidized to water vapor and carbon dioxide. The reactions involved in this process are illustrated below with CO but similar reactions occur for VOC as well. Oxidation begins with the reaction of CO with the hydroxyl radical. The hydrogen atom formed by this reacts rapidly with oxygen to give a peroxy radical HO2

$OH + CO \rightarrow H + CO_2$

$H + O_2 \rightarrow HO_2$

Peroxy radicals then go on to react with NO to give NO2 which is photolysed (indicated by hv) to give atomic oxygen and through reaction with oxygen a molecule of ozone:

$HO_2 + NO \rightarrow OH + NO_2$

$NO_2 + hv \rightarrow NO + O$

$O + O_2 \rightarrow O_3$

The net effect of these reactions is:

$CO + 2O_2 \rightarrow CO_2 + O_3$

This cycle involving HOx and NOx is terminated by the reaction of OH with NO2 to form nitric acid or by the reaction of peroxy radicals with each other to form peroxides. The chemistry involving VOCs is much more complex but the same reaction of peroxy radicals oxidizing NO to NO2 is the critical step leading to ozone formation.

Because the Project potential annual VOC emissions exceed 100 tons per year, an assessment of the project's potential effects on regional ozone concentrations is warranted. The Beaufort coastline nearest to the Project is part of the State of Alaska's Northern Alaska Intrastate Air Quality Control Region (40 CFR 81.246). This region is designated as attainment or unclassifiable for all criteria pollutants, including ozone (40 CFR part 81.302).

According to the U.S. Department of Energy, the Prudhoe Bay, Kuparuk River, and Alpine oil fields are ranked 1, 3, and 4, respectively, as the largest oil fields in the United States based on estimated oil production.[113] The latest data from the Western Regional Air Partnership (WRAP) Emissions Data Management System (EDMS) indicates North Slope Borough emissions in 2002 (latest year of data available) from all sources (mobile, non-mobile, point, etc.) of NOx and VOC (i.e., ozone precursors), were approximately 42,500 tons/year and 1,600 tons/year, respectively.[114] Table 8-2 provides a summary of NOx and VOC emissions for point sources (i.e., oil and gas facilities) located in the Deadhorse, Prudhoe Bay, and Kuparuk areas of the North Slope. Existing actual North Slope point source emissions of NOx and VOCs are approximately 41,000 tons and 1,100 tons/year, or 20 times more NOx and ten times more VOCs than potential emissions from the Project.

The ozone monitoring stations nearest the Shell lease areas are shown in Figure 8-2. As shown in Table 8-3, measured ozone concentrations are no more than two-thirds of the eight-hour ambient air quality standard. Such concentrations may very well be attributable to injection of elevated ozone concentrations from the upper atmosphere. In contrast to areas of elevated ozone in the lower 48 states, the North Slope has very low VOC emissions from biogenic and regional transportation sources. Photochemical Grid Model studies of the North Slope conducted in the 1990s indicated that the high ratio of NOx to VOC emissions inhibits the chemistry required to maintain elevated ozone from local sources.

Potential emissions the Project reveal a NOx:VOC ratio of approximately twelve. This will continue the imbalance that inhibits ozone formation. Consequently, we do not expect Project emissions to lead to increased ozone formation on the North Slope.

[113] U.S. Department of Energy. *Energy Information Administration Web Page*: http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/crude_oil_natural_gas_reserves/current/pdf/appb.pdf#page=9
[114] WRAP EDMS Database. Emissions Inventory Reports (EDMS). http://vista.cira.colostate.edu/tss/edms.aspx

Figure 8-2: Ozone Monitoring Stations on the North Slope

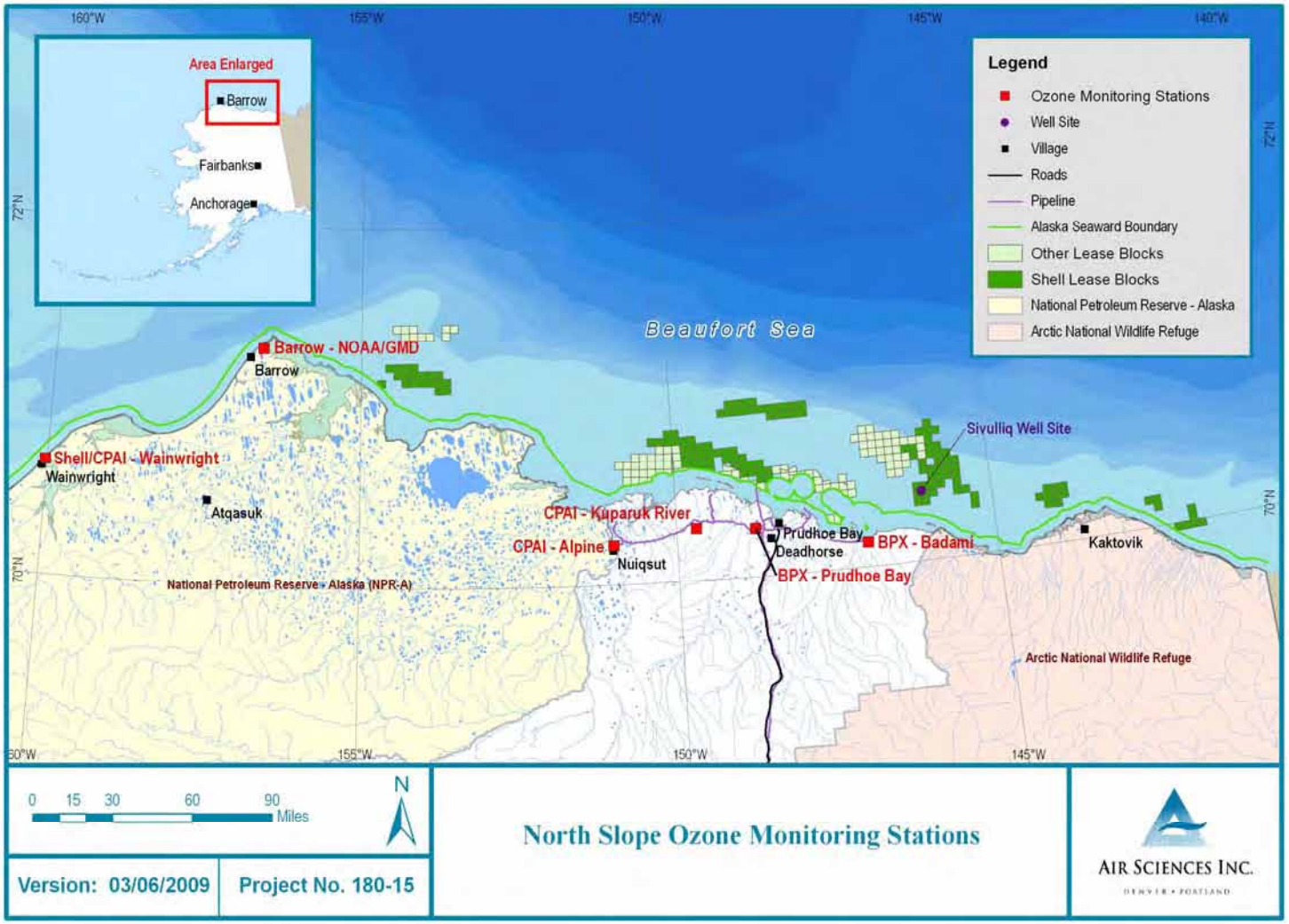


Table 8-2: Point Source Emissions of NO_x and VOCs – North Slope

Point Source Name	City	Emissions (tons/year) NOx	VOC
Trans Alaska Pipeline System Pump Station 1	North Slope	269	11
ConocoPhillips Central Production Facility #2	Kuparuk	1,759	27
BP Exploration (Alaska) - Inc. - Flow Station #2	Prudhoe Bay	1,398	19
BP Exploration (Alaska) - Inc. - Gathering Center #2 (GC-2)	Prudhoe Bay	1,212	46
BP Exploration (Alaska) - Inc. - Flow Station #1 (FS-1)	Prudhoe Bay	1,240	28
BP Exploration (Alaska) - Inc. - Seawater Injection Plant East	Prudhoe Bay	275	2
BP Exploration (Alaska) - Inc. - Seawater Treatment Plant - PBU	Prudhoe Bay	163	7
Trans Alaska Pipeline System Pump Station 3	Prudhoe Bay	251	4
BP Exploration (Alaska) - Inc. - Central Power Station	Prudhoe Bay	3,830	142
ConocoPhillips Central Production Facility #1	Umiat Meridian - Kuparuk	2,181	41
BP Exploration (Alaska) - Inc. - Gathering Center #3 (GC-3)	Prudhoe Bay	1,752	90
BP Exploration (Alaska) - Inc. - Central Gas Facility	Deadhorse	5,695	93
BP Exploration (Alaska) - Inc. - Milne Point Production Facility	North Slope	517	62
BP Exploration (Alaska) - Inc. - Badami Development	Deadhorse	64	1
ConocoPhillips Alpine Central Processing Facility	Umiat Meridian	1,058	16
BP Exploration (Alaska) - Inc. - Central Compressor Plant	Deadhorse	8,256	64
Haliburton Energy Services - Inc. - Deadhorse Facility	Deadhorse	235	5
BP Exploration (Alaska) - Inc. - Endicott Production Facility	Prudhoe Bay	2,700	46
ConocoPhillips Alaska - Kuparuk Seawater Treatment Plant	Kuparuk	101	4
BP Exploration (Alaska) - Inc. - Lisburne Production Center	Prudhoe Bay	1,782	91
ConocoPhillips Alaska - Central Production Facility #3	Kuparuk	1,498	18
BP Exploration (Alaska) - Inc. - Northstar Production Facility	Deadhorse	326	130
BP Exploration (Alaska) - Inc. - Gathering Center #1 (GC-1)	Prudhoe Bay	3,060	136
BP Exploration (Alaska) - Inc. - Flow Station #3	Prudhoe Bay	1,629	23
	Total >	41,252	1,105

Table 8-3: Maximum Measured Ozone Concentrations at North Slope Monitoring Stations

		Max. Monitored Ozone Concentration (ppb)	
Facility	**Data Dates**	**1-Hour**	**8-Hour**
Shell/CPAI - Wainwright	November 2008 [1]	35	34
Barrow - NOAA/GMD	2003, 2004, 2005 [2]	52	50
BPX - Badami	1999 [3]	48	48
BPX - Prudhoe Bay	2006, 2007 [3]	52	44
BPX - Prudhoe Bay	2006, 2007 [3]	73	43
CPAI - Alpine	Nov. 2004 - Dec. 2005 [3]	64	49
CPAI - Kuparuk River	June 2001 - June 2002 [3]	45	45 [4]
	Ambient Standard (ppb) >	120 [6]	75 [5]

[1] Preliminary data subject to change.

[2] Most recent three years of data from the World Data Centre for Greenhouse Gases; http://gaw.kishou.go.jp/cgi-bin/wdcgg/accessdata.cgi?index=BRW471N00-NOAA&select=inventory

[3] These data are the most recent available data available from Alaska DEC for these stations.

[4] Data pertaining to eight-hour average not available at this time. Conservatively assume that the maximum one-hour concentration persists for eight hours.

[5] Effective May 27, 2008, EPA revised the eight-hour primary ozone NAAQS, designed to protect public health, to a level of 75 ppb. An area meets the revised eight-hour standards if the three-year average of the annual fourth-highest daily maximum eight-hour average at an ozone monitor is less than or equal to the level of the standard (75 ppb).

[6] As of June 15, 2005, the EPA revoked its one-hour ozone standard in all areas except the eight-hour nonattainment Early Action Compact areas. The State of Alaska's Ambient Air Quality Standards for ozone, as amended in its regulations through November 9, 2008, (18 AAC 50.010(4)) are only based on the one-hour standard of 120 ppb, and the standards for the federal eight-hour standard are not listed in the Alaska regulations.

8.5 Warehouse Modeling

As noted in Section 2.6, Shell has determined that an onshore facility would be necessary to support drilling operations. The location is not certain, but the facility would most likely be in Barrow or Deadhorse. A screening level air quality impact analysis was performed for the warehouse at a generic flat terrain location.

It is anticipated that the only source of emissions from this onshore warehouse would be a small boiler used to heat the facility. The design capacity for the boiler was determined based on the estimated size of the warehouse. The warehouse is estimated to be approximately 400'x100' with a 20' ceiling height. Using a calculation procedure at http://www.heatershop.com/btu_calculator.htm, these building dimensions result in a heater design capacity of 3.6MMBtu/hr. To maintain a conservative analysis, emission factors were calculated based on a heater twice that size (7.2MMBtu/hr). Estimated emissions from the boiler are summarized in Table 8-4 below.

Table 8-4: Warehouse Emission Factors and Emission Rates.

Pollutant	Emission Factor ($lb/10^3gal$)	Reference	Emission Rate (lb/hr)[1]
Filterable Particulate Matter	2	AP-42 Table 1.3-1	0.11
Condensable Particulate Matter	1.3	AP-42 Table 1.3-2	0.07
Total Particulate Matter[2]	3.3	Filterable + Condensable	0.17
NO_x	20	AP-42 Table 1.3-1	1.05
CO	5	AP-42 Table 1.3-1	0.26
SO_2	12.8	AP-42 Table 1.3-1	0.67

[1]Emission rates calculated based on a heater design capacity of 7.2MMBtu/hr and a Diesel Heat Value of .137MMBtu/gal (AP-42 Appendix A)
[2]The emission rate for Total Particulate Matter was conservatively used for both PM_{10} and $PM_{2.5}$.

To maintain a conservative analysis the warehouse was modeled with a single stack on one end of the building. This stack location would be expected to result in worse case downwash. Fence line receptors were spaced every 10 meters along the warehouse building. A 2000x2000 meter grid of receptors with 25 meter spacing was also placed with the warehouse directly in the center.

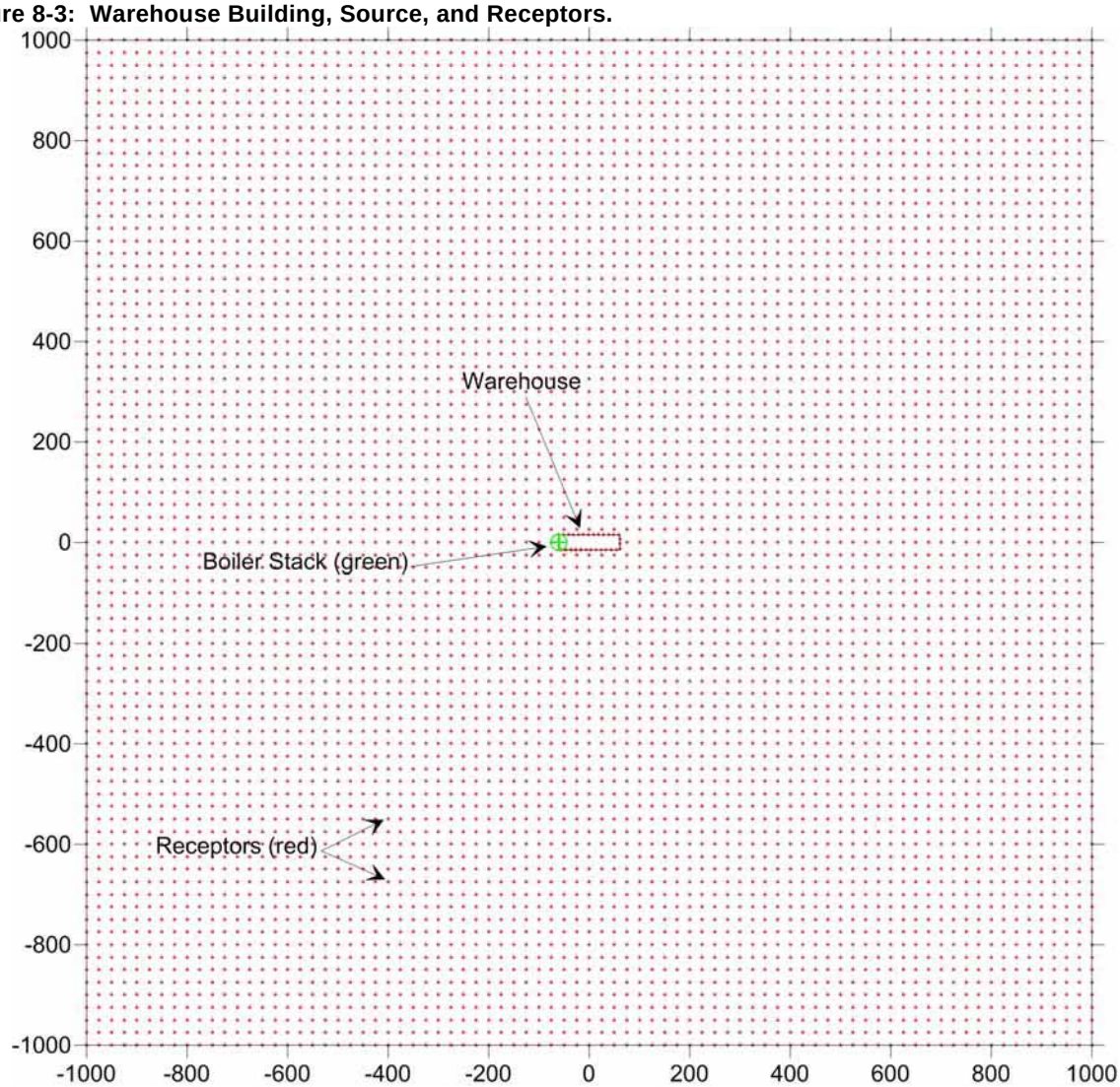
The building, source, and receptor locations for evaluating the warehouse boiler emissions are presented in Figure 8-3. Screening meteorological data with wind directions in increments of 45 degrees was used for warehouse air quality modeling. Because modeling was done using screening meteorological data, persistence factors were applied to peak 1 hour concentrations to determine maximum impact for each averaging period. Table 8-5 indicates the warehouse emissions would comply with all PSD increments and NAAQS.

Table 8-5: Peak Concentrations for Warehouse Modeling.

Pollutant	Averaging Period	Peak Concentration ($\mu g/m^3$)[3]	Background Concentration ($\mu g/m^3$)	Peak Concentration + Background ($\mu g/m^3$)	PSD Increment[1] ($\mu g/m^3$)	PSD Increment[1] Comply?	NAAQS[2] ($\mu g/m^3$)	NAAQS[2] Comply?
Particulate Matter (PM_{10})	24-Hour	10.8	7.9	18.7	30	Yes	50	Yes
	Annual	0.9	1.8	2.7	17	Yes	150	Yes
Particulate Matter ($PM_{2.5}$)	24-Hour	10.8	8.0	18.8	-	-	35	Yes
	Annual	0.9	2.0	2.9	-	-	15	Yes
NO_2	Annual	4.1	11.3	15.4	25	Yes	100	Yes
SO_2	3-Hour	69.4	36.4	105.8	512	Yes	1300	Yes
	24-Hour	41.6	13.0	54.6	91	Yes	365	Yes
	Annual	3.5	2.7	6.2	20	Yes	80	Yes
CO	1-Hour	27.2	1750.0	1777.2	-	-	40,000	Yes
	8-Hour	24.4	1070.0	1094.4	-	-	10,000	Yes

[1]PSD Increment compliance compares standards with the peak concentrations without background concentrations.
[2]NAAQS compliance compares standards with peak concentrations + background concentrations.
[3]All annual peak concentrations are divided by 2 to account for the warehouse only being in operation for half of the year.

Figure 8-3: Warehouse Building, Source, and Receptors.



8.6 Tanker Modeling

Shell anticipates maintaining a tanker 25 miles or farther from the *Discoverer*. At this distance, it is not part of the stationary OCS source but it can be considered a secondary source of emissions. Consequently, a quantitative air quality impact analysis has been performed for this tanker.

The tanker will be either the Affinity or a vessel of similar nature to the Affinity. The Affinity is a 228m long vessel whose engines burn primarily Distillate Marine C oil (DMC), which is similar to No. 4 oil. The design capacity of the vessel is 15820 kw or 54 MMBtu/hr. Using this design capacity, emission factors for the tanker were selected using AP-42 Table 1.3-1. These emission factors and the resulting emission rates are summarized in Table 8-6.

Table 8-6: Tanker Emission Factors and Rates.

Pollutant	Emission Factor ($lb/10^3gal$)[2]	Reference	Emission Rate (lb/hr)[1]
PM_{10}	7	AP-42 Table 1.3-1	2.7
$PM_{2.5}$	7	Same as PM_{10}	2.7
NO_x	20	AP-42 Table 1.3-1	7.7
SO_2	150S	AP-42 Table 1.3-1	0.1
CO	5	AP-42 Table 1.3-1	1.9

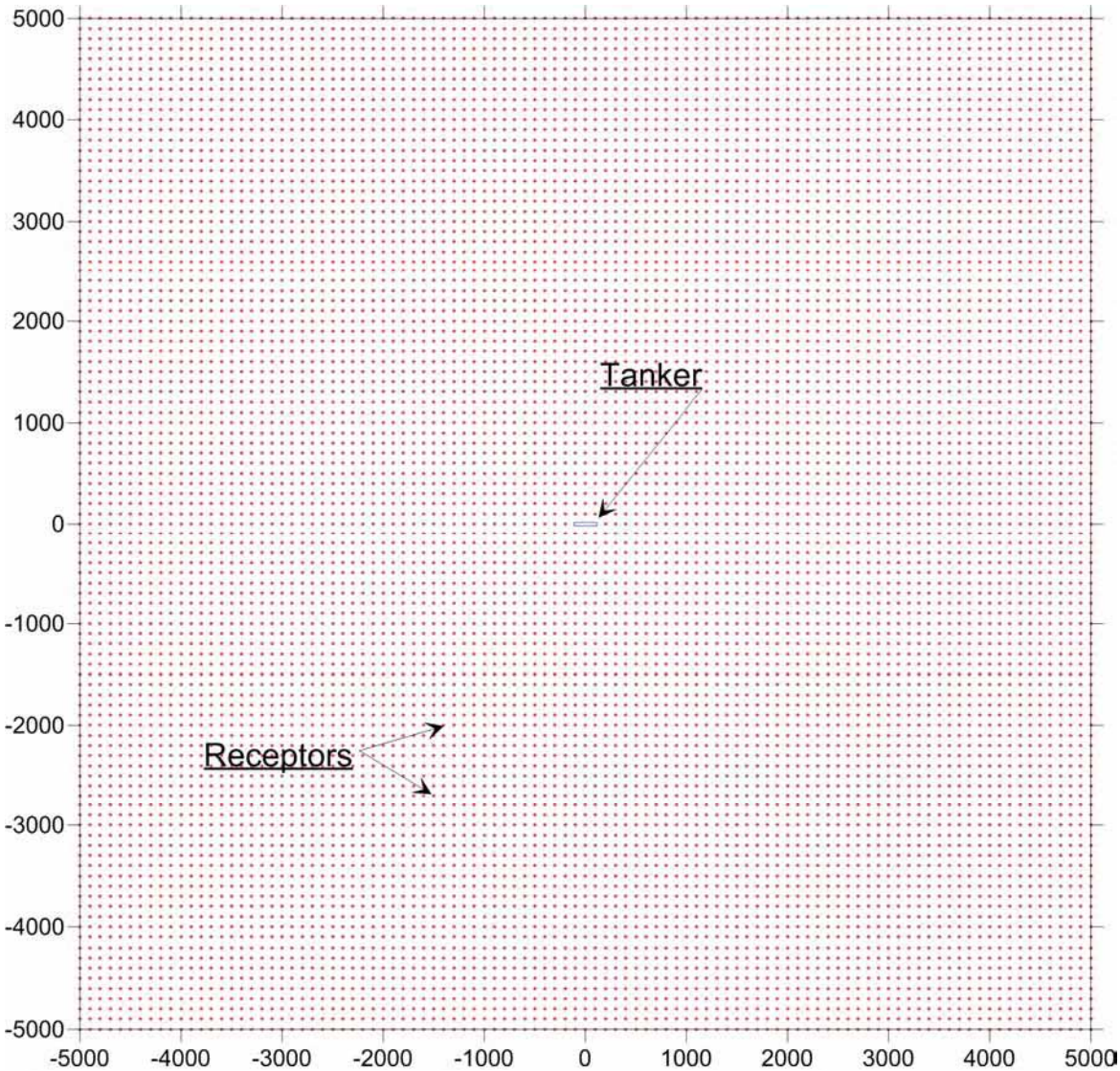
[1] Emission rates were calculated based on a 54 MMBtu/hr design capacity with a No. 4 oil heating value of 140000 BTU/gal (AP-42 Appendix A).
[2] S is % sulfur content. A sulfur content of .0015% (S=.0015) was used (ultra-low sulfur diesel).

Receptors were placed every 100 meters surrounding the tanker for 5 km in each direction. The receptor locations are depicted in Figure 8-4. The modeling results are summarized in Table 8-7 below.

Table 8-7: Peak Concentrations for Tanker Modeling.

Pollutant	Averaging Period	Peak Concentration ($\mu g/m^3$)[3]	PSD Increment[1] ($\mu g/m^3$)	PSD Increment[1] Comply?	Background Concentration ($\mu g/m^3$)	Peak Concentration + Background ($\mu g/m^3$)	NAAQS[2] ($\mu g/m^3$)	NAAQS[2] Comply?
NOx	Annual	1.5	25	Yes	11.3	12.8	100	Yes
PM_{10}	24-hour	6.9	30	Yes	7.9	14.8	150	Yes
	Annual	0.5	17	Yes	1.8	2.3	50	Yes
$PM_{2.5}$	24-hour	6.9	-	-	8.0	14.9	35	Yes
	Annual	0.5	-	-	2.0	2.5	15	Yes
SO_2	3-hour	0.4	512	Yes	36.4	36.8	1300	Yes
	24-hour	0.2	91	Yes	13	13.2	365	Yes
	Annual	0.02	20	Yes	2.7	2.7	80	Yes
CO	1-hour	8.3	-	-	1750	1758.3	40,000	Yes
	8-hour	7.4	100	Yes	1070	1077.4	10,000	Yes

Figure 8-4: Tanker Building and Receptors.



APPENDIX A

Emission Unit Calculations

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
	PROJECT NO: 180-15-1	PAGE: 1	OF: 17
ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009	

Emissions Unit: FD-1-6 Generator Engine **Make/Model:** Cat / D399 **Rating:** 1,325 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.057	0.057	0.112	0.0016	0.200	0.017	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
50%	50%	0.5 g/kW-hr	0%	80%	70%	0%

Rated fuel consumpt. MMBtu/hr	Capacity ORR	Max Actual fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
9.7	71%	6.91	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04

ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
168	27,878	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04

Operational Restrictions

Generators (six units combined) combined 71%

[1] Sulfur content on all stationary source engines on Discoverer & Na 0.0015% by wt.

Control Device Effectiveness		References
Generator SCR NOx control effectiveness	0.5 g/kW-hr	D.E.C. Marine AB letter, October 9, 2008, initial stack test and CEM
Generator Oxidation Catalyst CO reduction efficiency	80%	D.E.C. Marine AB letter, October 9, 2008, and initial stack test
Generator Oxidation Catalyst VOC, HAPs, Formaldehyde reduction efficiency	70%	D.E.C. Marine AB letter, October 9, 2008
Generator Oxidation Catalyst PM_{10} reduction efficiency	50%	D.E.C. Marine AB email, February 9, 2009
CCV on Crankcase vent [2]	100%	Crankcase emissions redirected to intake

[2] unless infeasible due to spatial considerations

Emissions Factor References

PM_{10}	Caterpillar D399 SCAC Engine Data Sheet, 05/95
$PM_{2.5}$	100% PM_{10}
NO_x	D.E.C. Marine AB letter, 10/9/08
SO_2	Sulfur Content Calculation
CO	Caterpillar D399 SCAC Engine Data Sheet, 05/95
VOC	Caterpillar D399 SCAC Engine Data Sheet, 05/95
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	Oxidation Catalyst	Control Efficiency:	50%		
	Uncontrolled emission rate:	251.2 g/hr	0.254 g/kW-hr		Ref:	Caterpillar D399 SCAC Engine Data Sheet, 05/95
	Proposed BACT emission rate:	125.6 g/hr	0.127 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	SCR to 0.5 g/kW-hr				
	Uncontrolled emission rate:	7993.9 g/hr	8.084 g/kW-hr		Ref:	Caterpillar D399 SCAC Engine Data Sheet, 05/95
	Proposed BACT emission rate:		0.5 g/kW-hr			
	Control efficiency:	94%				
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	Oxidation Catalyst	Control Efficiency:	80%		
	Uncontrolled emission rate:	882.7 g/hr	0.893 g/kW-hr		Ref:	Caterpillar D399 SCAC Engine Data Sheet, 05/95
	Proposed BACT emission rate:	176.54 g/hr	0.179 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
D399 Engines diesel heat rate	Caterpillar D399 SCAC Engine Data Sheet, 05/95	
237.5 g/kW-hr		
7350 Btu/hp-hr		
0.0073 MMBtu/hp-hr		

Emissions Unit: FD-8 Em Generator **Make/Model:** Caterpillar / 3304 **Rating:** 131 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.696	0.696	3.553	0.0016	1.953	0.366	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
0%	0%	0%	0%	0%	0%	0%

Rated fuel consumpt. MMBtu/hr	Max Actual fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.9	0.9	0.64	0.64	3.26	1.46E-03	1.79	0.34	2.66E-05

ORR days/yr	Use min/wk	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
168	120	44	1.53E-02	1.53E-02	7.82E-02	3.51E-05	4.30E-02	8.06E-03	6.38E-07

Operational Restrictions

Unit FD-8 (Emergency Generator) operation assumed for

[1] Sulfur content on all stationary source engines on Discovere 0.0015% by wt.

Emissions Factor References

PM_{10}	Max of 13 test from EPA/600/8-90/057F
$PM_{2.5}$	100% PM_{10}
NO_x	Max of 13 test from EPA/600/8-90/057F
SO_2	Sulfur Content Calculation
CO	Max of 13 test from EPA/600/8-90/057F
VOC	Max of 13 test from EPA/600/8-90/057F
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

Emissions Unit: FD-9-11 MLC Compressor **Make/Model:** Caterpillar / C-15 **Rating:** 540 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.050	0.050	0.993	0.0016	0.868	0.993	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
50%	50%	0%	0%	47%	0%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
3.6	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04

ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
63	5,413	0.07	0.07	2.69	4.32E-03	1.25	2.69	7.85E-05

Operational Restrictions

[1] Sulfur content on all stationary source engines on Discovere 0.0015% by wt.

Emissions Factor References

PM_{10}	Tier 3 emission limit
$PM_{2.5}$	100% PM_{10}
NO_x	Tier 3 emission limit
SO_2	Sulfur Content Calculation
CO	Tier 3 emission limit
VOC	Tier 3 emission limit
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	Integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	0.2 g/kW-hr			Ref:	Tier 3 emission limit
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	Integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	4.0 g/kW-hr			Ref:	Tier 3 emission limit
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	Integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	3.5 g/kW-hr			Ref:	Tier 3 emission limit
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
Caterpillar C15 engines diesel heat rate	Caterpillar C15 Specification Sheet, LEHW7443-000, 2008	
26.9 gal/hr		
0.00663 MMBtu/hp-hr		

Emissions Unit: FD-12-13 HPU Engine **Make/Model:** Detroit/8V71 **Rating:** 250 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.356	0.356	2.771	0.0016	0.844	0.418	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
85%	85%	0%	0%	90%	90%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
2.0	0.10	0.10	5.41	3.11E-03	0.16	0.08	5.66E-05

ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
63	2,951	0.08	0.08	4.09	2.35E-03	0.12	0.06	4.28E-05

Operational Restrictions

[1] Sulfur content on all stationary source engines on Discoverer & Nanuq 0.0015% by wt.

Control Device Effectiveness		References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%	CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation CDPF PM reduction efficiency	85%	California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT
CCV on Crankcase vent	100%	Crankcase emissions redirected to intake

Emissions Factor References

PM_{10}	Max of 4 test from EPA/600/8-90/057F
$PM_{2.5}$	100% PM_{10}
NO_x	Max of 4 test from EPA/600/8-90/057F
SO_2	Sulfur Content Calculation
CO	Max of 2 test from EPA/600/8-90/057F
VOC	Max of 2 test from EPA/600/8-90/057F
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	CDPF	Control Efficiency:	85%			
	Uncontrolled emission rate:		1.26 g/bhp-hr	1.688 g/kW-hr	Ref:	Max of 4 test from EPA/600/8-90/057F	
	Proposed BACT emission rate:		0.189 g/bhp-hr	0.253 g/kW-hr			
	Proposed emission test methods:		EPA methods 1-4 & 5, at engine load >50%		Interval:	triplicate consecutive 1-hour tests.	
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A			
	Uncontrolled & Controlled emission rate:		9.81 g/bhp-hr	13.145 g/kW-hr	Ref:	Max of 4 test from EPA/600/8-90/057F	
	Proposed emission test methods:		EPA methods 1-4 & 7E, at engine load >50%		Interval:	triplicate consecutive 1-hour tests.	
CO	Control Method:	CDPF	Control Efficiency:	90%			
	Uncontrolled emission rate:		2.99 g/bhp-hr	4.007 g/kW-hr	Ref:	Max of 2 test from EPA/600/8-90/057F	
	Proposed BACT emission rate:		0.299 g/bhp-hr	0.401 g/kW-hr			
	Proposed emission test methods:		EPA methods 1-4 & 10, at engine load >50%		Interval:	triplicate consecutive 1-hour tests.	

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
Detroit 8V-71N engines diesel heat rate	Detroit Diesel, Engine Performance Model: 8V-71N, 10/15/81	
0.415 lb/hp-hr		
0.0078 MMBtu/hp-hr		

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Emissions Unit: FD-14-15 Deck Cranes **Make/Model:** Cat / D343 **Rating:** 365 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.103	0.103	2.241	0.0016	0.473	0.138	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
85%	85%	0%	0%	90%	90%	0%

Max Actual fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
2.8	0.04	0.04	6.20	4.41E-03	0.13	0.04	8.02E-05

ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
63	4,181	0.03	0.03	4.68	3.33E-03	0.10	0.03	6.06E-05

Operational Restrictions

Crane (two units combined) maximum 62,824 gal/season

[1] Sulfur content on all stationary source engines on Discoverer & Na 0.0015% by wt.

Control Device Effectiveness		References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%	CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generati	85%	California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT
CCV on Crankcase vent	100%	Crankcase emissions redirected to intake

Emissions Factor References

PM_{10}	Caterpillar D343 Engine Data Sheet, 05/95
$PM_{2.5}$	100% PM_{10}
NO_x	Caterpillar D343 Engine Data Sheet, 05/95
SO_2	Sulfur Content Calculation
CO	Caterpillar D343 Engine Data Sheet, 05/95
VOC	Caterpillar D343 Engine Data Sheet, 05/95
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	CDPF	Control Efficiency:	85%		
	Uncontrolled emission rate:	129.8 g/hr	0.477 g/kW-hr		Ref:	Caterpillar D343 Engine Data Sheet, 05/95
	Proposed BACT emission rate:	19.47 g/hr	0.071 g/kW-hr			
	Proposed Emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	2810.9 g/hr	10.319 g/kW-hr		Ref:	Caterpillar D343 Engine Data Sheet, 05/95
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	CDPF	Control Efficiency:	90%		
	Uncontrolled emission rate:	593.6 g/hr	2.179 g/kW-hr		Ref:	Caterpillar D343 Engine Data Sheet, 05/95
	Proposed BACT emission rate:	59.36 g/hr	0.218 g/kW-hr			
	Proposed Emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
D343 engines diesel heat rate	Caterpillar D343 Engine Data Sheet, 05/95	
245 g/kW-hr	100% loads at 2100 RPM value, T Prechamber Engines	
7576 Btu/hp-hr		
0.0076 MMBtu/hp-hr		

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
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ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009	

Emissions Unit: FD-16-17 Cementing Unit **Make/Model:** Detroit / 8V-71N **Rating:** 335 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	
0.356	0.356	2.771	0.0016	0.844	0.847	2.9E-05	(hourly)
0.542	0.542	3.310	0.0016	1.850	0.847	2.9E-05	(annual)

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
85%	85%	0%	0%	90%	90%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
2.6	0.14	0.14	7.25	4.17E-03	0.22	0.22	7.58E-05

Capacity ORR	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
28%	168	2,931	0.12	0.12	4.85	2.34E-03	0.27	0.12	4.25E-05

Operational Restrictions

Cementing (three units) & Logging (two units) combined maximur 28% per day (of Cementing)

[1] Sulfur content on all stationary source engines on Discoverer & N 0.0015% by wt.

Control Device Effectiveness		References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%	CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and genera	85%	California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT
CCV on Crankcase vent	100%	Crankcase emissions redirected to intake

Emissions Factor References

PM_{10}	Tier 3 emission limit
$PM_{2.5}$	100% PM_{10}
NO_x	Max of 8 test from EPA/600/8-90/057F
SO_2	Sulfur Content Calculation
CO	Tier 3 emission limit
VOC	Tier 3 emission limit
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	CDPF	Control Efficiency:	85%		
	Uncontrolled emission rate:	0.2 g/bhp-hr	0.268 g/kW-hr		Ref:	Tier 3 emission limit
	Proposed BACT emission rate:	0.03 g/bhp-hr	0.040 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	11.72 g/bhp-hr	15.705 g/kW-hr		Ref:	Max of 8 test from EPA/600/8-90/057F
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	CDPF	Control Efficiency:	90%		
	Uncontrolled emission rate:	3.5 g/bhp-hr	4.690 g/kW-hr		Ref:	Tier 3 emission limit
	Proposed BACT emission rate:	0.35 g/bhp-hr	0.469 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
Detroit 8V-71N engines diesel heat rate	Detroit Diesel, Engine Performance Model: 8V-71N, 10/15/81	
0.415 lb/hp-hr		
0.0078 MMBtu/hp-hr		

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
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Emissions Unit: FD-18 Cementing Unit **Make/Model:** GM 3-71 **Rating:** 147 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.542	0.542	3.310	0.0016	1.850	0.847	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
85%	85%	0%	0%	90%	90%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
1.1	0.09	0.09	3.80	1.83E-03	0.21	0.10	3.33E-05

Capacity ORR	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
28%	168	1,286	0.05	0.05	2.13	1.03E-03	0.12	0.05	1.86E-05

Operational Restrictions

Cementing (three units) & Logging (two units) combined maximur 28% per day (of Cementing)

[1] Sulfur content on all stationary source engines on Discoverer & N 0.0015% by wt.

Control Device Effectiveness		References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%	CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and genera	85%	California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT
CCV on Crankcase vent	100%	Crankcase emissions redirected to intake

Emissions Factor References

PM_{10}	Tier 3 emission limit
$PM_{2.5}$	100% PM_{10}
NO_x	Max of 8 test from EPA/600/8-90/057F
SO_2	Sulfur Content Calculation
CO	Tier 3 emission limit
VOC	Tier 3 emission limit
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	CDPF	Control Efficiency:	85%		
	Uncontrolled emission rate:	0.2 g/bhp-hr	0.268 g/kW-hr	Ref:	Tier 3 emission limit	
	Proposed BACT emission rate:	0.03 g/bhp-hr	0.040 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%		Interval:	triplicate consecutive 1-hour tests.	
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	11.72 g/bhp-hr	15.705 g/kW-hr	Ref:	Max of 8 test from EPA/600/8-90/057F	
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%		Interval:	triplicate consecutive 1-hour tests.	
CO	Control Method:	CDPF	Control Efficiency:	90%		
	Uncontrolled emission rate:	3.5 g/bhp-hr	4.690 g/kW-hr	Ref:	Tier 3 emission limit	
	Proposed BACT emission rate:	0.35 g/bhp-hr	0.469 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%		Interval:	triplicate consecutive 1-hour tests.	

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
Detroit 8V-71N engines diesel heat rate	Detroit Diesel, Engine Performance Model: 8V-71N, 10/15/81	
0.415 lb/hp-hr		
0.0078 MMBtu/hp-hr		

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
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Emissions Unit: FD-19 Logging Winch **Make/Model:** Caterpillar/C7 **Rating:** 250 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	
0.050	0.050	0.993	0.0016	0.868	0.847	2.9E-05	(hourly)

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
85%	85%	0%	0%	80%	0%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
1.8	0.01	0.01	1.74	2.79E-03	0.30	1.48	5.08E-05

Capacity ORR	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
28%	168	1,962	0.01	0.01	0.97	1.56E-03	0.17	0.83	2.84E-05

Operational Restrictions

Cementing (three units) & Logging (two units) combined maximum 28%

Logging Units only operate when the cementing units are not operating

[1] Sulfur content on all stationary source engines on Discoverer & N 0.0015% by wt.

Control Device Effectiveness		References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%	CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and genera	85%	California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT
CCV on Crankcase vent	100%	Crankcase emissions redirected to intake

Emissions Factor References

PM_{10}	Tier 3 emission limit
$PM_{2.5}$	100% PM_{10}
NO_x	Max of 8 test from EPA/600/8-90/057F
SO_2	Sulfur Content Calculation
CO	Tier 3 emission limit
VOC	Tier 3 emission limit
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	CDPF	Control Efficiency:	85%		
	Uncontrolled emission rate:	0.2 g/bhp-hr	0.268 g/kW-hr		Ref:	Tier 3 emission limit
	Proposed BACT emission rate:	0.03 g/bhp-hr	0.040 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	11.72 g/bhp-hr	15.705 g/kW-hr		Ref:	Max of 8 test from EPA/600/8-90/057F
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	CDPF	Control Efficiency:	80%		
	Uncontrolled emission rate:	3.5 g/bhp-hr	4.690 g/kW-hr		Ref:	Tier 3 emission limit
	Proposed BACT emission rate:	0.7 g/bhp-hr	0.938 g/kW-hr			
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
Detroit 8V-71N engines diesel heat rate	Detroit Diesel, Engine Performance Model: 8V-71N, 10/15/81	
7,000.000 Btu/hp-hr		
0.0070 MMBtu/hp-hr		

Emissions Unit: FD-20 Logging Winch **Make/Model:** John Deere/PE4020TF270D **Rating:** 35 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.141	0.141	1.763	0.0016	1.293	1.763	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
85%	85%	0%	0%	90%	90%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.2	5.18E-03	5.18E-03	4.32E-01	3.91E-04	3.17E-02	4.32E-02	7.11E-06

Capacity ORR	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
28%	168	275	2.90E-03	2.90E-03	2.42E-01	2.19E-04	1.77E-02	2.42E-02	3.98E-06

Operational Restrictions

Cementing (three units) & Logging (two units) combined maximum 28%

Logging Units only operate when the cementing units are not operating

[1] Sulfur content on all stationary source engines on Discoverer & Na 0.0015% by wt.

Control Device Effectiveness		References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90%	CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generati	85%	California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT

Emissions Factor References

PM_{10}	Tier 2 emission limit
$PM_{2.5}$	100% PM_{10}
NO_x	Tier 2 emission limit
SO_2	Sulfur Content Calculation
CO	Tier 2 emission limit
VOC	Tier 2 emission limit
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	CDPF & Integral Design	Control Efficiency:	85%		
	Uncontrolled emission rate:	0.6 g/kW-hr			Ref:	Tier 2 emission limit
	Proposed BACT emission rate:	0.09 g/kW-hr				
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	Integral Design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	7.5 g/kW-hr			Ref:	Tier 2 emission limit
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	CDPF & Integral Design	Control Efficiency:	90%		
	Uncontrolled emission rate:	5.5 g/kW-hr			Ref:	Tier 2 emission limit
	Proposed BACT emission rate:	0.55 g/kW-hr				
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000.0 Btu/hp-hr		
0.007 MMBtu/hp-hr		

Emissions Unit: FD-21-22 Heat Boiler **Make/Model:** Clayton 200 Boiler **Rating:** 7.97 MMBtu/hr

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.024	0.024	0.201	0.0016	0.077	0.001	9.00E-06

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
0%	0%	0%	0%	0%	0%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
8.0	0.19	0.19	1.60	1.27E-02	0.62	0.01	7.17E-05

ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
168	32,135	0.38	0.38	3.23	2.56E-02	1.24	0.02	1.45E-04

Operational Restrictions

[1] Sulfur content on all stationary source engines on Discoverer & N 0.0015% by wt.

Emissions Factor References

PM_{10}	Clayton Industries, 8/2001
$PM_{2.5}$	100% PM_{10}
NO_x	Clayton Industries, 8/2001
SO_2	Sulfur Content Calculation
CO	Clayton Industries, 8/2001
VOC	Clayton Industries, 8/2001
Lead	AP42 Table 1.3-10. Emission Factors For Trace Elements From Distillate Fuel Oil Combustion Sources

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	4.5 lb/day	0.024 lb/MMBtu		Ref:	Clayton Industries, 8/2001
	Proposed emission test methods:	EPA methods 1-4 & 5, at boiler load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	38.5 lb/day	0.201 lb/MMBtu		Ref:	Clayton Industries, 8/2001
	Proposed emission test methods:	EPA methods 1-4 & 7E, at boiler load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	14.8 lb/day	0.077 lb/MMBtu		Ref:	Clayton Industries, 8/2001
	Proposed emission test methods:	EPA methods 1-4 & 10, at boiler load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

Emissions Unit: FD-23 Incinerator **Make/Model:** TeamTec/GS500C **Rating:** 276 lb/hr

Emissions Factors, lb/lb

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.0041	0.0035	0.0025	0.0013	0.0155	0.0015	1.07E-04

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
0%	0%	0%	0%	0%	0%	0%

Hourly Emission Rate, lb/hr

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
1.13	0.97	0.69	0.35	4.28	0.41	0.03

ORR	Annual Emission Rate, ton/yr						
days/yr	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
168	0.10	0.09	0.06	0.03	0.39	0.04	2.68E-03

Operational Restrictions

Discoverer Incinerator, 300 lb/trash per day

[1] Sulfur content on all stationary source engines on Discov 0.0015% by wt.

Emissions Factor References

PM_{10}	ORR
$PM_{2.5}$	ORR
NO_x	AP42 Table 2.2-1, multiple hearth
SO_2	ORR
CO	AP42 Table 2.2-1, multiple hearth
VOC	AP42 Table 2.1-12, 10/96
Lead	AP42 Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

BACT Emission Limits and Test Methods

PM_{10}	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	8.2	lb/ton		Ref:	ORR
	Proposed emission test methods:	EPA methods 1-4 & 5, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
NO_x	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	5	lb/ton		Ref:	AP42 Table 2.2-1, multiple hearth
	Proposed emission test methods:	EPA methods 1-4 & 7E, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.
CO	Control Method:	GCP & integral design	Control Efficiency:	N/A		
	Uncontrolled & Controlled emission rate:	31	lb/ton		Ref:	AP42 Table 2.2-1, multiple hearth
	Proposed emission test methods:	EPA methods 1-4 & 10, at engine load >50%			Interval:	triplicate consecutive 1-hour tests.

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

Emissions Units: FD-31 Resupply Ship - docked **Rating:** 292 hp per engine

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.31	0.31	4.41	0.0016	0.95	0.35	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
0%	0%	0%	0%	0%	0%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
2.0	0.63	0.63	9.01	0.00	1.94	0.72	5.93E-05

Use hr/day [2]	Use days/yr	Capacity [3]	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
12	8	100%	196.22	0.03	0.03	0.43	0.00	0.09	0.03	2.85E-06

Operational Restrictions

[1] Sulfur content on ice breaker, anchor har 0.00% by wt.

[2] Resupply ship while docked limited to 12 hr/day

[3] Resupply ship while docked generation limited to 1 engine, electrical switch allows only 1 generator to operate at a time: 100%

Emissions Factor References

PM_{10}	AP42 Table 3.3-1, 10/96
$PM_{2.5}$	100% PM_{10}
NO_x	AP42 Table 3.3-1, 10/96
SO_2	Sulfur Content Calculation
CO	AP42 Table 3.3-1, 10/96
VOC	AP42 Table 3.3-1, 10/96
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

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Emissions Units: Ice Breaker **Rating:** ICE Engines 25,520 hp Boilers 10 MMBtu/hr

Emissions Factors

	Units	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
ICE Engines	lb/MMBtu	0.249	0.22	5.876	0.0016	0.786	0.141	2.9E-05
Boilers	lb/MMBtu	0.025	0.025	0.150	0.0016	0.038	0.003	9.00E-06
Incinerators	lb/lb	0.0067	0.0046	0.0015	0.00125	0.15	0.05	1.1E-04

Control Efficiency

	PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
ICE Engines	0%	0%	0%	0%	0%	0%	0%
Boilers	0%	0%	0%	0%	0%	0%	0%
Incinerators	0%	0%	0%	0%	0%	0%	0%

	Rating		Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
ICE Engines			178.64	44.51	39.30	1049.66	0.29	140.36	25.19	5.18E-03
Boilers			10.00	0.25	0.25	1.50	0.02	0.38	0.03	9.00E-05
[2] Incinerators	154	lb/hr		1.02	0.70	0.23	0.19	23.10	7.70	1.64E-02
Total			188.64	45.78	40.25	1051.40	0.49	163.84	32.92	2.17E-02

	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x [3]	SO_2	CO	VOC	Lead
ICE Engines	168	288,081	36	32	846	0	113	20	4.18E-03
Boilers	168	40,320	0.50	0.50	3.03	0.03	0.76	0.05	0.00
Incinerators	168		2.06	1.41	0.47	0.39	46.57	15.52	0.03
Total		328,401	38	34	850	1	161	36	3.74E-02

Operational Restrictions

[1] Sulfur content on ice breaker, anchor hai 0.00% by wt.

[3] NOx ICE operation restriction based on 38% of 168 days
Remaining Pollutants Operations Restriction calculated based on 38% of 168 days

ICE Emissions Factor References

PM_{10}	generic factors consistent w/Ice breaker ORR
$PM_{2.5}$	generic factors consistent w/Ice breaker ORR
NO_x	generic factors consistent w/Ice mgmt fleet ORRs
SO_2	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98
CO	AP42 Table 3.4-1, 10/96
VOC	Corbett, Koehler. Revised: 05/03
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

Incinerator Emissions Factor References

PM_{10}	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
$PM_{2.5}$	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
NO_x	AP42 Table 2.1-12, 10/96
SO_2	AP42 Table 2.1-12, 10/96
CO	AP42 Table 2.1-12, 10/96
VOC	AP42 Table 2.1-12, 10/96
Lead	AP42 Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

Emissions Units: Anchor Handler Tor Viking II

Emissions Factors

	Units	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Propulsion Engines	lb/MMBtu	0.057	0.057	0.796	0.0017	0.786	0.141	2.9E-05
Generator Engines	lb/MMBtu	0.057	0.057	0.796	0.0017	0.786	0.141	2.9E-05
Boiler	lb/MMBtu	0.025	0.025	0.150	0.0016	0.038	0.003	9.0E-06
Incinerator	lb/lb	0.007	0.005	0.0015	0.0013	0.150	0.050	1.1E-04

Control Efficiency

	PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
All sources	0%	0%	0%	0%	0%	0%	0%

	Rating		Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Propulsion Engines	14,128	hp	98.90	5.67	5.67	78.76	0.17	77.70	13.95	2.87E-03
Generator Engines	2,336	hp	16.35	0.94	0.94	13.02	0.03	12.85	2.31	4.74E-04
Boiler	1.37	MMBtu/hr	1.37	0.03	0.03	0.21	0.00	0.05	0.00	1.23E-05
Incinerators	151.23	lb/hr		1.01	0.69	0.23	0.19	22.68	7.56	1.61E-02
Total			116.62	7.64	7.33	92.22	0.39	113.29	23.82	1.95E-02

	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x [2]	SO_2	CO	VOC	Lead
Propulsion Engines	168	178,622	4.34	4.34	60.34	0.13	59.53	10.68	5.78E-03
Generator Engines	168	25,054	0.72	0.72	9.98	0.02	9.84	1.77	9.56E-04
Boiler	168	5,524	0.07	0.07	0.42	0.00	0.10	0.01	2.49E-05
Incinerators	168		2.03	1.39	0.46	0.38	45.73	15.24	3.25E-02
Total		209,200	7.15	6.51	71.19	0.54	115.21	27.70	3.92E-02

Operational Restrictions

[1] Sulfur content on ice breaker, anchor hand 0.00% by wt.

[2] NOx ICE operation restriction based on 38% of 168 days

Propulsion & Generator Engine Emissions Factor References

PM_{10}	AP42 Table 3.4-2, 10/96
$PM_{2.5}$	100% PM_{10}
NO_x	generic factors consistent w/Anchor Handler ORR
SO_2	AP42 Table 3.4-1, 10/96
CO	AP42 Table 3.4-1, 10/96
VOC	AP42 Table 3.4-1, 10/96
Lead	AP42 Table 3.3-2, Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines

Boiler Emissions Factor References

PM_{10}	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98
$PM_{2.5}$	100% PM_{10}
NO_x	Permit R100CS-AK-07-01
SO_2	AP42 Table 1.3-1, 9/98
CO	AP42 Table 1.3-1, 9/98
VOC	AP42 Table 1.3-3, 9/98
Lead	Table 1.3-10. Emission Factors For Trace Elements From Distillate Fuel Oil Combustion Sources

Incinerator Emissions Factor References

PM_{10}	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
$PM_{2.5}$	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
NO_x	AP42 Table 2.1-12, 10/96
SO_2	AP42 Table 2.1-12, 10/96
CO	AP42 Table 2.1-12, 10/96
VOC	AP42 Table 2.1-12, 10/96
Lead	Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

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Emissions Units: Anchor Handler Hull 247

Emissions Factors

	Units	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Ice Engines	lb/MMBtu	0.059	0.059	0.423	0.0017	1.175	0.045	2.9E-05
Boiler	lb/MMBtu	0.025	0.025	0.150	0.0016	0.038	0.003	9.0E-06
Incinerator	lb/lb	0.007	0.005	0.0015	0.0013	0.150	0.050	1.1E-04

Control Efficiency

	PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
All sources	0%	0%	0%	0%	0%	0%	0%

	Rating		Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Ice Engines	24	MWe	180.16	10.59	10.59	76.22	0.31	211.72	8.05	5.22E-03
Boiler	4	MMBtu/hr	4.00	0.10	0.10	0.60	0.01	0.15	0.01	3.60E-05
Incinerators	151.23	lb/hr		1.01	0.69	0.23	0.19	22.68	7.56	1.61E-02
Total			184.16	11.69	11.37	77.05	0.51	234.56	15.62	2.14E-02

	ORR days/yr	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x [2]	SO_2	CO	VOC	Lead
Ice Engines	168	276,035	8.11	8.11	58.39	0.24	162.19	6.16	4.00E-03
Boiler	168	16,128	0.20	0.20	1.21	0.01	0.30	0.02	7.26E-05
Incinerators	168		2.03	1.39	0.46	0.38	45.73	15.24	3.25E-02
Total		292,163	10.34	9.70	60.06	0.63	208.23	21.43	3.65E-02

Operational Restrictions

[1] Sulfur content on ice breaker, anchor hand 0.00% by wt.

NOx ICE operation restriction based on 38% of 168 days

ICE Engine Emissions Factor References

PM_{10}	Tier 4 emission limit
$PM_{2.5}$	100% PM_{10}
NO_x	SCR Control
SO_2	AP42 Table 3.4-1, 10/96
CO	Marine Tier 2 emission limit
VOC	Tier 4 emission limit
Lead	AP42 Table 3.3-2, Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines

Boiler Emissions Factor References

PM_{10}	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98
$PM_{2.5}$	100% PM_{10}
NO_x	AP42 Table 1.3-1, 9/98
SO_2	AP42 Table 1.3-1, 9/98
CO	AP42 Table 1.3-1, 9/98
VOC	AP42 Table 1.3-3, 9/98
Lead	Table 1.3-10. Emission Factors For Trace Elements From Distillate Fuel Oil Combustion Sources

Incinerator Emissions Factor References

PM_{10}	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
$PM_{2.5}$	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
NO_x	AP42 Table 2.1-12, 10/96
SO_2	AP42 Table 2.1-12, 10/96
CO	AP42 Table 2.1-12, 10/96
VOC	AP42 Table 2.1-12, 10/96
Lead	Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

Emissions Units: Resupply Ship - in Transit **Rating:** 6,344 hp

Emissions Factors, lb/MMBtu

PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
0.45	0.36	5.97	0.0016	0.79	0.14	2.9E-05

Control Efficiency

PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
0%	0%	0%	0%	0%	0%	0%

Rated fuel consumpt. MMBtu/hr	Hourly Emission Rate, lb/hr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
44.4	20.04	16.07	265.11	0.07	34.89	6.26	1.29E-03

Use trips/yr [2]	Use hr/trip	Capacity	Max Actual fuel consumpt. MMBtu/yr	Annual Emission Rate, ton/yr PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
8	4	100%	1,421.06	0.32	0.26	4.24	0.00	0.56	0.10	2.06E-05

Operational Restrictions

[1] Sulfur content on ice breaker, anchor han 0.00% by wt.

Resupply Ship-transit maximum use 8 trips/yr , 4 hr/trip

Emissions Factor References

PM_{10}	Corbett, Koehler. Revised: 05/03
$PM_{2.5}$	EPA Ref: IVL
NO_x	EPA Memo, D. Meyer, June 12,
SO_2	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98
CO	AP42 Table 3.4-1, 10/96
VOC	Corbett, Koehler. Revised: 05/03
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines

Assumptions	References	Conversions
Diesel heat value	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340 hp/kW
133,098 Btu/gal		454 g/lb
0.1331 MMBtu/gal		3,600 sec/hour
Diesel density	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	2,000 lb/ton
847.9 kg/m^3		2 wt. conversion of S to SO2
7.08 lb/gal		264 gal/m^3
ICE Engines diesel heat rate	AP42 Table 3.3-1, 10/96	
7,000 Btu/hp-hr		
0.007 MMBtu/hp-hr		

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Emissions Units: OSR Fleet

Emissions Factors

	Units	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Nanuq ICE Propulsion Engines	lb/MMBtu	0.044	0.044	3.536	0.0016	0.190	0.257	2.90E-05
Nanuq ICE Generators	lb/MMBtu	0.451	0.362	5.970	0.0016	0.786	0.141	2.90E-05
Other OSR Main Ship ICE Propulsion Er	lb/MMBtu	0.044	0.044	3.536	0.0016	0.190	0.257	2.90E-05
Other OSR Main Ship Generators	lb/MMBtu	0.451	0.362	5.970	0.0016	0.786	0.141	2.90E-05
OSR Main Ship Incinerator	lb/lb	0.007	0.0046	0.0015	0.0013	0.150	0.050	1.07E-04
OSR Work Boat ICE Propulsion Engines	lb/MMBtu	0.024	0.024	1.463	0.0016	0.049	0.025	2.90E-05
OSR Work Boat ICE Generators	lb/MMBtu	0.310	0.310	4.41	0.0016	0.950	0.350	2.90E-05

Control Efficiency

	PM_{10}	$PM_{2.5}$	NO_x	SO_2 [1]	CO	VOC	Lead
Nanuq Propulsion & Generators	85%	85%	0%	0%	90%	90%	0%
All Remaining Sources	0%	0%	0%	0%	0%	0%	0%

Hourly Emission Rate, lb/hr

	Rating	Max Actual fuel consumpt. MMBtu/hr	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Nanuq ICE Propulsion Engines	7,268 hp	46.008	0.30	0.30	162.70	0.07	0.87	1.18	0.0013
Nanuq ICE Generators	2,570 hp	17.990	1.22	0.98	107.40	0.03	1.41	0.25	0.0005
Other OSR Main Ship ICE Propulsion Er	2,100 hp	13.303	0.59	0.59	47.04	0.02	2.52	3.42	0.0004
Other OSR Main Ship Generators	856 hp	5.992	2.70	2.17	35.77	0.01	4.71	0.84	0.0002
OSR Main Ship Incinerator	125 lb/hr		0.83	0.57	0.19	0.16	18.75	6.25	0.0133
OSR Work Boat ICE Propulsion Engines	2600 hp	18.200	0.44	0.44	26.62	0.03	0.89	0.45	0.0005
OSR Work Boat ICE Generators	33 hp	0.231	0.07	0.07	1.02	0.00	0.22	0.08	0.0000
Total OSR Fleet		**6.223**	**6.16**	**5.12**	**380.74**	**0.32**	**29.37**	**12.48**	**0.02**

ORR 168 days/yr

Annual Emission Rate, ton/yr

	Capacity	Use hr/day	Max Actual fuel consumpt. MMBtu/yr	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead
Nanuq ICE Propulsion Engines	100%	24	67,081	0.22	0.22	118.61	0.05	0.64	0.86	0.0010
Nanuq ICE Generators	100%	24	17,888	0.61	0.49	53.40	0.01	0.70	0.13	0.0003
Other OSR Main Ship ICE Propulsion Er	100%	24	53,637	1.18	1.18	94.84	0.04	5.08	6.90	0.0008
Other OSR Main Ship Generators	100%	24	24,160	5.45	4.37	72.12	0.02	9.49	1.70	0.0004
OSR Main Ship Incinerator	100%	24		1.68	1.15	0.38	0.32	37.80	12.60	0.03
OSR Work Boat ICE Propulsion Engines	100%	24	73,382	0.89	0.89	53.66	0.06	1.79	0.90	0.0011
OSR Work Boat ICE Generators	100%	24	931	0.14	0.14	2.05	0.00	0.44	0.16	0.0000
Total OSR Fleet				**10.17**	**8.44**	**395.06**	**0.50**	**55.95**	**23.25**	**0.03**

Operational Restrictions

[1] Sulfur content on all stationary source engines on Discoverer & Nanuq 0.0015% by wt.
[1] Sulfur content on ice breaker, anchor handler, and OSR work boats 0.0015% by wt.
[2] OSR Main Ship propulsion limited to: 3000 gal/day
[3] OSR Main Ship generation limited to : 800 gal/day

Control Device Effectiveness	References
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation Catalytic Diesel Particulate Filter (CDPF) CO, VOC, HAPs, reduction efficiency	90% CleanAIR CDPF guarantee
Discoverer small engines (other than Tier 3 engines) and Nanuq propulsion and generation CDPF PM reduction efficiency	85% California Air Resource Board Currently verified, January 2009, CleanAIR Systems PERMIT

Emissions Factor References

All Sources	**SO_2**	Sulfur Content Calculation
All ICE Engines	**Lead**	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines
OSR Main Ship ICE Propulsion Engines	**PM_{10}, NO_x, CO, VOC**	Caterpillar 3608 Specification Sheet, DM5529, 10/06
	$PM_{2.5}$	100% PM_{10}
OSR Main Ship ICE Generators	**NO_x, CO, VOC**	AP42 Table 3.4-2, 10/96
	PM_{10}, $PM_{2.5}$	Corbett, Koehler. Revised: 05/03
OSR Main Ship Incinerator	**PM_{10}, $PM_{2.5}$, NO_x, CO, VOC**	AP42 Table 2.1-12, 10/96
	Lead	AP42 Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors
OSR Work Boat ICE Propulsion Engines	**PM_{10}, NO_x, CO, VOC**	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06
	$PM_{2.5}$	100% PM_{10}
OSR Work Boat ICE Generators	**PM_{10}, NO_x, CO, VOC**	AP42 Table 3.3-1, 10/96
	$PM_{2.5}$	100% PM_{10}

Assumptions			References	Conversions	
Diesel heat value	133,098 Btu/gal	0.1331 MMBtu/gal	Keiser, Ronald email to Chris Tengco, 01/26/09.	1.340	hp/kW
Diesel density	847.9 kg/m^3	7.08 lb/gal	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.	454	g/lb
ICE Engines diesel heat rate				3,600	sec/hour
	7,000 Btu/hp-hr	0.007 MMBtu/hp-hr	AP42 Table 3.3-1, 10/96	2,000	lb/ton
OSR Main Ship Propulsion (Cat/3608) diesel heat rate				2	wt. conversion of S to SO2
204.7 g/kW-hr	6335 Btu/hp-hr	0.0063 MMBtu/hp-hr		264	gal/m^3

APPENDIX B

Emission Calculations Supporting Modeling

Introduction

For purposes of dispersion modeling, the short-term PM emissions represent maximum 24-hour values because the impact standards are averaged over 24 hours or longer. While Page 1 of this appendix contains the maximum hourly emissions, Page 2 emissions take into account any daily ORRs (limitations on daily use). The Page 2 emissions are carried over to the modeling emission inputs.

The CO emissions on Page 2 reflect maximum one-hour values (carried over with no modification from Page 1). Eight-hour CO emissions use maximum one-hour values for all emission units with the exception of the Resupply ship in transit and for specific other operating scenarios (discussed in Section 5).

Note that for SO_2 there are two short-term emission rates on Page 2, one that reflects the daily ORRs used for 24-hour modeling and one that reflects maximum one hour emission rates (carried over with no modification from page 1) used for the 3-hour SO_2 modeling.

Pages 3 and 4 contain maximum hourly emission information with daily ORRs applied for the two alternative incinerator configurations.

Page 5 contains the stack dimensions used in the impact model. Page 6 contains the partial loads emissions and impacts analyses.

Pages 7 through 10 contain the source conversion to forms that the model understands.

Page 11 is a plan view of the *Discoverer* deck showing locations of the source and is identical to Figure 2-2.

Page 12 contains the building dimensions used in the BPIP wake effect analysis.

Pages 13, 16, and 17 contain the tabulated hourly and annual emissions, including the hazardous air pollutants (HAPs), for inventorying purposes, and Pages 16 and 17 contain the emission factors used for all emission units.

Pages 14 and 15 contain tabulated hourly and daily emissions, including the hazardous air pollutants, for the two alternative incinerator configurations. While the fleet emission summaries are on the *Discoverer* emissions sheets, the fleet emissions, by emission unit, are calculated and displayed on the Fleet Emissions, Pages 1 through 3 (which are the last 3 pages of Appendix B). For a better understanding of the underlying calculations, it should be noted that values in blue are input values, values in black are calculated values.

The emissions of criteria (NAAQS) and total HAPs pollutants for the *Discoverer* and the associated fleets are calculated and provided in Tables 2-1 and 2-2 of Section 2. These

emissions are built on maximum emission unit use rates which account for any operational restrictions listed in Table 2-3 of Section 2, and emission factors are provided either by stack tests, the manufacturers, or generic EPA factors when manufacturer factors are not available. The data used to construct the main text emission tables are provided in this appendix. The ORRs in Table 2-3 of the main text will apply to normal exploration drilling and well completion operations and, except for fuel sulfur content, these restrictions are not applied to operations that are undertaken to protect human health, safety, or the environment in response to a well control event that might occur despite Shell having exercised reasonable due care to avoid such an occurrence.

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Frontier Discoverer Sources

Unit ID	Description	Make/Model	Rating	Max fuel consumpt. (MMBtu/hr) [1]	Maximum Emissions (lb/hr) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	Notes
FD-1	Generator Engine	Cat / D399	1,325 hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	2
FD-2	Generator Engine	Cat / D399	1,325 hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	2
FD-3	Generator Engine	Cat / D399	1,325 hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	2
FD-4	Generator Engine	Cat / D399	1,325 hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	2
FD-5	Generator Engine	Cat / D399	1,325 hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	2
FD-6	Generator Engine	Cat / D399	1,325 hp	6.91	0.20	0.20	0.77	1.10E-02	0.28	2
FD-7	Propulsion Engine	MI / 6UEC65	7,200 hp	0.00	0.00	0.00	0.00	0.00E+00	0.00	3, 4
FD-8	Em Generator	Caterpillar / 3304	131 hp	0.92	0.64	0.64	3.26	1.46E-03	1.79	5
FD-9	MLC Compressor	Caterpillar / C-15	540 hp	3.58	0.09	0.09	3.55	5.71E-03	1.65	6, 9
FD-10	MLC Compressor	Caterpillar / C-15	540 hp	3.58	0.09	0.09	3.55	5.71E-03	1.65	6, 9
FD-11	MLC Compressor	Caterpillar / C-15	540 hp	3.58	0.09	0.09	3.55	5.71E-03	1.65	6, 9
FD-12	HPU Engine	Detroit/8V71	250 hp	1.95	0.10	0.10	5.41	3.11E-03	0.16	7
FD-13	HPU Engine	Detroit/8V71	250 hp	1.95	0.10	0.10	5.41	3.11E-03	0.16	7
FD-14	Port Deck Crane	Cat / D343	365 hp	2.77	0.04	0.04	6.20	4.41E-03	0.13	7
FD-15	Starbd Deck Crane	Cat / D343	365 hp	2.77	0.04	0.04	6.20	4.41E-03	0.13	7
FD-16	Cementing Unit	Detroit / 8V-71N	335 hp	2.62	0.14	0.14	7.25	4.17E-03	0.22	7
FD-17	Cementing Unit	Detroit / 8V-71N	335 hp	2.62	0.14	0.14	7.25	4.17E-03	0.22	7
FD-18	Cementing Unit	GM 3-71	147 hp	1.15	0.09	0.09	3.80	1.83E-03	0.21	7
FD-19	Logging Winch	Caterpillar/C7	250 hp	1.75	0.01	0.01	1.74	2.79E-03	0.30	7
FD-20	Logging Winch	John Deere/PE4020TF270	35 hp	0.25	0.01	0.01	0.43	3.91E-04	0.03	7, 8
FD-21	Heat Boiler	Clayton 200 Boiler	7.97 MMBtu/hr	7.97	0.19	0.19	1.60	1.27E-02	0.62	
FD-22	Heat Boiler	Clayton 200 Boiler	7.97 MMBtu/hr	7.97	0.19	0.19	1.60	1.27E-02	0.62	
FD-23	Incinerator	TeamTec/GS500C	276 lb/hr		1.13	0.97	0.69	0.35	4.28	
FD-31	Resupply Ship - docked			2.04	0.63	0.63	9.01	0.00	1.94	
Discoverer total while drilling				88.9	4.91	4.74	75.14	0.49	17.43	

Associated Fleets		Max fuel consumpt. (MMBtu/hr) [1]	Maximum Emissions (lb/hr) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	Notes
Ice Breaker								
IB IC Engines		178.64	44.51	39.30	1,049.66	0.28	140.36	
IB Boiler		10.00	0.25	0.25	1.50	1.60E-02	0.38	
IB Incinerators	154 lb/hr		1.02	0.70	0.23	0.19	23.10	
Total Ice Breaker		188.64	45.78	40.25	1,051.40	0.49	163.84	
Anchor Handler								
AH ICE Engines		180.16	10.59	10.59	91.78	0.31	211.72	
AH Boiler		4.00	0.10	0.10	0.21	0.01	0.15	
AH Incinerator	151 lb/hr		1.01	0.69	0.23	0.19	22.68	
Total Anchor Handler		184.16	11.69	11.37	92.22	0.51	234.56	
Total Ice Management Fleet		*372.80*	*57.47*	*51.62*	*1,143.61*	*1.00*	*398.39*	
		-2%						
Resupply Ship - in Transit		*44.41*	*20.04*	*16.07*	*265.11*	*0.07*	*34.89*	
OSR Fleet								
Nanuq ICE Propulsion Engines		46.01	0.30	0.30	162.70	0.07	0.87	7
Nanuq ICE Generators		17.99	1.22	0.98	107.40	0.03	1.41	7
Other OSR Main Ship ICE Propulsion Engines		13.30	0.59	0.59	47.04	0.02	2.52	
Other OSR Main Ship Generators		5.99	2.70	2.17	35.77	0.01	4.71	
OSR Main Ship Incinerator	125 lb/hr		0.83	0.57	0.19	0.16	18.75	
OSR Main Ship Total		83.29	5.65	4.61	353.10	0.29	28.27	
OSR Work Boat ICE Propulsion Engines		18.20	0.44	0.44	26.62	0.03	0.89	
OSR Work Boat ICE Generators		0.23	0.07	0.07	1.02	0.00	0.22	
OSR Work Boats Total		18.43	0.51	0.51	27.64	0.03	1.11	
Total OSR Fleet		*101.72*	*6.16*	*5.12*	*380.74*	*0.32*	*29.37*	
Total Fleet		518.93	83.67	72.82	1,789.46	1.39	462.66	
	Total All	607.87	88.58	77.56	1,864.60	1.88	480.08	

Notes

1 All emissions are the maximum 1-hour values

2 Units FD-1-6 (Generator Engines) instantaneous capacity restriction, SCR NOx control effectiveness and Oxidation Catalyst reduction efficiencies applied

3 Not used during drilling 0%

4 Any emissions from the propulsion engine associated with travel to and from drill sites (within 25 miles of the sites) will be negligible and are included in the ice management fleet allowance.

5 Unit FD-8 (Emergency Generator) operation assumed for 120 min/week Ref: Wright, Alistair email to Anthony Wilson, 1/21/09.

6 Units FD-9-11 (MLC Compressors) are Tier 3 engines

7 CDPF PM & CO reduction efficiencies applied

8 Unit FD-20 (Logging Winch) is a Tier 2 engine

9 Oxidation catalyst PM reduction efficienciy applied

Values in blue are input.

Values in black are calculated or linked

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
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ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009	

Emissions Summary for Screening Modeling Purposes

Base Operating Scenario

Stack Identifier		Comments	PM_{10} Max 24-hr (lb/hr)	PM_{10} Max 24-hr (g/sec)	$PM_{2.5}$ Max 24-hr (lb/hr)	$PM_{2.5}$ Max 24-hr (g/sec)	NO_x Max 24-hr (lb/hr)	NO_x Max 24-hr (g/sec)	SO_2 Max 24-hr (lb/hr)	SO_2 Max 24-hr (g/sec)
F-D Stack No.										
1	FD-1, 2, 3, 4, 5, 6	Operating at 71%	1.18	0.15	1.18	0.15	4.64	0.59	6.62E-02	8.34E-03
	FD-7	Not used during drilling	0	0	0	0	0	0	0	0
	FD-8	120 min/wk	0.053	0.0067	0.053	0.0067	0.271	0.034	1.22E-04	1.54E-05
2	FD-9, 10, 11	Operating at 100%	0.27	0.03	0.27	0.03	10.66	1.34	1.71E-02	2.16E-03
3	FD-12, 13	Operating at 100%	0.21	0.03	0.21	0.03	10.81	1.36	6.23E-03	7.84E-04
4	FD-16, 17, 18	Operating at 28%	0.10	0.01	0.10	0.01	5.08	0.64	2.83E-03	3.56E-04
5a, 5b	FD-14, 15	Operating at 100%	0.09	0.01	0.09	0.01	12.39	1.56	8.82E-03	1.11E-03
6	FD-21, 22	Operating at 100%	0.38	0.05	0.38	0.05	3.21	0.40	2.54E-02	3.20E-03
7	FD-19, 20 [2]	Operating at 0%	0	0	0	0	0	0	0	0
8	FD-23	Operating at 300 lb/trash per day	0.05	0.01	0.04	0.01	0.03	0.00	0.02	0.00
	FD-31	Operating at 100% of 1 of 2 engine 12 hr/day [1]	0.16	0.02	0.16	0.02	2.25	0.28	0.00	0.00
	Total F-D		**2.48**	**0.31**	**2.47**	**0.31**	**49.36**	**6.22**	**0.14**	**0.018**
Ice Management Fleet										
	Ice Breaker		45.8	5.77	40.2	5.07	1,051.4	132.47	0.49	0.06
	Anchor Handler		11.7	1.47	11.4	1.43	92.2	11.62	0.51	0.06
Resupply - transit		4 hr/trip	3.3	0.42	2.7	0.34	44.2	5.57	0.01	0.00
OSR Main Ship		24 hr/day								
	Nanuq Propulsior	Operating at 3000 gal/day	0.1	0.01	0.1	0.01	58.8	7.41	0.03	3.34E-03
	Nanuq Generator	Operating at 800 gal/day	0.3	0.04	0.2	0.03	26.5	3.34	0.01	8.92E-04
	Other Main Ship I	Operating at 100%	0.6	0.07	0.6	0.07	47.0	5.93	0.02	2.67E-03
	Other Main Ship (	Operating at 100%	2.7	0.34	2.2	0.27	35.8	4.51	0.01	1.20E-03
	Incinerator	Operating at 100%	0.8	0.10	0.6	0.07	0.2	0.02	0.16	1.97E-02
			4.5	0.57	3.7	0.46	168.3	21.21	0.22	2.78E-02
OSR Work Boats		24 hr/day								
	Propulsion	Operating at 100%	0.4	0.06	0.4	0.06	26.6	3.35	0.0	3.66E-03
	Generators	Operating at 100%	0.1	0.01	0.1	0.01	1.0	0.13	0.0	4.64E-05
			0.5	0.06	0.5	0.06	27.6	3.48	0.03	3.70E-03
	Total Fleet		**65.9**	**8.3**	**58.5**	**7.4**	**1383.8**	**174.4**	**1.3**	**0.2**
	maximum total when drilling		**68.34**	**8.61**	**60.96**	**7.68**	**1,433.1**	**180.6**	**1.41**	**0.18**
		Check>>>	68.54		61.16		1436.2		1.41	

[1] 12 hr/day, 1 Generator operating at 100% Ref: Craik, Keith email to R. Steen, 11/11/08

[2] Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units for 24-hr

Stack Identifier		Comments	SO_2 Max 1-hr (lb/hr)	SO_2 Max 1-hr (g/sec)	CO Max 1-hr (lb/hr)	CO Max 1-hr (g/sec)
F-D Stack No.						
1	FD-1, 2, 3, 4, 5, 6	Operating at 71%	6.62E-02	8.34E-03	1.66	0.21
	FD-7	Not used during drilling	0	0	0	0
	FD-8	120 min/wk	1.46E-03	1.84E-04	1.79	0.23
2	FD-9, 10, 11	Operating at 100%	1.71E-02	2.16E-03	4.94	0.62
3	FD-12, 13	Operating at 100%	6.23E-03	7.84E-04	0.33	0.04
4	FD-16, 17, 18	Operating at 100%	1.02E-02	1.28E-03	0.65	0.08
5a, 5b	FD-14, 15	Operating at 100%	8.82E-03	1.11E-03	0.26	0.03
6	FD-21, 22	Operating at 100%	2.54E-02	3.20E-03	1.23	0.16
7	FD-19, 20 [3]	Operating at 100%	3.18E-03	4.01E-04	0.34	0.04
	FD-23	Operating at 100%	0.35	0.04	4.28	0.54
	FD-31	Operating at 100%	0.00	0.00	1.94	0.24
	Total F-D		**0.49**	**0.061**	**17.43**	**2.20**
Ice Management Fleet						
	Ice Breaker		0.49	0.06	163.84	20.64
	Anchor Handler		0.51	0.06	234.56	29.55
Resupply - transit			0.07	0.01	34.89	4.40
OSR Main Ship						
	Nanuq Propulsior	Operating at 100%	0.07	0.01	0.87	0.11
	Nanuq Generator	Operating at 100%	0.03	0.00	1.41	0.18
	Other Main Ship I	Operating at 100%	0.02	0.00	2.52	0.32
	Other Main Ship (	Operating at 100%	0.01	0.00	4.71	0.59
	Incinerator	Operating at 100%	0.16	0.02	18.75	2.36
			0.29	0.04	28.27	3.56
OSR Work Boats						
	Propulsion	Operating at 100%	0.0	0.00	0.9	0.11
	Generators	Operating at 100%	0.0	0.00	0.2	0.03
			0.03	0.00	1.11	0.14
	Total Fleet		**1.4**	**0.2**	**462.7**	**58.3**
	maximum total when drilling		**1.88**	**0.24**	**480.08**	**60.49**

Emissions Summary for Screening Modeling Purposes

Alternate Operating Scenario #1

Stack Identifier		Comments	PM_{10} Max 24-hr (lb/hr)	PM_{10} Max 24-hr (g/sec)	$PM_{2.5}$ Max 24-hr (lb/hr)	$PM_{2.5}$ Max 24-hr (g/sec)	NO_x Max 24-hr (lb/hr)	NO_x Max 24-hr (g/sec)	SO_2 Max 24-hr (lb/hr)	SO_2 Max 24-hr (g/sec)
F-D Stack No.										
1	FD-1, 2, 3, 4, 5, 6	Operating at 71%	1.18	0.15	1.18	0.15	4.64	0.59	6.62E-02	8.34E-03
	FD-7	Not used during drilling	0	0	0	0	0	0	0	0
	FD-8	120 min/wk	0.053	0.0067	0.053	0.0067	0.271	0.034	1.22E-04	1.54E-05
2	FD-9, 10, 11	Operating at ####	0.27	0.03	0.27	0.03	10.66	1.34	1.71E-02	2.16E-03
3	FD-12, 13	Operating at #### of 1 of 2 engine	0.10	0.01	0.10	0.01	5.41	0.68	3.11E-03	3.92E-04
4	FD-16, 17, 18	Operating at 28%	0.10	0.01	0.10	0.01	5.08	0.64	2.83E-03	3.56E-04
5a, 5b	FD-14, 15	Operating at ####	0.09	0.01	0.09	0.01	12.39	1.56	8.82E-03	1.11E-03
6	FD-21, 22	Operating at ####	0.38	0.05	0.38	0.05	3.21	0.40	2.54E-02	3.20E-03
7	FD-19, 20 [2]	Operating at 0%	0	0	0	0	0	0	0	0
8	FD-23	Operating at 800 lb/trash per day	0.14	0.02	0.12	0.01	0.08	0.01	0.04	0.01
	FD-31	Operating at #### of 1 of 2 engine	0.16	0.02	0.16	0.02	2.25	0.28	0.00	0.00
		12 hr/day [1]								
	Total F-D		**2.46**	**0.31**	**2.44**	**0.31**	**44.01**	**5.54**	**0.17**	**0.021**
			2.68077805							
Ice Management Fleet										
	Ice Breaker		45.8	5.77	40.2	5.07	1,051.4	132.47	0.49	0.06
	Anchor Handler		11.7	1.47	11.4	1.43	92.2	11.62	0.51	0.06
Resupply - transit		4 hr/trip	3.3	0.42	2.7	0.34	44.2	5.57	0.01	0.00
OSR Main Ship		24 hr/day								
	Nanuq Propulsior	Operating at 3000 gal/day	0.1	0.01	0.1	0.01	58.8	7.41	0.03	0.00
	Nanuq Generator	Operating at 800 gal/day	0.3	0.04	0.2	0.03	26.5	3.34	0.01	0.00
	Other Main Ship I	Operating at ####	0.6	0.07	0.6	0.07	47.0	5.93	0.02	0.00
	Other Main Ship (	Operating at ####	2.7	0.34	2.2	0.27	35.8	4.51	0.01	0.00
	Incinerator	Operating at ####	0.8	0.10	0.6	0.07	0.2	0.02	0.16	0.02
			4.5	0.57	3.7	0.46	168.3	21.21	0.22	0.03
OSR Work Boats		24 hr/day								
	Propulsion	Operating at ####	0.4	0.06	0.4	0.06	26.6	3.35	0.0	0.00
	Generators	Operating at ####	0.1	0.01	0.1	0.01	1.0	0.13	0.0	0.00
			0.5	0.06	0.5	0.06	27.6	3.48	0.03	0.00
	Total Fleet		**65.9**	**8.3**	**58.5**	**7.4**	**1383.8**	**174.4**	**1.3**	**0.2**
	maximum total when drilling		**68.32**	**8.61**	**60.93**	**7.68**	**1,427.8**	**179.9**	**1.43**	**0.18**
		Check>>>	68.52		61.13		1430.8		1.43	

[1] 12 hr/day, 1 Generator operating at 100% Ref: Craik, Keith email to R. Steen, 11/11/08

[2] Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units for 24-hr

Stack Identifier		Comments	SO_2 Max 1-hr (lb/hr)	SO_2 Max 1-hr (g/sec)	CO Max 1-hr (lb/hr)	CO Max 1-hr (g/sec)
F-D Stack No.						
1	FD-1, 2, 3, 4, 5, 6	Operating at 71%	6.62E-02	8.34E-03	1.66	0.21
	FD-7	Not used during drilling	0	0	0	0
	FD-8	120 min/wk	1.46E-03	1.84E-04	1.79	0.23
2	FD-9, 10, 11	Operating at ####	1.71E-02	2.16E-03	4.94	0.62
3	FD-12, 13	Operating at ####	6.23E-03	7.84E-04	0.33	0.04
4	FD-16, 17, 18	Operating at ####	1.02E-02	1.28E-03	0.65	0.08
5a, 5b	FD-14, 15	Operating at ####	8.82E-03	1.11E-03	0.26	0.03
6	FD-21, 22	Operating at ####	2.54E-02	3.20E-03	1.23	0.16
7	FD-19, 20 [3]	Operating at ####	3.18E-03	4.01E-04	0.34	0.04
	FD-23	Operating at ####	0.35	0.04	4.28	0.54
	FD-31	Operating at ####	0.00	0.00	1.94	0.24
	Total F-D		**0.49**	**0.061**	**17.43**	**2.20**
Ice Management Fleet						
	Ice Breaker		0.49	0.06	163.84	20.64
	Anchor Handler		0.51	0.06	234.56	29.55
Resupply - transit			0.07	0.01	34.89	4.40
OSR Main Ship						
	Nanuq Propulsior	Operating at ####	0.07	0.01	0.87	0.11
	Nanuq Generator	Operating at ####	0.03	0.00	1.41	0.18
	Other Main Ship I	Operating at ####	0.02	0.00	2.52	0.32
	Other Main Ship (	Operating at ####	0.01	0.00	4.71	0.59
	Incinerator	Operating at ####	0.16	0.02	18.75	2.36
			0.29	0.04	28.27	3.56
OSR Work Boats						
	Propulsion	Operating at ####	0.0	0.00	0.9	0.11
	Generators	Operating at ####	0.0	0.00	0.2	0.03
			0.03	0.00	1.11	0.14
	Total Fleet		**1.4**	**0.2**	**462.7**	**58.3**
	maximum total when drilling		**1.88**	**0.24**	**480.08**	**60.49**

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Emissions Summary for Screening Modeling Purposes

Alternate Operating Scenario #2

Stack Identifier		Comments	PM_{10} Max 24-hr		$PM_{2.5}$ Max 24-hr		NO_x Max 24-hr		SO_2 Max 24-hr	
F-D Stack No.			**(lb/hr)**	**(g/sec)**	**(lb/hr)**	**(g/sec)**	**(lb/hr)**	**(g/sec)**	**(lb/hr)**	**(g/sec)**
1	FD-1, 2, 3, 4, 5, 6	Operating at 71%	1.18	0.15	1.18	0.15	4.64	0.59	6.62E-02	8.34E-03
	FD-7	Not used during drilling	0	0	0	0	0	0	0	0
	FD-8	120 min/wk	0.053	0.0067	0.053	0.0067	0.271	0.034	1.22E-04	1.54E-05
2	FD-9, 10, 11	Operating at ####	0.27	0.03	0.27	0.03	10.66	1.34	1.71E-02	2.16E-03
3	FD-12, 13	Operating at 0%	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
4	FD-16, 17, 18	Operating at 28%	0.10	0.01	0.10	0.01	5.08	0.64	2.83E-03	3.56E-04
5a, 5b	FD-14, 15	Operating at ####	0.09	0.01	0.09	0.01	12.39	1.56	8.82E-03	1.11E-03
6	FD-21, 22	Operating at ####	0.38	0.05	0.38	0.05	3.21	0.40	2.54E-02	3.20E-03
7	FD-19, 20 [2]	Operating at 0%	0	0	0	0	0	0	0	0
8	FD-23	Operating at 1300 lb/trash per day	0.22	0.03	0.19	0.02	0.14	0.02	0.07	0.01
	FD-31	Operating at #### of 1 of 2 engine 12 hr/day [1]	0.16	0.02	0.16	0.02	2.25	0.28	0.00	0.00
	Total F-D		**2.44**	**0.31**	**2.41**	**0.30**	**38.65**	**4.87**	**0.19**	**0.024**
Ice Management Fleet										
	Ice Breaker		45.8	5.77	40.2	5.07	1,051.4	132.47	0.49	0.06
	Anchor Handler		11.7	1.47	11.4	1.43	92.2	11.62	0.51	0.06
Resupply - transit		4 hr/trip	3.3	0.42	2.7	0.34	44.2	5.57	0.01	0.00
OSR Main Ship		24 hr/day								
	Nanuq Propulsior	Operating at 3000 gal/day	0.1	0.01	0.1	0.01	58.8	7.41	0.03	0.00
	Nanuq Generator	Operating at 800 gal/day	0.3	0.04	0.2	0.03	26.5	3.34	0.01	0.00
	Other Main Ship I	Operating at ####	0.6	0.07	0.6	0.07	47.0	5.93	0.02	0.00
	Other Main Ship (	Operating at ####	2.7	0.34	2.2	0.27	35.8	4.51	0.01	0.00
	Incinerator	Operating at ####	0.8	0.10	0.6	0.07	0.2	0.02	0.16	0.02
			4.5	0.57	3.7	0.46	168.3	21.21	0.22	0.03
OSR Work Boats		24 hr/day								
	Propulsion	Operating at ####	0.4	0.06	0.4	0.06	26.6	3.35	0.0	0.00
	Generators	Operating at ####	0.1	0.01	0.1	0.01	1.0	0.13	0.0	0.00
			0.5	0.06	0.5	0.06	27.6	3.48	0.03	0.00
	Total Fleet		**65.9**	**8.3**	**58.5**	**7.4**	**1383.8**	**174.4**	**1.3**	**0.2**
	maximum total when drilling		**68.30**	**8.61**	**60.90**	**7.67**	**1,422.4**	**179.2**	**1.45**	**0.18**
		Check>>>	68.50		61.10		1425.4		1.45	

[1] hr/day, 1 Generator operating at 100% Ref: Craik, Keith email to R. Steen, 11/11/08

[2] Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units for 24-hr

Stack Identifier		Comments	SO_2 Max 1-hr		CO Max 1-hr	
F-D Stack No.			**(lb/hr)**	**(g/sec)**	**(lb/hr)**	**(g/sec)**
1	FD-1, 2, 3, 4, 5, 6	Operating at 71%	6.62E-02	8.34E-03	1.66	0.21
	FD-7	Not used during drilling	0	0	0	0
	FD-8	120 min/wk	1.46E-03	1.84E-04	1.79	0.23
2	FD-9, 10, 11	Operating at ####	1.71E-02	2.16E-03	4.94	0.62
3	FD-12, 13	Operating at 0%	0.00E+00	0.00E+00	0.00	0.00
4	FD-16, 17, 18	Operating at ####	1.02E-02	1.28E-03	0.65	0.08
5a, 5b	FD-14, 15	Operating at ####	8.82E-03	1.11E-03	0.26	0.03
6	FD-21, 22	Operating at ####	2.54E-02	3.20E-03	1.23	0.16
7	FD-19, 20 [3]	Operating at ####	3.18E-03	4.01E-04	0.34	0.04
	FD-23	Operating at ####	0.35	0.04	4.28	0.54
	FD-31	Operating at ####	0.00	0.00	1.94	0.24
	Total F-D		**0.48**	**0.061**	**17.10**	**2.15**
Ice Management Fleet						
	Ice Breaker		0.49	0.06	163.84	20.64
	Anchor Handler		0.51	0.06	234.56	29.55
Resupply - transit			0.07	0.01	34.89	4.40
OSR Main Ship						
	Nanuq Propulsior	Operating at ####	0.07	0.01	0.87	0.11
	Nanuq Generator	Operating at ####	0.03	0.00	1.41	0.18
	Other Main Ship I	Operating at ####	0.02	0.00	2.52	0.32
	Other Main Ship (	Operating at ####	0.01	0.00	4.71	0.59
	Incinerator	Operating at ####	0.16	0.02	18.75	2.36
			0.29	0.04	28.27	3.56
OSR Work Boats						
	Propulsion	Operating at ####	0.0	0.00	0.9	0.11
	Generators	Operating at ####	0.0	0.00	0.2	0.03
			0.03	0.00	1.11	0.14
	Total Fleet		**1.4**	**0.2**	**462.7**	**58.3**
	maximum total when drilling		**1.87**	**0.24**	**479.75**	**60.45**

Source Release Parameters for Screening Modeling Purposes

Rig Sources

Source Description	Model Src ID	Source Type	Vertical or Horizontal?	Source Location X (m)	Source Location Y (m)	Rel Ht. [1] (m)	Stk Dia. (m)	Exit Temp. (deg K)	Exit Vel. (m/s)
Stack #1: 6 Main Drill Engines [2]	MAINENGS	POINT	Vertical	154.1	55.2	12.83	0.32	710	32.9
Stack #2: 3 MLC Compressors [3]	COMPENGS	POINT	Vertical	102.0	63.0	8.53	0.21	700	40.0
Stack #3: 2 HPU Engines [3]	HPPENGS	POINT	Vertical	79.0	65.0	6.10	0.18	700	40.0
Stack #4: 3 Cementing Units [4]	CEMENT	POINT	Vertical	95.0	67.0	6.10	0.18	800	46.6
Stack #5a: Crane Engine (port) [3]	CRANE_PT	POINT	Vertical	114	66.0	13.72	0.25	672	20.1
Stack #5b: Crane Engine (stbd) [3]	CRANE_SB	POINT	Vertical	70.1	43.7	13.72	0.25	672	20.1
Stack #6: 2 Heat Boilers [5]	HEATBOIL	POINT	Vertical	154.3	52.2	12.83	0.46	478	7.3
Stack #7: 2 Logging Winches [3]	LOGWNCH	POINT	vertical	120.7	55.2	8.53	0.10	711	53.0
Stack #8: 1 Incinerator [3]	INCIN_D	POINT	Vertical	61.0	65.0	2.44	0.46	623	10.0

[1] Above main deck which is approximately 4.57 meters (15 feet) above the water surface.
[2] D399 Caterpillar Engine Data Sheet, 05/95 & D399 Stack Parameters Sheet
[3] Kulluk Permit R100CS-AK-07-01, June 2008
[4] Detroit Diesel Allison, Basic Engine Performance Model: 8V-71N, 10/15/81 & Detroit/8V-71N Stack Parameters Sheet; diameter from Kulluk Permit R100CS-AK-07-01, June 2008
[5] Clayton Industries, 8/2001

Fleet Sources

Source Description	Mod. Src. ID	Source Type	Ship Type	Stack Orientation	Rel. Ht. (m)	Stack Dia. [1] (m)	Exit Temp. (deg K)	Exit Vel. [1] (m/s)
Resupply [2]	KILABUK-T	POINT	Resupply	Vertical	15.24	0.18	700	40.0
Oil Spill Response (Kvichaks) [3a]	OILSPL3	POINT/VOLUMES	OSR Fleet (Kvichaks)	Vertical	3.35	0.15	694	32.9
Oil Spill Response (Nanuq) [3b]	OILSPL4	POINT/VOLUMES	OSR Fleet (Nanuq)	Vertical	15.24	0.76	644	40.0
Fennica/Nordica [4]	FENNICA2	POINT/VOLUMES	Secondary	Vertical	32.00	0.80	655	38.4
Vladimir Ignatjuk [5]	VLADIGN2	POINT/VOLUMES	Primary, Secondary	Vertical	24.38	0.79	668	33.2
Talagy 6	TALAGY	POINT/VOLUMES	Primary, Secondary	Vertical	25.91	0.80	594	43.7
Tor Viking II [7]	TOR_H	POINT/VOLUMES	Secondary	Horizontal	28.96	110.38	579	0.001
Odin Viking II [8]	ODIN_H	POINT/VOLUMES	Primary	Horizontal	28.96	94.61	579	0.001
Balder Viking [9]	BALD_H	POINT/VOLUMES	Secondary	Horizontal	28.96	110.38	579	0.001
Vidar Viking [10]	VIDAR_H	POINT/VOLUMES	Secondary	Horizontal	28.96	110.38	579	0.001

Fleet Sources, continued

Source Description	Source	Propulsion Engine	Max. Engine (kW)
Resupply [2]	Engine	---	---
Oil Spill Response (Kvichaks) [3a]	Engine	---	---
Oil Spill Response (Nanuq) [3b]	Engine	---	---
Fennica/Nordica [4]	Engine	2X Wartsila 16V32, 2X 12V32	6,000
Vladimir Ignatjuk [5]	Engine	4X Stork Werkspoor 8TM410	4,325
Talagy [6]	Engine	Sulzer 12 ZV 40/48	6,264
Tor Viking II [7]	Engine	2X MaK 8M32C, 2X 6M32C	3,840
Odin Viking II [8]	Engine	4X MaK 6M32C	2,880
Balder Viking [9]	Engine	2X MaK 8M32C, 2X 6M32C	3,840
Vidar Viking [10]	Engine	2X MaK 8M32C, 2X 6M32C	3,840

[1] Horizontal stacks adjusted per Alaska DEC recommendations to impeded vertical momentum (0.001 m/sec exit velocity), while allowing credit for buoyant rise from hot stacks. Adjustment to diameter is: 31.6 * (actual diameter in meters) * (square root of actual exit velocity in units of meters/sec).
[2] Resupply ship (Jim Kilabuk) configuration is taken from the Kulluk Permit R100CS-AK-07-01, June 2008.
[3a] OSR fleet configuration for the Kvichaks (34-foot boats) is from the Firebaugh Technical Memo.
[3b] OSR fleet configuration for the Nanuq is from the Firebaugh Technical Memo.
[4] Alaska Source Testing, LLC. Summary of Test Results Fennica/Nordica Icebreaker. June 28, 2007.
[5] TRC Environmental Corp. Emission Test Report - Vladimir Ignatjuk, Project No.150614. July 12, 2007.
[6] FEMCO-Management. Safety Quality Expertise – Fleet/AHTS "Talagy".
[7] TRC Environmental Corp. Emission Test Report - Tor Viking II, Project No.150614. July 12, 2007.
[8] Viking Supply Ships AS Shipowners. AHTS Odin Viking II - Main Characteristics.
[9] Viking Supply Ships AS Shipowners. AHTS/Icebreaker Balder Viking - Main Characteristics.
[10] Viking Supply Ships AS Shipowners. AHTS/Icebreaker Vidar Viking - Main Characteristics.

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Fleet Sources, Stack Parameters for Loads Analysis - SCREEN3

Source Description	Load	Mod. Src. ID	Source Type	Stack Orientation	Rel. Ht. (m)	Stack Dia. [1] (m)	Exit Temp. (deg K)	Exit Vel. [1] (m/s)
Vladimir Ignatjuk [3]	80%	VLD2_080	POINT	Vertical	24.38	0.79	668	33.2
Vladimir Ignatjuk [3]	57%	VLD2_057	POINT	Vertical	24.38	0.79	638	25.9
Vladimir Ignatjuk [3]	35%	VLD2_035	POINT	Vertical	24.38	0.79	581	16.3
Fennica/Nordica [4]	80%	FEN2_080	POINT	Vertical	32.00	0.80	655	38.4
Fennica/Nordica [4]	57%	FEN2_057	POINT	Vertical	32.00	0.80	633	30.0
Fennica/Nordica [4]	35%	FEN2_035	POINT	Vertical	32.00	0.80	637	20.3
Tor Viking II [5]	80%	TORH_080	POINT	Horizontal	28.96	110.4	579	0.001
Tor Viking II [5]	57%	TORH_057	POINT	Horizontal	28.96	101.6	607	0.001
Tor Viking II [5]	35%	TORH_035	POINT	Horizontal	28.96	74.7	630	0.001

Fleet Sources, Inputs and Outputs for Loads Analysis - ISC-PRIME

Source Description	Actual NOx Emissions (lb/hr)	Normalized NOx Emissions (g/sec) [6]	Lowest Final Plume Ht. (m) [2]	Sigma Y (m)	Sigma Z [2] (m)	Max. ISC-PRIME Impact (ug/m3)	Load
Vladimir Ignatjuk [3]	83.6	1.000	24.43	46.51	9.21	**110.7**	**80%**
Vladimir Ignatjuk [3]	68.4	0.818	24.42	46.51	9.21	90.6	57%
Vladimir Ignatjuk [3]	29.6	0.354	24.40	46.51	9.21	39.3	35%
Fennica/Nordica [4]	96.5	1.000	32.02	46.51	12.76	**78.4**	**80%**
Fennica/Nordica [4]	66.6	0.690	32.02	46.51	12.76	54.1	57%
Fennica/Nordica [4]	49.0	0.508	32.01	46.51	12.76	39.8	35%
Tor Viking II [5]	13.8	1.000	28.97	46.51	11.34	**89.4**	**80%**
Tor Viking II [5]	5.16	0.374	28.97	46.51	11.34	33.4	57%
Tor Viking II [5]	2.61	0.189	28.97	46.51	11.34	16.9	35%

[1] Horizontal stacks adjusted per Alaska DEC recommendations to impeded vertical momentum (0.001 m/sec exit velocity), while allowing credit for buoyant rise from hot stacks. Adjustment to diameter is: 31.6 * (actual diameter in meters) * (square root of actual exit velocity in units of meters/sec).

[2] From SCREEN3 model output.

[3] TRC Environmental Corp. Emission Test Report - Vladimir Ignatjuk, Project No.150614. July 12, 2007.

[4] Alaska Source Testing, LLC. Summary of Test Results Fennica/Nordica Icebreaker. June 28, 2007.

[5] TRC Environmental Corp. Emission Test Report - Tor Viking II, Project No.150614. July 12, 2007.

[6] Normalized emissions are based on the emissions at each load point (100%, 75%, 50%, etc.) divided by the emissions from the maximum load point (100%).

Stack Parameters for Loads Analysis [2]

Source Description	Load	Mod. Src. ID	Source Type	Stack Orientation	Rel. Ht. [1] (m)	Stack Dia. (m)	Exit Temp. (deg K)	Exit Vel. (m/s)
Stack #1: 6 Main Drill Engines	100%	MAIN_100	POINT	vertical	12.83	0.32	710	32.9
Stack #1: 6 Main Drill Engines	75%	MAIN_075	POINT	vertical	12.83	0.32	663	26.4
Stack #1: 6 Main Drill Engines	50%	MAIN_050	POINT	vertical	12.83	0.32	606	21.0

Inputs and Outputs for Loads Analysis (NOx and PM_{10}) - ISC-PRIME [2]

	Actual Emissions (g/hr)		Normalized Emissions (g/sec) [3]		Max. ISC-PRIME Impact (ug/m3)		
Source Description	NOx	PM_{10}	NOx	PM_{10}	NOx	PM_{10}	Load
Stack #1: 6 Main Drill Engines	7993.9	251.2	1.000	1.000	**64.7**	**64.7**	**100%**
Stack #1: 6 Main Drill Engines	6159.8	133.8	0.771	0.533	56.5	39.0	75%
Stack #1: 6 Main Drill Engines	4360.5	79.1	0.545	0.315	45.6	26.4	50%

Inputs and Outputs for Loads Analysis (CO and SO_2) - ISC-PRIME [2]

	Actual Emissions (g/hr)		Normalized Emissions (g/sec)		Max. ISC-PRIME Impact (ug/m3)		
Source Description	CO	SO_2	CO	SO_2	CO	SO_2	Load
Stack #1: 6 Main Drill Engines	882.7	7.0	1.000	1.000	**64.7**	**64.7**	**100%**
Stack #1: 6 Main Drill Engines	710.1	5.1	0.804	0.730	58.9	53.5	75%
Stack #1: 6 Main Drill Engines	622.6	3.5	0.705	0.498	59.0	41.7	50%

[1] Above main deck which is approximately 4.57 meters (15 feet) above the water surface.

[2] Caterpillar D399 Engine Data Sheet, 05/95

[3] Normalized emissions are based on the emissions at each load point (100%, 75%, 50%, etc.) divided by the emissions from the maximum load point (100%).

Source Release Parameters for Screening Modeling Purposes

Fleet Sources

Source Description	Model Src ID	Source Type	Source Location X (m)	Source Location Y (m)	Rel Ht. (m)	Sigma-Y (m)	Sigma-Z (m)
Oil Spill Response Ships k,n *	OILSP01k,n	VOLUME	-1984.3	980.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP02k,n	VOLUME	-1984.3	930.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP03k,n	VOLUME	-1984.3	880.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP04k,n	VOLUME	-1984.3	830.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP05k,n	VOLUME	-1984.3	780.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP06k,n	VOLUME	-1984.3	730.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP07k,n	VOLUME	-1984.3	680.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP08k,n	VOLUME	-1984.3	630.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP09k,n	VOLUME	-1984.3	580.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP10k,n	VOLUME	-1984.3	530.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP11k,n	VOLUME	-1984.3	480.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP12k,n	VOLUME	-1984.3	430.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP13k,n	VOLUME	-1984.3	380.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP14k,n	VOLUME	-1984.3	330.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP15k,n	VOLUME	-1984.3	280.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP16k,n	VOLUME	-1984.3	230.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP17k,n	VOLUME	-1984.3	180.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP18k,n	VOLUME	-1984.3	130.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP19k,n	VOLUME	-1984.3	80.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP20k,n	VOLUME	-1984.3	30.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP21k,n	VOLUME	-1984.3	-20.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP22k,n	VOLUME	-1984.3	-70.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP23k,n	VOLUME	-1984.3	-120.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP24k,n	VOLUME	-1984.3	-170.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP25k,n	VOLUME	-1984.3	-220.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP26k,n	VOLUME	-1984.3	-270.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP27k,n	VOLUME	-1984.3	-320.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP28k,n	VOLUME	-1984.3	-370.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP29k,n	VOLUME	-1984.3	-420.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP30k,n	VOLUME	-1984.3	-470.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP31k,n	VOLUME	-1984.3	-520.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP32k,n	VOLUME	-1984.3	-570.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP33k,n	VOLUME	-1984.3	-620.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP34k,n	VOLUME	-1984.3	-670.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP35k,n	VOLUME	-1984.3	-720.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP36k,n	VOLUME	-1984.3	-770.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP37k,n	VOLUME	-1984.3	-820.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP38k,n	VOLUME	-1984.3	-870.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP39k,n	VOLUME	-1984.3	-920.0	3.38, 17.55	23.26	1.42, 6.38
Oil Spill Response Ships k,n *	OILSP40k,n	VOLUME	-1984.3	-970.0	3.38, 17.55	23.26	1.42, 6.38
Secondary Ice Management Fleet	BRK_B01	VOLUME	1222.3	2405.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B02	VOLUME	1222.3	2305.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B03	VOLUME	1222.3	2205.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B04	VOLUME	1222.3	2105.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B05	VOLUME	1222.3	2005.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B06	VOLUME	1222.3	1905.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B07	VOLUME	1222.3	1805.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B08	VOLUME	1222.3	1705.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B09	VOLUME	1222.3	1605.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B10	VOLUME	1222.3	1505.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B11	VOLUME	1222.3	1405.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B12	VOLUME	1222.3	1305.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B13	VOLUME	1222.3	1205.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B14	VOLUME	1222.3	1105.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B15	VOLUME	1222.3	1005.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B16	VOLUME	1222.3	905.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B17	VOLUME	1222.3	805.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B18	VOLUME	1222.3	705.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B19	VOLUME	1222.3	605.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B20	VOLUME	1222.3	505.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B21	VOLUME	1222.3	405.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B22	VOLUME	1222.3	305.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B23	VOLUME	1222.3	205.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B24	VOLUME	1222.3	105.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B25	VOLUME	1222.3	5.0	25.22	46.51	9.21

* Each type of oil spill response ship is explicitly modeled. k denotes the Kvichaks (34-foot boats) and n denotes the Nanuq.

Source Release Parameters for Screening Modeling Purposes, contd.

Fleet Sources

Source Description	Model Src ID	Source Type	Source Location X (m)	Source Location Y (m)	Rel Ht. (m)	Sigma-Y (m)	Sigma-Z (m)
Secondary Ice Management Fleet	BRK_B26	VOLUME	1222.3	-95.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B27	VOLUME	1222.3	-195.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B28	VOLUME	1222.3	-295.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B29	VOLUME	1222.3	-395.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B30	VOLUME	1222.3	-495.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B31	VOLUME	1222.3	-595.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B32	VOLUME	1222.3	-695.0	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B33	VOLUME	1222.3	-795	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B34	VOLUME	1222.3	-895	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B35	VOLUME	1222.3	-995	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B36	VOLUME	1222.3	-1095	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B37	VOLUME	1222.3	-1195	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B38	VOLUME	1222.3	-1295	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B39	VOLUME	1222.3	-1395	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B40	VOLUME	1222.3	-1495	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B41	VOLUME	1222.3	-1595	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B42	VOLUME	1222.3	-1695	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B43	VOLUME	1222.3	-1795	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B44	VOLUME	1222.3	-1895	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B45	VOLUME	1222.3	-1995	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B46	VOLUME	1222.3	-2095	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B47	VOLUME	1222.3	-2195	25.22	46.51	9.21
Secondary Ice Management Fleet	BRK_B48	VOLUME	1222.3	-2295	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A01	VOLUME	5022.3	4805	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A02	VOLUME	5022.3	4705	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A03	VOLUME	5022.3	4605	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A04	VOLUME	5022.3	4505	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A05	VOLUME	5022.3	4405	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A06	VOLUME	5022.3	4305	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A07	VOLUME	5022.3	4205	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A08	VOLUME	5022.3	4105	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A09	VOLUME	5022.3	4005	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A10	VOLUME	5022.3	3905	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A11	VOLUME	5022.3	3805	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A12	VOLUME	5022.3	3705	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A13	VOLUME	5022.3	3605	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A14	VOLUME	5022.3	3505	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A15	VOLUME	5022.3	3405	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A16	VOLUME	5022.3	3305	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A17	VOLUME	5022.3	3205	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A18	VOLUME	5022.3	3105	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A19	VOLUME	5022.3	3005	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A20	VOLUME	5022.3	2905	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A21	VOLUME	5022.3	2805	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A22	VOLUME	5022.3	2705	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A23	VOLUME	5022.3	2605	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A24	VOLUME	5022.3	2505	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A25	VOLUME	5022.3	2405	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A26	VOLUME	5022.3	2305	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A27	VOLUME	5022.3	2205	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A28	VOLUME	5022.3	2105	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A29	VOLUME	5022.3	2005	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A30	VOLUME	5022.3	1905	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A31	VOLUME	5022.3	1805	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A32	VOLUME	5022.3	1705	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A33	VOLUME	5022.3	1605	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A34	VOLUME	5022.3	1505	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A35	VOLUME	5022.3	1405	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A36	VOLUME	5022.3	1305	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A37	VOLUME	5022.3	1205	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A38	VOLUME	5022.3	1105	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A39	VOLUME	5022.3	1005	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A40	VOLUME	5022.3	905	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A41	VOLUME	5022.3	805	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A42	VOLUME	5022.3	705	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A43	VOLUME	5022.3	605	25.22	46.51	9.21

Source Release Parameters for Screening Modeling Purposes, contd.

Fleet Sources

Source Description	Model Src ID	Source Type	Source Location X (m)	Source Location Y (m)	Rel Ht. (m)	Sigma-Y (m)	Sigma-Z (m)
Primary Ice Management Fleet	BRK_A44	VOLUME	5022.3	505	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A45	VOLUME	5022.3	405	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A46	VOLUME	5022.3	305	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A47	VOLUME	5022.3	205	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A48	VOLUME	5022.3	105	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A49	VOLUME	5022.3	5	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A50	VOLUME	5022.3	-95	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A51	VOLUME	5022.3	-195	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A52	VOLUME	5022.3	-295	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A53	VOLUME	5022.3	-395	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A54	VOLUME	5022.3	-495	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A55	VOLUME	5022.3	-595	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A56	VOLUME	5022.3	-695	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A57	VOLUME	5022.3	-795	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A58	VOLUME	5022.3	-895	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A59	VOLUME	5022.3	-995	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A60	VOLUME	5022.3	-1095	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A61	VOLUME	5022.3	-1195	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A62	VOLUME	5022.3	-1295	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A63	VOLUME	5022.3	-1395	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A64	VOLUME	5022.3	-1495	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A65	VOLUME	5022.3	-1595	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A66	VOLUME	5022.3	-1695	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A67	VOLUME	5022.3	-1795	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A68	VOLUME	5022.3	-1895	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A69	VOLUME	5022.3	-1995	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A70	VOLUME	5022.3	-2095	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A71	VOLUME	5022.3	-2195	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A72	VOLUME	5022.3	-2295	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A73	VOLUME	5022.3	-2395	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A74	VOLUME	5022.3	-2495	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A75	VOLUME	5022.3	-2595	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A76	VOLUME	5022.3	-2695	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A77	VOLUME	5022.3	-2795	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A78	VOLUME	5022.3	-2895	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A79	VOLUME	5022.3	-2995	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A80	VOLUME	5022.3	-3095	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A81	VOLUME	5022.3	-3195	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A82	VOLUME	5022.3	-3295	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A83	VOLUME	5022.3	-3395	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A84	VOLUME	5022.3	-3495	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A85	VOLUME	5022.3	-3595	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A86	VOLUME	5022.3	-3695	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A87	VOLUME	5022.3	-3795	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A88	VOLUME	5022.3	-3895	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A89	VOLUME	5022.3	-3995	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A90	VOLUME	5022.3	-4095	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A91	VOLUME	5022.3	-4195	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A92	VOLUME	5022.3	-4295	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A93	VOLUME	5022.3	-4395	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A94	VOLUME	5022.3	-4495	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A95	VOLUME	5022.3	-4595	25.22	46.51	9.21
Primary Ice Management Fleet	BRK_A96	VOLUME	5022.3	-4695	25.22	46.51	9.21
Resupply Ship in Transit	RST_1	VOLUME	25.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_2	VOLUME	-37.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_3	VOLUME	-100.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_4	VOLUME	-162.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_5	VOLUME	-225.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_6	VOLUME	-287.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_7	VOLUME	-350.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_8	VOLUME	-412.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_9	VOLUME	-475.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_10	VOLUME	-537.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_11	VOLUME	-600.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_12	VOLUME	-662.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_13	VOLUME	-725.0	-12.5	15.24	29.07	6.38

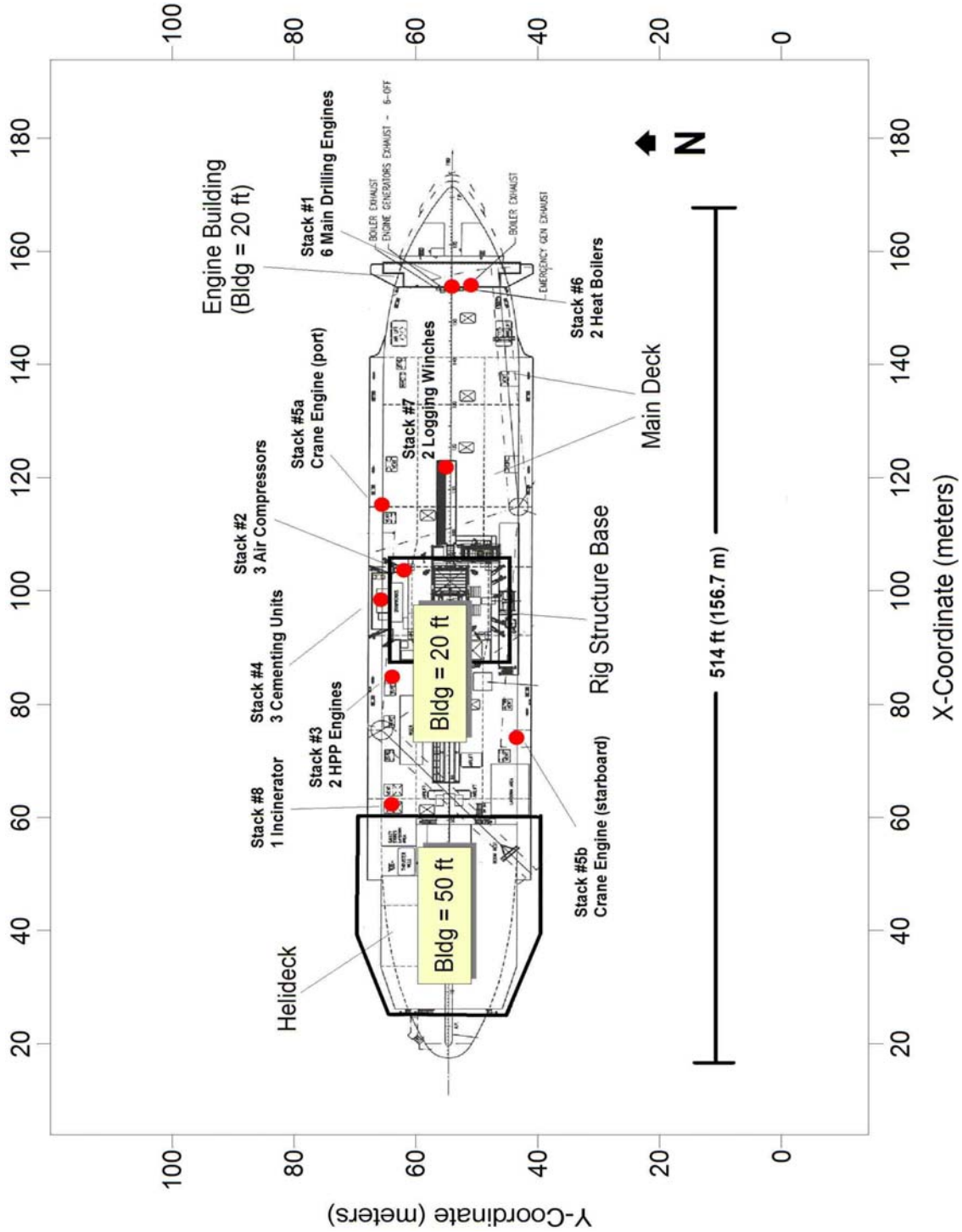
Source Release Parameters for Screening Modeling Purposes, contd.

Fleet Sources

Source Description	Model Src ID	Source Type	Source Location X (m)	Source Location Y (m)	Rel Ht. (m)	Sigma-Y (m)	Sigma-Z (m)
Resupply Ship in Transit	RST_14	VOLUME	-787.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_15	VOLUME	-850.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_16	VOLUME	-912.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_17	VOLUME	-975.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_18	VOLUME	-1037.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_19	VOLUME	-1100.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_20	VOLUME	-1162.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_21	VOLUME	-1225.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_22	VOLUME	-1287.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_23	VOLUME	-1350.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_24	VOLUME	-1412.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_25	VOLUME	-1475.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_26	VOLUME	-1537.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_27	VOLUME	-1600.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_28	VOLUME	-1662.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_29	VOLUME	-1725.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_30	VOLUME	-1787.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_31	VOLUME	-1850.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_32	VOLUME	-1912.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_33	VOLUME	-1975.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_34	VOLUME	-2037.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_35	VOLUME	-2100.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_36	VOLUME	-2162.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_37	VOLUME	-2225.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_38	VOLUME	-2287.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_39	VOLUME	-2350.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_40	VOLUME	-2412.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_41	VOLUME	-2475.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_42	VOLUME	-2537.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_43	VOLUME	-2600.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_44	VOLUME	-2662.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_45	VOLUME	-2725.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_46	VOLUME	-2787.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_47	VOLUME	-2850.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_48	VOLUME	-2912.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_49	VOLUME	-2975.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_50	VOLUME	-3037.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_51	VOLUME	-3100.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_52	VOLUME	-3162.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_53	VOLUME	-3225.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_54	VOLUME	-3287.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_55	VOLUME	-3350.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_56	VOLUME	-3412.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_57	VOLUME	-3475.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_58	VOLUME	-3537.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_59	VOLUME	-3600.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_60	VOLUME	-3662.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_61	VOLUME	-3725.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_62	VOLUME	-3787.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_63	VOLUME	-3850.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_64	VOLUME	-3912.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_65	VOLUME	-3975.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_66	VOLUME	-4037.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_67	VOLUME	-4100.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_68	VOLUME	-4162.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_69	VOLUME	-4225.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_70	VOLUME	-4287.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_71	VOLUME	-4350.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_72	VOLUME	-4412.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_73	VOLUME	-4475.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_74	VOLUME	-4537.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_75	VOLUME	-4600.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_76	VOLUME	-4662.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_77	VOLUME	-4725.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_78	VOLUME	-4787.5	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_79	VOLUME	-4850.0	-12.5	15.24	29.07	6.38
Resupply Ship in Transit	RST_80	VOLUME	-4912.5	-12.5	15.24	29.07	6.38

Configuration of Platform Equipment

* Building structure heights provided below are referenced above the main deck which is 15 feet above the water surface.



Building Information for ISC-BPIP Analysis

Structure Name	Main Deck		Helideck		Rig Structure Base		Engine Housing	
Height Above Water	4.57 m		19.81 m		10.67 m		10.67 m	
# Structure Corners	11		6		4		4	
Structure	Coordinate		Coordinate		Coordinate		Coordinate	
Corner #	X(m)	Y(m)	X(m)	Y(m)	X(m)	Y(m)	X(m)	Y(m)
1	15.7	55.3	59.0	40.5	81.6	66.0	154.1	47.5
2	32.6	67.8	38.5	40.5	81.6	44.0	154.1	62.5
3	141.6	67.8	23.6	45.0	104.1	44.0	158.5	62.5
4	141.8	66.0	23.6	64.8	104.1	66.0	158.5	47.5
5	158.8	62.5	38.5	69.8	---	---	---	---
6	172.3	55.0	59.0	69.8	---	---	---	---
7	158.8	47.0	---	---	---	---	---	---
8	143.4	44.3	---	---	---	---	---	---
9	141.6	42.3	---	---	---	---	---	---
10	47.5	42.3	---	---	---	---	---	---
11	32.6	42.3	---	---	---	---	---	---

Structure Name	Re-Supply-T		Re-Supply-S		Re-Supply-B	
Height Above Water	13.72 m		3.05 m		7.62 m	
# Structure Corners	11		6		4	
Structure	Coordinate		Coordinate		Coordinate	
Corner #	X(m)	Y(m)	X(m)	Y(m)	X(m)	Y(m)
1	63.0	-29.5	63.0	-12.0	63.0	-34.5
2	63.0	-15.5	63.0	28.0	63.0	-12.0
3	77.0	-15.5	77.0	28.0	77.0	-12.0
4	77.0	-29.5	77.0	-12.0	77.0	-34.5

Building Information for SCREEN3 Analyses

Source Description	Building Dimensions (m) [1]		
	Height	Max. Width	Min. Width
Resupply Ship	13.72	14.00	14.00
Oil Spill Response (Kvichaks)	3.05	4.88	3.66
Oil Spill Response (Nanuq)	13.72	15.24	15.24
Fennica/Nordica	27.43	26.00	21.34
Vladimir Ignatjuk	19.81	17.51	17.51
Talagy	19.81	17.25	13.72
Tor Viking II	24.38	18.00	15.24
Odin Viking II	24.38	16.90	16.90
Balder Viking	24.38	18.00	15.24
Vidar Viking	24.38	18.00	15.24

[1] Information derived from ships specifications and photographs (Ref: Firebaugh Technical Memo).

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor
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ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009

Hourly Discoverer Maximum Emissions

Unit ID	Description	Rating	Max fuel consumpt. (MMBtu/hr) [1]	Fuel Use gal/hr	Maximum Emissions (lb/hr) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Frontier Discoverer							0.77388					
FD-1	Generator Engine	1,325 hp	6.91	51.95	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04	2
FD-2	Generator Engine	1,325 hp	6.91	51.95	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04	2
FD-3	Generator Engine	1,325 hp	6.91	51.95	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04	2
FD-4	Generator Engine	1,325 hp	6.91	51.95	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04	2
FD-5	Generator Engine	1,325 hp	6.91	51.95	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04	2
FD-6	Generator Engine	1,325 hp	6.91	51.95	0.20	0.20	0.77	1.10E-02	0.28	0.04	2.01E-04	2
FD-7	Propulsion Engine	7,200 hp	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	3
FD-8	Em Generator	131 hp	0.92	6.89	0.64	0.64	3.26	1.46E-03	1.79	0.34	2.66E-05	4
FD-9	MLC Compressor	540 hp	3.58	26.90	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04	5
FD-10	MLC Compressor	540 hp	3.58	26.90	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04	5
FD-11	MLC Compressor	540 hp	3.58	26.90	0.09	0.09	3.55	5.71E-03	1.65	3.55	1.04E-04	5
FD-12	HPU Engine	250 hp	1.95	14.66	0.10	0.10	5.41	3.11E-03	0.16	0.08	5.66E-05	6
FD-13	HPU Engine	250 hp	1.95	14.66	0.10	0.10	5.41	3.11E-03	0.16	0.08	5.66E-05	6
FD-14	Port Deck Crane	365 hp	2.77	20.78	0.04	0.04	6.20	4.41E-03	0.13	0.04	8.02E-05	6
FD-15	Starbd Deck Crane	365 hp	2.77	20.78	0.04	0.04	6.20	4.41E-03	0.13	0.04	8.02E-05	6
FD-16	Cementing Unit	335 hp	2.62	19.65	0.14	0.14	7.25	4.17E-03	0.22	0.22	7.58E-05	6
FD-17	Cementing Unit	335 hp	2.62	19.65	0.14	0.14	7.25	4.17E-03	0.22	0.22	7.58E-05	6
FD-18	Cementing Unit	147 hp	1.15	8.62	0.09	0.09	3.80	1.83E-03	0.21	0.10	3.33E-05	6
FD-19	Logging Winch	250 hp	1.75	13.15	0.01	0.01	1.74	2.79E-03	0.30	1.48	5.08E-05	6
FD-20	Logging Winch	35 hp	0.25	1.84	0.01	0.01	0.43	3.91E-04	0.03	0.04	7.11E-06	6, 7
FD-21	Heat Boiler	7.97 MMBtu/hr	7.97	59.88	0.19	0.19	1.60	1.27E-02	0.62	0.01	7.17E-05	
FD-22	Heat Boiler	7.97 MMBtu/hr	7.97	59.88	0.19	0.19	1.60	1.27E-02	0.62	0.01	7.17E-05	
FD-23	Incinerator	276 lb/hr			1.13	0.97	0.69	0.35	4.28	0.41	0.03	
FD-31	Resupply Ship - docked		2.04	15.36	0.63	0.63	9.01	0.00	1.94	0.72	5.93E-05	
	Discoverer tc total while drilling		88.93	668.18	4.91	4.74	75.14	0.49	17.43	14.67	3.17E-02	

Hourly Fleet Maximum Emissions

		Max fuel consumpt. (MMBtu/hr) [1]	Fuel Use gal/hr	Maximum Emissions (lb/hr) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Ice Breaker											
IB IC Engines		178.64	1,342.17	44.51	39.30	1,049.66	0.29	140.36	25.19	5.18E-03	
IB Boiler		10.00	75.13	0.25	0.25	1.50	1.60E-02	0.38	0.03	9.00E-05	
IB Incinerators	154 lb/hr			1.02	0.70	0.23	0.19	23.10	7.70	1.64E-02	
Ice Breaker Total		188.64	1,417.30	45.78	40.25	1,051.40	0.49	163.84	32.92	2.17E-02	
Anchor Handler											
AH ICE Engines		180.16	1,353.60	10.59	10.59	91.78	0.31	211.72	16.25	5.22E-03	
AH Boiler		4.00	30.05	0.10	0.10	0.21	0.01	0.15	3.50E-03	3.60E-05	
AH Incinerator	151.23 lb/hr			1.01	0.69	0.23	0.19	22.68	7.56	1.61E-02	
Anchor Handler Total		184.16	1,383.65	11.69	11.37	92.22	0.51	234.56	23.82	2.14E-02	
Total Ice Management Fleet		*372.80*	*2,800.95*	*57.47*	*51.62*	*1,143.61*	*1.00*	*398.39*	*56.73*	*4.30E-02*	
Resupply Ship - in Transit		*44.41*	*333.65*	*20.04*	*16.07*	*265.11*	*0.07*	*34.89*	*6.26*	*1.29E-03*	
OSR Fleet											
Nanuq ICE Propulsion Engines		46.01	345.67	0.30	0.30	162.70	0.07	0.87	1.18	1.33E-03	6
Nanuq ICE Generators		17.99	135.16	1.22	0.98	107.40	0.03	1.41	0.25	5.22E-04	6
Other Main Ship ICE Propulsion Engines		13.30	99.95	0.59	0.59	47.04	0.02	2.52	3.42	3.86E-04	
Other Main Ship ICE Generators		5.99	45.02	2.70	2.17	35.77	0.01	4.71	0.84	1.74E-04	
OSR Main Ship Incinerator	125 lb/hr			0.83	0.57	0.19	0.16	18.75	6.25	1.33E-02	
OSR Main Ship Total		83.29	625.80	5.65	4.61	353.10	0.29	28.27	11.95	1.57E-02	
OSR Work Boat ICE Propulsion Engines		18.20	136.74	0.44	0.44	26.62	0.03	0.89	0.45	5.28E-04	
OSR Work Boat ICE Generators		0.23	1.74	0.07	0.07	1.02	0.00	0.22	0.08	6.70E-06	
OSR Work Boats Total		18.43	138.48	0.51	0.51	27.64	0.03	1.11	0.53	5.34E-04	
OSR Total		*101.72*	*764.28*	*6.16*	*5.12*	*380.74*	*0.32*	*29.37*	*12.48*	*1.63E-02*	
	Total All Fleet	518.93	3,898.88	83.67	72.82	1,789.46	1.39	462.66	75.48	6.06E-02	
	Total All	607.87	4,567.06	88.58	77.56	1,864.60	1.88	480.08	90.14	9.22E-02	

Notes

1 All emissions are the maximum 1-hour values
2 Units FD-1-6 (Generator Engines) instantaneous capacity restriction, SCR NOx control effectiveness and Oxidation Catalyst reduction efficiencies applied
3 Not used during drilling
4 Unit FD-8 (Emergency Generator) operation assumed for 120 min/week Ref: Wright, Alistair email to Anthony Wilson, 1/21/09.
5 Units FD-9-11 (MLC Compressors) are Tier 3 engines
6 CDPF PM & CO reduction efficiencies applied
7 Unit FD-20 (Logging Winch) is a Tier 2 engine

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ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009	

Base Operating Scenario

Dailly Discoverer Maximum Emissions

All Units	24 hr/day	except the following:	Unit FD-23	300 lb/trash per day	
Unit FD-8	120 min/week	2.00 hr/day	Unit FD-31	12 hr/day	

Unit ID	Description	Rating	Max fuel consumpt. (MMBtu/day) [1]	Fuel Use gal/day	Maximum Emissions (lb/day) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Frontier Discoverer												
FD-1	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-2	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-3	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-4	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-5	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-6	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-7	Propulsion Engine	7,200 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	3
FD-8	Em Generator	131 hp	1.83	13.78	1.28	1.28	6.52	0.00	3.58	0.67	5.32E-05	4
FD-9	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-10	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-11	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	3, 5
FD-12	HPU Engine	250 hp	46.84	351.89	2.50	2.50	129.76	0.07	3.96	1.96	1.36E-03	6
FD-13	HPU Engine	250 hp	46.84	351.89	2.50	2.50	129.76	0.07	3.96	1.96	1.36E-03	6
FD-14	Port Deck Crane	365 hp	66.36	498.60	1.03	1.03	148.73	0.11	3.14	0.91	1.92E-03	6
FD-15	Starbd Deck Crane	365 hp	66.36	498.60	1.03	1.03	148.73	0.11	3.14	0.91	1.92E-03	6
FD-16	Cementing Unit	335 hp	17.45	131.09	1.42	1.42	57.75	0.03	3.23	1.48	5.06E-04	6
FD-17	Cementing Unit	335 hp	17.45	131.09	1.42	1.42	57.75	0.03	3.23	1.48	5.06E-04	6
FD-18	Cementing Unit	147 hp	7.66	57.52	0.62	0.62	25.34	0.01	1.42	0.65	2.22E-04	6
FD-19	Logging Winch	250 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	6, 7
FD-20	Logging Winch	35 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	6, 7, 8
FD-21	Heat Boiler	7.97 MMBtu/hr	191.28	1,437.14	4.50	4.50	38.50	0.31	14.80	0.27	1.72E-03	
FD-22	Heat Boiler	7.97 MMBtu/hr	191.28	1,437.14	4.50	4.50	38.50	0.31	14.80	0.27	1.72E-03	
FD-23	Incinerator	276 lb/hr			1.23	1.05	0.75	0.38	4.65	0.45	0.03	
FD-31	Resupply Ship - docked		24.53	184.29	7.60	7.60	108.17	0.04	23.30	8.58	7.11E-04	
	Discoverer total while drilling		1,931.31	14,510.44	64.34	64.16	1257.57	3.46	241.65	280.57	8.03E-02	

Daily Fleet Maximum Emissions

Resupply - in Transit 4 hr/day

		Max fuel consumpt. (MMBtu/day) [1]	Fuel Use gal/day	Maximum Emissions (lb/day) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Ice Breaker											
IB IC Engines		4,287.36	32,212.05	1068.14	943.22	25,191.92	6.86	3368.64	604.61	1.24E-01	
IB Boiler		240.00	1,803.18	5.95	5.95	36.06	0.38	9.02	0.61	2.16E-03	
IB Incinerators	154 lb/hr			24.58	16.82	5.54	4.62	554.40	184.80	3.94E-01	
Ice Breaker Total		4,527.36	34,015.24	1098.67	965.99	25,233.53	11.87	3932.06	790.02	5.20E-01	
Anchor Handler											
AH ICE Engines		4,323.86	32,486.30	254.06	254.06	2,202.82	7.50	5,081.28	390.06	1.25E-01	
AH Boiler		96.00	721.27	2.38	2.38	4.94	0.15	3.61	0.08	8.64E-04	
AH Incinerator	151.23 lb/hr			24.14	16.51	5.44	4.54	544.44	181.48	3.87E-01	
Anchor Handler Total		4,419.86	33,207.58	280.58	272.96	2,213.20	12.19	5629.33	571.62	5.13E-01	
Total Ice Management Fleet		*8,947.22*	*67,222.81*	*1379.25*	*1238.95*	*27,446.74*	*24.05*	*9561.38*	*1361.64*	*1.03E+00*	
Resupply Ship - in Transit		*177.63*	1,334.60	*80.16*	*64.29*	*1,060.44*	*0.28*	*139.57*	*25.05*	*5.15E-03*	
OSR Fleet											
Nanuq ICE Propulsion Engines		399.29	3,000.00	2.64	2.64	1,412.03	0.64	7.57	10.27	1.16E-02	6, 9
Nanuq ICE Generators		106.48	800.00	7.21	5.78	635.66	0.17	8.37	1.50	3.09E-03	6, 9
Other Main Ship ICE Propulsion Engines		319.27	2,398.76	14.10	14.10	1,129.04	0.51	60.53	82.09	9.26E-03	
Other Main Ship ICE Generators		143.81	1,080.47	64.90	52.05	858.52	0.23	112.99	20.28	4.17E-03	
OSR Main Ship Incinerator	125 lb/hr			19.95	13.65	4.50	3.75	450.00	150.00	3.20E-01	
OSR Main Ship Total		968.85	7,279.22	108.79	88.22	4,039.75	5.30	639.46	264.14	3.48E-01	
OSR Work Boat ICE Propulsion Engines		436.80	3,281.79	10.59	10.59	638.87	0.70	21.32	10.73	1.27E-02	
OSR Work Boat ICE Generators		5.54	41.65	1.72	1.72	24.45	0.01	5.27	1.94	1.61E-04	
OSR Work Boats Total		442.34	3,323.45	12.31	12.31	663.32	0.71	26.59	12.67	1.28E-02	
OSR Total		*1,411.19*	*10,602.67*	*121.11*	*100.54*	*4,703.07*	*6.00*	*666.05*	*276.81*	*3.60E-01*	
	Total All Fleet	10,536.05	79,160.08	1580.51	1403.77	33,210.25	30.34	10367.00	1663.50	1.40E+00	
	Total All	12,467.36	93,670.51	1644.85	1467.93	34,467.81	33.79	10608.65	1944.07	1.48E+00	

Notes

1 All emissions are the maximum 24-hour values
2 Units FD-1-6 (Generator Engines) instantaneous capacity restriction, SCR NOx control effectiveness and Oxidation Catalyst reduction efficiencies applied
3 Assumed used during drilling 100%
4 Unit FD-8 (Emergency Generator) operation assumed for 120 min/week Ref: Wright, Alistair email to Anthony Wilson, 1/21/09.
5 Units FD-9-11 (MLC Compressors) are Tier 3 engines
6 CDPF PM & CO reduction efficiencies applied
7 Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units. 0%
8 Unit FD-20 (Logging Winch) is a Tier 2 engine
9 OSR Main Ship Propulsion and Generator Engines restriction applied

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Alternate Operating Scenario #1

Dailly Discoverer Maximum Emissions

All Units 24 hr/day except the following: Unit FD-23 800 lb/trash per day

Unit FD-8 120 min/week 2.00 hr/day Unit FD-31 12 hr/day

Unit ID	Description	Rating	Max fuel consumpt. (MMBtu/day) [1]	Fuel Use gal/day	Maximum Emissions (lb/day) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Frontier Discoverer												
FD-1	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-2	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-3	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-4	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-5	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-6	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-7	Propulsion Engine	7,200 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	3
FD-8	Em Generator	131 hp	1.83	13.78	1.28	1.28	6.52	0.00	3.58	0.67	5.32E-05	4
FD-9	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-10	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-11	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-12	HPU Engine	250 hp	46.84	351.89	2.50	2.50	129.76	0.07	3.96	1.96	1.36E-03	6
FD-13	HPU Engine	250 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	3, 6
FD-14	Port Deck Crane	365 hp	66.36	498.60	1.03	1.03	148.73	0.11	3.14	0.91	1.92E-03	6
FD-15	Starbd Deck Crane	365 hp	66.36	498.60	1.03	1.03	148.73	0.11	3.14	0.91	1.92E-03	6
FD-16	Cementing Unit	335 hp	17.45	131.09	1.42	1.42	57.75	0.03	3.23	1.48	5.06E-04	6
FD-17	Cementing Unit	335 hp	17.45	131.09	1.42	1.42	57.75	0.03	3.23	1.48	5.06E-04	6
FD-18	Cementing Unit	147 hp	7.66	57.52	0.62	0.62	25.34	0.01	1.42	0.65	2.22E-04	6
FD-19	Logging Winch	250 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	6, 7
FD-20	Logging Winch	35 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	6, 7, 8
FD-21	Heat Boiler	7.97 MMBtu/hr	191.28	1,437.14	4.50	4.50	38.50	0.31	14.80	0.27	1.72E-03	
FD-22	Heat Boiler	7.97 MMBtu/hr	191.28	1,437.14	4.50	4.50	38.50	0.31	14.80	0.27	1.72E-03	
FD-23	Incinerator	276 lb/hr			3.28	2.80	2.00	1.00	12.40	1.20	0.09	
FD-31	Resupply Ship - docked		24.53	184.29	7.60	7.60	108.17	0.04	23.30	8.58	7.11E-04	
	Discoverer total while drilling		1,884.47	14,158.55	63.89	63.41	1129.05	4.01	245.44	279.36	1.32E-01	

Daily Fleet Maximum Emissions

Resupply - in Transit 4 hr/day

		Max fuel consumpt. (MMBtu/day) [1]	Fuel Use gal/day	Maximum Emissions (lb/day) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Ice Breaker											
IB IC Engines		4,287.36	32,212.05	1068.14	943.22	25,191.92	6.86	3368.64	604.61	1.24E-01	
IB Boiler		240.00	1,803.18	5.95	5.95	36.06	0.38	9.02	0.61	2.16E-03	
IB Incinerators	154 lb/hr			24.58	16.82	5.54	4.62	554.40	184.80	3.94E-01	
Ice Breaker Total		4,527.36	34,015.24	1098.67	965.99	25,233.53	11.87	3932.06	790.02	5.20E-01	
Anchor Handler											
AH ICE Engines		4,323.86	32,486.30	254.06	254.06	2,202.82	7.50	5,081.28	390.06	1.25E-01	
AH Boiler		96.00	721.27	2.38	2.38	4.94	0.15	3.61	0.08	8.64E-04	
AH Incinerator	151.23 lb/hr			24.14	16.51	5.44	4.54	544.44	181.48	3.87E-01	
Anchor Handler Total		4,419.86	33,207.58	280.58	272.96	2,213.20	12.19	5629.33	571.62	5.13E-01	
Total Ice Management Fleet		*8,947.22*	*67,222.81*	*1379.25*	*1238.95*	*27,446.74*	*24.05*	*9561.38*	*1361.64*	*1.03E+00*	
Resupply Ship - in Transit		*177.63*	1,334.60	*80.16*	*64.29*	*1,060.44*	*0.28*	*139.57*	*25.05*	*5.15E-03*	
OSR Fleet											
Nanuq ICE Propulsion Engines		399.29	3,000.00	2.64	2.64	1,412.03	0.64	7.57	10.27	1.16E-02	6, 9
Nanuq ICE Generators		106.48	800.00	7.21	5.78	635.66	0.17	8.37	1.50	3.09E-03	6, 9
Other Main Ship ICE Propulsion Engines		319.27	2,398.76	14.10	14.10	1,129.04	0.51	60.53	82.09	9.26E-03	
Other Main Ship ICE Generators		143.81	1,080.47	64.90	52.05	858.52	0.23	112.99	20.28	4.17E-03	
OSR Main Ship Incinerator	125 lb/hr			19.95	13.65	4.50	3.75	450.00	150.00	3.20E-01	
OSR Main Ship Total		968.85	7,279.22	108.79	88.22	4,039.75	5.30	639.46	264.14	3.48E-01	
OSR Work Boat ICE Propulsion Engines		436.80	3,281.79	10.59	10.59	638.87	0.70	21.32	10.73	1.27E-02	
OSR Work Boat ICE Generators		5.54	41.65	1.72	1.72	24.45	0.01	5.27	1.94	1.61E-04	
OSR Work Boats Total		442.34	3,323.45	12.31	12.31	663.32	0.71	26.59	12.67	1.28E-02	
OSR Total		*1,411.19*	*10,602.67*	*121.11*	*100.54*	*4,703.07*	*6.00*	*666.05*	*276.81*	*3.60E-01*	
	Total All Fleet	10,536.05	79,160.08	1580.51	1403.77	33,210.25	30.34	10367.00	1663.50	1.40E+00	
	Total All	12,420.52	93,318.62	1644.40	1467.18	34,339.30	34.34	10612.44	1942.86	1.53E+00	

Notes

1 All emissions are the maximum 24-hour values

2 Units FD-1-6 (Generator Engines) instantaneous capacity restriction, SCR NOx control effectiveness and Oxidation Catalyst reduction efficiencies applied

3 Not Used this scenario 0%

4 Unit FD-8 (Emergency Generator) operation assumed for 120 min/week Ref: Wright, Alistair email to Anthony Wilson, 1/21/09.

5 Units FD-9-11 (MLC Compressors) are Tier 3 engines

6 CDPF PM & CO reduction efficiencies applied

7 Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units. 0%

8 Unit FD-20 (Logging Winch) is a Tier 2 engine

9 OSR Main Ship Propulsion and Generator Engines restriction applied

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
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ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009	

Alternate Operating Scenario #2

Dailly Discoverer Maximum Emissions

All Units	24 hr/day	except the following:	Unit FD-23	1300 lb/trash per day	
Unit FD-8	120 min/week	2.00 hr/day	Unit FD-31	12 hr/day	

Unit ID	Description	Rating	Max fuel consumpt. (MMBtu/day) [1]	Fuel Use gal/day	Maximum Emissions (lb/day) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Frontier Discoverer												
FD-1	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-2	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-3	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-4	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-5	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-6	Generator Engine	1,325 hp	165.94	1,246.77	4.72	4.72	18.57	0.26	6.63	0.85	4.81E-03	2
FD-7	Propulsion Engine	7,200 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	3
FD-8	Em Generator	131 hp	1.83	13.78	1.28	1.28	6.52	0.00	3.58	0.67	5.32E-05	4
FD-9	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-10	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-11	MLC Compressor	540 hp	85.93	645.60	2.13	2.13	85.29	0.14	39.55	85.29	2.49E-03	5
FD-12	HPU Engine	250 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	3, 6
FD-13	HPU Engine	250 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	3, 6
FD-14	Port Deck Crane	365 hp	66.36	498.60	1.03	1.03	148.73	0.11	3.14	0.91	1.92E-03	6
FD-15	Starbd Deck Crane	365 hp	66.36	498.60	1.03	1.03	148.73	0.11	3.14	0.91	1.92E-03	6
FD-16	Cementing Unit	335 hp	17.45	131.09	1.42	1.42	57.75	0.03	3.23	1.48	5.06E-04	6
FD-17	Cementing Unit	335 hp	17.45	131.09	1.42	1.42	57.75	0.03	3.23	1.48	5.06E-04	6
FD-18	Cementing Unit	147 hp	7.66	57.52	0.62	0.62	25.34	0.01	1.42	0.65	2.22E-04	6
FD-19	Logging Winch	250 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	6, 7
FD-20	Logging Winch	35 hp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	6, 7, 8
FD-21	Heat Boiler	7.97 MMBtu/hr	191.28	1,437.14	4.50	4.50	38.50	0.31	14.80	0.27	1.72E-03	
FD-22	Heat Boiler	7.97 MMBtu/hr	191.28	1,437.14	4.50	4.50	38.50	0.31	14.80	0.27	1.72E-03	
FD-23	Incinerator	276 lb/hr			5.33	4.55	3.25	1.63	20.15	1.95	0.14	
FD-31	Resupply Ship - docked		24.53	184.29	7.60	7.60	108.17	0.04	23.30	8.58	7.11E-04	
	Discoverer total while drilling		1,837.64	13,806.66	63.44	62.66	1000.54	4.56	249.24	278.15	1.84E-01	

Daily Fleet Maximum Emissions

Resupply - in Transit 4 hr/day

	Rating	Max fuel consumpt. (MMBtu/day) [1]	Fuel Use gal/day	Maximum Emissions (lb/day) [1] PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	Notes
Ice Breaker											
IB IC Engines		4,287.36	32,212.05	1068.14	943.22	25,191.92	6.86	3368.64	604.61	1.24E-01	
IB Boiler		240.00	1,803.18	5.95	5.95	36.06	0.38	9.02	0.61	2.16E-03	
IB Incinerators	154 lb/hr			24.58	16.82	5.54	4.62	554.40	184.80	3.94E-01	
Ice Breaker Total		4,527.36	34,015.24	1098.67	965.99	25,233.53	11.87	3932.06	790.02	5.20E-01	
Anchor Handler											
AH ICE Engines		4,323.86	32,486.30	254.06	254.06	2,202.82	7.50	5,081.28	390.06	1.25E-01	
AH Boiler		96.00	721.27	2.38	2.38	4.94	0.15	3.61	0.08	8.64E-04	
AH Incinerator	151.23 lb/hr			24.14	16.51	5.44	4.54	544.44	181.48	3.87E-01	
Anchor Handler Total		4,419.86	33,207.58	280.58	272.96	2,213.20	12.19	5629.33	571.62	5.13E-01	
Total Ice Management Fleet		*8,947.22*	*67,222.81*	*1379.25*	*1238.95*	*27,446.74*	*24.05*	*9561.38*	*1361.64*	*1.03E+00*	
Resupply Ship - in Transit		*177.63*	1,334.60	*80.16*	*64.29*	*1,060.44*	*0.28*	*139.57*	*25.05*	*5.15E-03*	
OSR Fleet											
Nanuq ICE Propulsion Engines		399.29	3,000.00	2.64	2.64	1,412.03	0.64	7.57	10.27	1.16E-02	6, 9
Nanuq ICE Generators		106.48	800.00	7.21	5.78	635.66	0.17	8.37	1.50	3.09E-03	6, 9
Other Main Ship ICE Propulsion Engines		319.27	2,398.76	14.10	14.10	1,129.04	0.51	60.53	82.09	9.26E-03	
Other Main Ship ICE Generators		143.81	1,080.47	64.90	52.05	858.52	0.23	112.99	20.28	4.17E-03	
OSR Main Ship Incinerator	125 lb/hr			19.95	13.65	4.50	3.75	450.00	150.00	3.20E-01	
OSR Main Ship Total		968.85	7,279.22	108.79	88.22	4,039.75	5.30	639.46	264.14	3.48E-01	
OSR Work Boat ICE Propulsion Engines		436.80	3,281.79	10.59	10.59	638.87	0.70	21.32	10.73	1.27E-02	
OSR Work Boat ICE Generators		5.54	41.65	1.72	1.72	24.45	0.01	5.27	1.94	1.61E-04	
OSR Work Boats Total		442.34	3,323.45	12.31	12.31	663.32	0.71	26.59	12.67	1.28E-02	
OSR Total		*1,411.19*	*10,602.67*	*121.11*	*100.54*	*4,703.07*	*6.00*	*666.05*	*276.81*	*3.60E-01*	
	Total All Fleet	10,536.05	79,160.08	1580.51	1403.77	33,210.25	30.34	10367.00	1663.50	1.40E+00	
	Total All	12,373.69	92,966.73	1643.95	1466.43	34,210.79	34.89	10616.24	1941.65	1.58E+00	

Notes

1 All emissions are the maximum 24-hour values
2 Units FD-1-6 (Generator Engines) instantaneous capacity restriction, SCR NOx control effectiveness and Oxidation Catalyst reduction efficiencies applied
3 Not used this scenario 0%
4 Unit FD-8 (Emergency Generator) operation assumed for 120 min/week Ref: Wright, Alistair email to Anthony Wilson, 1/21/09.
5 Units FD-9-11 (MLC Compressors) are Tier 3 engines
6 CDPF PM & CO reduction efficiencies applied
7 Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units. 0%
8 Unit FD-20 (Logging Winch) is a Tier 2 engine
9 OSR Main Ship Propulsion and Generator Engines restriction applied

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
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Base Operating Scenario

Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating	Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Maximum Emissions (ton/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	HAPs	Notes
Frontier Discoverer													
FD-1	Generator Engine	1,325 hp	27,878	209,457	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02	1
FD-2	Generator Engine	1,325 hp	27,878	209,457	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02	1
FD-3	Generator Engine	1,325 hp	27,878	209,457	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02	1
FD-4	Generator Engine	1,325 hp	27,878	209,457	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02	1
FD-5	Generator Engine	1,325 hp	27,878	209,457	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02	1
FD-6	Generator Engine	1,325 hp	27,878	209,457	0.40	0.40	1.56	2.22E-02	0.56	0.07	4.04E-04	0.02	1
FD-7	Propulsion Engine	7,200 hp	0	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00	2
FD-8	Em Generator	131 hp	44	331	1.53E-02	1.53E-02	7.82E-02	3.51E-05	4.30E-02	8.06E-03	6.38E-07	8.65E-05	3
FD-9	MLC Compressor	540 hp	5,413	40,673	0.07	0.07	2.69	4.32E-03	1.25	2.69	7.85E-05	0.01	4
FD-10	MLC Compressor	540 hp	5,413	40,673	0.07	0.07	2.69	4.32E-03	1.25	2.69	7.85E-05	0.01	4
FD-11	MLC Compressor	540 hp	0	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00	2, 4
FD-12	HPU Engine	250 hp	2,951	22,169	0.08	0.08	4.09	2.35E-03	0.12	0.06	4.28E-05	0.00	5, 6
FD-13	HPU Engine	250 hp	2,951	22,169	0.08	0.08	4.09	2.35E-03	0.12	0.06	4.28E-05	0.00	5, 6
FD-14	Port Deck Crane	365 hp	4,181	31,412	0.03	0.03	4.68	3.33E-03	0.10	0.03	6.06E-05	0.00	5, 7
FD-15	Starbd Deck Crane	365 hp	4,181	31,412	0.03	0.03	4.68	3.33E-03	0.10	0.03	6.06E-05	0.00	5, 7
FD-16	Cementing Unit	335 hp	2,931	22,022	0.12	0.12	4.85	2.34E-03	0.27	0.12	4.25E-05	0.00	5, 8
FD-17	Cementing Unit	335 hp	2,931	22,022	0.12	0.12	4.85	2.34E-03	0.27	0.12	4.25E-05	0.00	5, 8
FD-18	Cementing Unit	147 hp	1,286	9,664	0.05	0.05	2.13	1.03E-03	0.12	0.05	1.86E-05	0.00	5, 8
FD-19	Logging Winch	250 hp	0	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00	5, 9
FD-20	Logging Winch	35 hp	0	0	0.00	0.00	0.00	0.00E+00	0.00	0.00	0.00E+00	0.00	5, 9
FD-21	Heat Boiler	7.97 MMBtu/hr	32,135	241,439	0.38	0.38	3.23	2.56E-02	1.24	0.02	1.45E-04	0.01	
FD-22	Heat Boiler	7.97 MMBtu/hr	32,135	241,439	0.38	0.38	3.23	2.56E-02	1.24	0.02	1.45E-04	0.01	
FD-23	Incinerator	276 lb/hr			0.10	0.09	0.06	0.03	0.39	0.04	2.68E-03	0.00	
FD-31	Resupply Ship - docked		196	1,474	0.03	0.03	0.43	0.00	0.09	0.03	2.85E-06	3.86E-04	10
	Discoverer total while drilling		264,019	1,983,644	3.93	3.92	51.15	0.24	9.96	6.41	5.87E-03	0.14	

Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	38%	of	168 days/year	1532 hrs/yr	IB Adjustment	1.052522
IB & AH - For all remaining pollutants	38%	of	168 days/year	1532 hrs/yr	AH Adjustment	1.178835
Resupply - in Transit	8 trips/yr		4 hr/trip	32 hrs/yr		

		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Maximum Emissions (ton/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	HAPs	Notes
Ice Breaker												
IB IC Engines		288,081	2,164,424	35.89	31.69	846.36	0.23	113.17	20.31	4.18E-03	0.57	11
IB Boiler		40,320	302,935	0.50	0.50	3.03	0.03	0.76	0.05	1.81E-04	6.68E-03	
IB Incinerators	154 lb/hr			2.06	1.41	0.47	0.39	46.57	15.52	3.31E-02	3.89E-02	
Ice Breaker Total		328,401	2,467,359	38.45	33.60	849.86	0.65	160.50	35.89	3.74E-02	0.61	
Anchor Handler												
AH ICE Engines		276,035	2,073,926	9.56	9.56	70.31	0.28	191.20	14.68	4.72E-03	5.42E-01	12
AH Boiler		16,128	121,174	0.20	0.20	0.42	0.01	0.30	0.01	7.26E-05	2.67E-03	12
AH Incinerator	151.23 lb/hr			2.03	1.39	0.46	0.38	45.73	15.24	3.25E-02	3.82E-02	
Anchor Handler Total		292,163	2,195,099	11.79	11.15	71.19	0.68	237.24	29.93	3.73E-02	5.83E-01	
Total Ice Management Fleet		*620,564*	*4,662,458*	*50.24*	*44.75*	*921.04*	*1.33*	*397.74*	*65.82*	*7.47E-02*	*1.20E+00*	
Resupply Ship - in Transit		*1,421*	*10,677*	*0.32*	*0.26*	*4.24*	*0.00*	*0.56*	*0.10*	*2.06E-05*	*2.79E-03*	13
OSR Fleet												
Nanuq ICE Propulsion Engines		67,081.39	504,000	0.22	0.22	118.61	0.05	0.64	0.86	9.73E-04	1.32E-02	5, 14
Nanuq ICE Generators		17,888.37	134,400	0.61	0.49	53.40	0.01	0.70	0.13	2.59E-04	3.52E-03	5, 14
Other Main Ship ICE Propulsion Engines		53637.27	402,991	1.18	1.18	94.84	0.04	5.08	6.90	7.78E-04	1.05E-01	
Other Main Ship ICE Generators		24159.74	181,518	5.45	4.37	72.12	0.02	9.49	1.70	3.50E-04	4.75E-02	
OSR Main Ship Incinerator				1.68	1.15	0.38	0.32	37.80	12.60	2.68E-02	3.16E-02	
OSR Main Ship Total		162,767	1,222,909	9.14	7.41	339.34	0.44	53.71	22.19	2.92E-02	2.01E-01	
OSR Work Boats Total		74,314	558,339	1.03	1.03	55.72	0.06	2.23	1.06	1.08E-03	1.46E-01	
OSR Total		*237,081*	*1,781,248*	*10*	*8*	*395*	*1*	*56*	*23*	*3.03E-02*	*3.47E-01*	
Total All Fleet		859,066	6,454,383	61	53	1,320	2	454	89	1.05E-01	1.55	
Notes definitions see page 20 **Total All**		1,123,085	8,438,027	65	57	1,371	2	464	96	1.11E-01	1.69	

Emission Factors, Conversions and Assumptions

Conversions

1.340	hp/kW	3600	sec/hour	2	wt. conversion of S to SO2
454	g/lb	2000	lb/ton	264	gal/m^3

Assumptions			Reference
Diesel heat value	133,098 Btu/gal	0.1331 MMBtu/gal	Keiser, Ronald email to Chris Tengco, 01/26/09.
Diesel density	847.9 kg/m^3	7.08 lb/gal	SCANRAFF-Vladimir Ignatjuk Certificate of Quality. 09/19/04.

Diesel Heat Rates						Reference
Caterpillar D399 engines	237.5	g/kW-hr	7,350	Btu/hp-hr	0.0073 MMBtu/hp-hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95
						100% load at 1200RPM value
Caterpillar D343 engines	244.8	g/kW-hr	7,576	Btu/hp-hr	0.0076 MMBtu/hp-hr	Caterpillar D343 Engine Data Sheet, 05/95
						100% loads at 2100 RPM value, T Prechamber Engines
Caterpillar C15 engines			26.9	gal/hr	0.0066 MMBtu/hp-hr	Caterpillar C15 Specification Sheet, LEHW7443-000, 2008
Detroit 8V-71N engines			0.415	lb/hp-hr	0.0078 MMBtu/hp-hr	Detroit Diesel, Engine Performance Model: 8V-71N, 10/15/81
Caterpillar 3608 engines	204.7	g/kW-hr	6,335	Btu/hp-hr	0.0063 MMBtu/hp-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06
ICE engines			7,000	Btu/hp-hr	0.0070 MMBtu/hp-hr	AP42 Table 3.3-1, 10/96

NOx Factors - converted at 133098 Btu/gal

Description	EF		EF		EF		Reference
Discoverer generator engines (Cat/D399)			0.5	g/kW-hr	0.112	lb/MMBtu	D.E.C. Marine AB letter, 10/9/08
Discoverer propulsion engine					3.2	lb/MMBtu	AP42 Table 3.4-1, 10/96
Discoverer emergency generator (Cat/3304)			11.28	g/bhp-hr	3.553	lb/MMBtu	Max of 13 test from EPA/600/8-90/057F
Discoverer MLC Compressors (Cat/C-15)			4.0	g/kW-hr	0.993	lb/MMBtu	Tier 3 emission limit
Discoverer HPU Engines (Detroit/8V71)			9.81	g/bhp-hr	2.771	lb/MMBtu	Max of 4 test from EPA/600/8-90/057F
Discoverer Cranes (Cat/D343)	2810.9	g/hr	1.70E-02	lb/hp-hr	2.241	lb/MMBtu	Caterpillar D343 Engine Data Sheet, 05/95
Discoverer Cementing FD 16-17 Hourly			9.81	g/bhp-hr	2.771	lb/MMBtu	Max of 4 test from EPA/600/8-90/057F
Discoverer Cementing FD 16-17 Daily & Annual			11.72	g/bhp-hr	3.310	lb/MMBtu	Max of 8 test from EPA/600/8-90/057F
Discoverer Cementing FD 18 All time averages			11.72	g/bhp-hr	3.310	lb/MMBtu	Max of 8 test from EPA/600/8-90/057F
Discoverer Logging Winch FD-19 Hourly			4.0	g/kW-hr	0.993	lb/MMBtu	Tier 3 emission limit
Discoverer Logging Winch FD-19 Daily & Annual			11.72	g/bhp-hr	3.310	lb/MMBtu	Max of 8 test from EPA/600/8-90/057F
Discoverer Logging Generator FD-20 All time Average			7.5	g/kW-hr	1.763	lb/MMBtu	Tier 2 emission limit
Discoverer boilers			38.5	lb/day	0.201	lb/MMBtu	Clayton Industries, 8/2001
Discoverer Incinerator			5	lb/ton	0.0025	lb/lb	AP42 Table 2.2-1, multiple hearth
Resupply Ship-docked & OSR Work Boat Generators					4.41	lb/MMBtu	AP42 Table 3.3-1, 10/96
Ice Management Fleet factor			25	g/kW-hr	5.876	lb/MMBtu	generic factors consistent w/Ice mgmt fleet ORRs
Ice Breaker Boiler			20	lb/10^3 gal	0.150	lb/MMBtu	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98
All Other Incinerators			3	lb/ton	0.0015	lb/lb	AP42 Table 2.1-12, 10/96
Resupply-transit & OSR Main Ship ICE Generators			25.4	g/kW-hr	5.970	lb/MMBtu	EPA Memo, D. Meyer, June 12, 2008
OSR Main Ship ICE Propulsion (Cat/3608)			13.62	g/kW-hr	3.536	lb/MMBtu	Caterpillar 3608 Specification Sheet, DM5529, 10/06
OSR Work Boat ICE Propulsion Engines			4.644	g/hp-hr	1.463	lb/MMBtu	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06

PM Factors

Description	EF		EF		EF		Reference
PM_{10}							
Discoverer generator engines (Cat/D399)	251.2	g/hr	4.18E-04	lb/hp-hr	0.057	lb/MMBtu	Caterpillar D399 SCAC Engine Data Sheet, 05/95
Discoverer propulsion engine					0.0573	lb/MMBtu	AP42 Table 3.4-2, 10/96
Discoverer emergency generator (Cat/3304)			2.21	g/bhp-hr	0.696	lb/MMBtu	Max of 13 test from EPA/600/8-90/057F
Discoverer MLC Compressors (Cat/C-15)			0.2	g/kW-hr	0.050	lb/MMBtu	Tier 3 emission limit
Discoverer HPU Engines (Detroit/8V71)			1.26	g/bhp-hr	0.356	lb/MMBtu	Max of 4 test from EPA/600/8-90/057F
Discoverer Cranes (Cat/D343)	129.8	g/hr	7.84E-04	lb/hp-hr	0.103	lb/MMBtu	Caterpillar D343 Engine Data Sheet, 05/95
Discoverer Cementing FD-16-17 Hourly			1.26	g/bhp-hr	0.356	lb/MMBtu	Max of 4 test from EPA/600/8-90/057F
Discoverer Cementing & Logging FD 18 Hourly FD-16-20 Daily			1.92	g/bhp-hr	0.542	lb/MMBtu	Max of 8 test from EPA/600/8-90/057F
Discoverer Logging Winch FD-19 Hourly			0.2	g/kW-hr	0.050	lb/MMBtu	Tier 3 emission limit
Discoverer Logging Generator FD-20 Hourly			0.6	g/kW-hr	0.141	lb/MMBtu	Tier 2 emission limit
Discoverer boilers			4.5	lb/day	0.024	lb/MMBtu	Clayton Industries, 8/2001
Discoverer Incinerator			8.2	lb/ton	0.0041	lb/lb	ORR
Resupply Ship-docked & OSR Work Boat Generators					0.31	lb/MMBtu	AP42 Table 3.3-1, 10/96
Ice Management ICE Engines			1.06	g/kW-hr	0.249	lb/MMBtu	generic factors consistent w/Ice breaker ORR
Ice Breaker Boiler			3.3	lb/10^3 gal	0.025	lb/MMBtu	AP42 Table 1.3-1 (filterable PM) & Table 1.3-2 (total condensib
Ice Management & OSR Incinerators			13.3	lb/ton	0.0067	lb/lb	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
Resupply-transit & OSR Main Ship ICE Generators			1.92	g/kW-hr	0.451	lb/MMBtu	Corbett, Koehler. Revised: 05/03
OSR Main Ship ICE Propulsion (Cat/3608)			0.17	g/kW-hr	0.044	lb/MMBtu	Caterpillar 3608 Specification Sheet, DM5529, 10/06
OSR Work Boat ICE Propulsion Engines			0.077	g/hp-hr	0.024	lb/MMBtu	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06
$PM_{2.5}$							
All emissions units	100% PM_{10}	except the following:					
Discoverer Incinerator			7	lb/ton	0.0035	lb/lb	ORR
Ice Breaker IC Engines					0.22	lb/MMBtu	generic factors consistent w/Ice breaker ORR
Ice Management & OSR Incinerators			9.1	lb/ton	0.0046	lb/lb	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1
Resupply-transit & OSR Main Ship ICE Generators			1.54	g/kW-hr	0.362	lb/MMBtu	EPA Ref: IVL

SO_2 Factors- (Diesel Fuel)	S content	EF		EF		Reference
Discoverer & OSR Main Ship	0.0015% by wt.	0.00003	lb/lb fuel	0.0016	lb/MMBtu	Calculation
IB ICE, Resupply, OSR Work Boats	0.0015% by wt.	0.00003	lb/lb fuel	0.0016	lb/MMBtu	Calculation
Ice Breaker Boiler	0.0015% by wt.	142 S	lb/10^3	0.0016	lb/MMBtu	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98
Discoverer Incinerator		2.5	lb/ton	0.0013	lb/lb	ORR
All Other Incinerators		2.5	lb/ton	0.0013	lb/lb	AP42 Table 2.1-12, 10/96

CO Factors	EF	EF		EF		Reference
Discoverer generator engines (Cat/D399)	882.7 g/hr	1.47E-03	lb/hp-hr	0.200	lb/MMBtu	Caterpillar D399 SCAC Engine Data Sheet, 05/95
Disco Prop., Ice Mngt ICE, Resupply-transit, OSR Main G	3.34 g/kW	5.50E-03	lb/hp-hr	0.786	lb/MMBtu	AP42 Table 3.4-1, 10/96
Discoverer emergency generator (Cat/3304)		6.2	g/bhp-hr	1.953	lb/MMBtu	Max of 13 test from EPA/600/8-90/057F
Discoverer MLC Compressors (Cat/C-15)		3.5	g/kW-hr	0.868	lb/MMBtu	Tier 3 emission limit
Discoverer HPU Engines (Detroit/8V71)		2.99	g/bhp-hr	0.844	lb/MMBtu	Max of 2 test from EPA/600/8-90/057F
Discoverer Cranes (Cat/D343)	593.6 g/hr	3.59E-03	lb/hp-hr	0.473	lb/MMBtu	Caterpillar D343 Engine Data Sheet, 05/95
Discoverer Cementing FD-16-17 Hourly		2.99	g/bhp-hr	0.844	lb/MMBtu	Max of 2 test from EPA/600/8-90/057F
Discoverer Cementing & Logging FD-18 Hourly FD-16-20 Daily & Annual		6.55	g/bhp-hr	1.850	lb/MMBtu	Max of 6 test from EPA/600/8-90/057F
Discoverer Logging Winch FD-19 Hourly		3.5	g/kW-hr	0.868	lb/MMBtu	Tier 3 emission limit
Discoverer Logging Generator FD-20 Hourly		5.5	g/kW-hr	1.293	lb/MMBtu	Tier 2 emission limit
Discoverer boilers		14.8	lb/day	0.077	lb/MMBtu	Clayton Industries, 8/2001
Discoverer Incinerator		31	lb/ton	0.0155	lb/lb	AP42 Table 2.2-1, multiple hearth
Ice Breaker Boiler		5	lb/10^3 gal	0.038	lb/MMBtu	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98
All Other Incinerators		300	lb/ton	0.1500	lb/lb	AP42 Table 2.1-12, 10/96
Resupply Ship-docked & OSR Work Boat Generators				0.95	lb/MMBtu	AP42 Table 3.3-1, 10/96
OSR Main Ship ICE Propulsion (Cat/3608)		0.73	g/kW-hr	0.190	lb/MMBtu	Caterpillar 3608 Specification Sheet, DM5529, 10/06
OSR Work Boat ICE Propulsion Engines		0.155	g/hp-hr	0.049	lb/MMBtu	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06

VOC Factors	EF		EF		Reference
Discoverer generator engines (Cat/D399)	75.5	g/hr	0.017	lb/MMBtu	Caterpillar D399 SCAC Engine Data Sheet, 05/95
Discoverer propulsion engine			0.09	lb/MMBtu	AP42 Table 3.4-1, 10/96
Discoverer emergency generator (Cat/3304)	1.2	g/bhp-hr	0.366	lb/MMBtu	Max of 13 test from EPA/600/8-90/057F
Discoverer MLC Compressors (Cat/C-15)	4.0	g/kW-hr	0.993	lb/MMBtu	Tier 3 emission limit
Discoverer HPU Engines (Detroit/8V71)	1.5	g/bhp-hr	0.418	lb/MMBtu	Max of 2 test from EPA/600/8-90/057F
Discoverer Cranes (Cat/D343)	172.6	g/hr	0.138	lb/MMBtu	Caterpillar D343 Engine Data Sheet, 05/95
Discoverer Cementing FD-16-18 & Logging FD-19	3.00	g/bhp-hr	0.847	lb/MMBtu	Tier 3 emission limit
Discoverer John Deere Logging Generator	7.5	g/kW-hr	1.763	lb/MMBtu	Tier 2 emission limit
Discoverer boilers	0.27	lb/day	0.001	lb/MMBtu	Clayton Industries, 8/2001
Discoverer Incinerator	3	lb/ton	0.0015	lb/lb	AP42 Table 2.1-12, 10/96
Ice Mngt ICE, Resupply-transit & OSR Main Gen.	0.6	g/kW-hr	0.141	lb/MMBtu	Corbett, Koehler. Revised: 05/03
Ice Breaker Boiler	0.34	lb/10^3 gal	0.003	lb/MMBtu	AP42 Table 1.3-3, Commercial, Distillate oil fired , 9/98
All Other Incinerators	100	lb/ton	0.0500	lb/lb	AP42 Table 2.1-12, 10/96
Resupply Ship-docked & OSR Work Boat Generators			0.35	lb/MMBtu	AP42 Table 3.3-1, 10/96
OSR Main Ship ICE Propulsion (Cat/3608)	0.99	g/kW-hr	0.257	lb/MMBtu	Caterpillar 3608 Specification Sheet, DM5529, 10/06
OSR Work Boat ICE Propulsion Engines	0.078	g/hp-hr	0.025	lb/MMBtu	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06

Yearly Table Page 17 Notes

1 Units FD-1-6 (Generator Engines) instantaneous capacity restriction, SCR NOx control effectiveness and Oxidation Catalyst reduction efficiencies applied
2 Not used during drilling
3 Unit FD-8 (Emergency Generator) operation assumed for 120 min/week Ref: Wright, Alistair email to Anthony Wilson, 1/21/09.
4 Units FD-9-11 (MLC Compressors) operational restriction applied
5 CDPF PM & CO reduction efficiencies applied
6 Units FD-12 & FD-13 (HPU Engines) operational restriction applied
7 Units FD-14 & 15 (Cranes) operating restriction applied
8 Units FD-16, 17 & 18 (Cementing units) operating capacity restriction applied
9 Units FD-19 & 20 (Logging Winches) cannot operate simultaneously with cementing units, emissions combined with cementing units. 0%
10 Resupply Ship-docked maximum use 12 hr/day , 8 days/yr
11 ICE Engine NOx emissions are calculated at 38% of 168 days/yr, Remaining are calculated at 38% of 168 days/yr
12 Anchor Handler maximum use 168 days/yr
13 Resupply Ship-transit maximum use 8 trips/yr , 4 hr/trip
14 OSR Main Ship Propulsion and Generator Engines restriction applied

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Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
	PROJECT NO: 180-15-1	PAGE: 21	OF: 21
ENGINEERING CALCULATIONS	SUBJECT: Discoverer Emissions-AK OCS	DATE: September 14, 2009	

HAPs Emission Factors -(from AP42)

ICE Engines Emission Factors
AP42 Table 3.3-2, Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines

Pollutant	EF lb/MMBtu
Acaldehyde	7.67E-04
Acenaphthene	1.42E-06
Acenaphthylene	5.06E-06
Acrolein	9.25E-05
Anthracene	1.87E-06
Benzene	9.33E-04
Benzo(a)anthracene	1.68E-06
Benzo(a)pyrene	1.88E-07
Benzo(b)fluoranthene	9.91E-08
Benzo(g,h,I)perylene	4.89E-07
Benzo(k)fluoranthene	1.55E-07
1,3-Butadiene	3.91E-05
Chrysene	3.53E-07
Dibenz(a,h)anthracene	5.83E-07
Fluoranthene	7.61E-06
Fluorene	2.92E-05
Formaldehyde	1.18E-03
Indeno(1,2,3-cd)pyrene	3.75E-07
Naphthalene	8.48E-05
Phenanthrene	2.94E-05
Pyrene	4.78E-06
Toluene	4.09E-04
Xylenes	2.85E-04

Boiler Emission Factors
AP42 Table 1.3-9, Emission Factors For Speciated Organic Compounds From Fuel Oil Combustion

Pollutant	lb/10^3 gal	EF lb/MMBtu
Acenaphthene	2.11E-05	1.59E-07
Acenaphthylene	2.53E-07	1.90E-09
Anthracene	1.22E-06	9.17E-09
Benzene	2.14E-04	1.61E-06
Benz(a)anthracene	4.01E-06	3.01E-08
Benzo(b,k)fluoranthene	1.48E-06	1.11E-08
Benzo(g,h,i)perylene	2.26E-06	1.70E-08
Chrysene	2.38E-06	1.79E-08
Dibenzo(a,h)anthracene	1.67E-06	1.25E-08
Ethylbenzene	6.36E-05	4.78E-07
Fluoranthene	4.84E-06	3.64E-08
Fluorene	4.47E-06	3.36E-08
Formaldehyde	3.30E-02	2.48E-04
Indo(1,2,3-cd)pyrene	2.14E-06	1.61E-08
Naphthalene	1.13E-03	8.49E-06
Phenanthrene	1.05E-05	7.89E-08
Pyrene	4.25E-06	3.19E-08
Toluene	6.20E-03	4.66E-05
o-Xylene	1.09E-04	8.19E-07

Incinerator Emission Factors

Table 1.3-10. Emission Factors For Trace Elements From Distillate Fuel Oil Combustion Sources

Metal		lb/10^{12} Btu	EF lb/MMBtu
Arsenic	As	4	4.00E-06
Cadmium	Cd	3	3.00E-06
Chromium	Cr	3	3.00E-06
Lead	Pb	9	9.00E-06
Mercury	Hg	3	3.00E-06
Nickel	Ni	3	3.00E-06
Total HAPs			3.31E-04

Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

Metal		lb/ton	lb/lb
Arsenic	As	4.37E-03	2.19E-06
Cadmium	Cd	1.09E-02	5.45E-06
Chromium	Cr	8.97E-03	4.49E-06
Lead	Pb	2.13E-01	1.07E-04
Mercury	Hg	5.60E-03	2.80E-06
Nickel	Ni	7.85E-03	3.93E-06
Total HAPs		2.51E-01	1.25E-04

Metal		lb/MMBtu	
Arsenic	As		4.90E-06
Cadmium	Cd	11 lb/10^{12} Btu	1.10E-05
Chromium	Cr	0.35 lb/10^6 gal	2.63E-06
Lead	Pb		2.9E-05
Mercury	Hg	6.2 lb/10^{12} Btu	6.20E-06
Nickel	Ni	0.41 lb/10^6 gal	3.08E-06
Total HAPs			3.93E-03

ICE Metal References

Arsenic	L & E Air Emissions from Sources of Arsenic and Arsenic Compounds, EPA-454/R-98-013, June 1998, Table 4-20, Distillate Oil Fired Turbine
Cadmium	L & E Air Emissions from Sources of Cadmium and Cadmium Compounds, EPA-454/R-93-040, Sept. 1993, Table 6-12, No. 2 Distillate Oil
Chromium	L & E Air Emissions from Sources of Chromium, EPA-450/4-84-007g, July 1984, Table 36, Distillate #2
Lead	L & E Air Emissions from Sources of Lead and Lead Compounds, EPA 454/R-98-006, May 1998, Section 5.2.2, Distillate oil-fired gas turbines
Mercury	L & E Air Emissions from Sources of Mercury and Mercury Compounds, EPA-454/R-97-012, Dec. 1997, Table 6-12, Distillate No. 2
Nickel	L & E Air Emissions from Sources of Nickel, EPA-450/4-84-007f, March 1984, Table 26, Distillate #2

APPENDIX C

Emission Control Technology Review and References

Air Sciences Inc.	PROJECT TITLE: Discoverer Major Source Permit	BY: K. Lewis		
ENGINEERING CALCULATIONS	PROJECT NO: 180 - 15 - 6	PAGE: 1	OF: 3	SHEET: 1
	SUBJECT: CDPF PM Control Cost - Generators	DATE: February 19, 2009		

I. PM CONTROL EMISSION REDUCTION

			Reference
CDPF average control effectiveness	=	85.0%	California EPA Air Resource Board, *Verification Procedure - Currently Verified CleanAIR Systems PERMIT*, January 2009.

Discoverer-Generators	Model	Caterpillar / D399	Reference
Generators	1,325	hp units	
max number of units operating	6		
max power out	7,950	hp	
PM Emissions Factor	251.2	g/hr	Caterpillar D399 Engine Data Sheet, 05/95.

Uncontrolled emissions from Inventory:

0.554 Max lb PM/hr, each unit
3.323 Max lb PM/hr, total units

	Maximum		Expected		
% use			80%		
Use-days:	168	days/yr	134.4	days/yr	per unit
Units Operating	6		6		
Annual uncontrolled PM	6.699	tons/yr	5.359	tons/yr	total units
Annual controlled PM:	1.005	tons/yr	0.804	tons/yr	total units
Effectiveness of ctrl system	5.694	tons/yr	4.555	tons/yr	total units

Labor cost	$1,600	/day	$200 /hour	Craik, Keith, email to R. Steen, 02/19/09.

Conversions:		
	2,000	lb/ton
	24	hr/day
	453.59	g/lb

Reference Manual: *EPA Air Pollution Control Cost Manual, Sixth Edition, EPA-452-02-001*, January 2002.

Air Sciences Inc.	PROJECT TITLE: Discoverer Major Source Permit	BY: K. Lewis		
ENGINEERING CALCULATIONS	PROJECT NO: 180 - 15 - 6	PAGE: 2	OF: 3	SHEET: 1
	SUBJECT: CDPF PM Control Cost - Generators	DATE: February 19, 2009		

II. TOTAL CAPITAL INVESTMENT - DIRECT CAPITAL COSTS

				Reference
CleanAir CDPF Cost	$19,491.00 for	335 hp Cementing Unit		CleanAIR Systems, CDPF Invoice, 04/16/07.
Adjusted CDPF Cost	$77,091.27 for	1,325 hp Generator		

Purchased equipment costs

			Factor	Discoverer	
DPF Equipment	$77,091.27 each	6 units	A	$462,547.61	total units
Instrumentation			10% A	$46,254.76	
Sales taxes			3% A	$13,876.43	
Freight			5% A	$23,127.38	
Purchased Equipment Cost			18% A=B	$545,806.18	total units
Total Direct Capital Cost, DCC			B	**$545,806.18**	total units

III. TOTAL CAPITAL INVESTMENT - INDIRECT CAPITAL COSTS

Installation Indirect Costs

General Facilities	5% x B	$693.82	
Engineering and Home Office Fees	10% x B	$1,387.64	
Process Contingencies	5% x B	$693.82	
Total Indirect Installation Costs	20% x B=C	**$2,775.29**	total units
Project Contingency	15% x(B+C)=D	$82,287.22	
Total Plant Cost	B+C+D=E	**$630,868.69**	
Allowance for Funds During Construction	F	$0.00	for SCR
Royalty Allowance	G	$0.00	for SCR
Preproduction Cost	2% x (E+F)=H	$12,617.37	

IV. TOTAL CAPITAL INVESTMENT

Total Capital Investment, TCI	**$643,486.06**	total units

V. ANNUALIZED COST RECOVERY FACTOR

Diesel Particulate Filter

life (n)	=	7 yrs			EPA 420-F-03-017, June 2003, Pg 3.
cost of money (i)	=	6%			
1 + I	=	1.06			
CRF	=	$\frac{i}{(1-(1+i)^{-n})}$	=	0.1791	Manual, Sec. 4.2, Ch. 2, Eq. 2.53.

Air Sciences Inc.	PROJECT TITLE: Discoverer Major Source Permit	BY: K. Lewis		
	PROJECT NO: 180 - 15 - 6	PAGE: 3	OF: 3	SHEET: 1
ENGINEERING CALCULATIONS	SUBJECT: CDPF PM Control Cost - Generators	DATE: February 19, 2009		

VI. TOTAL ANNUAL INVESTMENT - DIRECT ANNUAL OPERATING COSTS

		Discoverer	
Operating labor			
Operator	NOT ESTIMATED	$0.00	
Supervisor	NOT ESTIMATED	$0.00	
Maintenance	1.5% x TCI	$9,652.29	total units
Utilities			
Electricity			
Annual Electricity cost= Power x Cost of Electricity x Total operating time		$0.00	
Power =	0 kW		
Filter Replacement	NEGLIGIBLE [1]	$0.00	
[1] From CleanAIR Systems PERMIT™ Filter Manual.			
	Total Direct Annual Cost, DAC	$9,652.29	

VII. TOTAL ANNUAL INVESTMENT - INDIRECT ANNUAL OPERATING COSTS

IDAC = CRF x TCI		$115,270.89	
	Total Indirect Annual Cost, IDAC	**$115,270.89**	total units

VIII. TOTAL ANNUAL INVESTMENT

Total Annual Cost, TAC	**$124,923.18**	total units
Expected Control Effectiveness ($/ton)	**$27,424.34**	total units
Maximum Control Effectiveness ($/ton)	**$21,939.47**	total units

Table C-1. Cam Shaft Cylinder Reengineering Kit

Fields	Value	References
Cost of diesel:	$2.79	http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm
Incremental Fuel Consumption	12%	http://www.arb.ca.gov/diesel/documents/rrpapp9.pdf
HC to ROG Conversion	1.26639	
Grams per Ton	907184.74	
Shipping Cost (two way)	$30,000	Shell
On-site Labor	$20,000	Shell

HPU	175-300 HP		Assumptions and References
	Tier 0 Baseline	CCTS	
NOx Emission Std (g/bhp-hr)	9.81	5.8	Offroad Engine Emission Standards
PM Emission Std (g/bhp-hr)	0.19	0.16	http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
HC Emission Std (g/bhp-hr)		1.00	CCTS EF: CARB certification claims
Average Horsepower (hp)	250	250	Permit Application
Load Factor	0.5	0.5	Assume 50% load
Activity (hr/yr)	1512	1512	Assume 24 hr/day operation for 63 days
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	
Fuel Usage (gal/yr)	19791	22165	Fuel penalty ranges between 0%-12%; assume worst case of 12%
Fuel Cost ($/yr)	55,156	61,775	
Incremental Fuel Cost/yr		$6,619	
Incremental Capital Cost		$6,100	http://www.arb.ca.gov/diesel/documents/rrpapp9.pdf
Shipping + Labor		$50,000	Shell
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$6,917	4% interest
NOx Emission Factor (g/hr)	1226	725	
PM Emission Factor (g/hr)	24	20	
HC Emission Factor (g/hr)	0	125	
NOx (tons/year)	2.04	1.21	
PM (tons/year)	0.04	0.03	
HC (tons/year)	-	0.21	
NOx Reduction (tons/year)		0.84	
PM Reduction (tons/year)		0.01	
HC Reduction (tons/year)		(0.21)	
NOx Cost-Effectiveness		***$16,202***	

Cementing Units	300-600 HP		Assumptions and References
	Tier 0 Baseline	CCTS	
NOx Emission Std (g/bhp-hr)	9.81	5.8	Offroad Engine Emission Standards
PM Emission Std (g/bhp-hr)	0.29	0.16	http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
HC Emission Std (g/bhp-hr)		1.00	CCTS EF: CARB certification claims
Average Horsepower (hp)	335	335	Permit Application
Load Factor	0.5	0.5	Assume 50% load
Activity (hr/yr)	1121	1121	Assume 27.8% per day operation for 168 days
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	
Fuel Usage (gal/yr)	19660	22019	
Fuel Cost ($/yr)	54,792	61,367	
Incremental Fuel Cost/yr		$6,575	
Incremental Capital Cost		$7,500	http://www.arb.ca.gov/diesel/documents/rrpapp9.pdf
Shipping + Labor		$50,000	Shell
Useful Life (years)	10	10	4% interest
Annualized Capital Cost ($/yr)		$7,089	
NOx Emission Factor (g/hr)	1643	972	
PM Emission Factor (g/hr)	48	27	
HC Emission Factor (g/hr)	0	168	
NOx (tons/year)	2.74	1.62	
PM (tons/year)	0.08	0.04	
HC (tons/year)	-	0.28	
NOx Reduction (tons/year)		1.12	
PM Reduction (tons/year)		0.04	
HC Reduction (tons/year)		(0.28)	
NOx Cost-Effectiveness		***$12,206***	

Table C-2. Engine Replacement

Fields	Value	References
HC to ROG Conversion	1.26639	
grams per ton	907184.14	
Shipping Cost (one way)	$15,000	Shell
On-site Labor	$20,000	Shell

Cost estimate given by Shell

HPU	175-300 HP		Assumptions and References
	Tier 0 Baseline	Tier 3 Engines	
NOx Emission Std (g/bhp-hr)	9.81	2.99	Offroad Engine Emission Standards http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
PM Emission Std (g/bhp-hr)	1.26	0.15	
CO Emission Std (g/bhp-hr)	2.99	2.60999254	
Average Horsepower (hp)	250	250	Permit Application
Load Factor	0.50	0.50	Assume 50% load
Activity (hr/yr)	1,512	1,512	Assume 24 hr/day operation for 63 days
Incremental Capital Cost		$ 100,000	Shell esimate
Shipping + Labor Cost		$ -	Shell esimate
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$12,329	4% interest
NOx Emission Factor (g/hr)	1226	373	
PM Emission Factor (g/hr)	158	19	
HC Emission Factor (g/hr)	374	326	
NOx (tons/year)	2.04	0.62	
PM (tons/year)	0.26	0.03	
HC (tons/year)	0.62	0.54	
NOx Reduction (tons/year)		1.42	
PM Reduction (tons/year)		0.23	
HC Reduction (tons/year)		0.08	
Cost-Effectiveness NOx ($/ton)		***$8,671***	
Cost-Effectiveness PM ($/ton)		***$53,278***	
Cost-Effectiveness CO ($/ton)		***$155,730***	

Cementing Units Unit Replacement	100-175 HP		300-600 HP		Assumptions and References
	Tier 0 Baseline	Tier 3 Engines	Tier 0 Baseline	Tier 3 Engine	
NOx Emission Std (g/bhp-hr)	11.72	2.99	11.72	2.99	Offroad Engine Emission Standards http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
PM Emission Std (g/bhp-hr)	1.92	0.15	1.92	0.15	
CO Emission Std (g/bhp-hr)	6.55	3.72856078	2.99	2.609992543	
Average Horsepower (hp)	147	147	335	335	Permit Application
Load Factor	0.5	0.5	0.50	0.50	Assume 50% load
Activity (hr/yr)	1121	1121	1121	1121	Assume 27.8% per day operation for 168 days
Incremental Capital Cost		$ 287,882		$ 656,059	Shell esimates $1.6M for 3 units
Useful Life (years)	10	10	10	10	
Annualized Capital Cost ($/yr)		$35,493		$80,886	4% interest
NOx Emission Factor (g/hr)	861	219	1963	500	
PM Emission Factor (g/hr)	141	11	322	25	
HC Emission Factor (g/hr)	481	274	501	437	
NOx (tons/year)	1.06	0.27	2.43	0.62	
PM (tons/year)	0.17	0.01	0.40	0.03	
HC (tons/year)	0.59	0.34	0.62	0.54	
NOx Reduction (tons/year)		0.79		1.81	
PM Reduction (tons/year)		0.16		0.37	
HC Reduction (tons/year)		0.26		0.08	
Cost-Effectiveness NOx ($/ton)		***$44,744***		***$44,744***	
Cost-Effectiveness PM ($/ton)		***$220,716***		***$220,716***	
Cost-Effectiveness CO ($/ton)		***$138,522***		***$1,028,483***	

Cranes	300-600 HP		Assumptions and References
	Tier 0 Baseline	Tier 3 Engines	
NOx Emission Std (g/bhp-hr)	7.7	2.99	Offroad Engine Emission Standards http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
PM Emission Std (g/bhp-hr)	0.36	0.15	
CO Emission Std (g/bhp-hr)	1.6283881	0.15	
Average Horsepower (hp)	365	365	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	504	504	Assume 8 hr/day operation for 63 days
Incremental Capital Cost		$ 65,000	Smith Power Products (Capital Cost + Installation)
Shipping + Labor Cost		$ 35,000	
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$12,329	4% interest
NOx Emission Factor (g/hr)	1405	545	
PM Emission Factor (g/hr)	66	27	
HC Emission Factor (g/hr)	297	27	
NOx (tons/year)	0.78	0.30	
PM (tons/year)	0.04	0.02	
HC (tons/year)	0.17	0.02	
NOx Reduction (tons/year)		0.48	
PM Reduction (tons/year)		0.02	
HC Reduction (tons/year)		-	
Cost-Effectiveness NOx ($/ton)		***$25,790***	
Cost-Effectiveness PM ($/ton)		***$576,997***	

Small Logging Generator	37kw - 56 kw		Assumptions and References
	Tier 2 Baseline	Tier 3 Engines	
NOx Emission Std (g/bhp-hr)	5.60	3.51	Offroad Engine Emission Standards http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm with CDPF
PM Emission Std (g/bhp-hr)	0.45	0.22	
HC Emission Std (g/bhp-hr)	4.10141685		
Average Horsepower (hp)	35	35	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	1121	1,121	Based on Cementing Units
Incremental Capital Cost		$ 20,000	Smith Power Products (Capital Cost + Installation)
Shipping + Labor Cost			
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$2,466	4% interest
NOx Emission Factor (g/hr)	98	61	
PM Emission Factor (g/hr)	8	4	
HC Emission Factor (g/hr)	72	0	
NOx (tons/year)	0.12	0.08	
PM (tons/year)	0.01	0.00	
HC (tons/year)	0.09	-	
NOx Reduction (tons/year)		0.05	
PM Reduction (tons/year)		0.00	
HC Reduction (tons/year)		-	
Cost-Effectiveness NOx ($/ton)		***$54,576***	
Cost-Effectiveness PM ($/ton)		***$509,374***	

Supply ship Generator	300-600 HP		Assumptions and References
	Tier 0 Baseline	Tier 3 Engines	
NOx Emission Std (g/bhp-hr)	14.00	2.99	Offroad Engine Emission Standards http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
PM Emission Std (g/bhp-hr)	0.98	0.10	
CO Emission Std (g/bhp-hr)	3.36	2.60999254	
Average Horsepower (hp)	292	292	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	96	96	Based on Cementing Units
Incremental Capital Cost		$ 50,000	Smith Power Products (Capital Cost + Installation)
Shipping + Labor Cost			
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$6,165	4% interest
NOx Emission Factor (g/hr)	2044	436	
PM Emission Factor (g/hr)	143	15	
CO Emission Factor (g/hr)	491	381	
NOx (tons/year)	0.22	0.05	
PM (tons/year)	0.02	0.00	0.10660981
CO (tons/year)	0.05	0.04	
NOx Reduction (tons/year)		0.17	
PM Reduction (tons/year)		0.01	
CO Reduction (tons/year)		0.01	
Cost-Effectiveness NOx ($/ton)		***$36,224***	
Cost-Effectiveness PM ($/ton)		***$455,728***	
Cost-Effectiveness CO ($/ton)		***$531,994***	

Table C-3. SCR Retrofits

Fields	Value	References
Cost of diesel (per gallon)	$2.79	http://tonto.eia.doe.gov/dnav/pet/pet_pri_gnd_dcus_nus_w.htm
Urea Cost (per gallon)	$3.00	Johnson and Matthey
NOx Reduction	70%	EPA Study (Nonroad Diesel Retrofit study)
PM Reduction	0%	
HC Reduction	0%	
HC to ROG Conversion	1.26639	
grams per ton	907184.14	
Cost of SCR system with initial catalyst installed	$85,000	Johnson and Matthey
Cost of Installation	$110,000	Johnson and Matthey
Cost of Catalyst (catalysit will be replaced at 6 years)	$8,000	Johnson and Matthey
Cost of Catalyst Maintenace (per year)	$7,500	Johnson and Matthey
Lifetime of Catalyst (years)	6	Johnson and Matthey
Urea Flow Rate (gal/hr) at full load	1.1	Johnson and Matthey
Shipping Cost (two way)		It is uncertain whether shipping and on-site labor are included
On-site Labor		in the Cost of installation above, so we have assumed $0 here.

MLC Air Compressors	300-600 HP		Assumptions and References
	Tier 3 Baseline	SCR	
NOx Emission Std (g/bhp-hr)	2.99	0.90	Offroad Engine Emission Standards http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
Average Horsepower (hp)	540	540	Permit Application
Load Factor	0.50	0.50	Assume 50% load
Activity (hr/yr)	1,512	1,512	Assume 24 hr/day operation for 63 days
Energy Consumption Factor (bhp-hr/gal)	19.1	19.1	
Fuel Usage (gal/yr)	42,748	42,748	
Urea Usage (gal/yr)		832	Assume linear relationship between load and urea usage
Fuel + Urea Cost ($/yr)	119,138	121,632	
Incremental Urea Fuel Cost/yr		$2,495	This is just urea cost = ($3/gal)(832 gal) <== Fuel is the same
Shipping + Labor Cost		$0	Assumed included - see note above
Cost system, installation and initial catalyst		$195,000	= Cost SCR system + Cost of Installation
Catalyst Replacement Cost		$5,333	= (4/6)(cost of catalyst) <=== Replaced catalyst has 4 years in proj.
ApplicableLife of replacement catalyst (years)		4	Catalyst lasts 6 years, but only 4 years applied to project
Total Capital Cost		$200,333	System (w/ catalyst) + installation + catalyst replacement
Useful Life (years)		10	
Annualized Capital Cost ($/yr)		$24,699	4% interest [Excel PMT function: -PMT(0.04,10,200333)]
Maintenance Cost Per year		$7,500	
Annual Cost		$34,694	Annualized Capital Cost + Maintenance + Incremental Urea
NOx Emission Factor (g/hr)	806	242	
NOx (tons/year)	1.34	0.40	
NOx Reduction (tons/year)		0.94	
Cost-Effectiveness, SCR only ($/ton)		$34,243	
CE Including Fuel & Urea ($/ton)		***$36,896***	

Table C-4. CDPF Addition to Specific Engines

Fields	Value	References
grams per ton	907184.14	

MLC Air Compressors	300-600 HP		Assumptions and References
	Tier 3 Baseline	CDPF	
			Offroad Engine Emission Standards
PM Emission Std (g/bhp-hr)	0.15	0.02	http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
			and 85% control assumed for CDPF
Average Horsepower (hp)	540	540	Permit Application
Load Factor	0.50	0.50	Assume 50% load
Activity (hr/yr)	1,512	1,512	Assume 24 hr/day operation for 63 days
Incremental Capital Cost		$19,491	Use cost for Cementing Unit
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$2,403	4% interest
PM Emission Factor (g/hr)	41	6	
PM (tons/year)	0.07	0.01	
PM Reduction (tons/year)		0.06	
Cost-Effectiveness PM ($/ton)		***$41,883***	

Supply ship Generator	300-600 HP		Assumptions and References
	Tier 0 Baseline	CDPF	
			AP-42 Table 3.3-1, 10/96 [0.31 lb/MMBtu and heat rate of 7,000 Btu/hp-hr]
PM Emission Std (g/bhp-hr)	0.98	0.15	(0.31 lb/MMBtu)(0.007 MMBtu/hp-hr)(453.59 g/lb) = 0.9843 g/hp-hr
			and 85% control for CDPF
Average Horsepower (hp)	292	292	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	96	96	Based on Cementing Units
Incremental Capital Cost		$ 19,491	Use cost for cementing unit
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$2,403	4% interest
PM Emission Factor (g/hr)	143	21	
PM (tons/year)	0.02	0.00	0.15
PM Reduction (tons/year)		0.01	
Cost-Effectiveness PM ($/ton)		***$186,720***	

Large Logging Engine (winch)	175-300 HP		Assumptions and References
	Tier 3 Baseline	CDPF	
			Offroad Engine Emission Standards
PM Emission Std (g/bhp-hr)	0.15	0.02	http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
			and 85% control assumed for CDPF
Average Horsepower (hp)	250	250	Permit Application
Load Factor	0.50	0.50	Assume 50% load
Activity (hr/yr)	1121	1,121	Assume 24 hr/day operation for 63 days
Incremental Capital Cost		$19,491	Use cost for Cementing Unit
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$2,403	4% interest
PM Emission Factor (g/hr)	19	3	
PM (tons/year)	0.03	0.00	
PM Reduction (tons/year)		0.03	
Cost-Effectiveness PM ($/ton)		***$90,467***	

Table C-5. OxyCat Addition to Specific Engines

Fields	Value	References
grams per ton	907184.14	

MLC Air Compressors	300-600 HP		Assumptions and References
	Tier 3 Baseline	OxyCat	
			Offroad Engine Emission Standards
PM Emission Std (g/bhp-hr)	0.15	0.08	http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
			and 50% control for OxyCat
Average Horsepower (hp)	540	540	Permit Application
Load Factor	0.50	0.50	Assume 50% load
Activity (hr/yr)	1,512	1,512	Assume 24 hr/day operation for 63 days
Installation Cost		$5,000	Environ Estimate
Incremental Capital Cost		$3,798	LADCO Report
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$1,085	4% interest
PM Emission Factor (g/hr)	41	20	
PM (tons/year)	0.07	0.03	
PM Reduction (tons/year)		0.03	
Cost-Effectiveness PM ($/ton)		***$32,139***	

Supply ship Generator	300-600 HP		Assumptions and References
	Tier 0 Baseline	OxyCat	
			AP-42 Table 3.3-1, 10/96 [0.31 lb/MMBtu and heat rate of 7,000 Btu/hp-hr]
PM Emission Std (g/bhp-hr)	0.98	0.49	(0.31 lb/MMBtu)(0.007 MMBtu/hp-hr)(453.59 g/lb) = 0.9843 g/hp-hr
			and 50% control for OxyCat
Average Horsepower (hp)	292	292	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	96	96	Based on Cementing Units
Installation Cost		$5,000	Environ Estimate
Incremental Capital Cost		$ 2,000	LADCO Report
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$863	4% interest
PM Emission Factor (g/hr)	143	72	
PM (tons/year)	0.02	0.01	0.5
PM Reduction (tons/year)		0.01	
Cost-Effectiveness PM ($/ton)		***$113,999***	

Large Logging Engine (winch)	175-300 HP		Assumptions and References
	Tier 3 Baseline	OxyCat	
			Offroad Engine Emission Standards
PM Emission Std (g/bhp-hr)	0.15	0.08	http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
			and 50% control for OxyCat
Average Horsepower (hp)	250	250	Permit Application
Load Factor	0.50	0.50	Assume 50% load
Activity (hr/yr)	1121	1,121	Assume 24 hr/day operation for 63 days
Shipping Plus Labor		$5,000	
Incremental Capital Cost		$2,000	LADCO Report
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$863	4% interest
PM Emission Factor (g/hr)	19	9	
PM (tons/year)	0.03	0.02	
PM Reduction (tons/year)		0.02	
Cost-Effectiveness PM ($/ton)		***$55,233***	

Table C-6. DPF Addition to Specific Engines

Supply ship Generator	300-600 HP		Assumptions and References
	Tier 0 Baseline	Tier 3 + DPF	
			AP-42 Table 3.3-1, 10/96 [0.31 lb/MMBtu and heat rate of 7,000 Btu/hp-hr]
PM Emission Std (g/bhp-hr)	0.98	0.49	(0.31 lb/MMBtu)(0.007 MMBtu/hp-hr)(453.59 g/lb) = 0.9843 g/hp-hr
			and 50% control for DPF
Average Horsepower (hp)	292	292	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	96	96	Based on Cementing Units
Incremental Capital Cost		$ 9,000	LADCO Report
Installation Cost		$ 5,000	Environ Estimate
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$1,726	4% interest
PM Emission Factor (g/hr)	143	72	
PM (tons/year)	0.02	0.01	0.5
PM Reduction (tons/year)		0.01	
Cost-Effectiveness PM ($/ton)		***$227,999***	

Table C-7. MLC Compressor Engines CDPF CO BACT			
DIRECT COSTS		**COST**	**Source**
I. Purchased Equipment			
a. Primary Equipment		$25,000	Smith Power Products, Inc
b. Instrumentation (None)		$0	
c. Sales tax (0.08*a)		$0	OAQPS
d. Freight (0.05*a)		$1,250	OAQPS
	Total Purchases Equipment Cost [TEC]	$26,250	*Calculation*
II. Direct Installation Costs			
a. Foundations and Supports (0.08*TEC)		$0	OAQPS
b. Handling and Erection (0.14*TEC)		$3,675	OAQPS
c. Electrical (0.04*TEC)		$0	OAQPS
d. Piping (0.02*TEC)		$525	OAQPS 6" stainless
e. Insulation for Ductwork (0.01*TEC)		$263	OAQPS
f. Painting (0.01*TEC)		$0	OAQPS
	Total Direct Costs [TDC](I+II)	$4,463	*Calculation*
INDIRECT COSTS			
III. Indirect Installation			
a. Engineering and Supervision (0.10*TEC)		$2,625	OAQPS
b. Construction and Field Expenses (0.05*TEC)		$1,313	OAQPS
c. Contractor Fee		$7,000	Smith Power Products, Inc.
d. Contractor travel		$5,000	Shell Estimate
e. Contingencies (0.03*TEC)		$788	OAQPS
IV. Other Indirect Costs			
a. Startup and Testing (0.03*TEC)		$788	OAQPS
b. Working Capital (30 days of direct operating costs [I-VII below/12])		$8	OAQPS
	Total Indirect Costs [TIC](III+IV)	$17,521	*Calculation*
	Total Capital Costs [TCC] (TEC+TDC+TIC)	$48,233	*Calculation*
	Total Annualized Capital Costs [TACC] (5 years @ 7% interest)	**$11,764**	*Calculation*
	DIRECT ANNUALIZED COSTS		
DIRECT OPERATING COSTS (DOC)			
I. Labor for operations ($100/person-hour)		$0	Engineering Estimate
II. Supervisory Labor (0.15* operations labor)		$0	OAQPS
III. Maintenance Labor ($100/person-hour)(1 hr/yr)		$100	Engineering Estimate
IV. Replacement Parts			
a. None		$0	Engineering Estimate
V. ULSD Fuel Cost = (none)		$0	Pettit Oil (2004)
VI. Urea costs =(none)		$0	CCA (2004)
VII. Fuel Penalty (5% reduction if fuel econ.) (21.3 gal/hr)*(500 hr/yr)*($1.90/gal)*(0.05)		$0	Unknown. 3" water backpressure
INDIRECT OPERATING COSTS (IOC)			
VIII. Overhead (0.6*O&M costs(I-III of DOC)		$0	OAQPS
IX. Administration (0.02*TCC)		$0	OAQPS
X. Insurance (0.01*TCC)		$482	OAQPS
	Total Direct Annualized Costs [TDAC] (DOC+IOC)	**$582**	*Calculation*
	TOTAL ANNUALIZED COSTS SCR [TAC_{SCR}] (TACC+TAC)	**$12,346**	*Calculation*

	CO		**Total**	
Baseline emissions	1.567	tons/year		*Calculation*
Controlled emissions (80% control)	0.313	tons/year		*Calculation*
Reduction from baseline	1.254	tons/year	1.3	*Calculation*
Cost per ton Conrolled		***$/ton***	**$ 9,848**	*Calculation*

OAQPS	"EPA Air Pollution Cost Manual" Sixth Edition, January 2002, EPA/452/B-02-001
	Office of Air Quaility Planning and Standards (OAQPS).

Table C-8. Logging Winch CDPF CO BACT									
DIRECT COSTS								**COST**	**Source**
I. Purchased Equipment									
	a. Primary Equipment							$12,500	Smith Power Products, Inc
	b. Instrumentation (None)							$0	
	c. Sales tax (0.08*a)							$0	OAQPS
	d. Freight (0.05*a)							$625	OAQPS
					Total Purchases Equipment Cost [TEC]			$13,125	*Calculation*
II. Direct Installation Costs									
	a. Foundations and Supports (0.08*TEC)							$0	OAQPS
	b. Handling and Erection (0.14*TEC)							$1,838	OAQPS
	c. Electrical (0.04*TEC)							$0	OAQPS
	d. Piping (0.02*TEC)							$263	OAQPS 6" stainless
	e. Insulation for Ductwork (0.01*TEC)							$131	OAQPS
	f. Painting (0.01*TEC)							$0	OAQPS
						Total Direct Costs [TDC](I+II)		$2,231	*Calculation*
INDIRECT COSTS									
III. Indirect Installation									
	a. Engineering and Supervision (0.10*TEC)							$1,313	OAQPS
	b. Construction and Field Expenses (0.05*TEC)							$656	OAQPS
	c. Contractor Fee							$4,000	Smith Power Products, Inc.
	d. Contractor travel							$5,000	Shell Estimate
	e. Contingencies (0.03*TEC)							$394	OAQPS
IV. Other Indirect Costs									
	a. Startup and Testing (0.03*TEC)							$394	OAQPS
	b. Working Capital (30 days of direct operating costs [I-VII below/12])							$8	OAQPS
						Total Indirect Costs [TIC](III+IV)		$11,765	*Calculation*
					Total Capital Costs [TCC] (TEC+TDC+TIC)			$27,121	*Calculation*
				Total Annualized Capital Costs [TACC] (5 years @ 7% interest)				**$6,615**	*Calculation*
				DIRECT ANNUALIZED COSTS					
DIRECT OPERATING COSTS (DOC)									
I. Labor for operations ($100/person-hour)								$0	Engineering Estimate
II. Supervisory Labor (0.15* operations labor)								$0	OAQPS
III. Maintenance Labor ($100/person-hour)(1 hr/yr)								$100	Engineering Estimate
IV. Replacement Parts									
	a. None							$0	Engineering Estimate
V. ULSD Fuel Cost = (none)								$0	Pettit Oil (2004)
VI. Urea costs =(none)								$0	CCA (2004)
VII. Fuel Penalty (5% reduction if fuel econ.) (21.3 gal/hr)*(500 hr/yr)*($1.90/gal)*(0.05)								$0	Unknown. 3" water backpressure
INDIRECT OPERATING COSTS (IOC)									
VIII. Overhead (0.6*O&M costs(I-III of DOC)								$0	OAQPS
IX. Administration (0.02*TCC)								$0	OAQPS
X. Insurance (0.01*TCC)								$271	OAQPS
				Total Direct Annualized Costs [TDAC] (DOC+IOC)				**$371**	*Calculation*
				TOTAL ANNUALIZED COSTS SCR [TAC_{SCR}] (TACC+TAC)				**$6,986**	*Calculation*
						CO		**Total**	
Baseline emissions						2.623	tons/year		*Calculation*
Controlled emissions (80% control)						0.525	tons/year		*Calculation*
Reduction from baseline						2.099	tons/year	2.10	*Calculation*
Cost per ton Conrolled							***$/ton***	**$ 3,329**	*Calculation*
OAQPS	"EPA Air Pollution Cost Manual" Sixth Edition, January 2002, EPA/452/B-02-001								
	Office of Air Quaility Planning and Standards (OAQPS).								

Table C-9. Supply Ship Generator CDPF CO BACT

Fields	Value	References
grams per ton	907184.14	

Supply ship Generator	300-600 HP		Assumptions and References
	Tier 0 Baseline	CDPF	
			AP-42 Table 3.3-1, 10/96 [0.31 lb/MMBtu and heat rate of 7,000 Btu/hp-hr]
PM Emission Std (g/bhp-hr)	0.98	0.15	(0.31 lb/MMBtu)(0.007 MMBtu/hp-hr)(453.59 g/lb) = 0.9843 g/hp-hr
CO Emission Std (g/bhp-hr)	3.36	1.78	and 85% control for CDPF
Average Horsepower (hp)	292	292	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	96	96	Based on Cementing Units
Incremental Capital Cost		$ 19,491	Use cost for cementing unit
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$2,403	4% interest
PM Emission Factor (g/hr)	143	21	
CO Emission Factor (g/hr)	491	260	
PM (tons/year)	0.02	0.00	0.15
CO (tons/year)	0.05	0.03	
PM Reduction (tons/year)		0.01	
CO Reduction (tons/year)		0.02	
Cost-Effectiveness PM ($/ton)		***$186,720***	
Cost-Effectiveness CO ($/ton)		***$98,491***	

Table C-10. MLC Compressor Engines Oxycat CO BACT			
DIRECT COSTS		**COST**	**Source**
I. Purchased Equipment			
a. Primary Equipment		$4,560	Smith Power Products, Inc
b. Instrumentation (None)		$0	
c. Sales tax (0.08*a)		$0	OAQPS
d. Freight (0.05*a)		$228	OAQPS
	Total Purchases Equipment Cost [TEC]	$4,788	*Calculation*
II. Direct Installation Costs			
a. Foundations and Supports (0.08*TEC)		$0	OAQPS
b. Handling and Erection (0.14*TEC)		$0	OAQPS (see contractor fee)
c. Electrical (0.04*TEC)		$0	OAQPS
d. Piping (0.02*TEC)		$96	OAQPS 6" stainless
e. Insulation for Ductwork (0.01*TEC)		$48	OAQPS
f. Painting (0.01*TEC)		$0	OAQPS
	Total Direct Costs [TDC](I+II)	$144	*Calculation*
INDIRECT COSTS			
III. Indirect Installation			
a. Engineering and Supervision (0.10*TEC)		$479	OAQPS
b. Construction and Field Expenses (0.05*TEC)		$239	OAQPS
c. Contractor Fee		$1,200	Smith Power Products, Inc.
d. Contractor travel		$5,000	Shell Estimate
e. Contingencies (0.03*TEC)		$144	OAQPS
IV. Other Indirect Costs			
a. Startup and Testing (0.03*TEC)		$144	OAQPS
b. Working Capital (30 days of direct operating costs [I-VII below/12])		$8	OAQPS
	Total Indirect Costs [TIC](III+IV)	$7,214	*Calculation*
	Total Capital Costs [TCC] (TEC+TDC+TIC)	$12,145	*Calculation*
	Total Annualized Capital Costs [TACC] (5 years @ 7% interest)	**$2,962**	*Calculation*
	DIRECT ANNUALIZED COSTS		
DIRECT OPERATING COSTS (DOC)			
I. Labor for operations ($100/person-hour)		$0	Engineering Estimate
II. Supervisory Labor (0.15* operations labor)		$0	OAQPS
III. Maintenance Labor ($100/person-hour)(1 hr/yr)		$100	Engineering Estimate
IV. Replacement Parts			
a. None		$0	Engineering Estimate
V. ULSD Fuel Cost = (none)		$0	Pettit Oil (2004)
VI. Urea costs =(none)		$0	CCA (2004)
VII. Fuel Penalty (5% reduction if fuel econ.) (21.3 gal/hr)*(500 hr/yr)*($1.90/gal)*(0.05)		$0	Unknown. 3" water backpressure
INDIRECT OPERATING COSTS (IOC)			
VIII. Overhead (0.6*O&M costs(I-III of DOC)		$0	OAQPS
IX. Administration (0.02*TCC)		$0	OAQPS
X. Insurance (0.01*TCC)		$121	OAQPS
	Total Direct Annualized Costs [TDAC] (DOC+IOC)	**$221**	*Calculation*
	TOTAL ANNUALIZED COSTS SCR [TAC_{SCR}] (TACC+TAC)	**$3,184**	*Calculation*

	CO		**Total**	
Baseline emissions	1.567	tons/year		*Calculation*
Controlled emissions (47% control)	0.831	tons/year		*Calculation*
Reduction from baseline	0.736	tons/year	0.74	*Calculation*
Cost per ton Conrolled		***$/ton***	**$ 4,323**	*Calculation*

OAQPS	"EPA Air Pollution Cost Manual" Sixth Edition, January 2002, EPA/452/B-02-001
	Office of Air Quaility Planning and Standards (OAQPS).

Table C-11. Logging Winch Oxycat CO BACT			
DIRECT COSTS		**COST**	**Source**
I. Purchased Equipment			
a. Primary Equipment		$2,560	Smith Power Products, Inc
b. Instrumentation (None)		$0	
c. Sales tax (0.08*a)		$0	OAQPS
d. Freight (0.05*a)		$128	OAQPS
Total Purchases Equipment Cost [TEC]		$2,688	*Calculation*
II. Direct Installation Costs			
a. Foundations and Supports (0.08*TEC)		$0	OAQPS
b. Handling and Erection (0.14*TEC)		$376	OAQPS
c. Electrical (0.04*TEC)		$0	OAQPS
d. Piping (0.02*TEC)		$54	OAQPS 6" stainless
e. Insulation for Ductwork (0.01*TEC)		$27	OAQPS
f. Painting (0.01*TEC)		$0	OAQPS
Total Direct Costs [TDC](I+II)		$457	*Calculation*
INDIRECT COSTS			
III. Indirect Installation			
a. Engineering and Supervision (0.10*TEC)		$269	OAQPS
b. Construction and Field Expenses (0.05*TEC)		$134	OAQPS
c. Contractor Fee		$1,200	Smith Power Products, Inc.
d. Contractor travel		$5,000	Shell Estimate
e. Contingencies (0.03*TEC)		$81	OAQPS
IV. Other Indirect Costs			
a. Startup and Testing (0.03*TEC)		$81	OAQPS
b. Working Capital (30 days of direct operating costs [I-VII below/12])		$8	OAQPS
Total Indirect Costs [TIC](III+IV)		$6,773	*Calculation*
Total Capital Costs [TCC] (TEC+TDC+TIC)		$9,918	*Calculation*
Total Annualized Capital Costs [TACC] (5 years @ 7% interest)		**$2,419**	*Calculation*
DIRECT ANNUALIZED COSTS			
DIRECT OPERATING COSTS (DOC)			
I. Labor for operations ($100/person-hour)		$0	Engineering Estimate
II. Supervisory Labor (0.15* operations labor)		$0	OAQPS
III. Maintenance Labor ($100/person-hour)(1 hr/yr)		$100	Engineering Estimate
IV. Replacement Parts			
a. None		$0	Engineering Estimate
V. ULSD Fuel Cost = (none)		$0	Pettit Oil (2004)
VI. Urea costs =(none)		$0	CCA (2004)
VII. Fuel Penalty (5% reduction if fuel econ.) (21.3 gal/hr)*(500 hr/yr)*($1.90/gal)*(0.05)		$0	Unknown. 3" water backpressure
INDIRECT OPERATING COSTS (IOC)			
VIII. Overhead (0.6*O&M costs(I-III of DOC)		$0	OAQPS
IX. Administration (0.02*TCC)		$0	OAQPS
X. Insurance (0.01*TCC)		$99	OAQPS
Total Direct Annualized Costs [TDAC] (DOC+IOC)		**$199**	*Calculation*
TOTAL ANNUALIZED COSTS SCR [TAC_{SCR}] (TACC+TAC)		**$2,618**	*Calculation*

	CO		**Total**	
Baseline emissions	2.623	tons/year		*Calculation*
Controlled emissions (47% control)	1.390	tons/year		*Calculation*
Reduction from baseline	1.233	tons/year	1.2	*Calculation*
Cost per ton Conrolled		***$/ton***	**$ 2,123**	*Calculation*

OAQPS "EPA Air Pollution Cost Manual" Sixth Edition, January 2002, EPA/452/B-02-001

Office of Air Quaility Planning and Standards (OAQPS).

Table C-12. Supply Ship Generator OxyCat CO BACT

Fields	Value	References
grams per ton	907184.14	

Supply ship Generator	300-600 HP		Assumptions and References
	Tier 0 Baseline	OxyCat	
			AP-42 Table 3.3-1, 10/96 [0.31 lb/MMBtu and heat rate of 7,000 Btu/hp-hr]
PM Emission Std (g/bhp-hr)	0.98	0.49	(0.31 lb/MMBtu)(0.007 MMBtu/hp-hr)(453.59 g/lb) = 0.9843 g/hp-hr
CO Emission Std (g/bhp-hr)	3.36	1.008	and 50% control for OxyCat
Average Horsepower (hp)	292	292	Permit Application
Load Factor	0.50	0.50	Variable, here assume 50% load
Activity (hr/yr)	96	96	Based on Cementing Units
Installation Cost		$5,000	Environ Estimate
Incremental Capital Cost		$ 2,000	LADCO Report
Useful Life (years)	10	10	
Annualized Capital Cost ($/yr)		$863	4% interest
PM Emission Factor (g/hr)	143	72	
CO Emission Factor (g/hr)	491	147	
PM (tons/year)	0.02	0.01	0.5
CO (tons/year)	0.05	0.02	
PM Reduction (tons/year)		0.01	
CO Reduction (tons/year)		0.04	
Cost-Effectiveness PM ($/ton)		***$113,999***	
Cost-Effectiveness CO ($/ton)		***$23,750***	

DEC
Marine

Diesel Emission Control
Date 2008-10-09

D. E. C. Marine AB
c/o Munters
P. O. Box 131
SE-421 22 VÄSTRA FRÖLUNDA
Sweden
2008-10-09

Mr. Keith Craik
Shell

Re: SCR/OxyCat control technology and attainable control efficiencies – Discoverer D399 Engines

Dear Mr. Craik:

At Shell's request we are providing herein an explanation of the capability of SCR / OxyCat systems for controlling nitrogen oxides (NOx) and combustibles (CO, VOCs) for marine applications. D. E. C. Marine has been installing such control systems on marine vessels since 1991 and has installed them on more than 70 vessels since then. D. E. C. has installed more of these in the world than any other company. We have also performed systematic tests together with Ministry of Defense for test bed development. For years we have been leading in the development within this field, by increasing performance quality while also continuously improving emission reduction rates. Our developmental tests, performed in co-operation with the SMA (Swedish Maritime Administration), have been trend-setting for the development within the marine sector.

With regard to the SCR technology, these systems are now capable under the proper balance of environmental and operational conditions to control to 0.1 grams per kW-hour of NOx, and the system proposed for the Discoverer Cat D399 engines should reach these control levels occasionally. However, because of the continually varying operating level of the Discoverer engines and severe environmental conditions these control levels cannot be attained continually. For the operational parameters provided D. E. C. which include NOx control in the operating range between 50-100 percent of the engines load capacity, and for guaranty purposes, the level of 0.5 grams per kW-hour is as low as can be reached reliably with currently available SCR control technology.

This system proposed for the Discoverer uses a tuned urea injection system where the rate of urea injection is a function of engine operating load, to continually adjust the urea injection rate. Furthermore, the system includes a NOx exhaust analyzer that sequences through the six engines to provide a direct emission measurement on a once per engine per hour frequency. This analyzer can provide measurements for compliance

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demonstration purposes, but is included in the SCR control system to provide a means for the urea injection algorithm to be optimized over time, essentially by learning.

The oxidation catalyst (Oxycat) is a passive device, installed immediately downstream of the SCR system. The system proposed for the Discoverer engines represents best currently available technology for this application and will be guaranteed to reduce CO by 80 percent, which means that under the anticipated operating conditions the control level will be better than this value. The rate of VOCs destruction is not guaranteed. It is a function of the complexity of the VOC being exhausted, but the typical destruction rate for engines such as the Cat D399s is 70-90 percent.

Sincerely,

D. E. C. Marine

Per Holmström
Manager

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From: Per Holmström [per.holmstrom@decmarine.com]
Sent: Monday, February 09, 2009 5:31 AM
To: rsteen@airsci.com
Cc: Karin Liljegren
Subject: FW: DEC SCR Converter system - particulate matter

Dear Rodger,

There are confirmed measurements on a combined SCR/OXI system, as proposed for Frontier Discoverer, with a particulate matter reduction of about 50% all over the size distribution less than 10 microns. For more details see attached report. We also have other results giving up to 80% reduction but only in low load condition <20% MCR.
The performance depends on the residence time for the soot in the catalyst and especially the flow velocity of the exhausts in the catalytic channels. The residence time can be increased by an increased cross-section of the Converter and by doing so create better chances for particulate oxidation.
For the Frontier Discoverer we have proposed about 50% increased cross-section compared to the system which was evaluated in the attached report. Dependent on available space onboard we could consider to increase the cross-section even further in order to safeguard that the particulate reduction is as good as possible for a system like this. According to what we seen onboard a 20-40% cross-section increase might be realistic.
Generally, the SCR/OXI system is an "open" system which means that even though the soot can be reduced by reduced flow velocity it will not trap the residual ash content. The ash heritages mainly from the lubrication oil and from the fuel sulfur and in an application like Frontier Discoverer, with very low sulfur diesel, it is most likely a small percentage of the total particulate weight, maybe < 20%. There are limitations with an "open" system, it will not perform well before the catalyst is heated up after cold-start and it will also release soot during load-swings of the engine.

In a CDPF (Catalytic Diesel Particulate Filter) the soot particles are trapped long enough for an almost complete oxidation into CO2 and water. The remaining ash will accumulate in the filter, even though up to 50% (of the ash) eventually will release and pass through. The accumulation results in an increased back-pressure over time which will require regularly back-blowing of the unit and yearly factory re-conditioning. A critical issue is the minimum re-generation temperature which is required in order for the soot to be oxidized, this is typically 320 C but can be as high as 400 C dependent on the exhaust emission composition regarding un-burned hydro-carbons. Ideally the filter should regenerate itself by the heat in the exhausts but if the temperature is to low it will be necessary to regularly heat the gases with an in-line oil-burner.
A CDPF can be added as an initial stage in the SCR Converter but it will require addition considerations:

1. Feasibility study: Before final design, the particulate emissions must be measured for each engine and the composition (size and type) defined. These data are required for evaluating the re-generation, the expected cleaning intervals and for the sizing of the CDPF. Necessity of oil-burner will be evaluated.
2. The Converter cross-section must be increased by about 50%. The height will be less.
3. The design back-pressure will be about 500 mm WC.
4. Manual handling for cleaning and/or exchange of filter elements will be necessary on a monthly basis.

It should be considered that the engines on Frontier Discoverer are heavy duty marine engines without modern electronic controlled fuel injection and to our knowledge there are no CDPF installations made on such engines in this type of application. With careful preparations we believe it is possible but redundancy and availability issues must be addressed properly.

Please let us have your response on above thoughts.

Best regards

Per Holmström
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From: Rodger G Steen [mailto:rsteen@airsci.com]
Sent: den 1 februari 2009 21:38
To: Karin Liljegren
Cc: keith.craik@shell.com
Subject: oxidation catalyst

Dear Karin,

Regarding the oxidation catalyst for the Frontier Discoverer, can you tell me what the expected destruction level is for particulate matter (less than 10 microns aerodynamic diameter)?? Can you tell us who the catalyst manufacturer is?

Is this control device the same as a Catalytic Diesel Particulate Filter (CDPF). If not, could a CDPF be installed on the Cat D399 engines?

Rodger

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fuel) ; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	IC ENGINE , 200 HP, DIESEL, CATERPILLAR	17.210	ARCTIC DIESEL	9 GAL/H	0.031 LB/HP-H	BACT-PSD	PERMIT LIMITS ARE IN LB/HP-H. - PERMIT IMPOSES LIMITS ON NOX AND VE. NOX TO BE TESTED AT THE DEPARTMENT'S REQUEST. NO REQUEST HAS BEEN MADE.	-
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	IC ENGINE, DIESEL, CUMMINS/ONAN	17.210	ARCTIC DIESEL	188 KW	0.031 LB/HP-H	BACT-PSD	PERMIT LIMIT IS IN LB/HP-HR - PERMIT IMPOSES LIMITS ON NOX AND VE. NOX TO BE TESTED AT DEPARTMENT'S REQUEST. NO REQUEST HAS BEEN MADE.	-
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	IC ENGINE, 50 KW, DIESEL, DETROIT	17.210	ARCTIC DIESEL	9 GAL/H	0.031 LB/HP-H	BACT-PSD	PERMIT LIMITS ARE IN LB/HP-H. - NOX TO BE TESTED AT DEPARTMENT'S REQUEST, NO REQUEST HAS BEEN MADE. PERMIT IMPOSES LIMITS ON NOX AND VE.	-
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	GENERATOR, DIESEL, 3208 TA CATERPILLAR	17.210	ARCTIC DIESEL	150 KW	0.031 LB/HP-H	BACT-PSD	EMISSION LIMITS SET IN LB/HP-H - NOX TO BE TESTED AT DEPARTMENT'S REQUEST, NO REQUEST HAS BEEN MADE. PERMIT IMPOSES LIMITS ON NOX AND VE.	-
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	IC ENGINE, DIESEL, 3406 CATERPILLAR, 2 UNITS	17.210	ARCTIC DIESEL	250 KW	0.031 LB/HP-H	BACT-PSD	PERMIT LIMITS SET IN LB/HP-H - TWO IDENTICAL 3406 CATERPILLAR DIESEL IC ENGINES. NOX TO BE TESTED AT DEPARTMENT'S REQUEST, NO REQUEST HAS BEEN MADE. PERMIT IMPOSES LIMITS ON NOX AND VE.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	ELECTRIC GENERATOR CAT 3412, EG704	17.210	DIESEL	4.8 MMBTU/H	3.1 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 4.8 MMBTU/H, BUT AUTHORIZED RATE CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 200 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	NORTH CUMMINS, P708A	17.210	DIESEL	290 HP	4.41 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 2.0 MMBTU/HR (ALSO LISTED AS 290 HP), BUT AUTHORIZED RATED CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 600 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	SOUTH CUMMINS, P708B	17.210	DIESEL	290 HP	4.41 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 290 HP. OPERATING LIMIT IS 600 H/YR.	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	IC ENGINES, FIREWATER PUMP, DIESEL, (2)	17.210	DIESEL			BACT-PSD	GOOD COMBUSTION PRACTICES - Two firewater pump engines, 186 and 230 HP, respectively, 1000 h/yr operating limit.	-
CA-0895	9/24/1999	10/11/2005	COACHELLA VALLEY WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	325 BHP	6.9 G/BHP-H	BACT-PSD	- ARB RECORD # A330-921-00 PERKINS MODEL 1303-9TAG1 DIESEL-FIRED COMPRESSION IGNITION ENGINE WITH A TURBOCHARGER AND INTERCOOLER, USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. PERMIT LIMIT (NOT BACT) INCLUDES LIMIT ON FUEL SULFUR CONTENT: < 0.05	AC
CA-0904	10/14/1999	10/11/2005	SANTA CLARITA VALLEY FOOD SERVICES	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	480 BHP	6.9 G/BHP-H	BACT-PSD	TURBOCHARGER AND AFTERCOOLER - ARB RECORD # A330-930-00 CUMMINS MODEL NTA855-G3 DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. BACT LIMITS SET FOR VOC, NOX, CO, AND PM10	AC
CA-0906	11/16/1999	10/11/2005	RUNNING SPRINGS WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	86 BHP	6.9 G/BHP-H	BACT-PSD	TURBOCHARGER AND 4 DEGREE TIMING RETARD - ARB RECORD # A330-932-00 CATERPILLAR MODEL 3054 DIT DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. VOC, NOX, CO, AND PM10 SUBJECT TO BACT. NO OTHER POLLUTANTS.	ITR
CA-0907	10/7/1999	10/11/2005	US GOVERNMENT NAVAL AIR STATION NORTH ISLAND	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	100 BHP	6.9 G/BHP-H	BACT-PSD	TURBOCHARGER AND 4 DEGREE TIMING RETARD - ARB RECORD # A330-933-00 JOHN DEERE MODEL 404STF DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. PERMIT REQUIRES LOW SULFUR FUEL (< 0.05% S BY WEIGHT). BACT DETERMINATION MAD	ITR
CA-0926	11/10/1999	12/3/2002	KERN ASPHALT PAVING SEALING	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	460 BHP	6.9 G/B-HP-H	BACT-PSD	NO CONTROL - ARB RECORD # A350-955-00. CATERPILLAR MODEL 3406C. BACT NOT TRIGGERED FOR SOX OR CO	-
CA-0989	5/1/2002	9/4/2003	FOLSOM SURGICAL CENTER	IC ENGINE	17.210	DIESEL FUEL	68 HP	6.9 G/B-HP-H	LAER	- EMERGENCY GENERATOR FOR SURGICAL CENTER	-
CA-0991	8/9/2002	9/4/2003	CENIC DBA UC DAVIS COMMUNICATIONS RESOURCES	IC ENGINES	17.210	DIESEL FUEL	277 HP	6.9 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-0998	1/7/2003	9/4/2003	WESTERN DEVCON	IC ENGINE	17.210	DIESEL FUEL	415 HP	6.9 G/B-HP-H	LAER	EPA CERTIFIED ENGINE - EMERGENCY GENERATOR	-
CA-1015	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	471 BHP	4.8 G/BHP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED - MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(471BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE USEPA ENGINE FAMILY TO W	AC
CA-1073	8/14/2003	2/14/2006	LOS ANGELES COUNTY PROBATION/FAC PLANNING/ISD	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	240 BHP	4.2 G/B-HP-H	BACT-PSD	5.5 DEGREES FUEL INJECTION TIMING RETARD-AFTER COOLER BY RAW WATER - EQUIP: , MFR: CLARKE (ENGINE MFR. IS JOHN DEERE), TYPE: 6-CYLINDER, 4-CYCLE, MODEL: JU6H-UF60 (ENGINE MODEL 6068), FUNC EQUIP: FOR EMERGENCY USE IN CASE OF FIRE, SCHEDULE: VARIABLE, H/D:	ITR/AC
CA-1075	5/14/2002	5/2/2006	ULTRAMAR INC.	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	300 HP	5.89 G/B-HP-H	BACT-PSD	AIR/FUEL CONTROLER + OPERATIONS LIMITED TO 200 H/YR. - EQUIP: COMPRESSION IGNITION, LEAN BURN, MFR: CUMMINS ENGINE CO., TYPE: LEAN BURN, MODEL: 6CTA8.3-F3, FUNC EQUIP: THE ENGINE DRIVES AN EMERGENCY FIRE WATER-PUMP., FUEL_TYPE: 15 PPM SULFUR DIESEL, SCHED	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fuel) ; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
CA-1077	10/7/1999	5/2/2006	US GOVERNMENT NAVAL AIR STATION, NORTH ISLAND	ICE: EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	100 BHP	6.9 G/B-HP-H	BACT-PSD	INTERNAL CONTROLS-TURBOCHARGER + OPERATIONS LIMITED TO 200 H/YR - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: JOHN DEERE, TYPE: COMPRESSION IGNITION-TURBOCHARGER, MODEL: 4045TF, FUNC EQUIP: THE ENGINE DRIVES A STANDBY ELECTRICAL GENERATOR., SCHEDULE: VARIABLE	-
CA-1144	4/25/2007	3/17/2008	BLYTHE ENERGY PROJECT II	FIRE PUMP	17.210	DIESEL	303 HP	7.5 LB/H	BACT-PSD	-	-
CO-0052	8/11/2002	9/29/2003	ROCKY MOUNTAIN ENERGY CENTER, LLC.	DISTILLATE FUEL OIL FIRED ENGINES (2)	17.210	DISTILLATE FUEL OIL		4.6 T/YR	Other Case-by-Case	- PROCESS CONSISTS OF ONE INTERNAL COMBUSTION ENGINE FIRING AN EMERGENCY GENERATOR AND A SECOND INTERNAL COMBUSTION ENGINE FIRING A FIRE PUMP. THESE ENGINES ARE USED FOR EMERGENCY PURPOSES ONLY. SUCH USE WILL NOT EXCEED 100 H/YR FOR GENERATOR AND 200 H/Y	-
IA-0058	4/10/2002	6/21/2004	GREATER DES MOINES ENERGY CENTER	FIRE PUMP	17.210	DIESEL	235 BHP	2.55 LB/H	BACT-PSD	RETARDED IGNITION TIMING (3-4) DEGREES -	ITR
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	FIRE PUMP	17.210	#2 DISTILLATE OIL	6500 GALLONS/YR	3.8 LB/H	BACT-PSD	GCP, TIMING RETARD -	ITR
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, EMERGENCY FIRE PUMP	17.210	#2 FUEL OIL	2.59 MMBTU/H	4.41 LB/MMBTU	Other Case-by-Case	IGNITION TIMING RETARD - Limited to 104 hours/yr. Standardized emission units not available.	ITR
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, BLACK-START GENERATOR (6)	17.210	#2 FUEL OIL	25 MMBTU/H	1.9 LB/MMBTU	Other Case-by-Case	- Each generator limited to 200 hours/yr. Additional throughput: 20.5 MMBTU/hr. No standardized emission limits.	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CLARIFIER DIESEL ENGINE	17.210	DIESEL FUEL	310 HP	9.6 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 48-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	WASTE CLARIFIER DIESEL ENGINE	17.210	DIESEL	413 HP	12.7 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 49-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	EFFLUENT LIFT PIT DIESEL ENGINE	17.210	DIESEL FUEL	152 HP	4.7 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISISON POINT 51-96	-
LA-0146	5/10/2000	8/5/2003	SHELL CHEMICAL COMPANY - GEISMAR PLANT	DIESEL GENERATOR HEATER	17.210	DIESEL	415 HP	15.36 LB/H	BACT-PSD	LOW NOX BURNERS - EMISSION POINT 322-99	LND
LA-0192	6/6/2005	4/8/2008	CRESCENT CITY POWER	DIESEL FIRED WATER PUMP	17.210			8.9 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES - 425 HP	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER BOOSTER PUMP DIESEL ENGINES 1-4	17.210	DIESEL	300 HP EA.	3.44 LB/H	BACT-PSD	GOOD ENGINE DESIGN & PROPER OPERATING PRACTICES - OPERATING TIME = 500 HR/YR.	-
LA-0224	3/20/2008	6/26/2008	ARSENAL HILL POWER PLANT	DFP DIESEL FIRE PUMP	17.210	DIESEL	310 HORSEPOWER	9.61 LB/H	BACT-PSD	USE OF LOW-SULFUR FUELS, LIMITING OPERATING HOURS AND PROPER ENGINE MAINTENANCE - EQT-016	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL GENERATOR	17.210	#2 FUEL OIL	700 KW		LAER	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL FIRE WATER PUMP	17.210	#2 FUEL OIL	200 HP		LAER	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0034	11/30/2000	3/1/2005	ROCK SPRINGS	EMERGENCY DIESEL FIREWATER PUMP	17.210	#2 FUEL OIL	200 HP	10.5 G/B-HP-H	LAER	APPLICATION OF GOOD COMBUSTION CONTROLS; LEAN BURN TECHNOLOGY -	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, SMALL, FUEL OIL (1)	17.210	DIESEL	250 HP	4.41 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - 2.017 MMBTU/H.	-
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, SMALL	17.210	DIESEL FUEL	290 HP	5.7 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	-
MO-0067	12/29/2004	10/10/2006	SOUTH HARPER PEAKING FACILITY	IC ENGINE, EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL	0.47 mmbtu/h		BACT-PSD	IGNITION TIMING RETARD (ITR) -	ITR
MT-0022	7/21/2003	6/29/2004	BULL MOUNTAIN, NO. 1, LLC - ROUNDUP POWER PROJECT	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	15.3 MMBTU/H	97.7 % REDUCTION	BACT-PSD	LIMITED HOURS OF OPERATION TO 200 H/YR - Inspections of the facility, including the emergency generator, will take place after construction.	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	250 KW	10.4 LB/H	BACT-PSD	LIMITED TO 500 H/YR - Stand-by emergency generator, limited to 500 h/yr operation	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, FIRE WATER PUMP	17.210	NO. 2 FUEL OIL	310 HP	9.6 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Limited to 500 h/yr operation	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY GENERATOR	17.210	DIESEL FUEL	11.4 MMBTU/H	36.48 LB/H	BACT-PSD	- usage limited to 500 h/yr	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY FIREWATER PUMP	17.210	DIESEL FUEL	11.4 MMBTU/H	36.48 LB/H	BACT-PSD	- usage limited to 200 h/yr	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	14.1 MMBTU/H	26.2 LB/H	Other Case-by-Case	NONE - MAX HOURS OF OPERATION= 55 H/YR, SULFUR IN OIL <= 0.05% BY WEIGHT, OPACITY <=20%	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	DIESEL FIRE PUMP	17.210	DISTILLATE OIL	3.5 MMBTU/H	15.5 LB/H	Other Case-by-Case	NONE - OIL MUST HAVE <= 0.05% SULFUR BY WEIGHT, OPACITY <=20%, HOURS OF OPERATION <= 500 H/YR	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	DIESEL FIRE PUMP	17.210	DIESEL (NO. 2 OIL)	1.5 MMBTU/H	3.35 LB/H	N/A	NONE - SULFUR MUST BE <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	11.93 MMBTU/H	31 LB/H	N/A	NONE - SULFUR CONTENT <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	BACKUP GENERATORS (2)	17.210	DIESEL	500 KW	10.2 LB/H	BACT-PSD	- (2) 500 KW DIESEL FIRED BACKUP GENERATORS, 670 HP, LIMITED TO 500 H/YR OPERATION.	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	FIRE WATER PUMP (1)	17.210	DIESEL	265 HP	8.2 LB/H	BACT-PSD	- (1) 265 HP DIESEL FIRED FIRE WATER PUMP, LIMITED TO 500 H/YR OPERATION.	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL FIRE PUMP ENGINE	17.210	DIESEL	400 HP	12.8 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 400 HP Emergency diesel fuel fired fire pump engine. Limited to 500 hr/yr of operation.	-
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	FIRE WATER PUMP	17.210	DIESEL	290 KW	0.24 T/YR	BACT-PSD	- 290 KW EMERGENCY DIESEL FUEL FIRE WATER PUMP, 389 HP. LIMITED TO 500 H/YR OPERATION.	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines (≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fuel) ; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL FUEL	1.6 MMBTU/H	5.14 LB/H	BACT-PSD	- RESTRICTED TO 499 HOURS OF OPERATION PER ROLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 0.58 MMBTU/H	17.210	FUEL OIL #2	0.58 MMBTU/H	2.55 LB/H	BACT-PSD	- RESTRICTION OF 19,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 4.68 MMBTU/H	17.210	FUEL OIL #2	4.68 MMBTU/H	14.99 LB/H	BACT-PSD	- RESTRICTION OF 80,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OK-0056	2/12/2002	5/6/2004	HORSESHOE ENERGY PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	250 HP	4.41 LB/MMBTU	BACT-PSD	ENGINE DESIGN -	-
OK-0070	6/13/2002	5/12/2004	GENOVA OK I POWER PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	200 BHP	4.41 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND LIMITATION OF HOURS - 200 HOUR LIMIT	-
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	300 HP	0.031 LB/B-HP-H	BACT-PSD	- 1 UNIT	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	270 HP	29.8 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, EMERGENCY GENERATOR	17.210	DIESEL	0.85 MMBUT/H	42 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, FIRE WATER PUMP	17.210	DIESEL	265 BHP	4.41 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND HOURS LIMIT (<100 H/YR) - operation limit: < 100 h/yr	-
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY FIREWATER PUMP	17.210	DIESEL	260 HP	8.1 LB/H	BACT-PSD	-	-
TX-0273	3/21/2000	1/4/2005	BASTROP CLEAN ENERGY CENTER	FIREWATER PUMP ENGINE	17.210	DIESEL FUEL	300 BHP	9.3 LB/H	BACT-PSD	- LIMITED TO 250 NON-EMERGENCY HOURS OF OPERATION ANNUALLY. EMISSION POINT NO. FWP-1.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY FIREWATER PUMP, EG-2	17.210	DIESEL FUEL	260 HP	8.1 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY GENERATOR, E-GEN	17.210		310 KW	17.14 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY FIREWATER PUMP, E-PUMP	17.210		250 HP	2.4 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0352	12/31/2002	5/24/2005	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	(2) FIRE WATER PUMPS, FWPUMP-1 & -2	17.210	DIESEL	300 HP	9.3 LB/H	BACT-PSD	NONE INDICATED - ALL DIESEL FIRED EQUIPMENT IS AUTHORIZED TO FIRE DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.3 WT % S, AND EACH SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.210	DIESEL	300 HP	9.3 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0285	1/6/2004	3/25/2004	INGENCO - CHESTER PLANT	IC ENGINE, DIESEL, (48)	17.210	DISTILLATE FUEL OIL	350 KW	2.4 LB/MMBTU	N/A	CONTINUAL EMISSION MONITORING DEVICES - EMISSIONS FROM THE OPERATION OF ANY OF THE 48 DUAL FUEL ENGINES WHEN THE FACILTY IS OPERATED IN THE SINGLE OR DUAL FUEL MODE SHALL NOT EXCEED THESE LIMITS.	-
WA-0291	1/3/2003	8/31/2006	WALLULA POWER PLANT	IC GENERATOR, EMERGENCY DIESEL	17.210	DIESEL		568 PPMDV @ 15% O2	Other Case-by-Case	- The emergency diesel generator shall be limited to 200 hours of operation per calendar year	-
WI-0227	10/13/2004	8/31/2006	PORT WASHINGTON GENERATING STATION	DIESEL ENGINE GENERATOR (P05 / S05)	17.210	DIESEL FUEL OIL	7.6 MMBTU/H	27.36 LB/H	BACT-PSD	ENGINE DESIGN, DIESEL FUEL OIL (0.05 WT.% S). - DIESEL FUEL GENERATOR 55.10 GAL/H	-
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	DIESEL BOOSTER PUMP (B27, S27)	17.210	DIESEL FUEL OIL	265 HP	8.21 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES WITH IGNITION RETARD ULTRA LOW SULFUR (0.003 WT% S) DIESEL FUEL OIL - THIS UNIT WILL ASSIST IN CIRCULATING THE WATER FOR THE STEAM TURBINE DURING STARTUP AND SHUT DOWNS. THE BOOSTER PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS P	ITR
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	MAIN FIRE PUMP (DIESEL ENGINE)	17.210	DIESEL FUEL OIL	460 HP	14.26 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, IGNITION TIMING RETARD, ULTRA LOW SULFUR (0.003 WT. % S) DIESEL FUEL OIL - THIS UNIT WILL BE USED AS THE MAIN FIRE PUMP AND ONLY WILL BE USED FOR FIRE SUPPRESSION PURPOSES. THE MAIN FIRE PUMP WILL HAVE OPERATIONAL LIMIT OF 200 H	ITR

Control Category Key:

AC	Air Cooling
ITR	Injection Timing Retard
LND	Low NOx Design

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	ELECTRIC GENERATOR CAT 3412, EG704	17.210	DIESEL	4.8 MMBTU/H	0.3627 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 4.8 MMBTU/H, BUT AUTHORIZED RATE CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 200 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	NORTH CUMMINS, P708A	17.210	DIESEL	290 HP	0.3627 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 2.0 MMBTU/HR (ALSO LISTED AS 290 HP), BUT AUTHORIZED RATED CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 600 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	SOUTH CUMMINS, P708B	17.210	DIESEL	290 HP	0.3627 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 290 HP. OPERATING LIMIT IS 600 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	CRANE, UNIT NO. 100	17.210	DIESEL	250 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES - TYPICAL OPERATION AFTER COMMISSIONING PERIOD; 8760 H/YR. THIS IS PORTABLE EQUIPMENT WITHOUT EMISSION LIMITS.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	LIGHT PLANT, UNIT NO. 101	17.210	DIESEL	12.1 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES - TYPICAL OPERATION DURING COMMISSIONING PERIOD, 1848 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. THIS IS PORTABLE EQUIPMENT WITHOUT EMISSION LIMITS.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	SNOWBLOWER, UNIT NO. 102, 103	17.210	DIESEL	15 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION DURING COMMISSIONING PERIOD, 1848 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. THIS IS PORTABLE EQUIPMENT WITHOUT EMISSION LIMITS.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	WELDER, UNIT NO. 104	17.210	DIESEL	38.2 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - NOTE: PROCESS TYPE CODE AND SCC CODE REFLECT THE WELDER ENGINE, NOT THE PROCESS OF WELDING. TYPICAL OPERATION DURING COMMISSIONING PERIOD, 1848 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. THIS IS PORTABLE EQUIP	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	PORTABLE HEATER (BLOWER ENGINE), UNIT NO. 105-107	17.210	DIESEL	22 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - PORTABLE HEATER PROCESS IS DIVIDED INTO BLOWER ENGINE AND HEATER, LISTED SEPARATELY IN DATABASE. TYPICAL OPERATION: DURING COMMISSIONING PERIOD, 1848 H; AFTER COMMISSIONING PERIOD, 8760 H/YR. NO EMISSION LIMITS FOR THE BLOWER	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISC. IC ENGINES < 200 HP	17.210	DIESEL	170 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION 1440 H/YR. EQUIPMENT LISTED IN THE CONTSTRUCTION RESERVE POOL.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	COLD START UNIT, UNIT NO. 205	17.210	DIESEL	314 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION DURING PRE-SEALIFT PERIOD, 2186 H; TYPICAL OPERATION DURING COMMISSIONING PERIOD, 24 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 2186 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 500 HP	17.210	DIESEL	500 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2190 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0047	7/13/2001	9/29/2003	MILNE POINT PRODUCTION FACILITY	ENGINES (2), PU-0110A AND PU-0110B	17.210	DIESEL	187 HP	0.05 GR/DSCF	N/A	- FACILITY TAG PU-0110A AND PU-0110B. OPERATING RESTRICTION OF NO MORE THAN 600 H DURING ANY 12 CONSECUTIVE MOS, COMBINED. OPERATING RESTRICTIONS OF COMBINED TOTALS OF 12 H/D UNDER SCENARIO 1, 16 H/D UNDER SCENARIO 2, AND 12 H/D UNDER SCENARIO 3.	-
CA-0895	9/24/1999	10/11/2005	COACHELLA VALLEY WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	325 BHP	0.38 G/BHP-H	BACT-PSD	0.05% BY WEIGHT FUEL SULFUR CONTENT - ARB RECORD # A330-921-00 PERKINS MODEL 1303-9TAG1 DIESEL-FIRED COMPRESSION IGNITION ENGINE WITH A TURBOCHARGER AND INTERCOOLER, USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. PERMIT LIMIT (NOT BACT) INCLUDES L	LSF
CA-0904	10/14/1999	10/11/2005	SANTA CLARITA VALLEY FOOD SERVICES	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	480 BHP	0.38 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-930-00 CUMMINS MODEL NTA855-G3 DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. BACT LIMITS SET FOR VOC, NOX, CO, AND PM10	-
CA-0906	11/16/1999	10/11/2005	RUNNING SPRINGS WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	86 BHP	0.38 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-932-00 CATERPILLAR MODEL 3054 DIT DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. VOC, NOX, CO, AND PM10 SUBJECT TO BACT. NO OTHER POLLUTANTS.	-
CA-0907	10/7/1999	10/11/2005	US GOVERNMENT NAVAL AIR STATION NORTH ISLAND	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	100 BHP	0.38 G/BHP-H	BACT-PSD	FUEL LIMITED TO < 0.05% SULFUR CONTENT, BY WEIGHT - ARB RECORD # A330-933-00 JOHN DEERE MODEL 404STF DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. PERMIT REQUIRES LOW SULFUR FUEL (< 0.05% S BY WEIGHT). BACT DETERMI	LSF
CA-0926	11/10/1999	12/3/2002	KERN ASPHALT PAVING SEALING	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	460 BHP	0.4 G/B-HP-H	Other Case-by-Case	LOW SULFUR DIESEL (<0.05% S BY WEIGHT) AND POSITIVE CRANKCASE VENTILATION - ARB RECORD # A350-955-00. CATERPILLAR MODEL 3406C. BACT NOT TRIGGERED FOR SOX OR CO	LSF/PCV
CA-0989	5/1/2002	9/4/2003	FOLSOM SURGICAL CENTER	IC ENGINE	17.210	DIESEL FUEL	68 HP	0.51 G/B-HP-H	LAER	- EMERGENCY GENERATOR FOR SURGICAL CENTER	-
CA-0991	8/9/2002	9/4/2003	CENIC DBA UC DAVIS COMMUNICATIONS RESOURCES	IC ENGINES	17.210	DIESEL FUEL	277 HP	0.15 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
CA-0998	1/7/2003	9/4/2003	WESTERN DEVCON	IC ENGINE	17.210	DIESEL FUEL	415 HP	0.1 G/B-HP-H	LAER	EPA CERTIFIED ENGINE - EMERGENCY GENERATOR	-
CA-1015	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	471 BHP	0.15 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(471BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE USEPA ENGINE FAMILY TO WHICH THIS ENGINES BELONGS HA	-
CA-1073	8/14/2003	2/14/2006	LOS ANGELES COUNTY PROBATION/FAC PLANNING/ISD	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	240 BHP	0.14 G/B-HP-H	BACT-PSD	OPERATIONS LIMITED TO 200 H/YR. - EQUIP: , MFR: CLARKE (ENGINE MFR. IS JOHN DEERE), TYPE: 6-CYLINDER, 4-CYCLE, MODEL: JU6H-UF60 (ENGINE MODEL 6068), FUNC EQUIP: FOR EMERGENCY USE IN CASE OF FIRE, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 12, NOTES: AFTER	-
CA-1075	5/14/2002	5/2/2006	ULTRAMAR INC.	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	300 HP	0.25 G/B-HP-H	BACT-PSD	OPERATIONS LIMIT 200 H/YR. - EQUIP: COMPRESSION IGNITION, LEAN BURN, MFR: CUMMINS ENGINE CO., TYPE: LEAN BURN, MODEL: 6CTA8.3-F3, FUNC EQUIP: THE ENGINE DRIVES AN EMERGENCY FIRE WATER-PUMP., FUEL_TYPE: 15 PPM SULFUR DIESEL, SCHEDULE: VARIABLE, H/D: 1, D/W	LSF
CA-1077	10/7/1999	5/2/2006	US GOVERNMENT NAVAL AIR STATION, NORTH ISLAND	ICE: EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	100 BHP	0.38 G/B-HP-H	BACT-PSD	INTERNAL CONTROLS-TURBOCHARGER + OPERATIONS LIMITED TO 200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: JOHN DEERE, TYPE: COMPRESSION IGNITION-TURBOCHARGER, MODEL: 4045TF, FUNC EQUIP: THE ENGINE DRIVES A STANDBY ELECTRICAL GENERATOR., SCHEDULE: VARIABL	-
CA-1144	4/25/2007	3/17/2008	BLYTHE ENERGY PROJECT II	FIRE PUMP	17.210	DIESEL	303 HP	0.1 LB/H	BACT-PSD	-	-
CO-0052	8/11/2002	9/29/2003	ROCKY MOUNTAIN ENERGY CENTER, LLC.	DISTILLATE FUEL OIL FIRED ENGINES (2)	17.210	DISTILLATE FUEL OIL		2.4 T/YR	Other Case-by-Case	- PROCESS CONSISTS OF ONE INTERNAL COMBUSTION ENGINE FIRING AN EMERGENCY GENERATOR AND A SECOND INTERNAL COMBUSTION ENGINE FIRING A FIRE PUMP. THESE ENGINES ARE USED FOR EMERGENCY PURPOSES ONLY. SUCH USE WILL NOT EXCEED 100 H/YR FOR GENERATOR AND 200 H/Y	-
IA-0058	4/10/2002	6/21/2004	GREATER DES MOINES ENERGY CENTER	FIRE PUMP	17.210	DIESEL	235 BHP	0.56 LB/H	BACT-PSD	-	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	FIRE PUMP	17.210	#2 DISTILLATE OIL	6500 GALLONS/YR	0.22 LB/H	BACT-PSD	GCP, TIMING RETARD -	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	FIRE PUMP	17.210	#2 DISTILLATE OIL	6500 GALLONS/YR	0.22 LB/H	BACT-PSD	GCP, TIMING RETARD -	-
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, EMERGENCY FIRE PUMP	17.210	#2 FUEL OIL	2.59 MMBTU/H	0.31 LB/MMBTU	Other Case-by-Case	LOW ASH FUEL AND GOOD OPERATING PRACTICES. - Limited to 104 hours/yr. Standardized emission units not available.	LSF
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, EMERGENCY FIRE PUMP	17.210	#2 FUEL OIL	2.59 MMBTU/H	0.31 LB/MMBTU	Other Case-by-Case	LOW ASH FUEL AND GOOD COMBUSTION PRACTICES. - Limited to 104 hours/yr. Standardized emission units not available.	LSF
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, BLACK-START GENERATOR (6)	17.210	#2 FUEL OIL	25 MMBTU/H	0.1 LB/MMBTU	Other Case-by-Case	LOW ASH FUEL AND GOOD COMBUSTION. - Each generator limited to 200 hours/yr. Additional throughput: 20.5 MMBTU/hr. No standardized emission limits.	LSF
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, BLACK-START GENERATOR (6)	17.210	#2 FUEL OIL	25 MMBTU/H	0.1 LB/MMBTU	Other Case-by-Case	LOW ASH FUEL AND GOOD COMBUSTION PRACTICES. - Each generator limited to 200 hours/yr. Additional throughput: 20.5 MMBTU/hr. No standardized emission limits.	LSF
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CLARIFIER DIESEL ENGINE	17.210	DIESEL FUEL	310 HP	0.67 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 48-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	WASTE CLARIFIER DIESEL ENGINE	17.210	DIESEL	413 HP	0.9 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 49-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	EFFLUENT LIFT PIT DIESEL ENGINE	17.210	DIESEL FUEL	152 HP	0.33 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISISON POINT 51-96	-
LA-0146	5/10/2000	8/5/2003	SHELL CHEMICAL COMPANY - GEISMAR PLANT	DIESEL GENERATOR HEATER	17.210	DIESEL	415 HP	1.01 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND ENGINEERING DESIGN, CLEAN BURNING FUEL - EMISSION POINT 322-99	LSF
LA-0192	6/6/2005	4/8/2008	CRESCENT CITY POWER	DIESEL FIRED WATER PUMP	17.210			0.14 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES - 425 HP	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER BOOSTER PUMP DIESEL ENGINES 1-4	17.210	DIESEL	300 HP EA.	0.06 LB/H	BACT-PSD	GOOD ENGINE DESIGN, PROPER OPERATING PRACTICES, AND USE OF LOW SULFUR DIESEL - OPERATING TIME = 500 HR/YR.	LSF
LA-0224	3/20/2008	6/26/2008	ARSENAL HILL POWER PLANT	DFP DIESEL FIRE PUMP	17.210	DIESEL	310 HORSEPOWER	0.68 LB/H	BACT-PSD	USE OF LOW-SULFUR FUELS, LIMITING OPERATING HOURS AND PROPER ENGINE MAINTENANCE - EQT-016	LSF
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL GENERATOR	17.210	#2 FUEL OIL	700 KW		BACT-PSD	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL FIRE WATER PUMP	17.210	#2 FUEL OIL	200 HP		BACT-PSD	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0034	11/30/2000	3/1/2005	ROCK SPRINGS	EMERGENCY DIESEL FIREWATER PUMP	17.210	#2 FUEL OIL	200 HP	0.15 G/B-HP-H	BACT-PSD	APPLICATION OF GOOD COMBUSTION CONTROLS; LEAN BURN TECHNOLOGY -	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, SMALL, FUEL OIL (1)	17.210	DIESEL	250 HP	0.31 LB/MMBTU	BACT-PSD	CLEAN FUEL AND GOOD COMBUSTION. - 2.017 MMBTU/H.	LSF

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, SMALL	17.210	DIESEL FUEL	290 HP	0.07 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	LSF
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, SMALL	17.210	DIESEL FUEL	290 HP	0.07 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	LSF
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	250 KW	0.74 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Stand-by emergency generator, limited to 500 h/yr operation	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, FIRE WATER PUMP	17.210	NO. 2 FUEL OIL	310 HP	0.68 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Limited to 500 h/yr operation	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY GENERATOR	17.210	DIESEL FUEL	11.4 MMBTU/H	1.14 LB/H	BACT-PSD	- usage limited to 500 h/yr	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY FIREWATER PUMP	17.210	DIESEL FUEL	11.4 MMBTU/H	1.14 LB/H	BACT-PSD	- usage limited to 200 h/yr	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	14.1 MMBTU/H	1.4 LB/H	Other Case-by-Case	NONE - MAX HOURS OF OPERATION= 55 H/YR, SULFUR IN OIL <= 0.05% BY WEIGHT, OPACITY <=20%	LSF
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	14.1 MMBTU/H	1.4 LB/H	Other Case-by-Case	NONE - MAX HOURS OF OPERATION= 55 H/YR, SULFUR IN OIL <= 0.05% BY WEIGHT, OPACITY <=20%	LSF
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	DIESEL FIRE PUMP	17.210	DISTILLATE OIL	3.5 MMBTU/H	1.1 LB/H	Other Case-by-Case	NONE - OIL MUST HAVE <= 0.05% SULFUR BY WEIGHT, OPACITY <=20%, HOURS OF OPERATION <= 500 H/YR	LSF
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	DIESEL FIRE PUMP	17.210	DISTILLATE OIL	3.5 MMBTU/H	1.1 LB/H	Other Case-by-Case	NONE - OIL MUST HAVE <= 0.05% SULFUR BY WEIGHT, OPACITY <=20%, HOURS OF OPERATION <= 500 H/YR	LSF
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	DIESEL FIRE PUMP	17.210	DIESEL (NO. 2 OIL)	1.5 MMBTU/H	0.25 LB/H	N/A	- SULFUR MUST BE <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	DIESEL FIRE PUMP	17.210	DIESEL (NO. 2 OIL)	1.5 MMBTU/H	0.25 LB/H	N/A	NONE - SULFUR MUST BE <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	11.93 MMBTU/H	2 LB/H	N/A	- SULFUR CONTENT <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	11.93 MMBTU/H	2 LB/H	N/A	NONE - SULFUR CONTENT <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	BACKUP GENERATORS (2)	17.210	DIESEL	500 KW	0.59 LB/H	BACT-PSD	- (2) 500 KW DIESEL FIRED BACKUP GENERATORS, 670 HP, LIMITED TO 500 H/YR OPERATION.	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	FIRE WATER PUMP (1)	17.210	DIESEL	265 HP	0.66 LB/H	BACT-PSD	- (1) 265 HP DIESEL FIRED FIRE WATER PUMP, LIMITED TO 500 H/YR OPERATION.	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL FIRE PUMP ENGINE	17.210	DIESEL	400 HP	0.88 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 400 HP Emergency diesel fuel fired fire pump engine. Limited to 500 hr/yr of operation.	LSF
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	FIRE WATER PUMP	17.210	DIESEL	290 KW	0.017 T/YR	BACT-PSD	- 290 KW EMERGENCY DIESEL FUEL FIRE WATER PUMP, 389 HP. LIMITED TO 500 H/YR OPERATION.	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL FUEL	1.6 MMBTU/H	0.31 LB/MMBTU		- RESTRICTED TO 499 HOURS OF OPERATION PER ROLING 12-MONTHS	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL FUEL	1.6 MMBTU/H	0.12 T/YR	BACT-PSD	- RESTRICTED TO 499 HOURS OF OPERATION PER ROLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 0.58 MMBTU/H	17.210	FUEL OIL #2	0.58 MMBTU/H	0.18 LB/H	BACT-PSD	- RESTRICTION OF 19,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 0.58 MMBTU/H	17.210	FUEL OIL #2	0.58 MMBTU/H	0.18 LB/H	BACT-PSD	- RESTRICTION OF 19,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 4.68 MMBTU/H	17.210	FUEL OIL #2	4.68 MMBTU/H	0.27 LB/H	BACT-PSD	- RESTRICTION OF 80,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 4.68 MMBTU/H	17.210	FUEL OIL #2	4.68 MMBTU/H	0.29 LB/H	BACT-PSD	- RESTRICTION OF 80,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OK-0056	2/12/2002	5/6/2004	HORSESHOE ENERGY PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	250 HP	0.31 LB/MMBTU	BACT-PSD	LOW ASH FUEL -	LSF
OK-0070	6/13/2002	5/12/2004	GENOVA OK I POWER PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	200 BHP	0.031 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND GOOD COMBUSTION - 200 HOUR LIMIT	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	270 HP	2.11 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, EMERGENCY GENERATOR	17.210	DIESEL	0.85 MMBUT/H	1.24 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, FIRE WATER PUMP	17.210	DIESEL	265 BHP	0.31 LB/MMBTU	BACT-PSD	COMBUSTION CONTROL AND GOOD ENGINE DESIGN - operation limit: < 100 h/yr	-
OK-0110	10/21/2005	8/14/2006	MUSKOGEE PORCELAIN FLOOR TILE PLT	EMERGENCY GENERATORS	17.210			0.0022 LB/HP-H		GOOD COMBUSTION -	-
OK-0111	10/14/2005	8/14/2006	MUSKOGEE PORCELAIN FLOOR TILE PLT	EMERGENCY GENERATORS	17.210			0.0022 LB/HP-H	BACT-PSD	GOOD COMBUSTION -	-
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY FIREWATER PUMP	17.210	DIESEL	260 HP	0.57 LB/H	BACT-PSD	-	-
TX-0273	3/21/2000	1/4/2005	BASTROP CLEAN ENERGY CENTER	FIREWATER PUMP ENGINE	17.210	DIESEL FUEL	300 BHP	0.66 LB/H	BACT-PSD	- LIMITED TO 250 NON-EMERGENCY HOURS OF OPERATION ANNUALLY. EMISSION POINT NO. FWP-1.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY FIREWATER PUMP, EG-2	17.210	DIESEL FUEL	260 HP	0.57 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY GENERATOR, E-GEN	17.210	0.000	310 KW	0.16 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY FIREWATER PUMP, E-PUMP	17.210	0.000	250 HP	0.14 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0352	12/31/2002	5/24/2005	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	(2) FIRE WATER PUMPS, FWPUMP-1 & -2	17.210	DIESEL	300 HP	0.66 LB/H	Other Case-by-Case	NONE INDICATED - ALL DIESEL FIRED EQUIPMENT IS AUTHORIZED TO FIRE DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.3 WT % S, AND EACH SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.210	DIESEL	300 HP	0.66 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0285	1/6/2004	3/25/2004	INGENCO - CHESTER PLANT	IC ENGINE, DIESEL, (48)	17.210	DISTILLATE FUEL OIL	350 KW	0.3 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES - EMISSIONS FROM THE OPERATION OF ANY OF THE 48 DUAL FUEL ENGINES WHEN THE FACILTY IS OPERATED IN THE SINGLE OR DUAL FUEL MODE SHALL NOT EXCEED THESE LIMITS.	-
VA-0285	1/6/2004	3/25/2004	INGENCO - CHESTER PLANT	IC ENGINE, DIESEL, (48)	17.210	DISTILLATE FUEL OIL	350 KW	0.3 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES - EMISSIONS FROM THE OPERATION OF ANY OF THE 48 DUAL FUEL ENGINES WHEN THE FACILTY IS OPERATED IN THE SINGLE OR DUAL FUEL MODE SHALL NOT EXCEED THESE LIMITS.	-
WI-0227	10/13/2004	8/31/2006	PORT WASHINGTON GENERATING STATION	DIESEL ENGINE GENERATOR (P05 / S05)	17.210	DIESEL FUEL OIL	7.6 MMBTU/H	0.89 LB/H	BACT-PSD	LOW SULFUR DIESEL FUEL OIL (0.05 WT% S). - DIESEL FUEL GENERATOR 55.10 GAL/H	LSF
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	DIESEL BOOSTER PUMP (B27, S27)	17.210	DIESEL FUEL OIL	265 HP	0.58 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, DIESEL FUEL SULFUR CONTENT (0.003 WT. % S) - THIS UNIT WILL ASSIST IN CIRCULATING THE WATER FOR THE STEAM TURBINE DURING STARTUP AND SHUT DOWNS. THE BOOSTER PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY WEIGH	LSF
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	MAIN FIRE PUMP (DIESEL ENGINE)	17.210	DIESEL FUEL OIL	460 HP	1.01 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, ULTRA LOW SULFUR (0.003 WT. % S) DIESEL FUEL OIL - THIS UNIT WILL BE USED AS THE MAIN FIRE PUMP AND ONLY WILL BE USED FOR FIRE SUPPRESSION PURPOSES. THE MAIN FIRE PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY	LSF

Control Category Key:

PCV Positive Crankcase Ventilation

LSF Low Sulfur (Clean) Fuels - less than 0.1 wt.% S

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	ELECTRIC GENERATOR CAT 3412, EG704	17.210	DIESEL	4.8 MMBTU/H	500 PPM	BACT-PSD	FUEL SULFUR CONTENT LIMITS AS FOLLOWS: DIESEL FUEL, 0.35% SULFUR; NATURAL GAS, 0.01% SULFUR; LPG, 0.01% SULFUR; REFINERY GAS, 168 PPMV H2S. - DESIGN CAPACITY IS 4.8 MMBTU/H, BUT AUTHORIZED RATE CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 200 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	NORTH CUMMINS, P708A	17.210	DIESEL	290 HP	500 PPM	BACT-PSD	FUEL SULFUR CONTENT LIMITS AS FOLLOWS: DIESEL, 0.35% SULFUR; NATURAL GAS, 0.01% SULFUR; LPG, 0.01% SULFUR; REFINERY GAS, 168 PPMV H2S. - DESIGN CAPACITY IS 2.0 MMBTU/HR (ALSO LISTED AS 290 HP), BUT AUTHORIZED RATED CAPACITY IS 1 MMBTU/H. OPERATING LIMIT O	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	SOUTH CUMMINS, P708B	17.210	DIESEL	290 HP	500 PPM	BACT-PSD	FUEL SULFUR CONTENT LIMITS AS FOLLOWS: DIESEL, 0.35% SULFUR; NATURAL GAS, 0.01% SULFUR; LPG, 0.01% SULFUR; REFINERY GAS, 168 PPMV H2S. - DESIGN CAPACITY IS 290 HP. OPERATING LIMIT IS 600 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	CRANE, UNIT NO. 100	17.210	DIESEL	250 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION AFTER COMMISSIONING PERIOD; 8760 H/YR. THIS IS PORTABLE EQUIPMENT WITHOUT EMISSION LIMITS.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	LIGHT PLANT, UNIT NO. 101	17.210	DIESEL	12.1 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION DURING COMMISSIONING PERIOD, 1848 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. THIS IS PORTABLE EQUIPMENT WITHOUT EMISSION LIMITS.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	SNOWBLOWER, UNIT NO. 102, 103	17.210	DIESEL	15 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT - TYPICAL OPERATION DURING COMMISSIONING PERIOD, 1848 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. THIS IS PORTABLE EQUIPMENT WITHOUT EMISSION LIMITS.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	WELDER, UNIT NO. 104	17.210	DIESEL	38.2 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - NOTE: PROCESS TYPE CODE AND SCC CODE REFLECT THE WELDER ENGINE, NOT THE PROCESS OF WELDING. TYPICAL OPERATION DURING COMMISSIONING PERIOD, 1848 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD,	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	PORTABLE HEATER (BLOWER ENGINE), UNIT NO. 105-107	17.210	DIESEL	22 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15%. - PORTABLE HEATER PROCESS IS DIVIDED INTO BLOWER ENGINE AND HEATER, LISTED SEPARATELY IN DATABASE. TYPICAL OPERATION: DURING COMMISSIONING PERIOD, 1848 H; AFTER COMMISSIONING PERIOD, 8760 H/YR. NO EMISSIO	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISC. IC ENGINES < 200 HP	17.210	DIESEL	170 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION 1440 H/YR. EQUIPMENT LISTED IN THE CONTSTRUCTION RESERVE POOL.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	COLD START UNIT, UNIT NO. 205	17.210	DIESEL	314 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION DURING PRE-SEALIFT PERIOD, 2186 H; TYPICAL OPERATION DURING COMMISSIONING PERIOD, 24 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 2186 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 500 HP	17.210	DIESEL	500 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2190 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0047	7/13/2001	9/29/2003	MILNE POINT PRODUCTION FACILITY	ENGINES (2), PU-0110A AND PU-0110B	17.210	DIESEL	187 HP	500 PPM	Other Case-by-Case	BURN FUEL OIL WITH NO GREATER THAN 0.30 % SULFUR BY WEIGHT. - FACILITY TAG PU-0110A AND PU-0110B. OPERATING RESTRICTION OF NO MORE THAN 600 H DURING ANY 12 CONSECUTIVE MOS, COMBINED. OPERATING RESTRICTIONS OF COMBINED TOTALS OF 12 H/D UNDER SCENARIO 1, 16	-
CA-0989	5/1/2002	9/4/2003	FOLSOM SURGICAL CENTER	IC ENGINE	17.210	DIESEL FUEL	68 HP	0.16 G/B-HP-H	LAER	- EMERGENCY GENERATOR FOR SURGICAL CENTER	-
CA-0991	8/9/2002	9/4/2003	CENIC DBA UC DAVIS COMMUNICATIONS RESOURCES	IC ENGINES	17.210	DIESEL FUEL	277 HP	0.1645 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-0998	1/7/2003	9/4/2003	WESTERN DEVCON	IC ENGINE	17.210	DIESEL FUEL	415 HP	0.16 G/B-HP-H	LAER	EPA CERTIFIED ENGINE - EMERGENCY GENERATOR	-
CA-1073	8/14/2003	2/14/2006	LOS ANGELES COUNTY PROBATION/FAC PLANNING/ISD	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	240 BHP	0.05 % S	BACT-PSD	SULFUR CONTENT OF FUEL LIMITED TO 0.0015% OR LESS. OPERATIONS LIMITED TO 200 H/YR. - EQUIP: , MFR: CLARKE (ENGINE MFR. IS JOHN DEERE), TYPE: 6-CYLINDER, 4-CYCLE, MODEL: JU6H-UF60 (ENGINE MODEL 6068), FUNC EQUIP: FOR EMERGENCY USE IN CASE OF FIRE, SCHEDULE	LSF

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
CA-1077	10/7/1999	5/2/2006	US GOVERNMENT NAVAL AIR STATION, NORTH ISLAND	ICE: EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	100 BHP	0.05 %	BACT-PSD	SULFUR CONTENT OF FUEL SHALL NOT EXCEED 0.05%BY WEIGHT + OPERATIONS LIMITED TO 200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: JOHN DEERE, TYPE: COMPRESSION IGNITION-TURBOCHARGER, MODEL: 4045TF, FUNC EQUIP: THE ENGINE DRIVES A STANDBY ELECTRICAL GENER	LSF
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, EMERGENCY FIRE PUMP	17.210	#2 FUEL OIL	2.59 MMBTU/H	0.51 LB/MMBTU	Other Case-by-Case	LOW SULFUR FUEL - Limited to 104 hours/yr. Standardized emission units not available.	LSF
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, BLACK-START GENERATOR (6)	17.210	#2 FUEL OIL	25 MMBTU/H	0.51 LB/MMBTU	Other Case-by-Case	LOW SULFUR FUEL. - Each generator limited to 200 hours/yr. Additional throughput: 20.5 MMBTU/hr. No standardized emission limits.	LSF
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CLARIFIER DIESEL ENGINE	17.210	DIESEL FUEL	310 HP	0.63 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 48-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	WASTE CLARIFIER DIESEL ENGINE	17.210	DIESEL	413 HP	0.84 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 49-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	EFFLUENT LIFT PIT DIESEL ENGINE	17.210	DIESEL FUEL	152 HP	0.31 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISISON POINT 51-96	-
LA-0192	6/6/2005	4/8/2008	CRESCENT CITY POWER	DIESEL FIRED WATER PUMP	17.210			0.61 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES - 425 HP	-
LA-0224	3/20/2008	6/26/2008	ARSENAL HILL POWER PLANT	DFP DIESEL FIRE PUMP	17.210	DIESEL	310 HORSEPOWER	0.64 LB/H	BACT-PSD	USE OF LOW-SULFUR FUELS, LIMITING OPERATING HOURS AND PROPER ENGINE MAINTENANCE - EQT-016	LSF
MD-0034	11/30/2000	3/1/2005	ROCK SPRINGS	EMERGENCY DIESEL FIREWATER PUMP	17.210	#2 FUEL OIL	200 HP		N/A	RESTRICTED TO NG ONLY -	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, SMALL, FUEL OIL (1)	17.210	DIESEL	250 HP	0.051 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL. - 2.017 MMBTU/H.	LSF
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, SMALL	17.210	DIESEL FUEL	290 HP	0.14 G/B-HP-H	BACT-PSD	LOW SULFUR FUEL - MAX. SULFUR CONTENT 0.05% BY WEIGHT	LSF
MN-0070	9/7/2007	10/30/2008	MINNESOTA STEEL INDUSTRIES, LLC	DIESEL FIRE WATER PUMPS (<500 HP)	17.210			0.05 %	BACT-PSD	LIMITED SULFUR IN FUEL; LIMITED HOURS - LIMITED TO 500 HOURS PER YEAR (12 MONTH ROLLING SUM); SULFUR CONTENT OF FUEL RESTRICTS SO2 EMISSIONS.	LSF
MT-0022	7/21/2003	6/29/2004	BULL MOUNTAIN, NO. 1, LLC - ROUNDUP POWER PROJECT	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	15.3 MMBTU/H	97.7 % REDUCTION	BACT-PSD	LOW SULFUR #2 FUEL OIL (0.05% S), LIMITED TO 200 H OF OPERATION PER YEAR - Inspections of the facility, including the emergency generator, wil take place after construction.	LSF
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	250 KW	0.13 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Stand-by emergency generator, limited to 500 h/yr operation	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, FIRE WATER PUMP	17.210	NO. 2 FUEL OIL	310 HP	0.12 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Limited to 500 h/yr operation	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY GENERATOR	17.210	DIESEL FUEL	11.4 MMBTU/H	0.58 LB/H	BACT-PSD	- usage limited to 500 h/yr	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY FIREWATER PUMP	17.210	DIESEL FUEL	11.4 MMBTU/H	0.58 LB/H	BACT-PSD	- usage limited to 200 h/yr	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	14.1 MMBTU/H	0.8 LB/H	Other Case-by-Case	SULFUR IN OIL LIMITED TO 0.05% BY WEIGHT. - MAX HOURS OF OPERATION= 55 H/YR, SULFUR IN OIL <= 0.05% BY WEIGHT, OPACITY <=20%	LSF
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	DIESEL FIRE PUMP	17.210	DISTILLATE OIL	3.5 MMBTU/H	1 LB/H	Other Case-by-Case	NONE - OIL MUST HAVE <= 0.05% SULFUR BY WEIGHT, OPACITY <=20%, HOURS OF OPERATION <= 500 H/YR	LSF
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	DIESEL FIRE PUMP	17.210	DIESEL (NO. 2 OIL)	1.5 MMBTU/H	0.08 LB/H	N/A	NONE - SULFUR MUST BE <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	11.93 MMBTU/H	0.62 LB/H	N/A	- SULFUR CONTENT <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	BACKUP GENERATORS (2)	17.210	DIESEL	500 KW	0.27 LB/H	BACT-PSD	LOW SULFUR FUEL - (2) 500 KW DIESEL FIRED BACKUP GENERATORS, 670 HP, LIMITED TO 500 H/YR OPERATION.	LSF
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	FIRE WATER PUMP (1)	17.210	DIESEL	265 HP	0.1 LB/H	BACT-PSD	LOW SULFUR FUEL - (1) 265 HP DIESEL FIRED FIRE WATER PUMP, LIMITED TO 500 H/YR OPERATION.	LSF
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL FIRE PUMP ENGINE	17.210	DIESEL	400 HP	0.84 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 400 HP Emergency diesel fuel fired fire pump engine. Limited to 500 hr/yr of operation.	LSF
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	FIRE WATER PUMP	17.210	DIESEL	290 KW	0.003 T/YR	BACT-PSD	LOW SULFUR FUEL - 290 KW EMERGENCY DIESEL FUEL FIRE WATER PUMP, 389 HP. LIMITED TO 500 H/YR OPERATION.	LSF
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL FUEL	1.6 MMBTU/H	0.8 LB/H	BACT-PSD	SULFUR LIMITED TO 0.05 % BY WEIGHT. OPERATIONS LIMITED TO 499 HOURS PER YEAR. - RESTRICTED TO 499 HOURS OF OPERATION PER ROLING 12-MONTHS	LSF
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 0.58 MMBTU/H	17.210	FUEL OIL #2	0.58 MMBTU/H	0.17 LB/H	BACT-PSD	- RESTRICTION OF 19,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 4.68 MMBTU/H	17.210	FUEL OIL #2	4.68 MMBTU/H	2.36 LB/H	BACT-PSD	- RESTRICTION OF 80,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OK-0056	2/12/2002	5/6/2004	HORSESHOE ENERGY PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	250 HP	0.05 LB/MMBTU	BACT-PSD	LOW SULFUR DIESEL FUEL -	LSF
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	300 HP	0.4 LB/MMBTU	BACT-PSD	- 1 UNIT	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	270 HP	2 GR/100SCF	BACT-PSD	USE OF LOW SULFUR NATURAL GAS -	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, EMERGENCY GENERATOR	17.210	DIESEL	0.85 MMBUT/H	2 GR/100 SCF	BACT-PSD	USE OF LOW SULFUR NATURAL GAS -	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, FIRE WATER PUMP	17.210	DIESEL	265 BHP	0.5 LB/H	BACT-PSD	USE OF VERY LOW SULFUR DIESEL FUEL (<0.05% S BY WT) - operation limit: < 100 h/yr	LSF
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY FIREWATER PUMP	17.210	DIESEL	260 HP	0.21 LB/H	BACT-PSD	-	-
TX-0273	3/21/2000	1/4/2005	BASTROP CLEAN ENERGY CENTER	FIREWATER PUMP ENGINE	17.210	DIESEL FUEL	300 BHP	0.62 LB/H	BACT-PSD	DISTILLATE FUEL OIL LIMITED TO 0.3 WEIGHT PERCENT SULFUR - LIMITED TO 250 NON-EMERGENCY HOURS OF OPERATION ANNUALLY. EMISSION POINT NO. FWP-1.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY FIREWATER PUMP, EG-2	17.210	DIESEL FUEL	260 HP	0.21 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY GENERATOR, E-GEN	17.210		310 KW	0.0022 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY FIREWATER PUMP, E-PUMP	17.210		250 HP	0.84 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0352	12/31/2002	5/24/2005	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	(2) FIRE WATER PUMPS, FWPUMP-1 & -2	17.210	DIESEL	300 HP	0.62 LB/H	Other Case-by-Case	BURN DIESEL W/ NO > 0.3 WT % S AND MAX OPERATION TIME OF 100 H/YR, NON-EMERGENCY USE. - ALL DIESEL FIRED EQUIPMENT IS AUTHORIZED TO FIRE DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.3 WT % S, AND EACH SOURCE IS LIMITED TO A MAXIMUM OF 100 NON- EMERGENCY	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.210	DIESEL	300 HP	0.62 LB/H	BACT-PSD	DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.2 WEIGHT PERCENT OF SULFUR. - LIMITED TO A MAXIMUM OF 100 NON EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0279	1/8/2003	6/28/2004	CINCAP - MARTINSVILLE	IC ENGINE, FIRE WATER PUMP	17.210	DIESEL	300 KW		BACT-PSD	FUEL SULFUR LIMIT: < 0.05% S BY WT - Additional throughput: 2.8 mmBtu/h. Fuel use limit: 10,057 gal of distillate oil/year	LSF
VA-0285	1/6/2004	3/25/2004	INGENCO - CHESTER PLANT	IC ENGINE, DIESEL, (48)	17.210	DISTILLATE FUEL OIL	350 KW	0.5 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES AND LOW SULFUR FUEL - EMISSIONS FROM THE OPERATION OF ANY OF THE 48 DUAL FUEL ENGINES WHEN THE FACILTY IS OPERATED IN THE SINGLE OR DUAL FUEL MODE SHALL NOT EXCEED THESE LIMITS.	LSF
WA-0291	1/3/2003	8/31/2006	WALLULA POWER PLANT	IC ENGINE, FIRE PUMP, DIESEL	17.210	DIESEL			Other Case-by-Case	LOW SULFUR FUEL. < 0.05 % BY WT (#2 DIESEL) - The diesel fire pump shall be limited to 100 hours of operation per calendar year. EFSEC selected reduced operating hours as BACT for this unit for CO, NOx, and PM10. Bact for SO2 is low sulfur fuel.	LSF
WI-0227	10/13/2004	8/31/2006	PORT WASHINGTON GENERATING STATION	DIESEL ENGINE GENERATOR (P05 / S05)	17.210	DIESEL FUEL OIL	7.6 MMBTU/H	0.38 LB/H	BACT-PSD	LOW SULFUR DIESEL FUEL OIL (0.05 WT% S) - DIESEL FUEL GENERATOR 55.10 GAL/H	LSF
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	DIESEL BOOSTER PUMP (B27, S27)	17.210	DIESEL FUEL OIL	265 HP	0.54 LB/H	BACT-PSD	FUEL SULFUR CONTENT LIMIT (0.003 WT. % S) GOOD COMBUSTION PRACTICES - THIS UNIT WILL ASSIST IN CIRCULATING THE WATER FOR THE STEAM TURBINE DURING STARTUP AND SHUT DOWNS. THE BOOSTER PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY WEIGHT	LSF
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	MAIN FIRE PUMP (DIESEL ENGINE)	17.210	DIESEL FUEL OIL	460 HP	0.94 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, ULTRA LOW SULFUR (0.003 WT. % S) DIESEL FUEL OIL - THIS UNIT WILL BE USED AS THE MAIN FIRE PUMP AND ONLY WILL BE USED FOR FIRE SUPPRESSION PURPOSES. THE MAIN FIRE PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY	LSF

Control Category Key:

LSF Low Sulfur (Clean) Fuels - less than 0.1 wt.% S

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	ELECTRIC GENERATOR CAT 3412, EG704	17.210	DIESEL	4.8 MMBTU/H	0.81 LB/MMBTU	Other Case-by-Case	NONE INDICATED. - DESIGN CAPACITY IS 4.8 MMBTU/H, BUT AUTHORIZED RATE CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 200 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	NORTH CUMMINS, P708A	17.210	DIESEL	290 HP	0.95 LB/MMBTU	Other Case-by-Case	NONE INDICATED. - DESIGN CAPACITY IS 2.0 MMBTU/HR (ALSO LISTED AS 290 HP), BUT AUTHORIZED RATED CAPACITY IS 1 MMBTU/H. OPERATING LIMIT OF 600 H/YR.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	SOUTH CUMMINS, P708B	17.210	DIESEL	290 HP	0.95 LB/MMBTU	Other Case-by-Case	NONE INDICATED. - DESIGN CAPACITY IS 290 HP. OPERATING LIMIT IS 600 H/YR.	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	IC ENGINES, FIREWATER PUMP, DIESEL, (2)	17.210	DIESEL			BACT-PSD	GOOD COMBUSTION PRACTICES - Two firewater pump engines, 186 and 230 HP, respectively, 1000 h/yr operating limit.	-
CA-0895	9/24/1999	10/11/2005	COACHELLA VALLEY WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	325 BHP	8.5 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-921-00 PERKINS MODEL 1303-9TAG1 DIESEL-FIRED COMPRESSION IGNITION ENGINE WITH A TURBOCHARGER AND INTERCOOLER, USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. PERMIT LIMIT (NOT BACT) INCLUDES LIMIT ON FUEL SULFUR CONTE	-
CA-0904	10/14/1999	10/11/2005	SANTA CLARITA VALLEY FOOD SERVICES	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	480 BHP	8.5 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-930-00 CUMMINS MODEL NTA855-G3 DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. BACT LIMITS SET FOR VOC, NOX, CO, AND PM10	-
CA-0906	11/16/1999	10/11/2005	RUNNING SPRINGS WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	86 BHP	8.5 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-932-00 CATERPILLAR MODEL 3054 DIT DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. VOC, NOX, CO, AND PM10 SUBJECT TO BACT. NO OTHER POLLUTANTS.	-
CA-0907	10/7/1999	10/11/2005	US GOVERNMENT NAVAL AIR STATION NORTH ISLAND	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	100 BHP	8.5 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-933-00 JOHN DEERE MODEL 404STF DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. PERMIT REQUIRES LOW SULFUR FUEL (< 0.05% S BY WEIGHT). BACT DETERMINATION MADE FOR VOC, CO, NOX, AND PM10	-
CA-0989	5/1/2002	9/4/2003	FOLSOM SURGICAL CENTER	IC ENGINE	17.210	DIESEL FUEL	68 HP	8.5 G/B-HP-H	LAER	- EMERGENCY GENERATOR FOR SURGICAL CENTER	-
CA-0991	8/9/2002	9/4/2003	CENIC DBA UC DAVIS COMMUNICATIONS RESOURCES	IC ENGINES	17.210	DIESEL FUEL	277 HP	8.5 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-0998	1/7/2003	9/4/2003	WESTERN DEVCON	IC ENGINE	17.210	DIESEL FUEL	415 HP	8.5 G/B-HP-H	LAER	EPA CERTIFIED ENGINE - EMERGENCY GENERATOR	-
CA-1015	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	471 BHP	2.6 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(471BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE USEPA ENGINE FAMILY TO WHICH THIS ENGINES BELONGS HA	-
CA-1073	8/14/2003	2/14/2006	LOS ANGELES COUNTY PROBATION/FAC PLANNING/ISD	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	240 BHP	0.44 G/B-HP-H	BACT-PSD	OPERATIONS LIMITED TO 200 H/YR. - EQUIP: , MFR: CLARKE (ENGINE MFR. IS JOHN DEERE), TYPE: 6-CYLINDER, 4-CYCLE, MODEL: JU6H-UF60 (ENGINE MODEL 6068), FUNC EQUIP: FOR EMERGENCY USE IN CASE OF FIRE, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 12, NOTES: AFTER	-
CA-1075	5/14/2002	5/2/2006	ULTRAMAR INC.	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	300 HP	3.55 G/B-HP-H	BACT-PSD	OPERATIONS LIMITED TO 200 H/YR + AIR/FUEL CONTROLLER - EQUIP: COMPRESSION IGNITION, LEAN BURN, MFR: CUMMINS ENGINE CO., TYPE: LEAN BURN, MODEL: 6CTA8.3-F3, FUNC EQUIP: THE ENGINE DRIVES AN EMERGENCY FIRE WATER-PUMP., FUEL_TYPE: 15 PPM SULFUR DIESEL, SCHED	-
CA-1077	10/7/1999	5/2/2006	US GOVERNMENT NAVAL AIR STATION, NORTH ISLAND	ICE: EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	100 BHP	8.5 G/B-HP-H	BACT-PSD	INTERNAL CONTROLS-TURBOCHARGER + OPERATIONS LIMITED TO 200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: JOHN DEERE, TYPE: COMPRESSION IGNITION-TURBOCHARGER, MODEL: 4045TF, FUNC EQUIP: THE ENGINE DRIVES A STANDBY ELECTRICAL GENERATOR., SCHEDULE: VARIABL	-
CA-1144	4/25/2007	3/17/2008	BLYTHE ENERGY PROJECT II	FIRE PUMP	17.210	DIESEL	303 HP	0.7 LB/H	BACT-PSD	-	-
IA-0058	4/10/2002	6/21/2004	GREATER DES MOINES ENERGY CENTER	FIRE PUMP	17.210	DIESEL	235 BHP	2.21 LB/H	BACT-PSD	-	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	FIRE PUMP	17.210	#2 DISTILLATE OIL	6500 GALLONS/YR	4.7 LB/H	BACT-PSD	GCP, TIMING RETARD -	-
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, EMERGENCY FIRE PUMP	17.210	#2 FUEL OIL	2.59 MMBTU/H	0.95 LB/MMBTU	Other Case-by-Case	GOOD COMBUSTION PRACTICES. - Limited to 104 hours/yr. Standardized emission units not available.	-
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, BLACK-START GENERATOR (6)	17.210	#2 FUEL OIL	25 MMBTU/H	0.85 LB/MMBTU	Other Case-by-Case	GOOD COMBUSTION PRACTICES. - Each generator limited to 200 hours/yr. Additional throughput: 20.5 MMBTU/hr. No standardized emission limits.	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CLARIFIER DIESEL ENGINE	17.210	DIESEL FUEL	310 HP	2.1 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 48-96	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	WASTE CLARIFIER DIESEL ENGINE	17.210	DIESEL	413 HP	2.8 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 49-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	EFFLUENT LIFT PIT DIESEL ENGINE	17.210	DIESEL FUEL	152 HP	1 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISISON POINT 51-96	-
LA-0146	5/10/2000	8/5/2003	SHELL CHEMICAL COMPANY - GEISMAR PLANT	DIESEL GENERATOR HEATER	17.210	DIESEL	415 HP	3.32 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND ENGINEERING DESIGN - EMISSION POINT 322-99	-
LA-0192	6/6/2005	4/8/2008	CRESCENT CITY POWER	DIESEL FIRED WATER PUMP	17.210			1.88 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES - 425 HP	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER BOOSTER PUMP DIESEL ENGINES 1-4	17.210	DIESEL	300 HP EA.	0.18 LB/H	BACT-PSD	GOOD ENGINE DESIGN & PROPER OPERATING PRACTICES - OPERATING TIME = 500 HR/YR.	-
LA-0224	3/20/2008	6/26/2008	ARSENAL HILL POWER PLANT	DFP DIESEL FIRE PUMP	17.210	DIESEL	310 HORSEPOWER	2.07 LB/H	BACT-PSD	USE OF LOW-SULFUR FUELS, LIMITING OPERATING HOURS AND PROPER ENGINE MAINTENANCE - EQT-016	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL GENERATOR	17.210	#2 FUEL OIL	700 KW		BACT-PSD	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL FIRE WATER PUMP	17.210	#2 FUEL OIL	200 HP		BACT-PSD	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0034	11/30/2000	3/1/2005	ROCK SPRINGS	EMERGENCY DIESEL FIREWATER PUMP	17.210	#2 FUEL OIL	200 HP	2.7 G/B-HP-H	BACT-PSD	APPLICATION OF GOOD COMBUSTION CONTROLS; LEAN BURN TECHNOLOGY -	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, SMALL, FUEL OIL (1)	17.210	DIESEL	250 HP	0.95 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - 2.017 MMBTU/H.	-
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, SMALL	17.210	DIESEL FUEL	290 HP	0.25 G/B-HP-H	N/A	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	-
MT-0022	7/21/2003	6/29/2004	BULL MOUNTAIN, NO. 1, LLC - ROUNDUP POWER PROJECT	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	15.3 MMBTU/H	97.7 % REDUCTION	BACT-PSD	LIMITED TO 200 HOURS OF OPERATION PER YEAR - Inspections of the facility, including the emergency generator, will take place after construction.	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	250 KW	2.24 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Stand-by emergency generator, limited to 500 h/yr operation	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, FIRE WATER PUMP	17.210	NO. 2 FUEL OIL	310 HP	2.1 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Limited to 500 h/yr operation	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY GENERATOR	17.210	DIESEL FUEL	11.4 MMBTU/H	9.69 LB/H	BACT-PSD	- usage limited to 500 h/yr	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY FIREWATER PUMP	17.210	DIESEL FUEL	11.4 MMBTU/H	9.69 LB/H	BACT-PSD	- usage limited to 200 h/yr	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	14.1 MMBTU/H	11.1 LB/H	Other Case-by-Case	NONE - MAX HOURS OF OPERATION= 55 H/YR, SULFUR IN OIL <= 0.05% BY WEIGHT, OPACITY <=20%	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	DIESEL FIRE PUMP	17.210	DISTILLATE OIL	3.5 MMBTU/H	3.3 LB/H	Other Case-by-Case	NONE - OIL MUST HAVE <= 0.05% SULFUR BY WEIGHT, OPACITY <=20%, HOURS OF OPERATION <= 500 H/YR	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	DIESEL FIRE PUMP	17.210	DIESEL (NO. 2 OIL)	1.5 MMBTU/H	1.2 LB/H	N/A	NONE - SULFUR MUST BE <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	11.93 MMBTU/H	7 LB/H	N/A	NONE - SULFUR CONTENT <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	BACKUP GENERATORS (2)	17.210	DIESEL	500 KW	12.6 LB/H	BACT-PSD	- (2) 500 KW DIESEL FIRED BACKUP GENERATORS, 670 HP, LIMITED TO 500 H/YR OPERATION.	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	FIRE WATER PUMP (1)	17.210	DIESEL	265 HP	1.8 LB/H	BACT-PSD	- (1) 265 HP DIESEL FIRED FIRE WATER PUMP, LIMITED TO 500 H/YR OPERATION.	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL FIRE PUMP ENGINE	17.210	DIESEL	400 HP	2.76 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 400 HP Emergency diesel fuel fired fire pump engine. Limited to 500 hr/yr of operation.	-
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	FIRE WATER PUMP	17.210	DIESEL	290 KW	0.05 T/YR	BACT-PSD	- 290 KW EMERGENCY DIESEL FUEL FIRE WATER PUMP, 389 HP. LIMITED TO 500 H/YR OPERATION.	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL FUEL	1.6 MMBTU/H	1.37 LB/H	BACT-PSD	- RESTRICTED TO 499 HOURS OF OPERATION PER ROLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 0.58 MMBTU/H	17.210	FUEL OIL #2	0.58 MMBTU/H	0.55 LB/H	BACT-PSD	- RESTRICTION OF 19,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 4.68 MMBTU/H	17.210	FUEL OIL #2	4.68 MMBTU/H	3.98 LB/H	BACT-PSD	- RESTRICTION OF 80,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OK-0056	2/12/2002	5/6/2004	HORSESHOE ENERGY PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	250 HP	0.95 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0070	6/13/2002	5/12/2004	GENOVA OK I POWER PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	200 BHP	0.95 LB/MMBTU	BACT-PSD	GOOD ENGINE DESIGN - 200 HOUR LIMIT	-
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	300 HP	0.0067 LB/B-HP-H	BACT-PSD	ENGINE DESIGN - 1 UNIT	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	270 HP	0.95 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, EMERGENCY GENERATOR	17.210	DIESEL	0.85 MMBUT/H	0.085 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, FIRE WATER PUMP	17.210	DIESEL	265 BHP	0.95 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND GOOD COMBUSTION PRACTICES - operation limit: < 100 h/yr	-
OK-0110	10/21/2005	8/14/2006	MUSKOGEE PORCELAIN FLOOR TILE PLT	EMERGENCY GENERATORS	17.210			0.0067 LB/HP-H		GOOD COMBUSTION -	-
OK-0111	10/14/2005	8/14/2006	MUSKOGEE PORCELAIN FLOOR TILE PLT	EMERGENCY GENERATORS	17.210			0.0067 LB/HP-H	BACT-PSD	GOOD COMBUSTION -	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY FIREWATER PUMP	17.210	DIESEL	260 HP	1.7 LB/H	BACT-PSD	-	-
TX-0273	3/21/2000	1/4/2005	BASTROP CLEAN ENERGY CENTER	FIREWATER PUMP ENGINE	17.210	DIESEL FUEL	300 BHP	2 LB/H	BACT-PSD	- LIMITED TO 250 NON-EMERGENCY HOURS OF OPERATION ANNUALLY. EMISSION POINT NO. FWP-1.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY FIREWATER PUMP, EG-2	17.210	DIESEL FUEL	260 HP	1.7 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY GENERATOR, E-GEN	17.210		310 KW	1.12 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY FIREWATER PUMP, E-PUMP	17.210		250 HP	1.053 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0352	12/31/2002	5/24/2005	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	(2) FIRE WATER PUMPS, FWPUMP-1 & -2	17.210	DIESEL	300 HP	2 LB/H	Other Case-by-Case	NONE INDICATED - ALL DIESEL FIRED EQUIPMENT IS AUTHORIZED TO FIRE DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.3 WT % S, AND EACH SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.210	DIESEL	300 HP	2 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0285	1/6/2004	3/25/2004	INGENCO - CHESTER PLANT	IC ENGINE, DIESEL, (48)	17.210	DISTILLATE FUEL OIL	350 KW	4.3 LB/MMBTU	N/A	CONTINUOUS EMISSION MONITORING DEVICES - EMISSIONS FROM THE OPERATION OF ANY OF THE 48 DUAL FUEL ENGINES WHEN THE FACILTY IS OPERATED IN THE SINGLE OR DUAL FUEL MODE SHALL NOT EXCEED THESE LIMITS.	-
WI-0227	10/13/2004	8/31/2006	PORT WASHINGTON GENERATING STATION	DIESEL ENGINE GENERATOR (P05 / S05)	17.210	DIESEL FUEL OIL	7.6 MMBTU/H	18.85 LB/H	BACT-PSD	ENGINE DESIGN, DIESEL FUEL OIL (0.05 WT.% S). - DIESEL FUEL GENERATOR 55.10 GAL/H	-
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	DIESEL BOOSTER PUMP (B27, S27)	17.210	DIESEL FUEL OIL	265 HP	1.77 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, ULTRA LOW S DIESEL FUEL OIL - THIS UNIT WILL ASSIST IN CIRCULATING THE WATER FOR THE STEAM TURBINE DURING STARTUP AND SHUT DOWNS. THE BOOSTER PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY WEIGHT SULFUR FUEL	-
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	MAIN FIRE PUMP (DIESEL ENGINE)	17.210	DIESEL FUEL OIL	460 HP	3.07 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, ULTRA LOW SULFUR (0.003 WT. % S) DIESEL FUEL OIL - THIS UNIT WILL BE USED AS THE MAIN FIRE PUMP AND ONLY WILL BE USED FOR FIRE SUPPRESSION PURPOSES. THE MAIN FIRE PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
CA-0895	9/24/1999	10/11/2005	COACHELLA VALLEY WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	325 BHP	1 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-921-00 PERKINS MODEL 1303-9TAG1 DIESEL-FIRED COMPRESSION IGNITION ENGINE WITH A TURBOCHARGER AND INTERCOOLER, USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. PERMIT LIMIT (NOT BACT) INCLUDES LIMIT ON FUEL SULFUR CONTE	-
CA-0904	10/14/1999	10/11/2005	SANTA CLARITA VALLEY FOOD SERVICES	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	480 BHP	1 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-930-00 CUMMINS MODEL NTA855-G3 DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. BACT LIMITS SET FOR VOC, NOX, CO, AND PM10	-
CA-0906	11/16/1999	10/11/2005	RUNNING SPRINGS WATER DISTRICT	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	86 BHP	1 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-932-00 CATERPILLAR MODEL 3054 DIT DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A PORTABLE STANDBY ELECTRICAL GENERATOR. VOC, NOX, CO, AND PM10 SUBJECT TO BACT. NO OTHER POLLUTANTS.	-
CA-0907	10/7/1999	10/11/2005	US GOVERNMENT NAVAL AIR STATION NORTH ISLAND	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	100 BHP	1 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-933-00 JOHN DEERE MODEL 404STF DIESEL-FIRED COMPRESSION IGNITION ENGINE USED TO DRIVE A STANDBY ELECTRICAL GENERATOR. PERMIT REQUIRES LOW SULFUR FUEL (< 0.05% S BY WEIGHT). BACT DETERMINATION MADE FOR VOC, CO, NOX, AND PM10	-
CA-0926	11/10/1999	12/3/2002	KERN ASPHALT PAVING SEALING	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.210	DIESEL	460 BHP	1 G/B-HP-H	BACT-PSD	POSITIVE CRANKCASE VENTILATION - ARB RECORD # A350-955-00. CATERPILLAR MODEL 3406C. BACT NOT TRIGGERED FOR SOX OR CO	-
CA-0989	5/1/2002	9/4/2003	FOLSOM SURGICAL CENTER	IC ENGINE	17.210	DIESEL FUEL	68 HP	1.05 G/B-HP-H	LAER	- EMERGENCY GENERATOR FOR SURGICAL CENTER	-
CA-0991	8/9/2002	9/4/2003	CENIC DBA UC DAVIS COMMUNICATIONS RESOURCES	IC ENGINES	17.210	DIESEL FUEL	277 HP	1 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-0998	1/7/2003	9/4/2003	WESTERN DEVCON	IC ENGINE	17.210	DIESEL FUEL	415 HP	1 G/B-HP-H	LAER	EPA CERTIFIED ENGINE - EMERGENCY GENERATOR	-
CA-1075	5/14/2002	5/2/2006	ULTRAMAR INC.	ICE: FIRE PUMP, COMPRESSION IGNITION	17.210	DIESEL	300 HP	0.73 G/B-HP-H	BACT-PSD	OPERATIONS LIMIT IS 200 H/YR + AIR/FUEL CONTROLLER. - EQUIP: COMPRESSION IGNITION, LEAN BURN, MFR: CUMMINS ENGINE CO., TYPE: LEAN BURN, MODEL: 6CTA8.3-F3, FUNC EQUIP: THE ENGINE DRIVES AN EMERGENCY FIRE WATER-PUMP., FUEL_TYPE: 15 PPM SULFUR DIESEL, SCHEDU	-
CA-1077	10/7/1999	5/2/2006	US GOVERNMENT NAVAL AIR STATION, NORTH ISLAND	ICE: EMERGENCY, COMPRESSION IGNITION	17.210	DIESEL	100 BHP	1 G/B-HP-H	BACT-PSD	INTERNAL CONTROLS-TURBOCHARGER + OPERATION LIMITED TO 200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: JOHN DEERE, TYPE: COMPRESSION IGNITION-TURBOCHARGER, MODEL: 4045TF, FUNC EQUIP: THE ENGINE DRIVES A STANDBY ELECTRICAL GENERATOR., SCHEDULE: VARIABLE	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	FIRE PUMP	17.210	#2 DISTILLATE OIL	6500 GALLONS/YR	0.54 LB/H	Other Case-by-Case	GCP, TIMING RETARD -	-
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, EMERGENCY FIRE PUMP	17.210	#2 FUEL OIL	2.59 MMBTU/H	0.0054 LB/MMBTU	Other Case-by-Case	GOOD COMBUSTION PRACTICES. - Limited to 104 hours/yr. Standardized emission units not available.	-
IA-0062	12/20/2002	6/21/2004	EMERY GENERATING STATION	IC ENGINE, BLACK-START GENERATOR (6)	17.210	#2 FUEL OIL	25 MMBTU/H	0.09 LB/MMBTU	Other Case-by-Case	GOOD COMBUSTION PRACTICES. - Each generator limited to 200 hours/yr. Additional throughput: 20.5 MMBTU/hr. No standardized emission limits.	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CLARIFIER DIESEL ENGINE	17.210	DIESEL FUEL	310 HP	0.76 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 48-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	WASTE CLARIFIER DIESEL ENGINE	17.210	DIESEL	413 HP	1 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 49-96	-
LA-0192	6/6/2005	4/8/2008	CRESCENT CITY POWER	DIESEL FIRED WATER PUMP	17.210			0.05 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES - 425 HP	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER BOOSTER PUMP DIESEL ENGINES 1-4	17.210	DIESEL	300 HP EA.	0.1 LB/H	BACT-PSD	GOOD ENGINE DESIGN & PROPER OPERATING PRACTICES - OPERATING TIME = 500 HR/YR.	-
LA-0224	3/20/2008	6/26/2008	ARSENAL HILL POWER PLANT	DFP DIESEL FIRE PUMP	17.210	DIESEL	310 HORSEPOWER	0.77 LB/H	BACT-PSD	USE OF LOW-SULFUR FUELS, LIMITING OPERATING HOURS AND PROPER ENGINE MAINTENANCE - EQT-016	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL GENERATOR	17.210	#2 FUEL OIL	700 KW		LAER	GOOD COMBUSTION CONTROLS OPERATIONAL LIMITATION -	-
MD-0033	9/27/2001	3/1/2005	KELSON RIDGE	EMERGENCY DIESEL FIRE WATER PUMP	17.210	#2 FUEL OIL	200 HP		LAER	GOOD COMBUSTION CONTROLS -	-
MD-0034	11/30/2000	3/1/2005	ROCK SPRINGS	EMERGENCY DIESEL FIREWATER PUMP	17.210	#2 FUEL OIL	200 HP		N/A	RESTRICTED TO NG ONLY -	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, SMALL, FUEL OIL (1)	17.210	DIESEL	250 HP	0.36 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - 2.017 MMBTU/H.	-
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, SMALL	17.210	DIESEL FUEL	290 HP	0.08 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, EMERGENCY GENERATOR	17.210	NO. 2 FUEL OIL	250 KW	0.84 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Stand-by emergency generator, limited to 500 h/yr operation	-
NC-0078	6/30/1999	3/22/2004	ROCKINGHAM POWER, LLC POWER GENERATING	IC ENGINE, FIRE WATER PUMP	17.210	NO. 2 FUEL OIL	310 HP	0.78 LB/H	BACT-PSD	LIMITED TO 500 H/YR OF OPERATION - Limited to 500 h/yr operation	-
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY GENERATOR	17.210	DIESEL FUEL	11.4 MMBTU/H	1.04 LB/H	BACT-PSD	- usage limited to 500 h/yr	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES LESS THAN OR EQUAL TO 500 HP - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.210 - Small Internal Combustion Engines ≤500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fue; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
NC-0101	9/29/2005	8/30/2006	FORSYTH ENERGY PLANT	IC ENGINE, EMERGENCY FIREWATER PUMP	17.210	DIESEL FUEL	11.4 MMBTU/H	1.04 LB/H	BACT-PSD	- usage limited to 200 h/yr	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	14.1 MMBTU/H	1.4 LB/H	Other Case-by-Case	NONE - MAX HOURS OF OPERATION= 55 H/YR, SULFUR IN OIL <= 0.05% BY WEIGHT, OPACITY <=20%	-
NJ-0043	3/28/2002	8/31/2006	LIBERTY GENERATING STATION	DIESEL FIRE PUMP	17.210	DISTILLATE OIL	3.5 MMBTU/H	1.2 LB/H	Other Case-by-Case	NONE - OIL MUST HAVE <= 0.05% SULFUR BY WEIGHT, OPACITY <=20%, HOURS OF OPERATION <= 500 H/YR	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	DIESEL FIRE PUMP	17.210	DIESEL (NO. 2 OIL)	1.5 MMBTU/H	0.1 LB/H	N/A	NONE - SULFUR MUST BE <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
NJ-0044	6/26/2001	6/23/2004	MANTUA CREEK GENERATING FACILITY	EMERGENCY GENERATOR	17.210	DISTILLATE OIL	11.93 MMBTU/H	0.8 LB/H	N/A	NONE - SULFUR CONTENT <= 0.2% BY WEIGHT; <= 100 HR/YR OPERATION	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	BACKUP GENERATORS (2)	17.210	DIESEL	500 KW	1.1 LB/H	BACT-PSD	- (2) 500 KW DIESEL FIRED BACKUP GENERATORS, 670 HP, LIMITED TO 500 H/YR OPERATION.	-
OH-0252	12/28/2004	7/5/2005	DUKE ENERGY HANGING ROCK ENERGY FACILITY	FIRE WATER PUMP (1)	17.210	DIESEL	265 HP	0.66 LB/H	BACT-PSD	- (1) 265 HP DIESEL FIRED FIRE WATER PUMP, LIMITED TO 500 H/YR OPERATION.	-
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	FIRE WATER PUMP	17.210	DIESEL	290 KW	0.02 T/YR	BACT-PSD	- 290 KW EMERGENCY DIESEL FUEL FIRE WATER PUMP, 389 HP. LIMITED TO 500 H/YR OPERATION.	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL FIRE PUMP	17.210	DIESEL FUEL	1.6 MMBTU/H	0.14 LB/H	BACT-PSD	- RESTRICTED TO 499 HOURS OF OPERATION PER ROLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 0.58 MMBTU/H	17.210	FUEL OIL #2	0.58 MMBTU/H	0.2 LB/H	BACT-PSD	- RESTRICTION OF 19,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OH-0281	6/10/2004	5/8/2007	RUMPKE SANITARY LANDFILL, INC	PORTABLE ENGINE 4.68 MMBTU/H	17.210	FUEL OIL #2	4.68 MMBTU/H	0.42 LB/H	BACT-PSD	- RESTRICTION OF 80,000 GALLONS OF #2 FUEL OIL PER ROLLING 12-MONTHS	-
OK-0056	2/12/2002	5/6/2004	HORSESHOE ENERGY PROJECT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL FUEL	250 HP	0.36 LB/MMBTU	BACT-PSD	COMBUSTION PRACTICES AND DESIGN -	-
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	300 HP	0.0025 LB/B-HP-H	BACT-PSD	ENGINE DESIGN - 1 UNIT	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, FIRE WATER PUMP	17.210	DIESEL	270 HP	0.35 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0074	5/1/2001	5/6/2004	KIAMICHI ENERGY FACILITY	DIESEL ENGINE, EMERGENCY GENERATOR	17.210	DIESEL	0.85 MMBUT/H	0.09 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES AND DESIGN -	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, FIRE WATER PUMP	17.210	DIESEL	265 BHP	0.7 LB/H	BACT-PSD	ENGINE DESIGN - operation limit: < 100 h/yr	-
OK-0110	10/21/2005	8/14/2006	MUSKOGEE PORCELAIN FLOOR TILE PLT	EMERGENCY GENERATORS	17.210			0.0025 LB/HP-H		GOOD COMBUSTION -	-
OK-0111	10/14/2005	8/14/2006	MUSKOGEE PORCELAIN FLOOR TILE PLT	EMERGENCY GENERATORS	17.210			0.0025 LB/HP-H	BACT-PSD	GOOD COMBUSTION -	-
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY FIREWATER PUMP	17.210	DIESEL	260 HP	0.65 LB/H	BACT-PSD	-	-
TX-0273	3/21/2000	1/4/2005	BASTROP CLEAN ENERGY CENTER	FIREWATER PUMP ENGINE	17.210	DIESEL FUEL	300 BHP	0.75 LB/H	BACT-PSD	- LIMITED TO 250 NON-EMERGENCY HOURS OF OPERATION ANNUALLY. EMISSION POINT NO. FWP-1.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY FIREWATER PUMP, EG-2	17.210	DIESEL FUEL	260 HP	0.65 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY GENERATOR, E-GEN	17.210		310 KW	0.2 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0326	7/20/2000	8/10/2006	AES WOLF HOLLOW LP	EMERGENCY FIREWATER PUMP, E-PUMP	17.210		250 HP	0.28 LB/H	Other Case-by-Case	NONE INDICATED - ASSUMED DIESEL AS FUEL TYPE FOR THE PURPOSES OF THIS DATABASE.	-
TX-0352	12/31/2002	5/24/2005	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	(2) FIRE WATER PUMPS, FWPUMP-1 & -2	17.210	DIESEL	300 HP	0.75 LB/H	Other Case-by-Case	NONE INDICATED - ALL DIESEL FIRED EQUIPMENT IS AUTHORIZED TO FIRE DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.3 WT % S, AND EACH SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.210	DIESEL	300 HP	0.74 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0285	1/6/2004	3/25/2004	INGENCO - CHESTER PLANT	IC ENGINE, DIESEL, (48)	17.210	DISTILLATE FUEL OIL	350 KW	0.4 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES - EMISSIONS FROM THE OPERATION OF ANY OF THE 48 DUAL FUEL ENGINES WHEN THE FACILTY IS OPERATED IN THE SINGLE OR DUAL FUEL MODE SHALL NOT EXCEED THESE LIMITS.	-
WI-0227	10/13/2004	8/31/2006	PORT WASHINGTON GENERATING STATION	DIESEL ENGINE GENERATOR (P05 / S05)	17.210	DIESEL FUEL OIL	7.6 MMBTU/H	2.15 LB/H	BACT-PSD	ENGINE DESIGN, DIESEL FUEL OIL (0.05 WT.% S). - DIESEL FUEL GENERATOR 55.10 GAL/H	-
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	DIESEL BOOSTER PUMP (B27, S27)	17.210	DIESEL FUEL OIL	265 HP	0.7 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, ULTRA LOW SULFUR (0.003 WT% S) DIESEL FUEL OIL - THIS UNIT WILL ASSIST IN CIRCULATING THE WATER FOR THE STEAM TURBINE DURING STARTUP AND SHUT DOWNS. THE BOOSTER PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY W	-
WI-0228	10/19/2004	8/31/2006	WPS - WESTON PLANT	MAIN FIRE PUMP (DIESEL ENGINE)	17.210	DIESEL FUEL OIL	460 HP	1.14 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, ULTRA LOW SULFUR (0.003 WT. % S) DIESEL FUEL OIL - THIS UNIT WILL BE USED AS THE MAIN FIRE PUMP AND ONLY WILL BE USED FOR FIRE SUPPRESSION PURPOSES. THE MAIN FIRE PUMP WILL HAVE OPERATIONAL LIMIT OF 200 HOURS PER YEAR. 0.003% BY	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	IC ENGINE, DIESEL , WARTSILA	17.110	ARCTIC DIESEL	5 MW	121.3 LB/H	BACT-PSD	LOW NOX CONVERSION PACKAGE - NOTE: EPA CURRENTLY DISPUTES THE NOX BACT DETERMINATION FOR THIS UNIT. AS OF 5/18/2000 THIS DISPUTE HAS NOT BEEN RESOLVED. NOT YET CONSTRUCTED, NO TESTING PERFORMED.	LND
AK-0034	5/8/2000	3/26/2001	DILLINGHAM POWER PLANT	IC ENGINES, DIESEL	17.110	DIESEL	2.1E+07 KW-H/YR	21.9 LB/H	BACT-PSD	LEAN BURN/LOW NOX PACKAGE - ONLY NOX LIMITS LISTED IN PERMIT.	LND
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	UPPER TANK FARM CAT 3412DT, P708C	17.110	DIESEL	660 HP	3.1 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 660 HP.OPERATING LIMIT OF 600 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	CAMP GENERATOR, UNIT 6,7	17.110	DIESEL	2362 KW	11 G/KW-H	Other Case-by-Case	VARIABLE FUEL INJECTION TIMING RETARD AS INCORPORATED BY THE MANUFACTURER - SPECIFIED THROUGHPUT IS FOR MAXIMUM RATING IN PRIME MODE. ADDITIONAL THROUGHPUT FOR MAXIMUM RATING IN STAND-BY MODE IS 2717 KW. MAXIMUM OPERATION: DURING PRE-SEALIFT PERIOD, 8760	ITR
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #9	17.110	DIESEL	2865 KW	106 LB/H	BACT-PSD	OPERATE WITH NO LESS THAN 2 DEGREES OF FUEL INJECTION TIMING RETARD AND WITH A 4-PASS AFTERCOOLER WITH SEPARATE COOLING WATER SUPPLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS AN EMD #20-645F4B GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 2865 KW AND	ITR/AC
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1500 KW	62 LB/H	BACT-PSD	OPERATE SOURCE NO. 11 WITH NO LESS THAN 2 DEGREES OF FUEL INJECTION TIMING RETARD. GOOD AIR POLLUTION CONTROL PRACTICE. - THIS IS AN EMD #12-645E4 GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 1500 KW AND MAXIMUM OPERATION LIMIT OF 8760 H/YR.	ITR
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #12A	17.110	DIESEL	3660 KW	188 LB/H	BACT-PSD	OPERATE SOURCE NO. 12A WITH NO LESS THAN 2.5 DEGREES OF FUEL INJECTION TIMING RETARD. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3616 GENERATOR THAT OPERATES UNDER 2 SCENARIOS. SCENARIO A IS WITH A DESIGN CAPACITY OF 3660 KW AND SCENAR	ITR
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #14	17.110	DIESEL	1875 KW	43 LB/H	BACT-PSD	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3516B-LS DIESEL ELECTRIC GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 1875 KW AND MAXIMUM OPERATION OF 8760 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #12B	17.110	DIESEL	4400 KW	203 LB/H	BACT-PSD	OPERATE SOURCE 12B WITH NO LESS THAN 4 DEGREES OF FUEL INJECTION TIMING RETARD. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3616 GENERATOR THAT OPERATES UNDER 2 SCENARIOS. SCENARIO A IS WITH A DESIGN CAPACITY OF 3660 KW AND SCENARIO B I	ITR
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #3	17.110	DIESEL	350 KW		Other Case-by-Case	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN PROCESS NOTES. - THIS UNIT IS A WHITE SUPERIOR #405X8 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 3 WITH A STACK HEIGH	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #5	17.110	DIESEL	750 KW		Other Case-by-Case	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A WHITE SUPERIOR #40V5X-12 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 5 WITH A STAC	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #6	17.110	DIESEL	1000 KW		Other Case-by-Case	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A WHITE SUPERIOR #40VX-16 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 6 WITH A STACK	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #8	17.110	DIESEL	835 KW		Other Case-by-Case	FOLLOW THE POWER GENERATION LIMITS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3516DI DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERTE SOURCE NO. 8 WITH A STACK HEI	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #9	17.110	DIESEL	835 KW		Other Case-by-Case	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3516DI DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 9 WITH A STACK HEI	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR, #10	17.110	DIESEL	1135 KW		Other Case-by-Case	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3516 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 10 WITH A STACK HEIG	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1050 KW	24.9 LB/H	BACT-PSD	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. OPERATE LEAN BURN/ LOW NOX ENGINE DESIGN WITH A SEPARATE AFTERCOOLER LOOP AND ELECTRONIC CONTROLS SET FOR LOW EMISSION STRATEGY. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATO	LND/AC
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #12	17.110	DIESEL	1050 KW	24.9 LB/H	BACT-PSD	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. OPERATE LEAN BURN/ LOW NOX ENGINE DESIGN WITH A SEPARATE AFTERCOOLER LOOP AND ELECTRONIC CONTROLS SET FOR LOW EMISSION STRATEGY. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATO	LND/AC
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #13	17.110	DIESEL	1050 KW	24.9 LB/H	BACT-PSD	FOLLOW POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. OPERATE WITH SEPARATE AFTERCOOLER LOOP AND ELECTRONIC CONTROLS SET FOR LOW EMISSION STRATEGY. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POW	LND/AC
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70003	17.110	FUEL OIL	2 MW	7 G/KW-H	BACT-PSD	AFTER-COOLING COMBINED WITH HIGH PRESSURE FUEL INJECTION PUMPS AND CYLINDER DESIGN TO ENSURE CLEAN BURN IN THE CYLINDER. - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS 500 H/YR LIQUID FUEL FOR A MAXIMUM OF 8 H/D. THE SCC CODE WAS CHOSEN FOR DISTILLATE FUE	HIP/AC
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70004	17.110	FUEL OIL	2 MW	7 G/KW-H	BACT-PSD	AFTER-COOLING COMBINED WITH HIGH PRESSURE FUEL INJECTION PUMPS AND CYLINDER DESIGN TO ENSURE CLEAN BURN IN THE CYLINDER. - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS LIQUID FUEL FOR 500 H/YR AND IS LIMITED TO OPERATING 8 H/D. THE SCC CODE WAS CHOSEN FOR	HIP/AC
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 2.9 MW	17.110	DIESEL	2.9 MW	101 LB/H	BACT-PSD	2 DEGREE FUEL INJECTION TIMING RETARD, IMPROVED IGNITION TECHNOLOGY, AND A 4-PASS AFTERCOOLER WITH SEPARATE COOLING WATER SUPPLY - 2,865 KW EMD #20-645F4B DIESEL ELECTRIC GENERATOR (SOURCE NO. 9)	ITR/AC
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 1.5 MW	17.110	DIESEL	1.5 MW	61 LB/H	BACT-PSD	2 DEGREE FUEL INJECTION TIMING RETARD AND REDUCED AFTERCOOLING WATER TEMPERATURES - 1,500 KW EMD #12-645E4 DIESEL ELECTRIC GENERATOR (SOURCE NO. 11)	ITR/AC
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 3.7 MW	17.110	DIESEL	3.7 MW	188 LB/H	BACT-PSD	2.5 DEGREE FUEL INJECTION TIMING RETARD AND REDUCED AFTERCOOLING WATER TEMPERATURE - 3,660 KW CATERPILLAR #3616 DIESEL ELECTRIC GENERATOR (SOURCE NO. 12A)	ITR/AC
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 4.4 MW	17.110	DIESEL	4.4 MW	203 LB/H	BACT-PSD	4 DEGREE FUEL INJECTION TIMING RETARD AND REDUCED AFTERCOOLING WATER TEMPERATURES - 4,400 KW CATERPILLAR #3616 DIESEL ELECTRIC GENERATOR (SOURCE NO. 12B)	ITR/AC
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 1.9 MW	17.110	DIESEL	1.9 MW	43 LB/H	BACT-PSD	LOW NOX PACKAGE - 1,875 KW CATERPILLAR #3516B-LS DIESEL ELECTRIC GENERATOR (SOURCE NO. 14)	LND
AK-0056	2/1/1999	1/16/2004	ALPINE DEVELOPMENT PROJECT, CENTRAL PROCESSING FAC	IC ENGINES, 2 MW	17.110	FUEL OIL	2 MW	7 G/KW-H	BACT-PSD	- EMERGENCY GENERATOR, SOURCE ID CF-G-70003, AND CF-G-70004, CUMMINS QWF 16V170	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	IC ENGINE, DIESEL, (2)	17.110	DIESEL	3000 KW	9.7 LB/H	BACT-PSD	SCR - Throughput for each. Units 5 & 6, Cooper Bessimer LSV16GDT.	SCR
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	IC ENGINES	17.110	DIESEL			BACT-PSD	GOOD COMBUSTION PRACTICES - Firewater pump engines (8), 160 - 1100 HP, operating limits 500 h/yr. Emergency generators (2), 600 kW, 500 h/yr operating limit. Aircraft barrier engines (4), 65.7 HP, gasoline fueled.	-
AK-0060	10/10/2003	6/3/2005	DUTCH HARBOR SEAFOOD PROCESSING FACILITY	IC ENGINE, GENERATOR, FUEL OIL, (3)	17.110	DISTILLATE FUEL OIL	2220 KW	42.3 LB/H	BACT-PSD	WATER INJECTION, LOW NOX DESIGN - Throughput for each. Three Wartsila Model 6R32D generators	WI/LND
AK-0061	11/5/2004	7/23/2007	SNAKE RIVER POWER PLANT	WARTSILA 12V32B DIESEL ELECTRIC GENERATOR	17.110	DIESEL FUEL	5211 kW	134 LB/H	BACT-PSD	1. FUEL INJECTION TIMING RETARD (THREE DEGRESS RETARD) AND SEPARATE LOW TEMPERATURE COOLING WATER SYSTEM / AFTER COOLER (LT SECTION) - THREE IDENTICAL UNITS.	ITR/AC
AR-0040	12/29/2000	6/30/2003	DUKE ENERGY HOT SPRINGS	GENERATORS, (2) DIESEL	17.110	#2 FUEL OIL	600 KW	14 G/B-HP-H	BACT-PSD	CLEAN FUEL, COMBUSTION CONTROL. - DIESEL ONLY. THROUGHPUT FOR EACH. LOW SULFUR RED DYE GRADE.	-
AR-0051	4/1/2002	5/6/2004	DUKE ENERGY-JACKSON FACILITY	GENERATOR, DIESEL-FIRED	17.110	DIESEL FUEL	671 HP	14 G/B-HP-H	BACT-PSD	GOOD OPERATING PRACTICE - backup generator, operates less than 500 h/yr	-
AZ-0046	4/14/2005	8/25/2006	ARIZONA CLEAN FUELS YUMA	FIRE WATER PUMPS NOS 1 AND 2	17.110	NO. 2 DIESEL FUEL	5.46 MMBTU/H	4 G/KW-H	BACT-PSD	- EQUIPMENT IDENTIFIED BY ID #S S-29200A AND S29200B	-
AZ-0046	4/14/2005	8/25/2006	ARIZONA CLEAN FUELS YUMA	EMERGENCY GENERATOR	17.110	NO. 2 DIESEL FUEL	10.9 MMBTU/H	6.4 G/KW-H	BACT-PSD	- EQUIPMENT IDENTIFIED BY ID # S-29100	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
CA-0868	3/22/1999	10/11/2005	MANSON CONSTRUCTION COMPANY	FOUR CATERPILLAR IC ENGINES	17.110	DIESEL FUEL	2600 HP	6.22 G/B-HP-H	Other Case-by-Case	SCR PROPOSED - ARB RECORD # A330-884-99 FOUR CATERPILLAR 3516B DITA ENGINES RATED AT 2,600 BHP (DREDGE ENGINES) AND ONE DETROIT DIESEL 6063-GK60 550 BHP (IMPORT ENGINE). AQIA PUBLIC NOTICE REQUIRED; ALSO PERMITTED IN SCAQMD - P/O # 345590 & 345586	SCR
CA-0892	9/24/1999	10/3/2001	KIEWIT PACIFIC CO	IC ENGINE, COMPRESSION IGNITION, PORTABLE	17.110	DIESEL	755 BHP	7 G/BHP-H	BACT-PSD	TURBOCHARGER AND INTERCOOLER - ARB RECORD # A330-915-00 PORTABLE 755 BHP COMPRESSION-IGNITION CATERPILLAR MODEL 3412 PCTA IC ENGINE WITH PRECOMBUSTION CHAMBER IGNITION, BEING TURBOCHARGED AND AFTERCOOLED, AND USED TO DRIVE A 500 KVA ELECTRICAL GENERATOR.	AC
CA-0927	8/17/1999	12/3/2002	CHANNEL & BASIN RECLAMATION	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.110	DIESEL	810 BHP	5.4 G/B-HP-H	BACT-PSD	TURBOCHARGER AND INTERCOOLER WITH TIMING RETARDED FOUR DEGREES FROM STANDARD SETTING - ARB RECORD # A330-956-00 LIMITED LIFE DIESEL-FIRED INTERNAL COMBUSTION ENGINE POWERING AN ELECTRICAL GENERATOR IN A REMOTE LOCATION. THE UNIT IS LOCATED IN A REMOTE ARE	ITR/AC
CA-0988	2/1/2003	9/4/2003	PACIFIC BELL	IC ENGINES	17.110	DIESEL FUEL	2935 HP	6.9 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-1010	7/11/2001	10/27/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	764 BHP	6.19 G/BHP-H	BACT-PSD	TURBOCHARGE AND AFTERCOOLED - MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(764BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED E	AC
CA-1011	8/17/1999	10/27/2005	CHANNEL & BASIN RECLAMATION	IC ENGINE, DIESEL	17.110	DIESEL	810 BHP	5.4 G/BHP-H	BACT-PSD	TURBOCHARGER AND INTERCOOLER W/TIMING RETARDED 4 DEGREES - EQUIP: DIESEL IC ENGINE POWERING AN ELECTRICAL GENERATOR, SCHEDULE: VARIABLE.	ITR/AC
CA-1012	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINES, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	685 BHP	4.17 G/BHP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED - MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(685BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR	AC
CA-1013	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	610 BHP	4.17 G/BHP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED - MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(610BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR	AC
CA-1014	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	536 BHP	4.8 G/BHP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED - MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(536BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE USEPA ENGINE FAMILY TO W	AC
CA-1078	11/9/1999	5/2/2006	INGRAM BOOK COMPANY	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1448 BHP	6.9 G/B-HP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED + OPERATION LIMIT <200 H/YR - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: MITSUBISHI, TYPE: CI, MODEL: 37 ODTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: 200 H/YR AND 4	AC
CA-1079	3/28/2000	5/2/2006	WALT DISNEY PICTURES AND TELEVISION	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1109 HP	6.9 G/B-HP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED + OPERATIONS LIMIT <200 H/YR. - MFR: CATERPILLAR, TYPE: CI, MODEL: 3412 DISTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: NOX: 5.93 GRAMS/B-HP-H CO: 0.71 G/B-HP-H;	AC
CA-1080	2/22/2000	3/1/2006	HOMEGROCER.COM	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1480 HP	6.9 G/B-HP-H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED + OPERATIONS LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3508B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OP	AC
CA-1082	2/1/2000	5/2/2006	CITY OF CORONA DEPT OF PUBLC WORKS	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	2155 HP	6.9 G/B-HP/H	BACT-PSD	TURBOCHARGED AND AFTERCOOLED OPERATIONS LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3512B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: THE ENGINE SHALL NOT OPER	AC
CA-1083	3/30/2000	11/3/2005	CUCUMONGA COUNTY WATER DISTRICT	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	890 HP	6.9 G/B-HP/H	BACT-PSD	TURBOCHARCHED AND AFTERCOOLED - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3412 DITA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN 200 HRS/YR. THE	AC

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
FL-0148	3/17/1999	6/5/2002	MIAMI-DADE WATER AND SEWER DEPT.	GENERATORS, DIESEL (3)	17.110	DIESEL	2.5 MW	58 LB/H	BACT-PSD	INJECTION TIMING RETARDATION AND COOLING OF COMBUSTION AIR Increasing hours of operation for three 2.5 MW diesel generators. Fuel is No. 2 diesel with 0.05% S. Emission limits are provided for only NOx, other pollutants are not PSD significant.	ITR/AC
FL-0158	7/15/1999	3/28/2002	MIAMI-DADE WATER AND SEWER DEPARTMENT	GENERATOR, DIESEL FUEL (4)	17.110	DIESEL	4000 BHP	4.12 LB/MMBTU	BACT-PSD	FUEL INJECTION TIMING RETARDATION AND TURBOCHARGER AFTERCOOLING - DIESEL FUELED INTERNAL COMBUSTION ENGINE - LARGE BORE. ANNUAL STACK TEST METHOD 7E FOR NOX. UNITS ARE USED FOR BACKUP POWER TO PLANT IN THE EVENT OF POWER LOSS. THE ONLY REQUIRED LIMITS ARE	ITR/AC
IA-0058	4/10/2002	6/21/2004	GREATER DES MOINES ENERGY CENTER	EMERGENCY GENERATOR	17.110	DIESEL	700 KW	22.69 LB/H	BACT-PSD	RETARDED INGITION TIMING (3-4 DEGREES) -	ITR
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	EMERGENCY GENERATOR	17.110	#2 DISTILLATE OIL	18500 GALLONS/YR	10.61 LB/H	BACT-PSD	GCP, TIMING RETARD - Limited to 18500 gallons per year	ITR
IA-0061	9/25/2002	5/6/2004	CITY OF PELLA	IC ENGINES, DIESEL, (14)	17.110	DIESEL	144 G/H	1.71 LB/MMBTU	Other Case-by-Case	COMBUSTION AIR CHILLER - Throughput for each engine. There are 14 engines at this site. They are all the same make, model, and size (2000 KW - HP unavailable). Each has its own individual stack. Engines operate no more than 475 h/yr. Only NOx exceeds PSD	AC
IA-0072	7/8/1999	3/17/2005	GUARDIAN INDUSTRIES	DIESEL GENERATOR	17.110	DIESEL FUEL	1750 KW	56.4 LB/H	BACT-PSD	4 DEGREE RETARD ON TIMING - Generators limited to 1460 hours per year total for both.	ITR
IA-0076	3/23/2005	4/22/2008	JOHN DEERE PRODUCT ENGINEERING CENTER	TEST CELL	17.110	DIESEL	24.5 GAL/H	1.52 LB/MMBTU	BACT-PSD	GOOD COMBUSTION PRACTICES. - THERE ARE 53 ENGINE TEST CELLS THAT RECIEVED PSD PERMITS. THE UNITS RANGE UP TO 24.5 GALLONS/HR AND UP TO 1000 HP. OTHER FUELS SUCH AS SOY DIESEL MAY BE USED BY THESE UNITS.	-
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	EMERGENCY GENERATOR	17.110	DIESEL	1500 KW	4.5 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 2 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THREE 1,500 KW EMERGENCY GENERATORS	TIER 2
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	FIRE PUMP	17.110	DIESEL #2	540 HP	2.8 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 3 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THE PROJECT INCLUDES FOUR IDENTICAL	TIER 3
KS-0028	10/18/2005	3/9/2006	NEARMAN CREEK POWER STATION	EMERGENCY BLACK START GENERATOR	17.110	NO. 2 FUEL OIL	24.1 MMBTU/H	84.8 LB/H	BACT-PSD	EMERGENCY DIESEL GENERATORS HAVE NOT BEEN REQUIRED TO INSTALL ADDITIONAL NOX CONTROLS BECAUSE OF INTERMITTENT OPERATION. - THE CUMMINS POWER GENERATION DIESEL GENERATOR (MODEL NO.: QSK78-G6) SHALL ONLY COMBUST NO. 2 FUEL OIL WITH VERY LOW SULFUR CONTENT A	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CATERPILLAR BACK-UP DIESEL AIR COMPRESSORS, 2	17.110	DIESEL FUEL	775 HP EACH	38.6 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 36-96, 37-97. THIS ENTRY IS FOR COMPRESSORS NO.1 & NO.2	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	AUXILIARY DIESEL GENERATORS NO.1 & NO.2	17.110	DIESEL FUEL	1100 HP EACH	34 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 38-96, 39-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	ADMINISTRATION BUILDING DIESEL GENERATOR	17.110	DIESEL	587 HP	18.1 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 50-96	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINES 1-3	17.110	DIESEL	660 HP EA.	12.2 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES -	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	STANDBY GENERATOR DIESEL ENGINES 1-2	17.110	DIESEL	2220 HP EA.	33.77 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES -	-
LA-0211	12/27/2006	7/16/2008	GARYVILLE REFINERY	EMERGENCY GENERATORS (DOCK & TANK FARM) (21-08 & 22-08)	17.110	DIESEL		0.031 LB/HP-H	BACT-PSD	USE OF DIESEL WITH A SULFUR CONTENT OF 15 PPMV OR LESS - 21-08: 1341 HP 22-08: 671 HP GENERATORS PERMITTED FOR 182 H/YR EA.	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	660 HP	10.07 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN INCORPORATING FUEL INJECTION TIMING RETARDATION (ITR) -	ITR
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	525 HP	6.74 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN INCORPORATING FUEL INJECTION TIMING RETARDATION (ITR) -	ITR
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	DIESEL EMERGENCY GENERATOR NOS. 1 & 2	17.110	DIESEL	2168 HP EA.	37.95 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN INCORPORATING FUEL INJECTION TIMING RETARDATION (ITR) -	ITR
MA-0029	9/29/1999	1/3/2003	SITHE MYSTIC DEVELOPMENT LLC	IC ENGINE, EMERGENCY DIESEL GENERATOR	17.110	DIESEL	1500 KW	37.44 LB/H	BACT-PSD	SCR - ADDITIONAL THROUGHPUT: 15.4 MMBTU/H. REQUIRED TO SHUT DOWN FACILITY IF NO POWER IS AVAILABLE FROM THE UTILITY GRID.	SCR
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, LARGE, FUEL OIL (1)	17.110	DIESEL	670 HP	3.28 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - 4.874 MMBTU/H.	-
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, LARGE	17.110	DIESEL FUEL	1850 HP	12.7 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	-
MS-0086	5/8/2007	4/7/2008	CHEVRON PRODUCTS COMPANY, PASCAGOULA REFINERY	TEMPORARY, PORTABLE CRUDE I GENERATOR	17.110	DIESEL		1.3 LB/H	BACT-PSD	SELECTIVE CATALYTIC REDUCTION (SCR) - THIS IS A PORTABLE GENERATOR THAT MEETS THE DEFINITION OF A NON-ROAD ENGINE. IT MAY NOT STAY ON SITE MORE THAN 12 MONTHS AND MAY NOT BE OPERATED MORE THAN 9 MONTHS IN A CALENDAR YEAR. IT ALSO MAY NOT BE USED PAST 2009	SCR

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
NC-0074	1/24/2003	3/12/2004	BRIDGESTONE/FIRESTONE NORTH AMERICAN TIRE	IC ENGINES, AIR COMPRESSORS, DIESEL, (5)	17.110	DIESEL	4.46 MMBTU/H	7.8 LB/H	BACT-PSD	IGNITION TIMING RETARD - Throughput for each. Additional throughput: 624 hp output each. ID no. ACDD-1 through ACDD-5	ITR
NC-0075	8/20/2001	3/12/2004	FORT BRAGG	IC ENGINES, DIESEL, (17)	17.110	DIESEL		44.4 T/YR	BACT-PSD	EACH GENERATOR USED IN PEAK SHAVING MODE SHALL OPERATE NO MORE THAN 250 H/YR. - Throughput varies from 230 kW to 1500 kW. Majority are 400 kW or more.	-
NC-0105	8/21/2003	1/11/2006	UNIVERSITY OF NORTH CAROLINA - CHAPEL HILL	EMERGENCY GENERATORS	17.110	DIESEL			N/A	BACT DOES NOT APPLY TO NONPROFIT EDUCATIONAL INSTITUTIONS	-
NC-0112	11/23/2004	8/14/2007	NUCOR STEEL	DIESEL FIRED EMERGENCY GENERATORS AND DIESEL FIRED EMERGENCY WATER PUMPS	17.110	FUEL OIL			BACT-PSD	OPERATION LIMITED TO 100 HOURS OF OPERATION FOR EACH EMERGENCY GENERATOR AND WATER PUMP PER 12 MONTH PERIOD -	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	EMERGENCY GENERATOR	17.110	DIESEL FUEL	49 MMBTU/H	159.65 LB/H	LAER	LIMITED USE - POSSIBLE BLACK-START CAPABILITY TO THE SITE IF GRID POWER IS LOST MAX ALLOWABLE USE LESS THAN 500 H/YR	-
NJ-0073	3/8/2008	8/12/2008	TRIGEN	DUAL FUEL ENGINES ON 100 % DISTILLATE FUEL OIL	17.110	DISTILLATE FUEL OIL	1 MMGAL/YR	12 G/B-HP-H	RACT	- THE TWO(2) DUAL FUEL COPPER BESSEMER DUAL FUEL ENGINES ARE ALLOWED TO COMBUST DISTILLATE FUEL OIL WITH 0.05 % SULFUR IN FUEL ONLY WHEN THE DUAL FUEL IS NOT AVAILABLE; MORE SPECIFICALLY DURING THE NATURAL GAS CURTAILMENT. THE PERMIT LIMITS EACH ENGINE T	-
NM-0049	5/20/2002	3/10/2005	PHELPS DODGE TYRONE, INC	IC ENGINES, NON-DUAL FUEL MODE, (15)	17.110	FUEL OIL	3090 HP/H	31.4 LB/H	Other Case-by-Case	GOOD OPERATING PRACTICE - 15 NORDBERG FSG-1316-HSC ENGINES MANUFACTURED BETWEEN 1967 AND 1972. THE ENGINES ARE ALLOWED TO USE DIESEL FUEL 20% OF THE TIME. BECAUSE THIS IS AN UNUSUAL PERMITTING SITUATION, THIS FACILITY HAS BEEN GIVEN EMISSION CAPS FOR OPER	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL-FIRED GENERATOR	17.110	DIESEL	600 KW	12.4 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 600 KW Emergency disel-fired generator. Limited to 500 hr/yr operation.	-
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	EMERGENCY GENERATOR	17.110	DIESEL	1000 KW	0.82 T/YR	BACT-PSD	- 1000 KW EMERGENCY DIESEL FUEL FIRED GENERATOR, 1341 HP. LIMITED TO 500 H/YR OF OPERATION.	-
OH-0266	8/15/2002	4/29/2008	UNIVERSITY OF CINCINNATI	DIESEL FIRED ENGINES (2), 2 MW, 2922 BHP	17.110	DIESEL FUEL OIL	19.17 MMBTU/H	40.92 LB/H	BACT-PSD	-	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL GENERATOR, 2	17.110	DIESEL FUEL	17.21 MMBTU/H	55.07 LB/H	BACT-PSD	- EACH EMERGENCY GENERATOR IS RESTRICTED TO 499 H/ROLLING 12-MONTHS OF OPERATION	-
OK-0070	6/13/2002	5/12/2004	GENOVA OK I POWER PROJECT	DIESEL ENGINE, BACKUP GENERATOR	17.110	DIESEL	750 KW	3.01 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND LIMITATION OF HOURS - 500 HOUR LIMIT	-
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, EMERGENCY GENERATOR	17.110	DIESEL FUEL	1818 HP	0.024 LB/B-HP-H	BACT-PSD	- 1 ENGINE	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, BACKUP GENERATOR, DIESEL	17.110	DIESEL	749 BHP	2.16 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND LIMITED HOURS OF OPERATION (<100 H/YR) - 500 kW generator, limited to < 100 h/yr	-
OK-0091	3/18/2003	10/10/2003	CARDINAL FG CO./ CARDINAL GLASS PLANT	IC ENGINES, EMERGENCY GENERATORS (2)	17.110	DIESEL	2000 KW	2.035 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND LIMIT ON HOURS OF OPERATION (<500 H/YR) - Throughput for each. Operation limit of < 500 h/yr each	-
OK-0118	2/9/2007	9/27/2007	HUGO GENERATING STA	EMERGENCY DIESEL INTERNAL COMBUSTION ENGINES	17.110				BACT-PSD	USE OF LOW SULFUR NO.2 FUEL OIL COMBINED WITH GOOD COMBUSTION PRACTICES AND LIMITED ANNUAL OPERATION -	-
PA-0158	6/19/2000	12/2/2002	FORD ELECTRONICS AND REFRIGERATION, LLC	DIESEL ENGINES	17.110	NO. 2 DIESEL	2 MW	20.8 LB/H	Other Case-by-Case	JOHNSON MATHEY QXH1020-145 SCR AND 3 DEGREE IGNITION RETARD. HOURLY LIMIT FOR EACH ENGINE, ANNUAL FOR ALL FIVE ENGINES. - FIVE CATERPILLAR MODEL 3516CITA ENGINES, 2596 HP EACH, GENERATING 2MW EACH.	ITR
PA-0209	11/8/2002	8/16/2006	ORCHARD PARK GENERATING STATION	IC ENGINE, GENERATOR	17.110	FUEL OIL	8086 BHP	1.5 G/BHP-H	Other Case-by-Case	LEAN BURN, SCR, LOW EMISSION COMBUSTION CONTROL - FUEL LIMITATIONS: NATURAL GAS 272,000 MCF OR DIESEL 751,040 GAL. RECORDKEEPING REQUIRED FOR HOURS, FUEL USAGE, SULFUR CONTENT OF #2 FUEL. BACT REVIEW DONE FOR NOX ONLY.	SCR
PA-0244	10/20/2004	3/10/2005	FIRST QUALITY TISSUE, LLC	FIRE PUMP	17.110	#2 FUEL OIL	575 hp	0.031 LB/HP-H	BACT-PSD	- THIS IS THE SAME FIRE PUMP THAT IS INCLUDED IN THE LIMITS LISTED UNDER THE OTHER SOURCES" PROCESS. THE NOX AND CO LIMITS LISTED HERE ARE SPECIFIC TO THE FIRE PUMP."	-
PR-0005	3/2/2000	8/31/2006	SAN JUAN REPOWERING PROJECT	AUXILIARY DIESEL GENERATOR	17.110	DIESEL FUEL	5000 KW	168 LB/H (AS NO2)	BACT-PSD	GOOD COMBUSTION CONTROL - LIMITED TO MAXIMUM OPERATION OF 40 HR/YR; MAX FUEL USAGE OF 15.66 GAL/YR (MONTHLY ROLLING AVG); SHALL NOT OPERATE CONCURRENTLY WITH ANY 2 COMBUSTION TURBINES. LIMITED OPERATION - 20% EXCEPT FOR 4 MIN IN 30 MIN PERIOD NOT TO EXCEE	-
SC-0064	5/23/2002	1/13/2003	SCE&G - JASPER COUNTY GENERATING FACILITY	GENERATOR, EMERGENCY,DIESEL FUEL	17.110	DIESEL	2000 KW	59.5 LB/H	BACT-PSD	-	-
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL FUEL	2000 KW	46.8 LB/H	BACT-PSD	- THROUGHPUT CONVERTS TO 2681 BHP	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.1, GEN 1, FUEL OIL	17.110	DIESEL	1.75 MW	58.7 LB/H	BACT-PSD	- EMISSION POINT NO: GEN 1. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.2, GEN 2, FUEL OIL	17.110	DIESEL	1.75 MW	58.7 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 2. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.3, GEN 3, FUEL OIL	17.110	DIESEL	1.75 MW	58.7 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 3. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.4, GEN 4, FUEL OIL	17.110	DIESEL	1.75 MW	58.7 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 4. OPERATIONAL LIMIT OF 100 H/YR.	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.5, GEN 5, FUEL OIL	17.110	DIESEL	1.75 MW	58.7 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 5. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.6, GEN 6	17.110	FUEL OIL	1759 KW	58.7 LB/H	BACT-PSD	- MAX OPERATION 100 H/YR	-
TX-0321	10/12/1999	1/3/2005	CR WING COGENERATION PLANT	STARTUP & EMERGENCY ELEC GENERATOR	17.110	DIESEL	2010 HP	54.5 LB/H	Other Case-by-Case	NONE INDICATED - SHALL OPERATE ONLY WHILE THE COMBUSTION TURBINES DO NOT OPERATE, EXCEPT STARTUP/SHUT DOWN OF EITHER THE DIESEL GENERATOR OR TURBINES AND FOR ROUTINE MAINTENANCE AND TESTING.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL	2000 KW	46.8 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110		1350 hp	41.9 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.110		300 hp	9.3 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	FIRE WATER PUMP	17.110			10.39 LB/H	BACT-PSD	-	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	EMERGENCY DIESEL GENERATOR	17.110			12.4 LB/H	BACT-PSD	-	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110	DIESEL	1350 HP	41.9 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0276	6/20/2003	2/20/2004	INGENCO - CHARLES CITY PLANT	IC ENGINES, (48)	17.110	FUEL OIL	550 HP	2.4 LB/MMBTU	N/A	AIR TO FUEL RATIO CONTROL, TURBOCHARGING, AND CHARGE AIR COOLING SYSTEMS. THE AIR TO FUEL RATIO SHALL BE CONTROLLED BY A SEPARATE ENGINE CONTROL MODULE FOR EACH ENGINE. - THIS SOURCE USED DISTILLATE OILS, MINERAL OIL, DIELECTRIC FLUID, AND TREATED LANDFIL	AC
VT-0013	6/8/2000	5/5/2003	MILL RIVER LUMBER, LTD.	ELECTRIC GENERATION-CATERPILLAR 3412C	17.110	NO 2 FUEL OIL	1023 HP	1.7 LB/H	Other Case-by-Case	SCR W/OXIDATION CATALYST. NO REGULATORY BASIS; LIMIT BASED ON MANUFACTURER'S GUARANTEE. - STACK TEST PERFORMED ON 2/27/01. ONLY NOX AND CO ARE LISTED ON THIS PERMIT; CONTROLS WERE INSTALLED TO REMAIN BELOW THE STATE THRESHOLD FOR MAJOR MODIFICATION.	SCR
VT-0014	9/5/2000	12/16/2002	OKEMO MOUNTAIN INC.	GENERATOR, FUEL OIL	17.110	NO 2 FUEL OIL	1480 BHP	1.6 G/B-HP-H	RACT	SCR - STACK TEST PERFORMED ON 2/27/01. ONLY NOX AND CO LISTED IN PERMIT, CO HAS NO REGULATORY BASIS.	SCR
WA-0329	2/11/2005	7/5/2006	DARRINGTON ENERGY COGENERATION POWER PLANT	STANDBY GENERATOR	17.110	DIESEL FUEL	1 MW		BACT-PSD	ENGINE MUST BE NEW AND SATISFY FEDERAL STANDARDS @ 40 CFR 89 -	TIER ?
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, GENERATOR (4)	17.110	DIESEL	3.5 MMBTU/H	15.44 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES. PERMIT LIMITS SET IN LB/H, NOT G/BHP-H. -	-
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, EMERGENCY FIRE PUMP	17.110	DIESEL	3.8 MMBTU/H	16.76 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, EQUIPMENT USAGE LIMITS. PERMIT LIMITS IN LB/H, NO LIMITS SET IN G/BHP-H -	-
WI-0207	1/21/2004	8/16/2005	ACE ETHANOL - STANLEY	IC ENGINE, DIESEL GENERATOR SET, B70	17.110		1850 BHP	13 G/B-HP-H	BACT-PSD	LIMIT ON HOURS OF OPERATION (16.7 HRS/MO, 12 MO. AVG.) - THE DIESEL ENGINE GENERATOR MAY NOT OPERATE MORE THAN 16.7 HOURS PER MONTH	-

Control Category Key:

AC	Air Cooling
HIP	High Injection Pressure
ITR	Injection Timing Retard
LND	Low NOx Design
SCR	Selective Catalytic Reduction
TIER 2 or 3	Non-Road Engine Emission Standards per 40 CFR 89.112.
WI	Water Injection

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	IC ENGINE, DIESEL , WARTSILA	17.110	ARCTIC DIESEL	5 MW	2.6 LB/H	BACT-PSD	- NOTE: EPA CURRENTLY DISPUTES THE NOX BACT DETERMINATION FOR THIS UNIT. AS OF 5/18/2000 THIS DISPUTE HAS NOT BEEN RESOLVED. NOT YET CONSTRUCTED, NO TESTING PERFORMED.	-
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	UPPER TANK FARM CAT 3412DT, P708C	17.110	DIESEL	660 HP	0.3627 LB/MMBTU	N/A	NONE INDICATED. - DESIGN CAPACITY IS 660 HP.OPERATING LIMIT OF 600 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	CAMP GENERATOR, UNIT 6,7	17.110	DIESEL	2362 KW	0.05 GR/DSCF	N/A	GOOD OPERATIONS PRACTICE. - SPECIFIED THROUGHPUT IS FOR MAXIMUM RATING IN PRIME MODE. ADDITIONAL THROUGHPUT FOR MAXIMUM RATING IN STAND-BY MODE IS 2717 KW. MAXIMUM OPERATION: DURING PRE-SEALIFT PERIOD, 8760 H; DURING COMMISSIONING PERIOD, 1848 H; AFTER CO	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	FIRE WATER PUMP, UNIT 8	17.110	DIESEL	755 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATION PRACTICES. - MAXIMUM OPERATION DURING PRE-SEALIFT PERIOD: 104 H. MAXIMUM OPERATION DURING COMMISIONING PERIOD: 154 H. MAXIMUM OPERATION AFTER COMMISIONING PERIOD: 104 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISC. IC ENGINES 950 HP	17.110	DIESEL	950 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION 1440 H/YR. EQUIPMENT IS IN CONSTRUCTION RESERVE POOL.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISC. IC ENGINES > 600 HP	17.110	DIESEL	650 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION, 1440 H/YR. EQUIPMENT IS LISTED IN THE CONSTRUCTION RESERVE POOL.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	RIG ENGINES, UNIT 211, 212	17.110	DIESEL	1215 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES - IF NATURAL GAS RIG ENGINES (UNITS 200-204) ARE OPERATING, THEN EXTRA DIESEL ENGINES MAY OPERATE FOR UP TO 5,674 H. IF NATURAL GAS RIG ENGINES ARE NOT OPERATING, THEN EXTRA DIESEL ENGINES MAY OPERATE FOR UP TO 6,894 H DURING PRE	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 3632 HP	17.110	DIESEL	3632 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 744 H. TYPICAL OPERATION AFTER COMMISSIONING, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 2195 HP	17.110	DIESEL	2195 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 744 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 961.2 MMBTU/H	17.110	DIESEL	961.2 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 3672 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 4425 HP	17.110	DIESEL	4425 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2976 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 4240 HP	17.110	DIESEL	4240 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD 2976 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 940 HP	17.110	DIESEL	940 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 1128 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 949 HP	17.110	DIESEL	949 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 1128 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 1200 HP	17.110	DIESEL	1200 HP	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2190 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD 0 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #5	17.110	DIESEL	1200 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS GENERATOR IS A COOPER-BESSEMER #LS8T WITH A NOMINAL DESIGN CAPACITY OF 1200 KW AND A MAXIMUM OPERATION LIMIT OF 4400 H/YR AND 18720 KWH/D.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #6	17.110	DIESEL	1000 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A FAIRBANKS MORSE #38TD8-1/8 GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 1000 KW AND A MAXIMUM OPERATION LIMIT OF 4400 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #9	17.110	DIESEL	2865 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS AN EMD #20-645F4B GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 2865 KW AND A MAXIMUM OPERATING LIMIT OF 8760 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1500 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICE. - THIS IS AN EMD #12-645E4 GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 1500 KW AND MAXIMUM OPERATION LIMIT OF 8760 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #12A	17.110	DIESEL	3660 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3616 GENERATOR THAT OPERATES UNDER 2 SCENARIOS. SCENARIO A IS WITH A DESIGN CAPACITY OF 3660 KW AND SCENARIO B IS WITH A DESIGN CAPACITY OF 4400 KW. THE GENERATOR OPERATES A MAXIMUM OF 8760 H/	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #14	17.110	DIESEL	1875 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3516B-LS DIESEL ELECTRIC GENERATOR WITH A NOMINAL DESIGN CAPACITY OF 1875 KW AND MAXIMUM OPERATION OF 8760 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #12B	17.110	DIESEL	4400 KW	0.05 GR/DSCF	N/A	GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3616 GENERATOR THAT OPERATES UNDER 2 SCENARIOS. SCENARIO A IS WITH A DESIGN CAPACITY OF 3660 KW AND SCENARIO B IS WITH A DESIGN CAPACITY OF 4400 KW. THE GENERATOR OPERATES A MAXIMUM OF 8760 H/	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #3	17.110	DIESEL	350 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A WHITE SUPERIOR #405X8 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 3 WITH A STACK HEIGHT OF NO LESS THAN 45 FEET ABOVE GROUND OR SUBMI	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #4	17.110	DIESEL	500 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CHICAGO PNEUMATIC #89A-CPS DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION.	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #5	17.110	DIESEL	750 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A WHITE SUPERIOR #40V5X-12 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 5 WITH A STACK HEIGHT OF NO LESS THAN 50 FEET ABOVE GROUND OR SU	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #6	17.110	DIESEL	1000 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A WHITE SUPERIOR #40VX-16 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 6 WITH A STACK HEIGHT OF NO LESS THAN 50 FEET ABOVE GROUND OR SUB	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #8	17.110	DIESEL	835 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CATERPILLAR #3516DI DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERTE SOURCE NO. 8 WITH A STACK HEIGHT OF NO LESS THAN 55 FEET ABOVE GROUND OR SUBMIT A	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #9	17.110	DIESEL	835 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CATERPILLAR #3516DI DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 9 WITH A STACK HEIGHT OF NO LESS THAN 55 FEET ABOVE GROUND OR SUBMIT	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR, #10	17.110	DIESEL	1135 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CATERPILLAR #3516 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITTEE MUST OPERATE SOURCE NO. 10 WITH A STACK HEIGHT OF NO LESS THAN 55 FEET ABOVE GROUND OR SUBMIT A	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1050 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POWER GENERATION. SOURCE 11 SHALL NOT OPERATE UNTIL SOURCE NO. 4 IS PERMANENTLY RETIRED FROM SERVICE. AFTER INITIAL STARTUP OF SOURCE NO. 11 PERMITT	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #12	17.110	DIESEL	1050 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POWER GENERATION. SOURCE NO. 12 SHALL NOT OPERATE UNTIL SOURCE NO. 8 IS PERMANENTLY RETIRED FROM SERVICE. AFTER INITIAL STARTUP OF SOURCE NO. 11 PER	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #13	17.110	DIESEL	1050 KW	0.05 GR/DSCF	N/A	NONE INDICATED - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POWER GENERATION. SOURCE NO. 13 SHALL NOT OPERATE UNTIL SOURCE NO. 9 IS PERMANENTLY RETIRED FROM SERVICE.AFTER INITIAL STARTUP OF SOURCE NO. 11 PERM	-
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70003	17.110	FUEL OIL	2 MW	0.0573 LB/MMBTU	BACT-PSD	GOOD OPERATIONAL PRACTICES AND MAINTENANCE. - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS 500 H/YR LIQUID FUEL FOR A MAXIMUM OF 8 H/D. THE SCC CODE WAS CHOSEN FOR DISTILLATE FUEL OIL BASED ON INFORMATION IN THE TECHNICAL ANALYSIS, NOT THE PERMIT. PERMITT	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70004	17.110	FUEL OIL	2 MW	0.0573 LB/MMBTU	BACT-PSD	GOOD OPERATIONAL PRACTICES AND MAINTENANCE - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS LIQUID FUEL FOR 500 H/YR AND IS LIMITED TO OPERATING 8 H/D. THE SCC CODE WAS CHOSEN FOR DISTILLATE FUEL BASED ON INFORMATION IN THE TECHNICAL ANALYSIS, NOT THE PERMI	-
AK-0056	2/1/1999	1/16/2004	ALPINE DEVELOPMENT PROJECT, CENTRAL PROCESSING FAC	IC ENGINES, 2 MW	17.110	FUEL OIL	2 MW		BACT-PSD	- EMERGENCY GENERATOR, SOURCE ID CF-G-70003, AND CF-G-70004, CUMMINS QWF 16V170	-
AK-0060	10/10/2003	6/3/2005	DUTCH HARBOR SEAFOOD PROCESSING FACILITY	IC ENGINE, GENERATOR, FUEL OIL, (3)	17.110	DISTILLATE FUEL OIL	2220 KW		BACT-PSD	GOOD COMBUSTION PRACTICE, OPACITY LIMITS - Throughput for each. Three Wartsila Model 6R32D generators	-
AK-0061	11/5/2004	7/23/2007	SNAKE RIVER POWER PLANT	WARTSILA 12V32B DIESEL ELECTRIC GENERATOR	17.110	DIESEL FUEL	5211 kW	206 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES - THREE IDENTICAL UNITS.	-
AR-0040	12/29/2000	6/30/2003	DUKE ENERGY HOT SPRINGS	GENERATORS, (2) DIESEL	17.110	#2 FUEL OIL	600 KW	1.8 LB/H	BACT-PSD	CLEAN FUELS. COMBUSTION CONTROLS - DIESEL ONLY. THROUGHPUT FOR EACH. LOW SULFUR RED DYE GRADE.	LSF
AR-0051	4/1/2002	5/6/2004	DUKE ENERGY-JACKSON FACILITY	GENERATOR, DIESEL-FIRED	17.110	DIESEL FUEL	671 HP	1.5 LB/H	BACT-PSD	GOOD OPERATING PRACTICE - backup generator, operates less than 500 h/yr	-
AZ-0046	4/14/2005	8/25/2006	ARIZONA CLEAN FUELS YUMA	FIRE WATER PUMPS NOS 1 AND 2	17.110	NO. 2 DIESEL FUEL	5.46 MMBTU/H	0.2 G/KW-H	BACT-PSD	- EQUIPMENT IDENTIFIED BY ID #S S-29200A AND S29200B	-
AZ-0046	4/14/2005	8/25/2006	ARIZONA CLEAN FUELS YUMA	EMERGENCY GENERATOR	17.110	NO. 2 DIESEL FUEL	10.9 MMBTU/H	0.02 G/KW-H	BACT-PSD	- EQUIPMENT IDENTIFIED BY ID # S-29100	-
CA-0892	9/24/1999	10/3/2001	KIEWIT PACIFIC CO	IC ENGINE, COMPRESSION IGNITION, PORTABLE	17.110	DIESEL	755 BHP	0.38 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-915-00 PORTABLE 755 BHP COMPRESSION-IGNITION CATERPILLAR MODEL 3412 PCTA IC ENGINE WITH PRECOMBUSTION CHAMBER IGNITION, BEING TURBOCHARGED AND AFTERCOOLED, AND USED TO DRIVE A 500 KVA ELECTRICAL GENERATOR. EMISSION LIMIT FOR	-
CA-0927	8/17/1999	12/3/2002	CHANNEL & BASIN RECLAMATION	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.110	DIESEL	810 BHP	0.237 G/B-HP-H	BACT-PSD	LOW-SULFUR DIESEL FUEL (< 0.05% S BY WEIGHT), AND POSITIVE CRANKCASE VENTILATION OR CRANKCASE CONTROL DEVICE THAT IS 90% EFFICIENT. - ARB RECORD # A330-956-00 LIMITED LIFE DIESEL-FIRED INTERNAL COMBUSTION ENGINE POWERING AN ELECTRICAL GENERATOR IN A REMOT	LSF/PCV
CA-0988	2/1/2003	9/4/2003	PACIFIC BELL	IC ENGINES	17.110	DIESEL FUEL	2935 HP	0.1 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-1010	7/11/2001	10/27/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	764 BHP	0.04 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(764BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FA	-
CA-1012	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINES, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	685 BHP	0.07 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(685BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FAMILY (1CPXL15	-
CA-1013	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	610 BHP	0.07 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(610BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FAMILY (1CPXL15	-
CA-1014	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	536 BHP	0.15 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(536BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE USEPA ENGINE FAMILY TO WHICH THIS ENGINES BELONGS HA	-
CA-1078	11/9/1999	5/2/2006	INGRAM BOOK COMPANY	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1448 BHP	0.38 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATIONS LIMITED <200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: MITSUBISHI, TYPE: CI, MODEL: 37 ODTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: 200 H/YR AND 4 DEGREE TIMI	-
CA-1079	3/28/2000	5/2/2006	WALT DISNEY PICTURES AND TELEVISION	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1109 HP	0.38 G/B-HP-H	BACT-PSD	OPERATION LIMIT <200 H/YR. - MFR: CATERPILLAR, TYPE: CI, MODEL: 3412 DISTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: NOX: 5.93 GRAMS/B-HP-H CO: 0.71 G/B-HP-H; ROG: 0.03 G/B-HP-H PM10: 0.109 G	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
CA-1080	2/22/2000	3/1/2006	HOMEGROCER.COM	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1480 HP	0.38 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATION LIMIT < 200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3508B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN	-
CA-1082	2/1/2000	5/2/2006	CITY OF CORONA DEPT OF PUBLC WORKS	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	2155 HP	0.38 G/B-HP-H	BACT-PSD	TURBOCHAGER + OPERATIONS LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3512B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN 2	-
CA-1083	3/30/2000	11/3/2005	CUCUMONGA COUNTY WATER DISTRICT	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	890 HP	0.38 G/B-HP/H	BACT-PSD	- EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3412 DITA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN 200 HRS/YR. THE ENGINE EMISSIONS, AS PROVIDE	-
CO-0055	2/3/2006	3/1/2006	LAMAR LIGHT & POWER POWER PLANT	DIESEL ENGINES FOR SWITCHING, LOCOMOTIVE & FIRE PUMP	17.110	DIESEL	1500 HP	0.016 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL - %0.05 BY WEIGHT - RAIL MOVEMENT ON SITE	LSF
IA-0058	4/10/2002	6/21/2004	GREATER DES MOINES ENERGY CENTER	EMERGENCY GENERATOR	17.110	DIESEL	700 KW	0.95 LB/H	Other Case-by-Case	-	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	EMERGENCY GENERATOR	17.110	#2 DISTILLATE OIL	18500 GALLONS/YR	0.34 LB/H	BACT-PSD	GCP, TIMING RETARD - Limited to 18500 gallons per year	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	EMERGENCY GENERATOR	17.110	#2 DISTILLATE OIL	18500 GALLONS/YR	0.34 LB/H	BACT-PSD	GCP, TIMING RETARD - Limited to 18500 gallons per year	-
IA-0072	7/8/1999	3/17/2005	GUARDIAN INDUSTRIES	DIESEL GENERATOR	17.110	DIESEL FUEL	1750 KW	2.82 LB/H	BACT-PSD	4 DEGREE RETARD ON TIMING - Generators limited to 1460 hours per year total for both.	-
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	EMERGENCY GENERATOR	17.110	DIESEL	1500 KW	0.15 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 2 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THREE 1,500 KW EMERGENCY GENERATORS	Tier 2
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	EMERGENCY GENERATOR	17.110	DIESEL	1500 KW	0.15 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 2 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THREE 1,500 KW EMERGENCY GENERATORS	Tier 2
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	FIRE PUMP	17.110	DIESEL #2	540 HP	0.15 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 3 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THE PROJECT INCLUDES FOUR IDENTICAL	Tier 3
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	FIRE PUMP	17.110	DIESEL #2	540 HP	0.15 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 3 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THE PROJECT INCLUDES FOUR IDENTICAL	Tier 3
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CATERPILLAR BACK-UP DIESEL AIR COMPRESSORS, 2	17.110	DIESEL FUEL	775 HP EACH	1.7 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 36-96, 37-97. THIS ENTRY IS FOR COMPRESSORS NO.1 & NO.2	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	AUXILIARY DIESEL GENERATORS NO.1 & NO.2	17.110	DIESEL FUEL	1100 HP EACH	2.4 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 38-96, 39-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	ADMINISTRATION BUILDING DIESEL GENERATOR	17.110	DIESEL	587 HP	1.3 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 50-96	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINES 1-3	17.110	DIESEL	660 HP EA.	1.24 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES -	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	STANDBY GENERATOR DIESEL ENGINES 1-2	17.110	DIESEL	2220 HP EA.	1.96 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES -	-
LA-0211	12/27/2006	7/16/2008	GARYVILLE REFINERY	EMERGENCY GENERATORS (DOCK & TANK FARM) (21-08 & 22-08)	17.110	DIESEL		0.0022 LB/HP-H	BACT-PSD	USE OF DIESEL WITH A SULFUR CONTENT OF 15 PPMV OR LESS - 21-08: 1341 HP 22-08: 671 HP GENERATORS PERMITTED FOR 182 H/YR EA.	LSF
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	660 HP	0.64 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, GOOD ENGINE DESIGN, AND USE OF LOW SULFUR AND LOW ASH DIESEL -	LSF
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	525 HP	0.28 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, GOOD ENGINE DESIGN, AND USE OF LOW SULFUR AND LOW ASH DIESEL -	LSF
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	DIESEL EMERGENCY GENERATOR NOS. 1 & 2	17.110	DIESEL	2168 HP EA.	0.69 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, GOOD ENGINE DESIGN, AND USE OF LOW SULFUR AND LOW ASH DIESEL -	LSF
MA-0029	9/29/1999	1/3/2003	SITHE MYSTIC DEVELOPMENT LLC	IC ENGINE, EMERGENCY DIESEL GENERATOR	17.110	DIESEL	1500 KW	0.87 LB/H	BACT-PSD	GOOD COMBUSTION CONTROL - ADDITIONAL THROUGHPUT: 15.4 MMBTU/H. REQUIRED TO SHUT DOWN FACILITY IF NO POWER IS AVAILABLE FROM THE UTILITY GRID.	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, LARGE, FUEL OIL (1)	17.110	DIESEL	670 HP	0.1 LB/MMBTU	BACT-PSD	CLEAN FUEL AND GOOD COMBUSTION. - 4.874 MMBTU/H.	LSF
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, LARGE	17.110	DIESEL FUEL	1850 HP	0.07 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	LSF
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, LARGE	17.110	DIESEL FUEL	1850 HP	0.07 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	LSF
NC-0112	11/23/2004	8/14/2007	NUCOR STEEL	DIESEL FIRED EMERGENCY GENERATORS AND DIESEL FIRED EMERGENCY WATER PUMPS	17.110	FUEL OIL			BACT-PSD	OPERATION LIMITED TO 100 HOURS OF OPERATION FOR EACH EMERGENCY GENERATOR AND WATER PUMP PER 12 MONTH PERIOD -	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	EMERGENCY GENERATOR	17.110	DIESEL FUEL	49 MMBTU/H	2.67 LB/H	BACT-PSD	LIMITED USE - POSSIBLE BLACK-START CAPABILITY TO THE SITE IF GRID POWER IS LOST MAX ALLOWABLE USE LESS THAN 500 H/YR	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL-FIRED GENERATOR	17.110	DIESEL	600 KW	0.72 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 600 KW Emergency disel-fired generator. Limited to 500 hr/yr operation.	LSF
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	EMERGENCY GENERATOR	17.110	DIESEL	1000 KW	0.01 T/YR	BACT-PSD	- 1000 KW EMERGENCY DIESEL FUEL FIRED GENERATOR, 1341 HP. LIMITED TO 500 H/YR OF OPERATION.	-
OH-0266	8/15/2002	4/29/2008	UNIVERSITY OF CINCINNATI	DIESEL FIRED ENGINES (2), 2 MW, 2922 BHP	17.110	DIESEL FUEL OIL	19.17 MMBTU/H	0.23 LB/H	BACT-PSD	-	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL GENERATOR, 2	17.110	DIESEL FUEL	17.21 MMBTU/H	0.27 T/YR	BACT-PSD	- EACH EMERGENCY GENERATOR IS RESTRICTED TO 499 H/ROLLING 12-MONTHS OF OPERATION	-
OK-0070	6/13/2002	5/12/2004	GENOVA OK I POWER PROJECT	DIESEL ENGINE, BACKUP GENERATOR	17.110	DIESEL	750 KW	0.033 LB/MMBTU	BACT-PSD	COMBUSTION CONTROL AND GOOD ENGINE DESIGN - 500 HOUR LIMIT	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, BACKUP GENERATOR, DIESEL	17.110	DIESEL	749 BHP	0.124 LB/MMBTU	BACT-PSD	COMBUSTION CONTROL AND GOOD ENGINE DESIGN - 500 kW generator, limited to < 100 h/yr	-
OK-0091	3/18/2003	10/10/2003	CARDINAL FG CO./ CARDINAL GLASS PLANT	IC ENGINES, EMERGENCY GENERATORS (2)	17.110	DIESEL	2000 KW	0.0444 LB/MMBTU	BACT-PSD	ENGINE DESIGN - Throughput for each. Operation limit of < 500 h/yr each	-
OK-0118	2/9/2007	9/27/2007	HUGO GENERATING STA	EMERGENCY DIESEL INTERNAL COMBUSTION ENGINES	17.110				BACT-PSD	USE OF LOW SULFUR NO.2 FUEL OIL COMBINED WITH GOOD COMBUSTION PRACTICES AND LIMITED ANNUAL OPERATION -	LSF
OR-0037	12/29/2000	9/29/2003	KLAMATH FALLS COGENERATION	EMERGENCY GENERATOR	17.110	FUEL OIL	6 MMBTU/H	0.1 GR/SCF	N/A	-	-
PA-0158	6/19/2000	12/2/2002	FORD ELECTRONICS AND REFRIGERATION, LLC	DIESEL ENGINES	17.110	NO. 2 DIESEL	2 MW	1.2 LB/H	Other Case-by-Case	HOURLY LIMIT FOR EACH ENGINE, ANNUAL FOR ALL FIVE ENGINES. - FIVE CATERPILLAR MODEL 3516CITA ENGINES, 2596 HP EACH, GENERATING 2MW EACH.	-
PR-0005	3/2/2000	8/31/2006	SAN JUAN REPOWERING PROJECT	AUXILIARY DIESEL GENERATOR	17.110	DIESEL FUEL	5000 KW	7.18 LB/H	BACT-PSD	LIMITED OPERATION, GOOD COMBUSTION PRACTICES - LIMITED TO MAXIMUM OPERATION OF 40 HR/YR; MAX FUEL USAGE OF 15.66 GAL/YR (MONTHLY ROLLING AVG); SHALL NOT OPERATE CONCURRENTLY WITH ANY 2 COMBUSTION TURBINES. LIMITED OPERATION - 20% EXCEPT FOR 4 MIN IN 30 MI	-
SC-0064	5/23/2002	1/13/2003	SCE&G - JASPER COUNTY GENERATING FACILITY	GENERATOR, EMERGENCY,DIESEL FUEL	17.110	DIESEL	2000 KW	1.9 LB/H	BACT-PSD	CLEAN FUEL(LOW SULFUR DIESEL), GOOD COMBUSTION PRACTICES -	LSF
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL FUEL	2000 KW	2.07 LB/H	BACT-PSD	- THROUGHPUT CONVERTS TO 2681 BHP	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.1, GEN 1, FUEL OIL	17.110	DIESEL	1.75 MW	0.43 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 1. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.2, GEN 2, FUEL OIL	17.110	DIESEL	1.75 MW	0.43 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 2. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.3, GEN 3, FUEL OIL	17.110	DIESEL	1.75 MW	0.43 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 3. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.4, GEN 4, FUEL OIL	17.110	DIESEL	1.75 MW	0.43 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 4. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.5, GEN 5, FUEL OIL	17.110	DIESEL	1.75 MW	0.43 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 5. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.6, GEN 6	17.110	FUEL OIL	1759 KW	0.43 LB/H	BACT-PSD	- MAX OPERATION 100 H/YR	-
TX-0321	10/12/1999	1/3/2005	CR WING COGENERATION PLANT	STARTUP & EMERGENCY ELEC GENERATOR	17.110	DIESEL	2010 HP	0.5 LB/H	Other Case-by-Case	NONE INDICATED - SHALL OPERATE ONLY WHILE THE COMBUSTION TURBINES DO NOT OPERATE, EXCEPT STARTUP/SHUT DOWN OF EITHER THE DIESEL GENERATOR OR TURBINES AND FOR ROUTINE MAINTENANCE AND TESTING.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL	2000 KW	2.07 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110		1350 hp	2.97 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.110		300 hp	0.66 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	FIRE WATER PUMP	17.110			0.74 LB/H	BACT-PSD	-	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	EMERGENCY DIESEL GENERATOR	17.110			0.88 LB/H	BACT-PSD	-	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110	DIESEL	1350 HP	2.97 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0276	6/20/2003	2/20/2004	INGENCO - CHARLES CITY PLANT	IC ENGINES, (48)	17.110	FUEL OIL	550 HP	0.2 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES. - THIS SOURCE USED DISTILLATE OILS, MINERAL OIL, DIELECTRIC FLUID, AND TREATED LANDFILL GAS.	-
VA-0276	6/20/2003	2/20/2004	INGENCO - CHARLES CITY PLANT	IC ENGINES, (48)	17.110	FUEL OIL	550 HP	0.2 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES - THIS SOURCE USED DISTILLATE OILS, MINERAL OIL, DIELECTRIC FLUID, AND TREATED LANDFILL GAS.	-
VT-0018	1/3/2000	10/6/2003	AGRIMARK/ CABOT INC. (AMC)	IC ENGINE, DIESEL	17.110	DIESEL	250 KW	0.5 LB/MMBTU	BACT-PSD	- limited to no more than 100 hr operation per year.	-
VT-0018	1/3/2000	10/6/2003	AGRIMARK/ CABOT INC. (AMC)	IC ENGINE, DIESEL	17.110	DIESEL	100 KW	0.5 LB/MMBTU	BACT-PSD	- limited to no more than 100 hr operation per year.	-
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, GENERATOR (4)	17.110	DIESEL	3.5 MMBTU/H	0.35 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES. FUEL < 0.05 % BY WT. SULFUR. PERMIT LIMITS SET IN LB/H, NOT G/BHP-H. -	LSF
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, EMERGENCY FIRE PUMP	17.110	DIESEL	3.8 MMBTU/H	0.38 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, USE OF FUEL < 0.05% S BY WT., EQUIPMENT USAGE LIMIT. -	LSF
WI-0207	1/21/2004	8/16/2005	ACE ETHANOL - STANLEY	IC ENGINE, DIESEL GENERATOR SET, B70	17.110		1850 BHP	0.07 G/HP-H	BACT-PSD	USE OF VERY LOW SULFUR DIESEL FUEL (0.05 WT % S). - THE DIESEL ENGINE GENERATOR MAY NOT OPERATE MORE THAN 16.7 HOURS PER MONTH	LSF

Control Category Key:

PCV Positive Crankcase Ventilation

LSF Low Sulfur (Clean) Fuels - less than 0.1 wt.% S

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	UPPER TANK FARM CAT 3412DT, P708C	17.110	DIESEL	660 HP	500 PPM	BACT-PSD	FUEL SULFUR CONTENT LIMITS AS FOLLOWS: DIESEL, 0.35% SULFUR; NATURAL GAS, 0.01% SULFUR; LPG, 0.01% SULFUR; REFINERY GAS, 168 PPMV H2S. - DESIGN CAPACITY IS 660 HP.OPERATING LIMIT OF 600 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	CAMP GENERATOR, UNIT 6,7	17.110	DIESEL	2362 KW	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - SPECIFIED THROUGHPUT IS FOR MAXIMUM RATING IN PRIME MODE. ADDITIONAL THROUGHPUT FOR MAXIMUM RATING IN STAND-BY MODE IS 2717 KW. MAXIMUM OPERATION: DURING PRE-SEALIFT PERIOD, 8760 H; DURING COM	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	FIRE WATER PUMP, UNIT 8	17.110	DIESEL	755 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT - MAXIMUM OPERATION DURING PRE-SEALIFT PERIOD: 104 H. MAXIMUM OPERATION DURING COMMISIONING PERIOD: 154 H. MAXIMUM OPERATION AFTER COMMISIONING PERIOD: 104 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISC. IC ENGINES 950 HP	17.110	DIESEL	950 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION 1440 H/YR. EQUIPMENT IS IN CONSTRUCTION RESERVE POOL.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISC. IC ENGINES > 600 HP	17.110	DIESEL	650 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION, 1440 H/YR. EQUIPMENT IS LISTED IN THE CONSTRUCTION RESERVE POOL.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	RIG ENGINES, UNIT 211, 212	17.110	DIESEL	1215 HP		Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - IF NATURAL GAS RIG ENGINES (UNITS 200-204) ARE OPERATING, THEN EXTRA DIESEL ENGINES MAY OPERATE FOR UP TO 5,674 H. IF NATURAL GAS RIG ENGINES ARE NOT OPERATING, THEN EXTRA DIESEL ENGINES MAY O	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 3632 HP	17.110	DIESEL	3632 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 744 H. TYPICAL OPERATION AFTER COMMISSIONING, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 2195 HP	17.110	DIESEL	2195 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 744 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 961.2 MMBTU/H	17.110	DIESEL	961.2 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 3672 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 4425 HP	17.110	DIESEL	4425 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2976 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 4240 HP	17.110	DIESEL	4240 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD 2976 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 940 HP	17.110	DIESEL	940 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 1128 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 949 HP	17.110	DIESEL	949 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 1128 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS IC ENGINES, 1200 HP	17.110	DIESEL	1200 HP	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2190 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD 0 H/YR.	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #5	17.110	DIESEL	1200 KW	500 PPM	N/A	THE SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50% BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCE NOS. 5, 6, 9, 11, 12, AND 14 MAY BE OPERATED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS GENERATOR IS A COOPER-BESSEMER #LS8T WITH A NOMINAL	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #6	17.110	DIESEL	1000 KW	500 PPM	N/A	SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50% BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCES NO. 5, 6, 9, 11, 12, AND 14, MAY BE BURNED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A FAIRBANKS MORSE #38TD8-1/8 GENERATOR WITH A NOMINAL	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #9	17.110	DIESEL	2865 KW	500 PPM	BACT-PSD	THE SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50% BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCE NOS. 5, 6, 9, 11, 12, AND 14 MAY BE BURNED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS AN EMD #20-645F4B GENERATOR WITH A NOMINAL DESIGN	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1500 KW	500 PPM	BACT-PSD	THE SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50% BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCES NO. 5, 6, 9, 11, 12, AND 14, MAY BE BURNED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICE. - THIS IS AN EMD #12-645E4 GENERATOR WITH A NOMINAL DESIGN C	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #12A	17.110	DIESEL	3660 KW	500 PPM	BACT-PSD	THE SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCES NO. 5, 6, 9, 11, 12, AND 14 MAY BE BURNED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3616 GENERATOR THAT OPERATES	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #14	17.110	DIESEL	1875 KW	500 PPM	BACT-PSD	THE SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCES NO. 5, 6, 9, 11, AND 14 MAY BE BURNED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3516B-LS DIESEL ELECTRIC GENERAT	-
AK-0042	12/28/1999	9/29/2003	SNAKE RIVER POWER PLANT	DIESEL ELECTRIC GENERATOR #12B	17.110	DIESEL	4400 KW	500 PPM	BACT-PSD	THE SULFUR CONTENT OF FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. ONLY 4 OF SOURCES NO. 5, 6, 11, 12, 9, AND 14 MAY BE BURNED CONCURRENTLY. GOOD AIR POLLUTION CONTROL PRACTICES. - THIS IS A CATERPILLAR #3616 GENERATOR THAT OPERATES	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #3	17.110	DIESEL	350 KW	63.3 T/12 MO. PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A WHITE SUPERIOR #405X8 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GEN	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #4	17.110	DIESEL	500 KW	63.3 T/12 MO PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. - THIS UNIT IS A CHICAGO PNEUMATIC #89A-CPS DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERATION.	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #5	17.110	DIESEL	750 KW	63.3 T/12 MO PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A WHITE SUPERIOR #40V5X-12 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #6	17.110	DIESEL	1000 KW	63.3 T/12 MO. PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A WHITE SUPERIOR #40VX-16 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER G	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #8	17.110	DIESEL	835 KW	63.3 T/12 MO PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3516DI DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENER	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #9	17.110	DIESEL	835 KW	63.3 T/12 MO. PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3516DI DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENER	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR, #10	17.110	DIESEL	1135 KW	63.3 T/12 MO. PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3516 DIESEL ELECTRIC GENERATOR USED FOR PRIMARY POWER GENERAT	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1050 KW	63.3 T/12 MO PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

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RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #12	17.110	DIESEL	1050 KW	63.3 T/12 MO. PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #13	17.110	DIESEL	1050 KW	63.3 T/12 MO PERIOD	Other Case-by-Case	THE SULFUR CONTENT OF THE FUEL OIL BURNED MUST NOT EXCEED 0.50 PERCENT BY WEIGHT AT ANY TIME. FOLLOW THE POWER GENERATION LIMITS AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY	-
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70003	17.110	FUEL OIL	2 MW		BACT-PSD	USE ONLY FUEL GAS WITH A HYDROGEN SULFIDE CONTENT NOT TO EXCEED 200 PPM AND USE DISTILLATE FUEL OIL WITH A SULFUR CONTENT NOT TO EXCEED 0.15%. - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS 500 H/YR LIQUID FUEL FOR A MAXIMUM OF 8 H/D. THE SCC CODE WAS CHO	-
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70004	17.110	FUEL OIL	2 MW		Other Case-by-Case	USE ONLY FUEL GAS WITH A HYDROGEN SULFIDE CONTENT NOT TO EXCEED 200 PPM AND USE DISTILLATE FUEL OIL WITH A SULFUR CONTENT NOT TO EXCEED 0.15%. - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS LIQUID FUEL FOR 500 H/YR AND IS LIMITED TO OPERATING 8 H/D. THE S	-
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 2.9 MW	17.110	DIESEL	2.9 MW		BACT-PSD	FUEL SULFUR RESTRICTION OF 0.50% SULFUR BY WEIGHT FOR NO. 2 FUEL - 2,865 KW EMD #20-645F4B DIESEL ELECTRIC GENERATOR (SOURCE NO. 9)	-
AK-0055	12/28/1999	1/12/2004	SNAKE RIVER POWER PLANT	IC ENGINE, 3.7 MW	17.110	DIESEL	3.7 MW		BACT-PSD	FUEL SULFUR RESTRICTION OF 0.50% SULFUR BY WEIGHT FOR NO. 2 FUEL - 3,660 KW CATERPILLAR #3616 DIESEL ELECTRIC GENERATOR (SOURCE NO. 12A)	-
AK-0056	2/1/1999	1/16/2004	ALPINE DEVELOPMENT PROJECT, CENTRAL PROCESSING FAC	IC ENGINES, 2 MW	17.110	FUEL OIL	2 MW		BACT-PSD	FUEL OIL SULFUR CONTENT NOT TO EXCEED 0.15% SULFUR BY WEIGHT - EMERGENCY GENERATOR, SOURCE ID CF-G-70003, AND CF-G-70004, CUMMINS QWF 16V170	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	IC ENGINES	17.110	DIESEL			BACT-PSD	LOW SULFUR FUEL: < 0.3% S BY WT - Firewater pump engines (8), 160 - 1100 HP, operating limits 500 h/yr. Emergency generators (2), 600 kW, 500 h/yr operating limit. Aircraft barrier engines (4), 65.7 HP, gasoline fueled.	-
AK-0060	10/10/2003	6/3/2005	DUTCH HARBOR SEAFOOD PROCESSING FACILITY	IC ENGINE, GENERATOR, FUEL OIL, (3)	17.110	DISTILLATE FUEL OIL	2220 KW		BACT-PSD	LOW SULFUR FUEL: SULFUR RESTRICTION OF 0.24% S BY WT FOR A JET A AND DIESEL NO. 2 FUEL BLEND. - Throughput for each. Three Wartsila Model 6R32D generators	-
AK-0061	11/5/2004	7/23/2007	SNAKE RIVER POWER PLANT	WARTSILA 12V32B DIESEL ELECTRIC GENERATOR	17.110	DIESEL FUEL	5211 kW	0.5 % S BY WT	BACT-PSD	LIMIT SULFUR CONTENT IN DIESEL FUEL. - THREE IDENTICAL UNITS.	LSF
AK-0062	8/19/2005	7/31/2007	BADAMI DEVELOPMENT FACILITY	CUMMINS IC ENGINE GENERATOR	17.110	DIESEL FUEL	1855 HP	0.15 % BY WT	BACT-PSD	LIMIT SULFUR CONTENT OF FUEL COMBUSTED - TWO IDENTICAL UNITS.	LSF
AR-0051	4/1/2002	5/6/2004	DUKE ENERGY-JACKSON FACILITY	GENERATOR, DIESEL-FIRED	17.110	DIESEL FUEL	671 HP		BACT-PSD	FUELS LIMIT: 0.05% S BY WT - backup generator, operates less than 500 h/yr	LSF
CA-0927	8/17/1999	12/3/2002	CHANNEL & BASIN RECLAMATION	IC ENGINE, COMPRESSION IGNITION, DIESEL	17.110	DIESEL	810 BHP	0.158 G/B-HP-H	BACT-PSD	LOW SULFUR DIESEL (<0.05% S BY WEIGHT) - ARB RECORD # A330-956-00 LIMITED LIFE DIESEL-FIRED INTERNAL COMBUSTION ENGINE POWERING AN ELECTRICAL GENERATOR IN A REMOTE LOCATION. THE UNIT IS LOCATED IN A REMOTE AREA WITH NO COMMERCIAL UTILITY POWER OR NATURAL	LSF
CA-0988	2/1/2003	9/4/2003	PACIFIC BELL	IC ENGINES	17.110	DIESEL FUEL	2935 HP	0.16 G/B-HP-H	LAER	- EMERGENCY GENERATOR	LSF
CA-1079	3/28/2000	5/2/2006	WALT DISNEY PICTURES AND TELEVISION	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1109 HP	0.05 %	BACT-PSD	SULFUR CONTENT OF THE FUEL SHALL NOT EXCEED 0.05% BY WEIGHT + OPERATION LIMIT <200 H/YR. - MFR: CATERPILLAR, TYPE: CI, MODEL: 3412 DISTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: NOX: 5.93 GR	LSF
CA-1080	2/22/2000	3/1/2006	HOMEGROCER.COM	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1480 HP	0.05 %	BACT-PSD	SULFUR CONTENT OF THE FUEL SHALL NOT EXCEED 0.05% BY WEIGHT. + OPERATION LIMIT < 200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3508B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52	LSF
CA-1082	2/1/2000	5/2/2006	CITY OF CORONA DEPT OF PUBLC WORKS	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	2155 HP	0.05 %	BACT-PSD	SULFUR CONTENT OF THE FUEL SHALL NOT EXCEED 0.05% BY WEIGHT + OPERATIONS LIMIT < 200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3512B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52	LSF

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SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

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CA-1083	3/30/2000	11/3/2005	CUCUMONGA COUNTY WATER DISTRICT	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	890 HP	0.05 % MAX	BACT-PSD	SULFUR CONTENT OF THE FUEL SHALL NOT EXCEED 0.05% BY WEIGHT. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3412 DITA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OP	LSF
CO-0055	2/3/2006	3/1/2006	LAMAR LIGHT & POWER POWER PLANT	DIESEL ENGINES FOR SWITCHING, LOCOMOTIVE & FIRE PUMP	17.110	DIESEL	1500 HP	0.06 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL. LESS TAN 0.05 BY WHEIGHT - RAIL MOVEMENT ON SITE	LSF
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	EMERGENCY GENERATOR	17.110	DIESEL	1500 KW	0.17 G/BHP-H	BACT-PSD	BURN LOW-SULFUR DIESEL FUEL. 0.05% BY WEIGHT OR LESS NOT TO EXCEED THE NSPS REQUIREMENT. - THREE 1,500 KW EMERGENCY GENERATORS ARE BEING INSTALLED AS A PART OF THIS PROJECT. PERMITS 07-A-542-P, 07-A-576-P AND 07-A-577-P. THE PROJECT ALSO INCLUDES THE INST	LSF
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	FIRE PUMP	17.110	DIESEL #2	540 HP	0.17 G/BHP-H	BACT-PSD	BURN LOW-SULFUR DIESEL FUEL. 0.05% BY WEIGHT OR LESS NOT TO EXCEED THE NSPS REQUIREMENT. - THE PROJECT INCLUDES FOUR IDENTICAL DIESEL FIRE PUMPS. PERMITS 07-A-572-P, 07-A-573-P, 07-A-574-P AND 07-A-55-P.	LSF
KS-0028	10/18/2005	3/9/2006	NEARMAN CREEK POWER STATION	EMERGENCY BLACK START GENERATOR	17.110	NO. 2 FUEL OIL	24.1 MMBTU/H	1.2 LB/H	BACT-PSD	GOOD COMBUSTION CONTROL - THE CUMMINS POWER GENERATION DIESEL GENERATOR (MODEL NO.: QSK78-G6) SHALL ONLY COMBUST NO. 2 FUEL OIL WITH VERY LOW SULFUR CONTENT AS THE PRIMARY FUEL TYPE. THERE WILL BE NO SECONDARY FUEL FOR BACKUP. [NOTE: THE INCREASE IN SIZE	LSF
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CATERPILLAR BACK-UP DIESEL AIR COMPRESSORS, 2	17.110	DIESEL FUEL	775 HP EACH	1.6 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 36-96, 37-97. THIS ENTRY IS FOR COMPRESSORS NO.1 & NO.2	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	AUXILIARY DIESEL GENERATORS NO.1 & NO.2	17.110	DIESEL FUEL	1100 HP EACH	2.2 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 38-96, 39-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	ADMINISTRATION BUILDING DIESEL GENERATOR	17.110	DIESEL	587 HP	1.2 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 50-96	-
LA-0211	12/27/2006	7/16/2008	GARYVILLE REFINERY	EMERGENCY GENERATORS (DOCK & TANK FARM) (21-08 & 22-08)	17.110	DIESEL		0.02 MAX LB/H	BACT-PSD	- 21-08: 1341 HP 22-08: 671 HP GENERATORS PERMITTED FOR 182 H/YR EA.	-
MA-0029	9/29/1999	1/3/2003	SITHE MYSTIC DEVELOPMENT LLC	IC ENGINE, EMERGENCY DIESEL GENERATOR	17.110	DIESEL	1500 KW	0.95 LB/H	BACT-PSD	SULFUR CONTENT THAT DOES NOT EXCEED .05% BY WEIGHT, LIMITED TO CONSUMPTION OF 8.250 GALLONS BASED ON 75 HOURS OF OPERATION PER 12 MONTH ROLLING PERIOD. - ADDITIONAL THROUGHPUT: 15.4 MMBTU/H. REQUIRED TO SHUT DOWN FACILITY IF NO POWER IS AVAILABLE FROM THE	LSF
MN-0050	5/4/2000	9/29/2003	LAKEFIELD JUNCTION LP GENERATING STATION	GENERATOR, BLACK-START	17.110	DIESEL	2 MW	0.5 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL; LIMITED OPERATION TO 1,000 H/ROLLING 12-MO -	LSF
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, LARGE, FUEL OIL (1)	17.110	DIESEL	670 HP	0.051 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL. - 4.874 MMBTU/H.	LSF
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, LARGE	17.110	DIESEL FUEL	1850 HP	0.59 G/B-HP-H	BACT-PSD	LOW SULFUR FUEL - MAX. SULFUR CONTENT 0.05% BY WEIGHT	LSF
MN-0070	9/7/2007	10/30/2008	MINNESOTA STEEL INDUSTRIES, LLC	EMERGENCY POWER GENERATION - DIESEL	17.110	DIESEL		0.05 %	BACT-PSD	LIMITED HOURS, LIMITED SULFUR IN FUEL - (>500 HP, LARGE IC)	LSF
NC-0074	1/24/2003	3/12/2004	BRIDGESTONE/FIRESTONE NORTH AMERICAN TIRE	IC ENGINES, AIR COMPRESSORS, DIESEL, (5)	17.110	DIESEL	4.46 MMBTU/H	2.3 LB/MMBTU	Other Case-by-Case	- Throughput for each. Additional throughput: 624 hp output each. ID no. ACDD-1 through ACDD-5	-
NC-0075	8/20/2001	3/12/2004	FORT BRAGG	IC ENGINES, DIESEL, (17)	17.110	DIESEL		2.3 LB/MMBTU	Other Case-by-Case	- Throughput varies from 230 kW to 1500 kW. Majority are 400 kW or more.	-
NC-0112	11/23/2004	8/14/2007	NUCOR STEEL	DIESEL FIRED EMERGENCY GENERATORS AND DIESEL FIRED EMERGENCY WATER PUMPS	17.110	FUEL OIL			BACT-PSD	OPERATION LIMITED TO 100 HOURS OF OPERATION FOR EACH EMERGENCY GENERATOR AND WATER PUMP PER 12 MONTH PERIOD -	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	EMERGENCY GENERATOR	17.110	DIESEL FUEL	49 MMBTU/H	2.45 LB/H	BACT-PSD	LOW SULFUR FUEL - POSSIBLE BLACK-START CAPABILITY TO THE SITE IF GRID POWER IS LOST MAX ALLOWABLE USE LESS THAN 500 H/YR	LSF
NM-0049	5/20/2002	3/10/2005	PHELPS DODGE TYRONE, INC	IC ENGINES, NON-DUAL FUEL MODE, (15)	17.110	FUEL OIL	3090 HP/H		Other Case-by-Case	FUEL SULFUR LIMIT: LOW SULFUR DIESEL (< 0.05% S BY WT) - 15 NORDBERG FSG-1316-HSC ENGINES MANUFACTURED BETWEEN 1967 AND 1972. THE ENGINES ARE ALLOWED TO USE DIESEL FUEL 20% OF THE TIME. BECAUSE THIS IS AN UNUSUAL PERMITTING SITUATION, THIS FACILITY HAS BE	LSF
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL-FIRED GENERATOR	17.110	DIESEL	600 KW	0.4 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 600 KW Emergency diesel-fired generator. Limited to 500 hr/yr operation.	LSF
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	EMERGENCY GENERATOR	17.110	DIESEL	1000 KW	0.01 T/YR	BACT-PSD	LOW SULFUR FUEL - 1000 KW EMERGENCY DIESEL FUEL FIRED GENERATOR, 1341 HP. LIMITED TO 500 H/YR OF OPERATION.	LSF
OH-0266	8/15/2002	4/29/2008	UNIVERSITY OF CINCINNATI	DIESEL FIRED ENGINES (2), 2 MW, 2922 BHP	17.110	DIESEL FUEL OIL	19.17 MMBTU/H	0.043 LB/MMBTU	BACT-PSD	SULFUR CONTENT OF DIESEL FUEL LESS THAN 0.05 PERCENT. -	LSF
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL GENERATOR, 2	17.110	DIESEL FUEL	17.21 MMBTU/H	8.61 LB/H	BACT-PSD	SULFUR LIMITED TO 0.05 % BY WEIGHT. OPERATIONS LIMITED TO 499 HOUR PER YEAR - EACH EMERGENCY GENERATOR IS RESTRICTED TO 499 H/ROLLING 12-MONTHS OF OPERATION	LSF
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, EMERGENCY GENERATOR	17.110	DIESEL FUEL	1818 HP	0.4 LB/MMBTU	BACT-PSD	- 1 ENGINE	-

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RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, BACKUP GENERATOR, DIESEL	17.110	DIESEL	749 BHP	0.3 LB/H	BACT-PSD	USE OF LOW SULFUR DIESEL FUEL (< 0.05% S BY WT) - 500 kW generator, limited to < 100 h/yr	LSF
OK-0091	3/18/2003	10/10/2003	CARDINAL FG CO./ CARDINAL GLASS PLANT	IC ENGINES, EMERGENCY GENERATORS (2)	17.110	DIESEL	2000 KW	0.05 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL, < 0.05% S - Throughput for each. Operation limit of < 500 h/yr each	LSF
OK-0118	2/9/2007	9/27/2007	HUGO GENERATING STA	EMERGENCY DIESEL INTERNAL COMBUSTION ENGINES	17.110				BACT-PSD	USE OF LOW SULFUR NO.2 FUEL OIL COMBINED WITH GOOD COMBUSTION PRACTICES AND LIMITED ANNUAL OPERATION -	LSF
PA-0158	6/19/2000	12/2/2002	FORD ELECTRONICS AND REFRIGERATION, LLC	DIESEL ENGINES	17.110	NO. 2 DIESEL	2 MW	4 LB/H	Other Case-by-Case	HOURLY LIMIT FOR EACH ENGINE, ANNUAL FOR ALL FIVE ENGINES. EMISSION LIMITS AVAILABLE ONLY IN LB/H AND T/YR. - FIVE CATERPILLAR MODEL 3516CITA ENGINES, 2596 HP EACH, GENERATING 2MW EACH.	-
PR-0005	3/2/2000	8/31/2006	SAN JUAN REPOWERING PROJECT	AUXILIARY DIESEL GENERATOR	17.110	DIESEL FUEL	5000 KW	2.65 LB/H	BACT-PSD	GOOD COMBUSTION CONTROL - LIMITED TO MAXIMUM OPERATION OF 40 HR/YR; MAX FUEL USAGE OF 15.66 GAL/YR (MONTHLY ROLLING AVG); SHALL NOT OPERATE CONCURRENTLY WITH ANY 2 COMBUSTION TURBINES. LIMITED OPERATION - 20% EXCEPT FOR 4 MIN IN 30 MIN PERIOD NOT TO EXCEE	-
SC-0064	5/23/2002	1/13/2003	SCE&G - JASPER COUNTY GENERATING FACILITY	GENERATOR, EMERGENCY,DIESEL FUEL	17.110	DIESEL	2000 KW	0.9 LB/H	BACT-PSD	LOW SULFUR (0.05%) DIESEL -	LSF
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL FUEL	2000 KW	1.9 LB/H	BACT-PSD	- THROUGHPUT CONVERTS TO 2681 BHP	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.1, GEN 1, FUEL OIL	17.110	DIESEL	1.75 MW	0.86 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 1. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.2, GEN 2, FUEL OIL	17.110	DIESEL	1.75 MW	0.86 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 2. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.3, GEN 3, FUEL OIL	17.110	DIESEL	1.75 MW	0.86 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 3. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.4, GEN 4, FUEL OIL	17.110	DIESEL	1.75 MW	0.86 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 4. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.5, GEN 5, FUEL OIL	17.110	DIESEL	1.75 MW	0.86 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR EMISSION POINT NO: GEN 5. OPERATIONAL LIMIT OF 100 H/YR.	LSF
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.6, GEN 6	17.110	FUEL OIL	1759 KW	0.86 LB/H	BACT-PSD	FUEL S CONTENT NO MORE THAN 0.05% S; MAX OPERATION 100 H/YR MAX OPERATION 100 H/YR	LSF
TX-0321	10/12/1999	1/3/2005	CR WING COGENERATION PLANT	STARTUP & EMERGENCY ELEC GENERATOR	17.110	DIESEL	2010 HP	0.5 LB/H	Other Case-by-Case	NONE INDICATED - SHALL OPERATE ONLY WHILE THE COMBUSTION TURBINES DO NOT OPERATE, EXCEPT STARTUP/SHUT DOWN OF EITHER THE DIESEL GENERATOR OR TURBINES AND FOR ROUTINE MAINTENANCE AND TESTING.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL	2000 KW	1.9 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110		1350 hp	2.77 LB/H	BACT-PSD	FUEL SULFUR LIMIT: < 0.3 WT % S - EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.110		300 hp	0.62 LB/H	BACT-PSD	FUEL SULFUR LIMITS: < 0.3 WT % S - EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	FIRE WATER PUMP	17.110			0.69 LB/H	BACT-PSD	-	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	EMERGENCY DIESEL GENERATOR	17.110			0.82 LB/H	BACT-PSD	-	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110	DIESEL	1350 HP	2.77 LB/H	BACT-PSD	DISTILLATE FUEL OIL CONTAINING NO MORE THAN 0.2 WEIGHT PERCENT OF SULFUR. - LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0276	6/20/2003	2/20/2004	INGENCO - CHARLES CITY PLANT	IC ENGINES, (48)	17.110	FUEL OIL	550 HP	0.5 LB/MMBTU	RACT	GOOD COMBUSTION PRACTICES - THIS SOURCE USED DISTILLATE OILS, MINERAL OIL, DIELECTRIC FLUID, AND TREATED LANDFILL GAS.	-
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, GENERATOR (4)	17.110	DIESEL	3.5 MMBTU/H	1.02 LB/H	BACT-PSD	SULFUR CONTENT <= .05% BY WT. PERMIT LIMITS ARE FUEL SULFUR CONTENT LIMIT AND LB/H LIMIT, NOT G/BHP-H. -	LSF
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, EMERGENCY FIRE PUMP	17.110	DIESEL	3.8 MMBTU/H	1.1 LB/H	BACT-PSD	THE USE OF DIESEL FUEL HAVING A SULFUR CONTENT OF .05% BY WT., AND EQUIPMENT USAGE LIMITS. PERMIT LIMITS ARE FUEL SULFUR CONTENT LIMITS AND LB/H LIMIT, NO LIMIT IN G/BHP-H. -	LSF

Control Category Key:

LSF Low Sulfur (Clean) Fuels - less than 0.1 wt.% S

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
AK-0037	3/21/2000	1/5/2005	KENAI REFINERY	UPPER TANK FARM CAT 3412DT, P708C	17.110	DIESEL	660 HP	0.81 LB/MMBTU	Other Case-by-Case	NONE INDICATED. - DESIGN CAPACITY IS 660 HP.OPERATING LIMIT OF 600 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	CAMP GENERATOR, UNIT 6,7	17.110	DIESEL	2362 KW	13.2 LB/H	Other Case-by-Case	NONE INDICATED - SPECIFIED THROUGHPUT IS FOR MAXIMUM RATING IN PRIME MODE. ADDITIONAL THROUGHPUT FOR MAXIMUM RATING IN STAND-BY MODE IS 2717 KW. MAXIMUM OPERATION: DURING PRE-SEALIFT PERIOD, 8760 H; DURING COMMISSIONING PERIOD, 1848 H; AFTER COMISSIONING	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	FIRE WATER PUMP, UNIT 8	17.110	DIESEL	755 HP	6.4 LB/H	Other Case-by-Case	NONE INDICATED - MAXIMUM OPERATION DURING PRE-SEALIFT PERIOD: 104 H. MAXIMUM OPERATION DURING COMMISIONING PERIOD: 154 H. MAXIMUM OPERATION AFTER COMMISIONING PERIOD: 104 H/YR.	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #11	17.110	DIESEL	1050 KW	90 T/12 MO PERIOD	Other Case-by-Case	COMPLY WITH POWER GENERATION LIMIT AS SPECIFIED IN THE PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POWER GENERATION. SOURCE 11 SHALL NOT OPERATE UNTIL SOURCE NO. 4 IS PERMANENTLY RETIRED FROM	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #12	17.110	DIESEL	1050 KW	90 T/12 MO PERIOD	Other Case-by-Case	COMPLY WITH POWER GENERATION LIMITS AS SPECIFIED IN PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POWER GENERATION. SOURCE NO. 12 SHALL NOT OPERATE UNTIL SOURCE NO. 8 IS PERMANENTLY RETIRED FROM	-
AK-0043	5/8/2000	1/5/2005	DILLINGHAM POWER PLANT	DIESEL ELECTRIC GENERATOR #13	17.110	DIESEL	1050 KW	90 T/12 MO PERIOD	Other Case-by-Case	COMPLY WITH POWER GENERATION LIMITS AS SPECIFIED IN PROCESS NOTES. - THIS UNIT IS A CATERPILLAR #3512B DIESEL ELECTRIC GENERATOR (SLOW-SPEED) USED FOR PRIMARY POWER GENERATION. SOURCE NO. 13 SHALL NOT OPERATE UNTIL SOURCE NO. 9 IS PERMANENTLY RETIRED FROM	-
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70003	17.110	FUEL OIL	2 MW	1.95 G/KW-H	BACT-PSD	GOOD OPERATIONAL PRACTICES AND MAINTENANCE - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS 500 H/YR LIQUID FUEL FOR A MAXIMUM OF 8 H/D. THE SCC CODE WAS CHOSEN FOR DISTILLATE FUEL OIL BASED ON INFORMATION IN THE TECHNICAL ANALYSIS, NOT THE PERMIT. PERMITTE	-
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	EMERGENCY GENERATOR, CF-G-70004	17.110	FUEL OIL	2 MW	1.95 G/KW-H	BACT-PSD	GOOD OPERATIONAL PRACTICES AND MAINTENANCE - CUMMINS QWF 16V170 EMERGENCY GENERATOR BURNS LIQUID FUEL FOR 500 H/YR AND IS LIMITED TO OPERATING 8 H/D. THE SCC CODE WAS CHOSEN FOR DISTILLATE FUEL BASED ON INFORMATION IN THE TECHNICAL ANALYSIS, NOT THE PERMI	-
AK-0056	2/1/1999	1/16/2004	ALPINE DEVELOPMENT PROJECT, CENTRAL PROCESSING FAC	IC ENGINES, 2 MW	17.110	FUEL OIL	2 MW	1.97 G/KW-H	BACT-PSD	- EMERGENCY GENERATOR, SOURCE ID CF-G-70003, AND CF-G-70004, CUMMINS QWF 16V170	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	IC ENGINE, DIESEL, (2)	17.110	DIESEL	3000 KW	4.4 LB/H	BACT-PSD	SCR OXIDATION CATALYST - Throughput for each. Units 5 & 6, Cooper Bessimer LSV16GDT.	OXCAT
AK-0061	11/5/2004	7/23/2007	SNAKE RIVER POWER PLANT	WARTSILA 12V32B DIESEL ELECTRIC GENERATOR	17.110	DIESEL FUEL	5211 kW	10.5 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES - THREE IDENTICAL UNITS.	-
AR-0040	12/29/2000	6/30/2003	DUKE ENERGY HOT SPRINGS	GENERATORS, (2) DIESEL	17.110	#2 FUEL OIL	600 KW	31 G/B-HP-H	BACT-PSD	PROPER COMBUSTION. - DIESEL ONLY. THROUGHPUT FOR EACH. LOW SULFUR RED DYE GRADE.	-
AR-0051	4/1/2002	5/6/2004	DUKE ENERGY-JACKSON FACILITY	GENERATOR, DIESEL-FIRED	17.110	DIESEL FUEL	671 HP	8.5 G/B-HP-H	BACT-PSD	GOOD OPERATING PRACTICE - backup generator, operates less than 500 h/yr	-
AZ-0046	4/14/2005	8/25/2006	ARIZONA CLEAN FUELS YUMA	FIRE WATER PUMPS NOS 1 AND 2	17.110	NO. 2 DIESEL FUEL	5.46 MMBTU/H	3.5 G/KW-H	BACT-PSD	- EQUIPMENT IDENTIFIED BY ID #S S-29200A AND S29200B	-
AZ-0046	4/14/2005	8/25/2006	ARIZONA CLEAN FUELS YUMA	EMERGENCY GENERATOR	17.110	NO. 2 DIESEL FUEL	10.9 MMBTU/H	3.5 G/KW-H	BACT-PSD	- EQUIPMENT IDENTIFIED BY ID # S-29100	-
CA-0892	9/24/1999	10/3/2001	KIEWIT PACIFIC CO	IC ENGINE, COMPRESSION IGNITION, PORTABLE	17.110	DIESEL	755 BHP	8.5 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-915-00 PORTABLE 755 BHP COMPRESSION-IGNITION CATERPILLAR MODEL 3412 PCTA IC ENGINE WITH PRECOMBUSTION CHAMBER IGNITION, BEING TURBOCHARGED AND AFTERCOOLED, AND USED TO DRIVE A 500 KVA ELECTRICAL GENERATOR. EMISSION LIMIT FOR	-
CA-0988	2/1/2003	9/4/2003	PACIFIC BELL	IC ENGINES	17.110	DIESEL FUEL	2935 HP	8.5 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-1010	7/11/2001	10/27/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	764 BHP	0.37 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(764BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FA	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
CA-1012	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINES, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	685 BHP	0.52 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(685BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FAMILY (1CPXL15	-
CA-1013	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	610 BHP	0.52 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(610BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FAMILY (1CPXL15	-
CA-1014	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	536 BHP	2.6 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(536BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE USEPA ENGINE FAMILY TO WHICH THIS ENGINES BELONGS HA	-
CA-1078	11/9/1999	5/2/2006	INGRAM BOOK COMPANY	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1448 BHP	8.5 G/B-HP-H	BACT-PSD	INTERNAL CONTROLS-TURBOCHARGER + OPERATIONS LIMIT <200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: MITSUBISHI, TYPE: CI, MODEL: 37 ODTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: 200 H/YR A	-
CA-1079	3/28/2000	5/2/2006	WALT DISNEY PICTURES AND TELEVISION	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1109 HP	8.5 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATIONS LIMIT < 200 H/YR. - MFR: CATERPILLAR, TYPE: CI, MODEL: 3412 DISTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: NOX: 5.93 GRAMS/B-HP-H CO: 0.71 G/B-HP-H; ROG: 0.03 G/B-H	-
CA-1080	2/22/2000	3/1/2006	HOMEGROCER.COM	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1480 HP	8.5 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATION LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3508B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN 2	-
CA-1082	2/1/2000	5/2/2006	CITY OF CORONA DEPT OF PUBLC WORKS	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	2155 HP	8.5 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATIONS LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3512B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN	-
CA-1083	3/30/2000	11/3/2005	CUCUMONGA COUNTY WATER DISTRICT	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	890 HP	8.5 G/B-HP/H	BACT-PSD	- EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3412 DITA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN 200 HRS/YR. THE ENGINE EMISSIONS, AS PROVIDE	-
CO-0055	2/3/2006	3/1/2006	LAMAR LIGHT & POWER POWER PLANT	DIESEL ENGINES FOR SWITCHING, LOCOMOTIVE & FIRE PUMP	17.110	DIESEL	1500 HP	0.61 LB/MMBTU	BACT-PSD	GOOD COMBUSTION MANAGEMENT PRACTICE - THIS IS USED FOR MOVING AND PLACEMENT OF CAOAL RAILCARS	-
IA-0058	4/10/2002	6/21/2004	GREATER DES MOINES ENERGY CENTER	EMERGENCY GENERATOR	17.110	DIESEL	700 KW	2.86 LB/H	BACT-PSD	-	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	EMERGENCY GENERATOR	17.110	#2 DISTILLATE OIL	18500 GALLONS/YR	0.22 LB/H	BACT-PSD	GCP, TIMING RETARD - Limited to 18500 gallons per year	-
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	EMERGENCY GENERATOR	17.110	DIESEL	1500 KW	2.6 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 2 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THREE 1,500 KW EMERGENCY GENERATORS	Tier 2
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	FIRE PUMP	17.110	DIESEL #2	540 HP	2.6 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 3 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THE PROJECT INCLUDES FOUR IDENTICAL	Tier 3
KS-0028	10/18/2005	3/9/2006	NEARMAN CREEK POWER STATION	EMERGENCY BLACK START GENERATOR	17.110	NO. 2 FUEL OIL	24.1 MMBTU/H	7.01 LB/H	BACT-PSD	GOOD ENGINE DESIGN IS PROPOSED AS BACT - THE CUMMINS POWER GENERATION DIESEL GENERATOR (MODEL NO.: QSK78-G6) SHALL ONLY COMBUST NO. 2 FUEL OIL WITH VERY LOW SULFUR CONTENT AS THE PRIMARY FUEL TYPE. THERE WILL BE NO SECONDARY FUEL FOR BACKUP. [NOTE: THE IN	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CATERPILLAR BACK-UP DIESEL AIR COMPRESSORS, 2	17.110	DIESEL FUEL	775 HP EACH	5.4 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 36-96, 37-97. THIS ENTRY IS FOR COMPRESSORS NO.1 & NO.2	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	AUXILIARY DIESEL GENERATORS NO.1 & NO.2	17.110	DIESEL FUEL	1100 HP EACH	10.6 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 38-96, 39-96	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	ADMINISTRATION BUILDING DIESEL GENERATOR	17.110	DIESEL	587 HP	3.9 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 50-96	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINES 1-3	17.110	DIESEL	660 HP EA.	0.55 LB/H	BACT-PSD	GOOD ENGINE DESIGN AMD PROPER OPERATING PRACTICES -	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	STANDBY GENERATOR DIESEL ENGINES 1-2	17.110	DIESEL	2220 HP EA.	41.6 LB/H	BACT-PSD	GOOD ENGINE DESIGN AND PROPER OPERATING PRACTICES -	-
LA-0211	12/27/2006	7/16/2008	GARYVILLE REFINERY	EMERGENCY GENERATORS (DOCK & TANK FARM) (21-08 & 22-08)	17.110	DIESEL		0.0067 LB/HP-H	BACT-PSD	USE OF DIESEL WITH A SULFUR CONTENT OF 15 PPMV OR LESS - 21-08: 1341 HP 22-08: 671 HP GENERATORS PERMITTED FOR 182 H/YR EA.	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	660 HP	0.3 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN INCORPORATING FUEL INJECTION TIMING RETARDATION (ITR) -	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	525 HP	1.6 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN INCORPORATING FUEL INJECTION TIMING RETARDATION (ITR) -	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	DIESEL EMERGENCY GENERATOR NOS. 1 & 2	17.110	DIESEL	2168 HP EA.	12.24 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN INCORPORATING FUEL INJECTION TIMING RETARDATION (ITR) -	-
MA-0029	9/29/1999	1/3/2003	SITHE MYSTIC DEVELOPMENT LLC	IC ENGINE, EMERGENCY DIESEL GENERATOR	17.110	DIESEL	1500 KW	3.05 LB/H	BACT-PSD	OXIDATION CATALYST - ADDITIONAL THROUGHPUT: 15.4 MMBTU/H. REQUIRED TO SHUT DOWN FACILITY IF NO POWER IS AVAILABLE FROM THE UTILITY GRID.	OXCAT
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, LARGE, FUEL OIL (1)	17.110	DIESEL	670 HP	0.76 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - 4.874 MMBTU/H.	-
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, LARGE	17.110	DIESEL FUEL	1850 HP	1 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	-
MS-0086	5/8/2007	4/7/2008	CHEVRON PRODUCTS COMPANY, PASCAGOULA REFINERY	TEMPORARY, PORTABLE CRUDE I GENERATOR	17.110	DIESEL		2.16 LB/H	BACT-PSD	- THIS IS A PORTABLE GENERATOR THAT MEETS THE DEFINITION OF A NON-ROAD ENGINE. IT MAY NOT STAY ON SITE MORE THAN 12 MONTHS AND MAY NOT BE OPERATED MORE THAN 9 MONTHS IN A CALENDAR YEAR. IT ALSO MAY NOT BE USED PAST 2009.	-
NC-0112	11/23/2004	8/14/2007	NUCOR STEEL	DIESEL FIRED EMERGENCY GENERATORS AND DIESEL FIRED EMERGENCY WATER PUMPS	17.110	FUEL OIL			BACT-PSD	OPERATION LIMITED TO 100 HOURS OF OPERATION FOR EACH EMERGENCY GENERATOR AND WATER PUMP PER 12 MONTH PERIOD -	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	EMERGENCY GENERATOR	17.110	DIESEL FUEL	49 MMBTU/H	1.11 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICE - POSSIBLE BLACK-START CAPABILITY TO THE SITE IF GRID POWER IS LOST MAX ALLOWABLE USE LESS THAN 500 H/YR	-
NM-0049	5/20/2002	3/10/2005	PHELPS DODGE TYRONE, INC	IC ENGINES, NON-DUAL FUEL MODE, (15)	17.110	FUEL OIL	3090 HP/H	9.4 LB/H	Other Case-by-Case	GOOD OPERATING PRACTICES - 15 NORDBERG FSG-1316-HSC ENGINES MANUFACTURED BETWEEN 1967 AND 1972. THE ENGINES ARE ALLOWED TO USE DIESEL FUEL 20% OF THE TIME. BECAUSE THIS IS AN UNUSUAL PERMITTING SITUATION, THIS FACILITY HAS BEEN GIVEN EMISSION CAPS FOR OPE	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL-FIRED GENERATOR	17.110	DIESEL	600 KW	15.2 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 600 KW Emergency diesel-fired generator. Limited to 500 hr/yr operation.	-
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	EMERGENCY GENERATOR	17.110	DIESEL	1000 KW	0.22 T/YR	BACT-PSD	- 1000 KW EMERGENCY DIESEL FUEL FIRED GENERATOR, 1341 HP. LIMITED TO 500 H/YR OF OPERATION.	-
OH-0266	8/15/2002	4/29/2008	UNIVERSITY OF CINCINNATI	DIESEL FIRED ENGINES (2), 2 MW, 2922 BHP	17.110	DIESEL FUEL OIL	19.17 MMBTU/H	1.73 LB/H	BACT-PSD	-	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL GENERATOR, 2	17.110	DIESEL FUEL	17.21 MMBTU/H	14.63 LB/H	BACT-PSD	- EACH EMERGENCY GENERATOR IS RESTRICTED TO 499 H/ROLLING 12-MONTHS OF OPERATION	-
OK-0070	6/13/2002	5/12/2004	GENOVA OK I POWER PROJECT	DIESEL ENGINE, BACKUP GENERATOR	17.110	DIESEL	750 KW	0.31 LB/MMBTU	BACT-PSD	ENGINE DESIGN - 500 HOUR LIMIT	-
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, EMERGENCY GENERATOR	17.110	DIESEL FUEL	1818 HP	0.055 LB/B-HP-H	BACT-PSD	ENGINE DESIGN - 1 ENGINE	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, BACKUP GENERATOR, DIESEL	17.110	DIESEL	749 BHP	2.66 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND GOOD COMBUSTION PRACTICES - 500 kW generator, limited to < 100 h/yr	-
OK-0091	3/18/2003	10/10/2003	CARDINAL FG CO./ CARDINAL GLASS PLANT	IC ENGINES, EMERGENCY GENERATORS (2)	17.110	DIESEL	2000 KW	0.202 LB/MMBTU	BACT-PSD	ENGINE DESIGN AND LIMIT ON HOURS OF OPERATION (<500 H/YR) - Throughput for each. Operation limit of < 500 h/yr each	-
OK-0118	2/9/2007	9/27/2007	HUGO GENERATING STA	EMERGENCY DIESEL INTERNAL COMBUSTION ENGINES	17.110				BACT-PSD	USE OF LOW SULFUR NO.2 FUEL OIL COMBINED WITH GOOD COMBUSTION PRACTICES AND LIMITED ANNUAL OPERATION -	-
PA-0158	6/19/2000	12/2/2002	FORD ELECTRONICS AND REFRIGERATION, LLC	DIESEL ENGINES	17.110	NO. 2 DIESEL	2 MW	34 LB/H	Other Case-by-Case	HOURLY LIMIT FOR EACH ENGINE, ANNUAL FOR ALL FIVE ENGINES. - FIVE CATERPILLAR MODEL 3516CITA ENGINES, 2596 HP EACH, GENERATING 2MW EACH.	-
PA-0244	10/20/2004	3/10/2005	FIRST QUALITY TISSUE, LLC	FIRE PUMP	17.110	#2 FUEL OIL	575 hp	0.0067 LB/HP-H	BACT-PSD	- THIS IS THE SAME FIRE PUMP THAT IS INCLUDED IN THE LIMITS LISTED UNDER THE OTHER SOURCES" PROCESS. THE NOX AND CO LIMITS LISTED HERE ARE SPECIFIC TO THE FIRE PUMP."	-
PR-0005	3/2/2000	8/31/2006	SAN JUAN REPOWERING PROJECT	AUXILIARY DIESEL GENERATOR	17.110	DIESEL FUEL	5000 KW	44.6 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES - LIMITED TO MAXIMUM OPERATION OF 40 HR/YR; MAX FUEL USAGE OF 15.66 GAL/YR (MONTHLY ROLLING AVG); SHALL NOT OPERATE CONCURRENTLY WITH ANY 2 COMBUSTION TURBINES. LIMITED OPERATION - 20% EXCEPT FOR 4 MIN IN 30 MIN PERIOD NOT TO EXC	-
SC-0064	5/23/2002	1/13/2003	SCE&G - JASPER COUNTY GENERATING FACILITY	GENERATOR, EMERGENCY,DIESEL FUEL	17.110	DIESEL	2000 KW	15.8 LB/H	BACT-PSD	-	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL EQUIPMENT / PROCESS MODIFICATION	CONTROL CATEGORY
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL FUEL	2000 KW	34.9 LB/H	BACT-PSD	- THROUGHPUT CONVERTS TO 2681 BHP	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.1, GEN 1, FUEL OIL	17.110	DIESEL	1.75 MW	7.6 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 1. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.2, GEN 2, FUEL OIL	17.110	DIESEL	1.75 MW	7.6 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 2. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.3, GEN 3, FUEL OIL	17.110	DIESEL	1.75 MW	7.6 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 3. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.4, GEN 4, FUEL OIL	17.110	DIESEL	1.75 MW	7.6 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 4. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.5, GEN 5, FUEL OIL	17.110	DIESEL	1.75 MW	7.6 LB/H	BACT-PSD	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 5. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.6, GEN 6	17.110	FUEL OIL	1759 KW	7.6 LB/H	BACT-PSD	- MAX OPERATION 100 H/YR	-
TX-0321	10/12/1999	1/3/2005	CR WING COGENERATION PLANT	STARTUP & EMERGENCY ELEC GENERATOR	17.110	DIESEL	2010 HP	10.7 LB/H	Other Case-by-Case	NONE INDICATED - SHALL OPERATE ONLY WHILE THE COMBUSTION TURBINES DO NOT OPERATE, EXCEPT STARTUP/SHUT DOWN OF EITHER THE DIESEL GENERATOR OR TURBINES AND FOR ROUTINE MAINTENANCE AND TESTING.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL	2000 KW	34.9 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110		1350 hp	9.02 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.110		300 hp	2 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	FIRE WATER PUMP	17.110			2.24 LB/H	BACT-PSD	-	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	EMERGENCY DIESEL GENERATOR	17.110			2.67 LB/H	BACT-PSD	-	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110	DIESEL	1350 HP	9.02 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0276	6/20/2003	2/20/2004	INGENCO - CHARLES CITY PLANT	IC ENGINES, (48)	17.110	FUEL OIL	550 HP	3.3 LB/MMBTU	Other Case-by-Case	LIMITING THE TREATED LANDFILL GAS HEAT INPUT RATION TO 50% AND A LANDFILL GAS TREATMENT SYSTEM. - THIS SOURCE USED DISTILLATE OILS, MINERAL OIL, DIELECTRIC FLUID, AND TREATED LANDFILL GAS.	-
VT-0013	6/8/2000	5/5/2003	MILL RIVER LUMBER, LTD.	ELECTRIC GENERATION-CATERPILLAR 3412C	17.110	NO 2 FUEL OIL	1023 HP	0.6 LB/H	Other Case-by-Case	SCR OXIDATION CATALYST WITH UREA INJECTION. NO REGULATORY BASIS, LIMIT BASED ON MANUFACTURER'S GUARANTEE. - STACK TEST PERFORMED ON 2/27/01. ONLY NOX AND CO ARE LISTED ON THIS PERMIT; CONTROLS WERE INSTALLED TO REMAIN BELOW THE STATE THRESHOLD FOR MAJOR M	OXCAT
VT-0014	9/5/2000	12/16/2002	OKEMO MOUNTAIN INC.	GENERATOR, FUEL OIL	17.110	NO 2 FUEL OIL	1480 BHP	0.6 G/B-HP-H	Other Case-by-Case	SCR OXIDATION CATALYST WITH UREA INJECTION, NO REGULATORY BASIS - STACK TEST PERFORMED ON 2/27/01. ONLY NOX AND CO LISTED IN PERMIT, CO HAS NO REGULATORY BASIS.	OXCAT
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, GENERATOR (4)	17.110	DIESEL	3.5 MMBTU/H	3.33 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES. PERMIT LIMITS SET IN LB/H, NOT G/BHP-H. -	-
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, EMERGENCY FIRE PUMP	17.110	DIESEL	3.8 MMBTU/H	3.61 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, EQUIPMENT USAGE LIMITS. PERMIT LIMITS SET IN LB/H, NO LIMITS IN G/B-HP-H. -	-
WI-0207	1/21/2004	8/16/2005	ACE ETHANOL - STANLEY	IC ENGINE, DIESEL GENERATOR SET, B70	17.110		1850 BHP	1 G/B-HP-H	BACT-PSD	LIMITED OPERATION, DESIGN - THE DIESEL ENGINE GENERATOR MAY NOT OPERATE MORE THAN 16.7 HOURS PER MONTH	-

Control Category Key:

OXCAT Oxidation Catalyst

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AR-0040	12/29/2000	6/30/2003	DUKE ENERGY HOT SPRINGS	GENERATORS, (2) DIESEL	17.110	#2 FUEL OIL	600 KW	1.1 G/B-HP-H	BACT-PSD	PROPER COMBUSTION PRACTICE - DIESEL ONLY. THROUGHPUT FOR EACH. LOW SULFUR RED DYE GRADE.	-
AR-0051	4/1/2002	5/6/2004	DUKE ENERGY-JACKSON FACILITY	GENERATOR, DIESEL-FIRED	17.110	DIESEL FUEL	671 HP	1.1 G/B-HP-H	BACT-PSD	GOOD OPERATING PRACTICE - backup generator, operates less than 500 h/yr	-
CA-0892	9/24/1999	10/3/2001	KIEWIT PACIFIC CO	IC ENGINE, COMPRESSION IGNITION, PORTABLE	17.110	DIESEL	755 BHP	1 G/BHP-H	BACT-PSD	NO CONTROL - ARB RECORD # A330-915-00 PORTABLE 755 BHP COMPRESSION-IGNITION CATERPILLAR MODEL 3412 PCTA IC ENGINE WITH PRECOMBUSTION CHAMBER IGNITION, BEING TURBOCHARGED AND AFTERCOOLED, AND USED TO DRIVE A 500 KVA ELECTRICAL GENERATOR. EMISSION LIMIT FOR	-
CA-0988	2/1/2003	9/4/2003	PACIFIC BELL	IC ENGINES	17.110	DIESEL FUEL	2935 HP	1 G/B-HP-H	LAER	- EMERGENCY GENERATOR	-
CA-1010	7/11/2001	10/27/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	764 BHP	0.03 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(764BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FA	-
CA-1012	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINES, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	685 BHP	0.07 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(685BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FAMILY (1CPXL15	-
CA-1013	7/11/2001	10/28/2005	POWER SYSTEM ASSOCIATES/JOHNSON POWER SYSTEMS	IC ENGINE, EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	610 BHP	0.07 G/BHP-H	BACT-PSD	- MFR: CATERPILLAR, TYPE: TURBOCHARGED AND AFTERCOOLED, MODEL: 3456 DITA-AA(610BHP), FUNC EQUIP: DRIVE A ELECTRICAL GENERATOR-EMERGENCY USE ONLY, SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: CARB-CERTIFIED EMISSIONS FOR THIS ENGINE FAMILY (1CPXL15	-
CA-1078	11/9/1999	5/2/2006	INGRAM BOOK COMPANY	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1448 BHP	1 G/B-HP-H	BACT-PSD	TURBOCHARGE + OPERATIONS LIMIT <200 H/YR. - EQUIP: EMERGENCY DIESEL GENERATOR, MFR: MITSUBISHI, TYPE: CI, MODEL: 37 ODTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: 200 H/YR AND 4 DEGREE TIMING	-
CA-1079	3/28/2000	5/2/2006	WALT DISNEY PICTURES AND TELEVISION	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1109 HP	1 G/B-HP-H	BACT-PSD	OPERATIONS LIMIT < 200 H/YR. - MFR: CATERPILLAR, TYPE: CI, MODEL 3412 DISTA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: NOX: 5.93 GRAMS/B-HP-H CO: 0.71 G/B-HP-H; ROG: 0.03 G/B-HP-H PM10: 0.109	-
CA-1080	2/22/2000	3/1/2006	HOMEGROCER.COM	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	1480 HP	1 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATIONS LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3508B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR., FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN	-
CA-1082	2/1/2000	5/2/2006	CITY OF CORONA DEPT OF PUBLC WORKS	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	2155 HP	1 G/B-HP-H	BACT-PSD	TURBOCHARGER + OPERATIONS LIMIT <200 H/YR. - EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3512B SCAC, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/YR: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN	-
CA-1083	3/30/2000	11/3/2005	CUCUMONGA COUNTY WATER DISTRICT	ICE: EMERGENCY, COMPRESSION IGNITION	17.110	DIESEL	890 HP	1 G/B-HP/H	BACT-PSD	- EQUIP: , MFR: CATERPILLAR, TYPE: , MODEL: 3412 DITA, FUNC EQUIP: THE ENGINE DRIVES A STANDBY GENERATOR, FUEL_TYPE: , SCHEDULE: VARIABLE, H/D: 1, D/W: 1, W/Y: 52, NOTES: THE ENGINE SHALL NOT OPERATE MORE THAN 200 HRS/YR. THE ENGINE EMISSIONS, AS PROVIDE	-
IA-0060	7/23/2002	5/6/2004	HAWKEYE GENERATING, LLC	EMERGENCY GENERATOR	17.110	#2 DISTILLATE OIL	18500 GALLONS/YR	0.07 LB/H	BACT-PSD	GCP, TIMING RETARD - Limited to 18500 gallons per year	-
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	EMERGENCY GENERATOR	17.110	DIESEL	1500 KW	0.3 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 2 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THREE 1,500 KW EMERGENCY GENERATORS	Tier 2
IA-0088	6/29/2007	10/9/2007	ADM CORN PROCESSING - CEDAR RAPIDS	FIRE PUMP	17.110	DIESEL #2	540 HP	0.2 G/BHP-H	BACT-PSD	NO SPECIFIC CONTROL TECHNOLOGY IS SPECIFED. ENGINE IS REQUIRED TO MEET LIMITS ESTABLISHED AS BACT (TIER 3 NONROAD). THIS COULD REQUIRE ANY NUMBER OF CONTROL TECHNOLOGIES AND OPERATIONAL REQ. TO MEET THE BACT STANDARD. - THE PROJECT INCLUDES FOUR IDENTICAL	Tier 3
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	CATERPILLAR BACK-UP DIESEL AIR COMPRESSORS, 2	17.110	DIESEL FUEL	775 HP EACH	1.9 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 36-96, 37-97. THIS ENTRY IS FOR COMPRESSORS NO.1 & NO.2	-
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	AUXILIARY DIESEL GENERATORS NO.1 & NO.2	17.110	DIESEL FUEL	1100 HP EACH	2.7 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINTS 38-96, 39-96	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
LA-0122	8/14/2001	3/17/2005	MANSFIELD MILL	ADMINISTRATION BUILDING DIESEL GENERATOR	17.110	DIESEL	587 HP	1.4 LB/H	BACT-PSD	PREVENTATIVE MAINTENANCE - EMISSION POINT 50-96	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINES 1-3	17.110	DIESEL	660 HP EA.	0.07 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES -	-
LA-0194	11/24/2004	5/9/2007	SABINE PASS LNG IMPORT TERMINAL	STANDBY GENERATOR DIESEL ENGINES 1-2	17.110	DIESEL	2220 HP EA.	4.89 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES -	-
LA-0211	12/27/2006	7/16/2008	GARYVILLE REFINERY	EMERGENCY GENERATORS (DOCK & TANK FARM) (21-08 & 22-08)	17.110	DIESEL		0.0025 LB/HP-H	BACT-PSD	USE OF DIESEL WITH A SULFUR CONTENT OF 15 PPMV OR LESS - 21-08: 1341 HP 22-08: 671 HP GENERATORS PERMITTED FOR 182 H/YR EA.	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	660 HP	0.04 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN -	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	FIREWATER PUMP DIESEL ENGINE	17.110	DIESEL	525 HP	0.09 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN -	-
LA-0219	8/15/2007	4/22/2008	CREOLE TRAIL LNG IMPORT TERMINAL	DIESEL EMERGENCY GENERATOR NOS. 1 & 2	17.110	DIESEL	2168 HP EA.	1.67 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES AND GOOD ENGINE DESIGN -	-
MA-0029	9/29/1999	1/3/2003	SITHE MYSTIC DEVELOPMENT LLC	IC ENGINE, EMERGENCY DIESEL GENERATOR	17.110	DIESEL	1500 KW	1.16 LB/H	LAER	GOOD COMBUSTION CONTROL - ADDITIONAL THROUGHPUT: 15.4 MMBTU/H. REQUIRED TO SHUT DOWN FACILITY IF NO POWER IS AVAILABLE FROM THE UTILITY GRID.	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	IC ENGINE, LARGE, FUEL OIL (1)	17.110	DIESEL	670 HP	0.1 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - 4.874 MMBTU/H.	-
MN-0054	12/4/2003	8/24/2006	MANKATO ENERGY CENTER	INTERNAL COMBUSTION ENGINE, LARGE	17.110	DIESEL FUEL	1850 HP	0.12 G/B-HP-H	BACT-PSD	GOOD COMBUSTION - MAX. SULFUR CONTENT 0.05% BY WEIGHT	-
NC-0112	11/23/2004	8/14/2007	NUCOR STEEL	DIESEL FIRED EMERGENCY GENERATORS AND DIESEL FIRED EMERGENCY WATER PUMPS	17.110	FUEL OIL			BACT-PSD	OPERATION LIMITED TO 100 HOURS OF OPERATION FOR EACH EMERGENCY GENERATOR AND WATER PUMP PER 12 MONTH PERIOD -	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	EMERGENCY GENERATOR	17.110	DIESEL FUEL	49 MMBTU/H	12.04 LB/H	LAER	GOOD COMBUSTION - POSSIBLE BLACK-START CAPABILITY TO THE SITE IF GRID POWER IS LOST MAX ALLOWABLE USE LESS THAN 500 H/YR	-
OH-0254	8/14/2003	7/5/2005	DUKE ENERGY WASHINGTON COUNTY LLC	EMERGENCY DIESEL-FIRED GENERATOR	17.110	DIESEL	600 KW	1.76 LB/H	BACT-PSD	LOW SULFUR FUEL, COMBUSTION CONTROL - 600 KW Emergency disel-fired generator. Limited to 500 hr/yr operation.	-
OH-0255	3/29/2001	5/12/2008	AEP WATERFORD ENERGY LLC	EMERGENCY GENERATOR	17.110	DIESEL	1000 KW	0.02 T/YR	BACT-PSD	- 1000 KW EMERGENCY DIESEL FUEL FIRED GENERATOR, 1341 HP. LIMITED TO 500 H/YR OF OPERATION.	-
OH-0266	8/15/2002	4/29/2008	UNIVERSITY OF CINCINNATI	DIESEL FIRED ENGINES (2), 2 MW, 2922 BHP	17.110	DIESEL FUEL OIL	19.17 MMBTU/H	1.04 LB/H	BACT-PSD	-	-
OH-0275	8/24/2004	8/31/2006	PSI ENERGY-MADISON STATION	EMERGENCY DIESEL GENERATOR, 2	17.110	DIESEL FUEL	17.21 MMBTU/H	1.55 LB/H	BACT-PSD	- EACH EMERGENCY GENERATOR IS RESTRICTED TO 499 H/ROLLING 12-MONTHS OF OPERATION	-
OK-0072	5/6/2002	7/7/2003	REDBUD POWER PLT	DIESEL ENGINE, EMERGENCY GENERATOR	17.110	DIESEL FUEL	1818 HP	0.0007 LB/B-HP-H	BACT-PSD	ENGINE DESIGN - 1 ENGINE	-
OK-0090	3/21/2003	10/10/2003	DUKE ENERGY STEPHENS, LLC STEPHENS ENERGY	IC ENGINE, BACKUP GENERATOR, DIESEL	17.110	DIESEL	749 BHP	1.7 LB/H	BACT-PSD	BACT IS GOOD ENGINE DESIGN - 500 kW generator, limited to < 100 h/yr	-
OK-0091	3/18/2003	10/10/2003	CARDINAL FG CO./ CARDINAL GLASS PLANT	IC ENGINES, EMERGENCY GENERATORS (2)	17.110	DIESEL	2000 KW	2.17 LB/H	BACT-PSD	ENGINE DESIGN AND LIMIT ON HOURS OF OPERATION (<500 H/YR) - Throughput for each. Operation limit of < 500 h/yr each	-
OK-0118	2/9/2007	9/27/2007	HUGO GENERATING STA	EMERGENCY DIESEL INTERNAL COMBUSTION ENGINES	17.110				BACT-PSD	USE OF LOW SULFUR NO.2 FUEL OIL COMBINED WITH GOOD COMBUSTION PRACTICES AND LIMITED ANNUAL OPERATION -	-
PA-0158	6/19/2000	12/2/2002	FORD ELECTRONICS AND REFRIGERATION, LLC	DIESEL ENGINES	17.110	NO. 2 DIESEL	2 MW	0.46 LB/H	Other Case-by-Case	HOURLY LIMIT FOR EACH ENGINE, ANNUAL FOR ALL FIVE ENGINES. EMISSION LIMITS AVAILABLE ONLY IN LB/H AND T/YR. - FIVE CATERPILLAR MODEL 3516CITA ENGINES, 2596 HP EACH, GENERATING 2MW EACH.	-
PR-0005	3/2/2000	8/31/2006	SAN JUAN REPOWERING PROJECT	AUXILIARY DIESEL GENERATOR	17.110	DIESEL FUEL	5000 KW	4.3 LB/H	BACT-PSD	GOOD COMBUSTION; LIMITED OPERATION - LIMITED TO MAXIMUM OPERATION OF 40 HR/YR; MAX FUEL USAGE OF 15.66 GAL/YR (MONTHLY ROLLING AVG); SHALL NOT OPERATE CONCURRENTLY WITH ANY 2 COMBUSTION TURBINES. LIMITED OPERATION - 20% EXCEPT FOR 4 MIN IN 30 MIN PERIOD N	-
SC-0064	5/23/2002	1/13/2003	SCE&G - JASPER COUNTY GENERATING FACILITY	GENERATOR, EMERGENCY,DIESEL FUEL	17.110	DIESEL	2000 KW	1.7 LB/H	LAER	-	-
TX-0262	1/3/2000	10/7/2003	ARCHER GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL FUEL	2000 KW	2.9 LB/H	BACT-PSD	- THROUGHPUT CONVERTS TO 2681 BHP	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.1, GEN 1, FUEL OIL	17.110	DIESEL	1.75 MW	0.29 LB/H	Other Case-by-Case	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 1. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.2, GEN 2, FUEL OIL	17.110	DIESEL	1.75 MW	0.29 LB/H	Other Case-by-Case	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 2. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.3, GEN 3, FUEL OIL	17.110	DIESEL	1.75 MW	0.29 LB/H	Other Case-by-Case	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 3. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.4, GEN 4, FUEL OIL	17.110	DIESEL	1.75 MW	0.29 LB/H	Other Case-by-Case	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 4. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.5, GEN 5, FUEL OIL	17.110	DIESEL	1.75 MW	0.29 LB/H	Other Case-by-Case	MAX OPERATION 100 H/YR - EMISSION POINT NO: GEN 5. OPERATIONAL LIMIT OF 100 H/YR.	-
TX-0291	5/7/1999	1/4/2005	TENASKA GATEWAY GENERATING STATION	BLACK START GENERATOR NO.6, GEN 6	17.110	FUEL OIL	1759 KW	0.29 LB/H	Other Case-by-Case	- MAX OPERATION 100 H/YR	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - IC ENGINES GREATER THAN 500 HP - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 17.110 - Large Internal Combustion Engines (>500 HP); Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu; PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
TX-0321	10/12/1999	1/3/2005	CR WING COGENERATION PLANT	STARTUP & EMERGENCY ELEC GENERATOR	17.110	DIESEL	2010 HP	1.3 LB/H	Other Case-by-Case	NONE INDICATED - SHALL OPERATE ONLY WHILE THE COMBUSTION TURBINES DO NOT OPERATE, EXCEPT STARTUP/SHUT DOWN OF EITHER THE DIESEL GENERATOR OR TURBINES AND FOR ROUTINE MAINTENANCE AND TESTING.	-
TX-0324	11/18/1999	1/25/2005	ODESSA-ECTOR GENERATING STATION	EMERGENCY ELECTRICAL GENERATOR	17.110	DIESEL	2000 KW	2.9 LB/H	BACT-PSD	NONE INDICATED -	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110		1350 hp	3.39 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0384	8/23/2000	10/26/2004	BRAZOS VALLEY ELECTRIC GENERATING FACILITY	FIRE WATER PUMP	17.110		300 hp	0.75 LB/H	N/A	- EACH DIESEL FIRED EMISSION SOURCE IS LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	FIRE WATER PUMP	17.110			0.84 LB/H	BACT-PSD	-	-
TX-0401	12/15/2000	8/30/2004	COTTONWOOD ENERGY PROJECT	EMERGENCY DIESEL GENERATOR	17.110			1.01 LB/H	BACT-PSD	-	-
TX-0407	12/6/2002	10/26/2004	STERNE ELECTRIC GENERATING FACILITY	EMERGENCY GENERATOR	17.110	DIESEL	1350 HP	3.33 LB/H	BACT-PSD	- LIMITED TO A MAXIMUM OF 100 NON-EMERGENCY HOURS OF OPERATION ANNUALLY.	-
VA-0276	6/20/2003	2/20/2004	INGENCO - CHARLES CITY PLANT	IC ENGINES, (48)	17.110	FUEL OIL	550 HP	0.4 LB/MMBTU	N/A	GOOD COMBUSTION PRACTICES. - THIS SOURCE USED DISTILLATE OILS, MINERAL OIL, DIELECTRIC FLUID, AND TREATED LANDFILL GAS.	-
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, GENERATOR (4)	17.110	DIESEL	3.5 MMBTU/H	1.26 LB/H	Other Case-by-Case	GOOD COMBUSTION PRACTICES. PERMIT LIMITS SET IN LB/H, NOT G/BHP-H. -	-
WI-0174	9/20/2000	12/3/2002	BADGER GENERATING CO LLC	DIESEL ENGINE, EMERGENCY FIRE PUMP	17.110	DIESEL	3.8 MMBTU/H	1.37 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES, EQUIPMENT USAGE LIMITS. PERMIT LIMITS SET IN LB/H, NO LIMITS IN G/BHP-H. -	-
WI-0207	1/21/2004	8/16/2005	ACE ETHANOL - STANLEY	IC ENGINE, DIESEL GENERATOR SET, B70	17.110		1850 BHP	0.12 G/HP-H	BACT-PSD	LIMITED OPERATION, DESIGN - THE DIESEL ENGINE GENERATOR MAY NOT OPERATE MORE THAN 16.7 HOURS PER MONTH	-

Control Category Key:

TIER 2 or 3 Non-Road Engine Emission Standards per 40 CFR 89.112.

EPA RACT/BACT/LAER CLEARINGHOUSE - BOILERS LESS THAN OR EQUAL TO 100 MMBTU/HR - NO_X CONTROL DETERMINATIONS

PROJECT 180-15

SEARCH CONDITIONS - PROCESS CODE 13.220 - Commercial/Institutional-Size Boilers/Furnaces≤100 million BTU/H); Distillate Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0033	12/10/1999	1/30/2003	COMINCO RED DOG MINE	HEATERS, ABCO, 3 UNITS	13.220	ARCTIC DIESEL	13.4 MMBTU/H	0.084 LB/MMBTU	BACT-PSD	LOW NOX BURNERS - 3 ABCO HEATERS OF 13.4 MMBTU/HR EACH. ONLY NOX AND VE FOR THIS PROCESS.	LNB
ID-0009	6/26/2000	2/19/2004	ID NAT'L ENGINEERING AND ENVT'L LAB/NUCLEAR TECH	(4) CPP-606 BOILERS AND (1) INTEC PORTABLE BOILER	13.220	DISTILLATE	29976 GAL/D	599.5 LB/D	BACT-PSD	FLUE GAS RECIRCULATION - FOUR CPP-606 BOILERS AND 1 INTEC PORTABLE BOILER ARE INCLUDED IN THIS ENTRY.	FRG
ID-0013	6/26/2000	2/20/2004	IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER	BOILERS, STATIONARY FIRETUBE, (4)	13.220	DISTILLATE FUEL OIL	36.4 MMBTU/H	599.5 LB/D	BACT-PSD	FLUE GAS RECIRCULATION - TOTAL FUEL COMBUSTED FOR ALL BOILERS, INCLUDING THE PORTABLE BOILER, IS LIMITED TO 29,976 GAL/DAY.	FRG
ID-0013	6/26/2000	2/20/2004	IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER	BOILER, PORTABLE FIRETUBE, (1)	13.220	DISTILLATE FUEL OIL	29.3 MMBTU/H	599.5 LB/D	BACT-PSD	FLUE GAS RECIRCULATION - TOTAL FUEL COMBUSTED FOR ALL BOILERS, INCLUDING THE PORTABLE BOILER, IS LIMITED TO 29,976 GAL/DAY.	LNB/FGR
MI-0355	9/16/2003	1/16/2004	ABBOTT LABORATORIES, STURGIS PLANT	BOILER, FUEL OIL	13.220	#2 FUEL OIL	98.51 MMBTU/H	0.14 LB/MMBTU	BACT-PSD	LOW NOX BURNERS AND FLUE GAS RECIRCULATION - FUEL OIL USED AS BACKUP	LNB/FGR
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	BOILER, DISTILLATE OIL (1)	13.220	#2 FUEL OIL	40 MMBTU/H	0.058 LB/MMBTU	BACT-PSD	LOW NOX BURNER AND FGR. - AUXILIARY BOILER.	LNB/FGR
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	AUXILIARY BOILER- DISTILLATE OIL	13.220	DISTILLATE FUEL OIL	99 MMBTU/H	0.1 LB/MMBTU	LAER	LIMIT BOILER USE TO 3600 H/YR - DISTILLATE OIL USED AS BACK-UP FUEL- SEE NOTES FOR NATURAL GAS IN AUX. BOILER	-
OH-0251	11/29/2001	7/24/2008	CENTRAL SOYA COMPANY INC.	BOILER, NO 2 FUEL OIL	13.220	NO 2 FUEL OIL	91.2 MMBTU/H	9.21 LB/H	N/A	USE OF LOW NOX BURNERS - Restriction on the gallons of #2 oil that can be used: 1,787,000 gallons per rolling 12-months. Fuel oil is backup fuel. There is a separate entry for this boiler when firing natural gas.	LNB
OH-0309	5/3/2007	8/16/2007	TOLEDO SUPPLIER PARK- PAINT SHOP	BOILER (2), NO. 2 FUEL OIL	13.220	FUEL OIL #2	20.4 MMBTU/H	1.5 LB/H	LAER	LOW NOX BURNERS AND FLUE GAS RECIRCULATION - TWO BOILERS WITH LOW NOX BURNERS AND FLUE GAS RECIRCULATION. USING NATURAL GAS WITH #2 OIL BACKUP. TWO SET OF LIMITS, THIS ONE FOR #2 OIL. EACH BOILER IS RESTRICTED TO 250,000 GALLONS OF FUEL OIL PER ROLLING 12	LNB/FGR
VA-0271	3/24/2003	8/23/2006	HARRISONBURG RESOURCE RECOVER FACILITY	BOILER NO.2	13.220	DISTILLATE FUEL OIL	43.2 MMBTU	6.17 LB/H	Other Case-by-Case	FLUE GAS RECIRCULATION WITH LOW NOX BURNER. GOOD COMBUSTION PRACTICES. CONTINUOUS EMISSION MONITORING SYSTEM. - One of two units	LNB/FGR
VA-0299	6/19/2006	6/18/2007	UNITED STATES GYPSUM COMPANY	BOILER, MIXER HOT WATER	13.220		2.6 MMBTU/H	0.3 LB/H	BACT-PSD	-	-

Control Category Key:

LNB Low NOx Burners

FGR Flue Gas Recirculation

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - BOILERS LESS THAN OR EQUAL TO 100 MMBTU/HR - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 13.220 - Commercial/Institutional-Size Boilers/Furnaces≤100 million BTU/H); Distillate Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	GLYCOL SKID HEATER (DIESEL), UNIT NO. 14	13.220	DIESEL	1.05 LB/MMBTU	0.05 GR/DSCF	Other Case-by-Case	NONE INDICATED - GLYCOL SKID HEATER ALSO USES NATURAL GAS AS FUEL, LISTED SEPARATELY. MAXIMUM OPERATION: DURING PRE-SEALIFT PERIOD, 8760 H; DURING COMMISSIONING PERIOD, 1848 H; AFTER COMMISSIONING PERIOD, 1000 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	PORTABLE HEATER, UNIT NO. 105-107	13.220	DIESEL	1 MMBTU/H	0.05 GR/DSCF	N/A	GOOD OPERATIONS PRACTICES - TYPICAL OPERATION DURING COMMISSIONING PERIOD; 1848 H, TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. PORTABLE HEATER AND BLOWER ENGINE ON PORTABLE HEATER ARE LISTED SEPARATELY FOR DATABASE.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS HEATERS	13.220	DIESEL	13 MMBTU/H	0.05 GR/DSCF	N/A	GOOD OPERATIONS PRACTICES - EQUIPMENT PART OF CONSTRUCTION RESERVE POOL. TYPICAL OPERATION, 1440 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	RIG BOILER, DIESEL, UNIT 206, 207	13.220	DIESEL	6.3 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - PERMIT LISTS UNIT 6 AND 7 AS BOTH BURNING NATURAL GAS AND DIESEL-- LISTED SEPARATELY IN DATABASE. TYPICAL OPERATION DURING PRE-SEALIFT PERIOD, 8760 H; DURING COMMISSIONING PERIOD, 924 H; AFTER COMMISSIONING PERIOD, 8760 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATER (DIESEL), UNIT 208, 209	13.220	DIESEL	3.5 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICE - PERMIT LISTS UNIT 208 AND 209 AS BURNING DIESEL FUEL AND NATURAL GAS. THESE ARE LISTED SEPARATELY IN DATABASE. DURING PRE-SEALIFT PERIOD AND COMMISSIONING PERIOD, UNITS MAY BE OPERATED WITH NATURAL GAS OR DIESEL FOR THE SAME AMO	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATER (DIESEL), UNIT 210	13.220	DIESEL	4.2 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - DURING PRE-SEALIFT PERIOD AND COMMISSIONING PERIOD, UNITS MAY BE OPERATED WITH NATURAL GAS OR DIESEL FOR THE SAME AMOUNT OF TIME. DURING LONG-TERM OPERATIONS, UNIT MAY BE RUN FULL-TIME ON NATURAL GAS, WITH DIESEL USE FOR 18 H/	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 4.0 MMBTU/H	13.220	DIESEL	4 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 3672 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 35.0 MMBTU/H	13.220	DIESEL	35 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2976 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 2.0 MMBTU/H	13.220	DIESEL	2 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 1128 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 20.0 MMBTU/H	13.220	DIESEL	20 MMBTU/H	0.05 GR/DSCF	Other Case-by-Case	GOOD OPERATIONS PRACTICES. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2190 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0058	8/16/2000	1/16/2004	NORTHSTAR DEVELOPMENT FACILITY	HEATERS	13.220	DIESEL	10 MMBTU/H		Other Case-by-Case	GOOD COMBUSTION PRACTICE - SOURCE ID: 210B, 215, 216, 217, AND 218.	-
ID-0009	6/26/2000	2/19/2004	ID NAT'L ENGINEERING AND ENVT'L LAB/NUCLEAR TECH	(4) CPP-606 BOILERS AND (1) INTEC PORTABLE BOILER	13.220	DISTILLATE	29976 GAL/D	0.05 GR/DSCF @ 3% O2	N/A	NONE INDICATED - FOUR CPP-606 BOILERS AND 1 INTEC PORTABLE BOILER ARE INCLUDED IN THIS ENTRY.	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	BOILER, DISTILLATE OIL (1)	13.220	#2 FUEL OIL	40 MMBTU/H	0.024 LB/MMBTU	BACT-PSD	CLEAN FUEL AND GOOD COMBUSTION. - AUXILIARY BOILER.	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	AUXILIARY BOILER- DISTILLATE OIL	13.220	DISTILLATE FUEL OIL	99 MMBTU/H	3.96 LB/H	BACT-PSD	LIMITED USE - DISTILLATE OIL USED AS BACK-UP FUEL- SEE NOTES FOR NATURAL GAS IN AUX. BOILER	-
OH-0251	11/29/2001	7/24/2008	CENTRAL SOYA COMPANY INC.	BOILER, NO 2 FUEL OIL	13.220	NO 2 FUEL OIL	91.2 MMBTU/H	0.47 LB/H	BACT-PSD	- Restriction on the gallons of #2 oil that can be used: 1,787,000 gallons per rolling 12-months. Fuel oil is backup fuel. There is a separate entry for this boiler when firing natural gas.	-
OH-0309	5/3/2007	8/16/2007	TOLEDO SUPPLIER PARK- PAINT SHOP	BOILER (2), NO. 2 FUEL OIL	13.220	FUEL OIL #2	20.4 MMBTU/H	0.5 LB/H	BACT-PSD	- TWO BOILERS WITH LOW NOX BURNERS AND FLUE GAS RECIRCULATION. USING NATURAL GAS WITH #2 OIL BACKUP. TWO SET OF LIMITS, THIS ONE FOR #2 OIL. EACH BOILER IS RESTRICTED TO 250,000 GALLONS OF FUEL OIL PER ROLLING 12-MONTHS.	-
OH-0309	5/3/2007	8/16/2007	TOLEDO SUPPLIER PARK- PAINT SHOP	BOILER (2), NO. 2 FUEL OIL	13.220	FUEL OIL #2	20.4 MMBTU/H	0.31 LB/H	BACT-PSD	- TWO BOILERS WITH LOW NOX BURNERS AND FLUE GAS RECIRCULATION. USING NATURAL GAS WITH #2 OIL BACKUP. TWO SET OF LIMITS, THIS ONE FOR #2 OIL. EACH BOILER IS RESTRICTED TO 250,000 GALLONS OF FUEL OIL PER ROLLING 12-MONTHS.	-
VA-0271	3/24/2003	8/23/2006	HARRISONBURG RESOURCE RECOVER FACILITY	BOILER NO.2	13.220	DISTILLATE FUEL OIL	43.2 MMBTU	0.62 LB/H	N/A	GOOD COMBUSTION PRACTICES - One of two units	-
VA-0271	3/24/2003	8/23/2006	HARRISONBURG RESOURCE RECOVER FACILITY	BOILER NO.2	13.220	DISTILLATE FUEL OIL	43.2 MMBTU	0.32 LB/H	N/A	GOOD COMBUSTION PRACTICES - One of two units	-
VT-0016	10/26/1999	2/26/2004	OMYA / VERPOL	BOILER, FIRE TUBE	13.220	# 2 FUEL OIL	24 MMBTU/H	0.35 LB/MMBTU	Other Case-by-Case	LOW SULFUR FUEL, GOOD OPERATING PRACTICE. - fire tube boiler, 600 hp, 20,700 lb steam/h. fuel: < 0.3% S	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - BOILERS LESS THAN OR EQUAL TO 100 MMBTU/HR - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 13.220 - Commercial/Institutional-Size Boilers/Furnaces≤100 million BTU/H); Distillate Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	GLYCOL SKID HEATER (DIESEL), UNIT NO. 14	13.220	DIESEL	1.05 LB/MMBTU	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - GLYCOL SKID HEATER ALSO USES NATURAL GAS AS FUEL, LISTED SEPARATELY. MAXIMUM OPERATION: DURING PRE-SEALIFT PERIOD, 8760 H; DURING COMMISSIONING PERIOD, 1848 H; AFTER COMMISSIONING PERIOD, 1000	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	PORTABLE HEATER, UNIT NO. 105-107	13.220	DIESEL	1 MMBTU/H	500 PPM	N/A	ENSURE THE EMISSION LIMIT IS MET BY USING FUEL OIL WITH A SULFUR CONTENT NOT TO EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION DURING COMMISSIONING PERIOD; 1848 H, TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 8760 H/YR. PORTABLE HEATER AND BLOWER ENGINE ON	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	MISCELLANEOUS HEATERS	13.220	DIESEL	13 MMBTU/H	500 PPM	N/A	TO ENSURE COMPLIANCE WITH THE EMISSION LIMIT, THE SULFUR CONTENT OF THE FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - EQUIPMENT PART OF CONSTRUCTION RESERVE POOL. TYPICAL OPERATION, 1440 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	RIG BOILER, DIESEL, UNIT 206, 207	13.220	DIESEL	6.3 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - PERMIT LISTS UNIT 6 AND 7 AS BOTH BURNING NATURAL GAS AND DIESEL-- LISTED SEPARATELY IN DATABASE. TYPICAL OPERATION DURING PRE-SEALIFT PERIOD, 8760 H; DURING COMMISSIONING PERIOD, 924 H; AFTER	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATER (DIESEL), UNIT 208, 209	13.220	DIESEL	3.5 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT - PERMIT LISTS UNIT 208 AND 209 AS BURNING DIESEL FUEL AND NATURAL GAS. THESE ARE LISTED SEPARATELY IN DATABASE. DURING PRE-SEALIFT PERIOD AND COMMISSIONING PERIOD, UNITS MAY BE OPERATED WITH NAT	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATER (DIESEL), UNIT 210	13.220	DIESEL	4.2 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - DURING PRE-SEALIFT PERIOD AND COMMISSIONING PERIOD, UNITS MAY BE OPERATED WITH NATURAL GAS OR DIESEL FOR THE SAME AMOUNT OF TIME. DURING LONG-TERM OPERATIONS, UNIT MAY BE RUN FULL-TIME ON NATU	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 4.0 MMBTU/H	13.220	DIESEL	4 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 3672 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 35.0 MMBTU/H	13.220	DIESEL	35 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2976 H; TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 2.0 MMBTU/H	13.220	DIESEL	2 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 1128 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0038	2/5/1999	1/5/2005	NORTHSTAR DEVELOPMENT PROJECT	HEATERS, 20.0 MMBTU/H	13.220	DIESEL	20 MMBTU/H	500 PPM	Other Case-by-Case	SULFUR CONTENT OF FUEL OIL SHALL NOT EXCEED 0.15% BY WEIGHT. - TYPICAL OPERATION BEFORE AND DURING COMMISSIONING PERIOD, 2190 H. TYPICAL OPERATION AFTER COMMISSIONING PERIOD, 0 H/YR.	-
AK-0058	8/16/2000	1/16/2004	NORTHSTAR DEVELOPMENT FACILITY	HEATERS	13.220	DIESEL	10 MMBTU/H		BACT-PSD	FUEL SULFUR LIMITS: USED OIL BLENDS LIMITED TO 0.5% SULFUR BY WEIGHT - SOURCE ID: 210B, 215, 216, 217, AND 218.	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	BOILERS, DIESEL, (5)	13.220	DIESEL			BACT-PSD	LOW SULFUR FUEL: < 0.3 % S BY WT - Boiler units numbers 78-82. Throughputs range from 2.01- 2.79 mmBtu/h. Boiler 78 fires a blend of diesel and reclaimed oil, 2:1 ratio.	-
ID-0009	6/26/2000	2/19/2004	ID NAT'L ENGINEERING AND ENVT'L LAB/NUCLEAR TECH	(4) CPP-606 BOILERS AND (1) INTEC PORTABLE BOILER	13.220	DISTILLATE	29976 GAL/D	1295 LB/D	BACT-PSD	FUEL CONTENT NO GREATER THAN 0.3 WEIGHT PERCENT SULFUR - FOUR CPP-606 BOILERS AND 1 INTEC PORTABLE BOILER ARE INCLUDED IN THIS ENTRY.	-
ID-0013	6/26/2000	2/20/2004	IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER	BOILERS, STATIONARY FIRETUBE, (4)	13.220	DISTILLATE FUEL OIL	36.4 MMBTU/H	1295 LB/D	BACT-PSD	LOW SULFUR FUEL 0.3% SULFUR BY WEIGHT - TOTAL FUEL COMBUSTED FOR ALL BOILERS, INCLUDING THE PORTABLE BOILER, IS LIMITED TO 29,976 GAL/DAY.	-
ID-0013	6/26/2000	2/20/2004	IDAHO NUCLEAR TECHNOLOGY & ENGINEERING CENTER	BOILER, PORTABLE FIRETUBE, (1)	13.220	DISTILLATE FUEL OIL	29.3 MMBTU/H	1295 LB/D	BACT-PSD	LOW SULFUR FUEL, 0.3% SULFUR BY WEIGHT - TOTAL FUEL COMBUSTED FOR ALL BOILERS, INCLUDING THE PORTABLE BOILER, IS LIMITED TO 29,976 GAL/DAY.	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	BOILER, DISTILLATE OIL (1)	13.220	#2 FUEL OIL	40 MMBTU/H	0.051 LB/MMBTU	BACT-PSD	LOW SULFUR FUEL. - AUXILIARY BOILER.	LSF
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	AUXILIARY BOILER- DISTILLATE OIL	13.220	DISTILLATE FUEL OIL	99 MMBTU/H	5.021 LB/H	BACT-PSD	LOW SULFUR OIL (NO PERCENTAGES GIVEN) - DISTILLATE OIL USED AS BACK-UP FUEL- SEE NOTES FOR NATURAL GAS IN AUX. BOILER	LSF
OH-0251	11/29/2001	7/24/2008	CENTRAL SOYA COMPANY INC.	BOILER, NO 2 FUEL OIL	13.220	NO 2 FUEL OIL	91.2 MMBTU/H	18.2 LB/H	N/A	- Restriction on the gallons of #2 oil that can be used: 1,787,000 gallons per rolling 12-months. Fuel oil is backup fuel. There is a separate entry for this boiler when firing natural gas.	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - BOILERS LESS THAN OR EQUAL TO 100 MMBTU/HR - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 13.220 - Commercial/Institutional-Size Boilers/Furnaces≤100 million BTU/H); Distillate Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
OH-0309	5/3/2007	8/16/2007	TOLEDO SUPPLIER PARK- PAINT SHOP	BOILER (2), NO. 2 FUEL OIL	13.220	FUEL OIL #2	20.4 MMBTU/H	10.4 LB/H	BACT-PSD	- TWO BOILERS WITH LOW NOX BURNERS AND FLUE GAS RECIRCULATION. USING NATURAL GAS WITH #2 OIL BACKUP. TWO SET OF LIMITS, THIS ONE FOR #2 OIL. EACH BOILER IS RESTRICTED TO 250,000 GALLONS OF FUEL OIL PER ROLLING 12-MONTHS.	-
VA-0271	3/24/2003	8/23/2006	HARRISONBURG RESOURCE RECOVER FACILITY	BOILER NO.2	13.220	DISTILLATE FUEL OIL	43.2 MMBTU	2.19 LB/H	N/A	GOOD COMBUSTION PRACTICES AND CONTINUOUS EMISSION MONITORING SYSTEM. - One of two units	-

Control Category Key:

LSF Low Sulfur (Clean) Fuels - less than 0.1 wt.% S

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - BOILERS LESS THAN OR EQUAL TO 100 MMBTU/HR - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 13.220 - Commercial/Institutional-Size Boilers/Furnaces≤100 million BTU/H); Distillate Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	BOILERS, DIESEL, (5)	13.220	DIESEL			BACT-PSD	GOOD COMBUSTION PRACTICES - Boiler units numbers 78-82. Throughputs range from 2.01- 2.79 mmBtu/h. Boiler 78 fires a blend of diesel and reclaimed oil, 2:1 ratio.	-
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	BOILER, DISTILLATE OIL (1)	13.220	#2 FUEL OIL	40 MMBTU/H	0.036 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - AUXILIARY BOILER.	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	AUXILIARY BOILER- DISTILLATE OIL	13.220	DISTILLATE FUEL OIL	99 MMBTU/H	9.9 LB/H	BACT-PSD	GOOD COMBUSTION PRACTICES - DISTILLATE OIL USED AS BACK-UP FUEL- SEE NOTES FOR NATURAL GAS IN AUX. BOILER	-
OH-0251	11/29/2001	7/24/2008	CENTRAL SOYA COMPANY INC.	BOILER, NO 2 FUEL OIL	13.220	NO 2 FUEL OIL	91.2 MMBTU/H	11.8 LB/H	N/A	- Restriction on the gallons of #2 oil that can be used: 1,787,000 gallons per rolling 12-months. Fuel oil is backup fuel. There is a separate entry for this boiler when firing natural gas.	-
OH-0309	5/3/2007	8/16/2007	TOLEDO SUPPLIER PARK- PAINT SHOP	BOILER (2), NO. 2 FUEL OIL	13.220	FUEL OIL #2	20.4 MMBTU/H	0.73 LB/H	BACT-PSD	- TWO BOILERS WITH LOW NOX BURNERS AND FLUE GAS RECIRCULATION. USING NATURAL GAS WITH #2 OIL BACKUP. TWO SET OF LIMITS, THIS ONE FOR #2 OIL. EACH BOILER IS RESTRICTED TO 250,000 GALLONS OF FUEL OIL PER ROLLING 12-MONTHS.	-
VA-0271	3/24/2003	8/23/2006	HARRISONBURG RESOURCE RECOVER FACILITY	BOILER NO.2	13.220	DISTILLATE FUEL OIL	43.2 MMBTU	3.56 LB/H	N/A	GOOD COMBUSTION PRACTICES AND CONTINUOUS EMISSION MONITORING SYSTEM. - One of two units	-
VA-0299	6/19/2006	6/18/2007	UNITED STATES GYPSUM COMPANY	BOILER, MIXER HOT WATER	13.220		2.6 MMBTU/H	0.2 LB/H	BACT-PSD	-	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - BOILERS LESS THAN OR EQUAL TO 100 MMBTU/HR - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS CODE 13.220 - Commercial/Institutional-Size Boilers/Furnaces≤100 million BTU/H); Distillate Fuel Oil (ASTM #1,2, includes kerosene, aviation, diesel fu PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
MN-0053	7/15/2004	9/21/2004	FAIRBAULT ENERGY PARK	BOILER, DISTILLATE OIL (1)	13.220	#2 FUEL OIL	40 MMBTU/H	0.003 LB/MMBTU	BACT-PSD	GOOD COMBUSTION. - AUXILIARY BOILER.	-
NJ-0036	10/24/2001	7/8/2008	AES RED OAK LLC	AUXILIARY BOILER- DISTILLATE OIL	13.220	DISTILLATE FUEL OIL	99 MMBTU/H	0.495 LB/H	LAER	GOOD COMBUSTION PRACTICES - DISTILLATE OIL USED AS BACK-UP FUEL- SEE NOTES FOR NATURAL GAS IN AUX. BOILER	-
OH-0251	11/29/2001	7/24/2008	CENTRAL SOYA COMPANY INC.	BOILER, NO 2 FUEL OIL	13.220	NO 2 FUEL OIL	91.2 MMBTU/H	1.18 LB/H	BACT-PSD	- Restriction on the gallons of #2 oil that can be used: 1,787,000 gallons per rolling 12-months. Fuel oil is backup fuel. There is a separate entry for this boiler when firing natural gas.	-
OH-0309	5/3/2007	8/16/2007	TOLEDO SUPPLIER PARK- PAINT SHOP	BOILER (2), NO. 2 FUEL OIL	13.220	FUEL OIL #2	20.4 MMBTU/H	0.03 LB/H	LAER	- TWO BOILERS WITH LOW NOX BURNERS AND FLUE GAS RECIRCULATION. USING NATURAL GAS WITH #2 OIL BACKUP. TWO SET OF LIMITS, THIS ONE FOR #2 OIL. EACH BOILER IS RESTRICTED TO 250,000 GALLONS OF FUEL OIL PER ROLLING 12-MONTHS.	-
VA-0271	3/24/2003	8/23/2006	HARRISONBURG RESOURCE RECOVER FACILITY	BOILER NO.2	13.220	DISTILLATE FUEL OIL	43.2 MMBTU	0.23 LB/H	N/A	GOOD COMBUSTION PRACTICES - One of two units	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - INCINERATORS - NO_X CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS DESCTIPTION = WASTE INCINERATOR (NON-HAZARDOUS); PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	WASTE INCINERATOR, CF-U-590001B	50.008	WASTE	350 LB/H	0.8 LB/H	Other Case-by-Case	PROPER OPERATION AND MAINTENANCE - THE ENERWASTE BOS 3.5T BURNS WASTE FOR 7300 H/YR. WILL COMBUST WASTES CONTAINING <10% SEWAGE SLUDGE (DRY BASIS) AND WILL CHARGE <1,000 KG/DAY OF SEWAGE SLUDGE (DRY BASIS). AS SUCH THE WASTE INCINERATORS ARE NOT SUBJECT T	-
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	INCINERATOR, SOLID WASTE	21.100	SOLID WASTE	750 LB/H		BACT-PSD	GOOD COMBUSTION PRACTICES - Solid waste supplemented with diesel.	-
NJ-0037	3/22/2002	8/22/2006	CAMDEN RESOURCE-RECOVERY FACILITY	4 MASS BURNING WATER WALL INCINERATORS	21.400	WASTE-UNPROCESSED	350 T/D	5.08 LB/T	BACT-PSD	ESP, SEMI-DRY SCRUBBER - 1) NATURAL GAS WILL BE USED AS AUXILIARY FUEL TO BRING THE FURNACE TEMPERATURE TO 1500 DEGREES F BEFORE WASTE BURNING STARTS, 2) COMBINED BOTTOM ASH FROM FURNACES AND FLYASH FROM ESP WILL BE TRANSPORTED TO A LANDFILL IN ENCLOSED C	-
NJ-0060	6/26/2003	12/7/2005	GLOUCESTER COUNTY RRF	WATER WALL INCINERATORS(2)	21.400	MUNIC. SOLID WASTE	209875 T/YR	65.8 LB/H	BACT-PSD	SEMI- DRY SCRUBBER SELECTIVE NON CATALYTIC REDUCTION(SNCR). - NATURAL GAS AS BACK-UP FUEL. NATURAL GAS IS USED TO HEAT FURNACE TO 1500 DEG.F; SOLID WASTE MAY NOT BE COMBUSTED BELOW 1500 DEG. F. ADDITIONAL THROUGHPUT IS 460 TO 620 T/DAY.	SNCR

Control Category Key:

SNCR Selective Non-Catalytic Reduction

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - INCINERATORS - PM CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS DESCTIPTION = WASTE INCINERATOR (NON-HAZARDOUS); PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
NJ-0037	3/22/2002	8/22/2006	CAMDEN RESOURCE-RECOVERY FACILITY	4 MASS BURNING WATER WALL INCINERATORS	21.400	WASTE-UNPROCESSED	350 T/D	0.31 LB/T	BACT-PSD	ESP- SEMI-DRY SCRUBBER - 1) NATURAL GAS WILL BE USED AS AUXILIARY FUEL TO BRING THE FURNACE TEMPERATURE TO 1500 DEGREES F BEFORE WASTE BURNING STARTS, 2) COMBINED BOTTOM ASH FROM FURNACES AND FLYASH FROM ESP WILL BE TRANSPORTED TO A LANDFILL IN ENCLOSED C	ESP
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	WASTE INCINERATOR, CF-U-590001B	50.008	WASTE	350 LB/H	0.2 LB/H	Other Case-by-Case	PROPER OPERATION AND MAINTENANCE - THE ENERWASTE BOS 3.5T BURNS WASTE FOR 7300 H/YR. WILL COMBUST WASTES CONTAINING <10% SEWAGE SLUDGE (DRY BASIS) AND WILL CHARGE <1,000 KG/DAY OF SEWAGE SLUDGE (DRY BASIS). AS SUCH THE WASTE INCINERATORS ARE NOT SUBJECT T	-

Control Category Key:

ESP Electrostatic Precipitator

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - INCINERATORS - SO2 CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS DESCTIPTION = WASTE INCINERATOR (NON-HAZARDOUS); PERMITTED SINCE JANUARY 1, 1999

SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
AK-0059	9/29/2003	3/25/2004	USAF EARECKSON AIR STATION	INCINERATOR, SOLID WASTE	21.100	SOLID WASTE	750 LB/H		BACT-PSD	LOW SULFUR FUEL: < 0.3% S BY WT - Solid waste supplemented with diesel.	-
NJ-0037	3/22/2002	8/22/2006	CAMDEN RESOURCE-RECOVERY FACILITY	4 MASS BURNING WATER WALL INCINERATORS	21.400	WASTE-UNPROCESSED	350 T/D	2.36 LB/T	BACT-PSD	ESP, SEMI-DRY SCRUBBER - 1) NATURAL GAS WILL BE USED AS AUXILIARY FUEL TO BRING THE FURNACE TEMPERATURE TO 1500 DEGREES F BEFORE WASTE BURNING STARTS, 2) COMBINED BOTTOM ASH FROM FURNACES AND FLYASH FROM ESP WILL BE TRANSPORTED TO A LANDFILL IN ENCLOSED C	SDS
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	WASTE INCINERATOR, CF-U-590001B	50.008	WASTE	350 LB/H	0.42 LB/H	Other Case-by-Case	REDUCED-SULFUR FUELS - THE ENERWASTE BOS 3.5T BURNS WASTE FOR 7300 H/YR. WILL COMBUST WASTES CONTAINING <10% SEWAGE SLUDGE (DRY BASIS) AND WILL CHARGE <1,000 KG/DAY OF SEWAGE SLUDGE (DRY BASIS). AS SUCH THE WASTE INCINERATORS ARE NOT SUBJECT TO SUBPART O.	LSF

Control Category Key:

SDS Semi-Dry Scrubber

LSF Low Sulfur (Clean) Fuels - less than 0.1 wt.% S

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - INCINERATORS - CO CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS DESCTIPTION = WASTE INCINERATOR (NON-HAZARDOUS); PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
NJ-0060	6/26/2003	12/7/2005	GLOUCESTER COUNTY RRF	WATER WALL INCINERATORS(2)	21.400	MUNIC. SOLID WASTE	209875 T/YR	11.3 LB/H	BACT-PSD	GOOD COMBUSTION - NATURAL GAS AS BACK-UP FUEL. NATURAL GAS IS USED TO HEAT FURNACE TO 1500 DEG.F; SOLID WASTE MAY NOT BE COMBUSTED BELOW 1500 DEG. F. ADDITIONAL THROUGHPUT IS 460 TO 620 T/DAY.	-
NJ-0037	3/22/2002	8/22/2006	CAMDEN RESOURCE-RECOVERY FACILITY	4 MASS BURNING WATER WALL INCINERATORS	21.400	WASTE-UNPROCESSED	350 T/D	4.13 LB/T	BACT-PSD	ESP, SEMI-DRY SCRUBBER - 1) NATURAL GAS WILL BE USED AS AUXILIARY FUEL TO BRING THE FURNACE TEMPERATURE TO 1500 DEGREES F BEFORE WASTE BURNING STARTS, 2) COMBINED BOTTOM ASH FROM FURNACES AND FLYASH FROM ESP WILL BE TRANSPORTED TO A LANDFILL IN ENCLOSED C	-
AK-0053	3/21/2000	1/5/2005	KENAI REFINERY	WASTE INCINERATOR, CF-U-590001B	50.008	WASTE	350 LB/H	0.12 LB/H	Other Case-by-Case	PROPER OPERATION AND MAINTENANCE - THE ENERWASTE BOS 3.5T BURNS WASTE FOR 7300 H/YR. WILL COMBUST WASTES CONTAINING <10% SEWAGE SLUDGE (DRY BASIS) AND WILL CHARGE <1,000 KG/DAY OF SEWAGE SLUDGE (DRY BASIS). AS SUCH THE WASTE INCINERATORS ARE NOT SUBJECT T	-

PROJECT 180-15

EPA RACT/BACT/LAER CLEARINGHOUSE - INCINERATORS - VOC CONTROL DETERMINATIONS

SEARCH CONDITIONS - PROCESS DESCTIPTION = WASTE INCINERATOR (NON-HAZARDOUS); PERMITTED SINCE JANUARY 1, 1999
SEARCH PERFORMED ON FEBRUARY 6, 2009

RBLC ID	PERMIT ISSUED	LAST UPDATE	FACILITY	PERMITTED ITEM	PROCESS TYPE	FUEL	THRUPUT	EMISSIONS LIMIT	LIMIT BASIS	CONTROL DESCRIPTION / PROCESS NOTE	CONTROL CATEGORY
NJ-0037	3/22/2002	8/22/2006	CAMDEN RESOURCE-RECOVERY FACILITY	4 MASS BURNING WATER WALL INCINERATORS	21.400	WASTE-UNPROCESSED	350 T/D	0.2 LB/T	BACT-PSD	ESP, SCRUBBER - 1) NATURAL GAS WILL BE USED AS AUXILIARY FUEL TO BRING THE FURNACE TEMPERATURE TO 1500 DEGREES F BEFORE WASTE BURNING STARTS, 2) COMBINED BOTTOM ASH FROM FURNACES AND FLYASH FROM ESP WILL BE TRANSPORTED TO A LANDFILL IN ENCLOSED CARRIERS	-

BACT Clearinghouse Database Lookup Results

2 Match(s) for Code 96.C

I.C. Engines - Compression Ignition, Non-Emergency < 228 hp

Project Name & Description	A/C Issue Date & ARB File No.	Pollutant
Cunningham Davis Environmental 173 diesel-fired John Deere model no. 6068T IC engine driving portable pugmill (Detailed Information)	4/5/96 (A/C no. N-3653-3-0 A330-685-96 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909	**NOx** (Detailed Control Information) Turbocharger and 4 degrees of retard from standard timing 10.4 g/bhp-hr ---------- **PM** (Detailed Control Information) Low-sulfur diesel fuel (0.05% S by wt.) or crankcase control device that is 90% efficient 1.0 g/bhp-hr ----------
Ryan-Murphy, Inc. 211 hp diesel engine for nonemergency electrical generator used in soil remediation by heat treatment (Detailed Information)	1/6/92 (A/C no. 0245002) A330-558-92 District Contact: Tom Goff/Glen Steven San Joaquin Valley Unified APCD (805) 862-5200	**NOx** (Detailed Control Information) Timing retard, turbocharger, and water injection 2.88 lbm/hr (Expected control efficiency of 64%) (A/C expired, unit never built) ---------- **SOx** (Detailed Control Information) 0.05% fuel sulfur content 0.04 lbm/hr as SO2 0.02 lbm/hr as SO4 (A/C expired, unit never built) ---------- **PM** (Detailed Control Information) Water injection 0.09 lbm/hr (Estimated control efficiency of 40%) (A/C expired, unit never built) ---------- **VOC/HC**

		(Detailed Control Information) Catalyst and positive crank-case ventilation 0.09 lbm/day (Estimated control efficiency of 30%) (A/C expired, unit never built) ---------- **CO** (Detailed Control Information) Catalyst (Estimated control efficiency of 90%) (A/C expired, unit never built) ----------

Click here to return the CAPCOA BACT Search Page

BACT Clearinghouse Database Lookup Results

20 Match(s) for Code 96.D

I.C. Engines - Compression Ignition, Non-Emergency => 228 hp

Project Name & Description	A/C Issue Date & ARB File No.	Pollutant
Kiewit Pacific Co. Portable 755 bhp compression-ignition Caterpillar model 3412 PCTA IC engine with precombustion chamber ignition, being turbocharged and aftercooled, and used to drive a 500 kVA electrical generator. (Detailed Information)	n.d. A340-915-00 District Contact: Thai Tran South Coast AQMD (909) 3... ttran@aqmd.gov	**NOx** (Detailed Control Information) Turbocharger and Aftercooler 7.0 g/bhp-hr ---------- **PM** (Detailed Control Information) No control 0.38 g/bhp-hr (Based on equivalent emission level with Johnson Matthey diesel oxidation catalyst, which is capable of 25% PM reduction) ---------- **VOC/HC** (Detailed Control Information) No control 1.0 g/bhp-hr ---------- **CO** (Detailed Control Information) No control 8.5 g/bhp-hr ----------
Manson Construction Company Four 2,600 bhp Caterpillar 3516B DITA dredge IC engines and one 550 bhp Detriot Diesel 6063-GK60 import IC engine with total fuel use limits of 11,700 gals/day and 105,000 gals/yr of diesel (Detailed Information)	3/22/99 (A/C No. 972496) A330-884-99 District Contact: Alta Stengel San Diego APCD (61...	**NOx** (Detailed Control Information) Selective catalytic reduction proposed 6.22 g/bhp-hr ----------

City of Lompoc 7.8 MMBtu/day Caterpillar 3406B; Portable 460 bhp diesel-fired greenwaste tubgrinder IC engine at the Lompoc Landfill, and elsewhere in SB County. Unit not eleigible for CARB PERP as it operates more than 90 days at landfill. (Detailed Information)	12/1/98 (A/C no. 9678) A330-865-98 District Contact: Steve Sterner Santa Barbara County APCD **(805) 961-8886** sterners@sbcapcd.org	**NOx** (Detailed Control Information) Direct injection, turbocharged, intake air intercooler 580 ppmvd @ 15% O2 7 g/bhp-hr ----------
Archie Crippen 500 bhp Detroit Diesel model 8V-92TA IC engine limited to 25 gal/hr diesel input and limited to 8 hr/day and 500 hr/yr of operation (Detailed Information)	12/9/97 (A/C no. C-53-4-0) A330-829-98 District Contact: George Heinen San Joaquin Valley Unified APCD **(559) 2...**	**NOx** (Detailed Control Information) No control 6.2 g/bhp-hr ---------- **PM** (Detailed Control Information) Low-sulfur diesel fuel and PCV 0.41 g/bhp-hr ---------- **VOC/HC** (Detailed Control Information) Positive Crankcase Ventilation 0.3 g/bhp-h4 ---------- **CO** (Detailed Control Information) No control 0.51 g/bhp-hr ----------
Ross Island Sand and Gravel	8/2/96 (A/C no. N-3325-4-0)	**NOx** (Detailed Control Information) Selective catalytic reduction with ammonia 28.8 lbm/day (Equivalent to 85% control efficiency) ---------- **SOx** (Detailed Control Information) Low-sulfur diesel fuel (0.05% by wt.)

685 hp Cummins model no. KTA 19-G3 diesel-fired IC engine serving a deep water dredge (Detailed Information)	A330-742-97 District Contact: George Heinen San Joaquin Valley Unified APCD **(559) 2...**	2.5 lbm/day ---------- **PM** (Detailed Control Information) Positive crankcase ventilation system and low-sulfur diesel fuel (0.05% by wt.) 14.4 lbm/day ---------- **VOC/HC** (Detailed Control Information) Catalytic oxidation and positive crankcase ventilation system 0.04 lbm/day ----------
Tracy Material Recovery 360 hp Cummins NTA855P diesel-fired IC enginine serving a tub grinder (Detailed Information)	10/29/96 (A/C no. N-3187-7-0 A330-726-97 District Contact: George Heinen San Joaquin Valley Unified APCD **(559) 2...**	**NOx** (Detailed Control Information) Turbocharger, aftercooler, and 10 degrees BTDC for injection timing 21.3 lbm/day ----------
Parker Hannifin Corp. 450 hp diesel-fired Detroit Diesel model 6V92 IC engine driving an electrical generator limited to 227 gal/day (Detailed Information)	1/11/96 (A/C no. N-2089-3-0) A330-708-96 District Contact: George Heinen San Joaquin Valley Unified APCD **(559) 2...**	**NOx** (Detailed Control Information) Turbocharger, aftercooler, and 4 degrees timing retard of stardard timing 9.5 g/bhp-hr ---------- **PM** (Detailed Control Information) Low-sulfur diesel fuel (not to exceed 0.05% S by wt.) and the use of positive crankcase ventilation or a crankcase control device 1.0 g/bhp-hr ----------
Southern Pacific Milling Company	10/26/93 (A/C # 8993) A330-622-94	**NOx** (Detailed Control Information)

1.89 MMBtu/hr Caterpillar 3306 DITA 250 bhp diesel powered portable AC electric generator (Detailed Information)	District Contact: Steve Sterner Santa Barbara County APCD (805) 916-8886 sterners@sbcapcd.org	Turbocharging, intake air cooling, and fuel injection No limit ----------
Ryan-Murphy Inc. 1.71 MMBtu/hr Aggreko Custom 175 kW AC generator powered by a 252 bhp diesel-fired Cummins model 6CTA8.3-G IC engine (Detailed Information)	3/31/94 (A/C # 9183) A330-621-94 District Contact: Steve Sterner Santa Barbara County APCD (805) 916-8886 sterners@sbcapcd.org	**NOx** (Detailed Control Information) Turbocharger, intercooler, engine design to emit no more than 1670 ppm NOx at 3% oxygen No limit ----------
Ryan-Murphy Inc. 1.71 MMBtu/hr Aggreko Custom 175 kW AC generator powered by a 252 bhp diesel-fired Cummins model 6CTA8.3-G IC engine (Detailed Information)	3/31/94 (A/C # 9188) A330-620-94 District Contact: Steve Sterner Santa Barbara County APCD (805) 916-8886 sterners@sbcapcd.org	**NOx** (Detailed Control Information) Turbocharger, intercooler, engine design to emit no more than 1670 ppm NOx at 3% oxygen No limit ----------
Southern Pacific Milling Company 4.27 MMBtu/hr Caterpillar 3408 DITA 603 bhp diesel powered 400 kW AC electrical generator (Detailed Information)	9/7/93 (A/C # 8959) A330-619-94 District Contact: Steve Sterner Santa Barbara County APCD (805) 916-8886 sterners@sbcapcd.org	**NOx** (Detailed Control Information) Turbocharging, intake air intercooling, 4 deg. from standard timing retard No limit ----------
Robison, Carlon, and Carlon 600 kw Caterpillar generator model no. 3412 at an aggregate processing facility (Detailed Information)	6/15/94 (A/C no. A45-693-Y) A330-593-93 District Contact: Dave Mehl Feather River AQMD (916) 6...	**NOx** (Detailed Control Information) 4 degree injection retard No limit ----------
		NOx (Detailed Control Information) Turbocharger, aftercooler,

Resource Renewal Technologies, Inc. 951 diesel IC engine operating no more than 500 hr/yr as part of an asphalt batching operation (permit action is a transfer of location) (Detailed Information)	6/18/93 (A/C no. S-1856-3-1) A330-575-93 District Contact: Tom Goff San Joaquin Valley Unified APCD (805) 8...	and injection timing retard of at least 4 degrees 6.6 g/bhp-hr (Equivalent to 40% control efficiency) ---------- **SOx** (Detailed Control Information) Low-sulfur diesel fuel, i.e., less than 0.05% by wt.) 0.2328 g/hp-hr 11.7 lbm/day ----------
Benton Oil and Gas Co. 480 hp Cummins KTA-1150 diesel reciprocating engine fired on fuel oil no. 1 as part of an exploration oil drilling rig w/ 7 diesel-fired reciprocating engines which can fire a total of 650 gal/day and operate only 360 hours, (Detailed Information)	12/21/90 (A/C no. 5789) A330-446-90 District Contact: Gregory Chee Monterey Bay Unified APCD (408) 443-1135	**NOx** (Detailed Control Information) Engine injection timing retardation of 6 degrees (Estimated project emissions of 305 lbm/day) ----------
Benton Oil and Gas Co. 400 hp Detroit Diesel 8V92TA reciprocating engine fired on fuel oil 1 as part of an exploration oil drilling rig w/ 7 diesel-fired reciprocating engines which can fire a total of 650 gal/day and operate only 360 hours over t (Detailed Information)	12/21/90 (A/C no. 5789) A330-445-90 District Contact: Gregory Chee Monterey Bay Unified APCD (408) 443-1135	**NOx** (Detailed Control Information) Engine injection timing retardation of 6 degrees (Estimated total project emissions of 305 lbm/day) ----------
Western Pacific Dredging Co. General Motors Model No. 12-567 diesel-fired IC engine manifolded together with two other engines to common control devices (see determinations A330-428-90 and A330-429-90) (Detailed Information)	2/7/90 (App. no. 212138) A330-430-90 District Contact: Kien Huynh South Coast AQMD (909) 3... khuynh@aqmd.gov	**NOx** (Detailed Control Information) Selective catalytic reduction No limit (94% estimated control) ---------- **PM** (Detailed Control Information) Catalyst guard bed No limit (80% control expected) ---------- **VOC/HC** (Detailed Control

		Information) Oxidation catalyst No limit (80% control expected) ----------
Western Pacific Dredging Co. Cooper Bessemer Model No. JS-8-1 diesel-fired IC engine manifolded together with two other engines to common control devices (see determinations A330-428-90 and A330-430-90) (Detailed Information)	2/7/90 (App. no. 212138) A330-429-90 District Contact: Kien Huynh South Coast AQMD (909) 3... khuynh@aqmd.gov	**NOx** (Detailed Control Information) Selective catalytic reduction No limit (94% estimated control) ---------- **PM** (Detailed Control Information) Catalyst guard bed No limit (80% control expected) ---------- **VOC/HC** (Detailed Control Information) Oxidation catalyst No limit (80% control expected) ----------
Western Pacific Dredging Co. Cooper Bessemer Model No. LSV-16 diesel-fired IC engine manifolded together with two other engines to common control devices (see determinations A330-429-90 and A330-430-90) (Detailed Information)	2/7/90 (App no. 212138) A330-428-90 District Contact: Kien Huynh South Coast AQMD (909) 3... khuynh@aqmd.gov	**NOx** (Detailed Control Information) Selective catalytic reduction using NERGAS catalyst No limit (94% estimated control) ---------- **PM** (Detailed Control Information) Catalyst guard bed No limit (80% control expected) ---------- **VOC/HC** (Detailed Control Information) Oxidation catalyst No limit (80% control expected) ----------
	8/31/89	

Smith-Rice Co. 2100 hp diesel-fired Caterpillar IC engine operated at 25% average capacity (Detailed Information)	(App. no. 185702) A330-422-90 District Contact: Kien Huynh South Coast AQMD (909) 3... khuynh@aqmd.gov	**NOx** (Detailed Control Information) Selective catalytic reduction using NERGAS catalyst 80% control (at 25% load) ----------
Texaco, Inc. B.S. Duff #1 Well Three 850 hp Caterpillar Model D398TA diesel IC engines (temporary source) (Detailed Information)	10/27/89 (A/C no. 5017) A330-345-90 District Contact: Gregory Chee Monterey Bay Unified APCD (408) 443-1135	**NOx** (Detailed Control Information) Five degrees individual engine ignition timing retard 13.3 lbm/hr/unit (equivalent to 7.1 g/bhp-hr) ----------

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BACT Determination Detail

Category

Source Category:	ICE: Compression Ignition > = 175 hp
SIC Code	3731
NAICS Code	

Emission Unit Informaiton

Manufacturer:	Cummins
Type:	2 diesel fired engines to power 2 crane
Model:	QST30-G1
Equipment Description:	2 Crane Engines turbocharged, Aftercooled, part. filter & SCR
Capacity / Dimentions	Each 1030 horsepwer
Fuel Type	Diesel
Multiple Fuel Types	
Operating Schedule (hours/day)/(days/week)/ (weeks/year)e	Variable (24/7/52)
Function of Equipment	provide power for crane

Bact Information

NOx Limit	54
NOx Limit Units	ppmv @15% oxygen
NOx Average Time	
NOx Control Method	Add-on
NOx Control Method Desc	

CO Limit	450
CO Limit Units	ppmv @15% oxygen
CO Average Time	
CO Control Method	Add-on
CO Control Method Desc	

Project / Permit Information

Application/Permit No.:	975360, 975361
New Construction/Modification:	New Construction
ATC Date:	06-14-2001
PTO Date:	09-26-2002
Startup Date:	02-28-2002

Technology Status:	BACT Determination
Source Test Available:	Yes
Source Test Results:	NOx: 18.36 ppmv @15% oxygen CO : 450 ppmv @15% oxygen

Facility / District Information

Facility Name:	National Steel and Shipbuilding
Facility Zip Code:	92113
Facility County:	San Diego
District Name:	San Diego County APCD
District Contact:	Alta Stengel
Contact Phone No.:	(8...
Contact E-Mail:	

Notes

Notes:	2 Identical crane engines with same permit limits.

Report Error In Determination

BACT Determination Detail

Category

Source Category:	ICE: Compression Ignition > = 175 hp
SIC Code	7999
NAICS Code	713990

Emission Unit Informaiton

Manufacturer:	Cummins
Type:	diesel
Model:	QSK78-G6
Equipment Description:	Turbocharged, aftercooled, lean-burn
Capacity / Dimentions	2835 bhp
Fuel Type	Diesel
Multiple Fuel Types	
Operating Schedule (hours/day)/(days/week)/ (weeks/year)e	Variable (/ /)
Function of Equipment	Drives 2199 kW generator

Bact Information

NOx Limit	50
NOx Limit Units	ppmvd@15%O2
NOx Average Time	
NOx Control Method	Add-on
NOx Control Method Desc	SCR system and diesel particulate filter

CO Limit	89
CO Limit Units	ppmvd@15%O2
CO Average Time	
CO Control Method	Add-on
CO Control Method Desc	SCR system and diesel particulate filter

VOC Limit	39
VOC Limit Units	ppmvd@15%O2
VOC Average Time	
VOC Control Method	Add-on
VOC Control Method Desc	SCR system and diesel particulate filter

PM10 Limit	0.045
PM10 Limit Units	G/B-HP-H

PM10 Average Time	
PM10 Control Method	Add-on
PM10 Control Method Desc	SCR system and diesel particulate filter

Other Limit	10
Other Limit Units	PPM as NH3
Other Average Time	
Other Control Method	Add-on
Other Control Method Desc	SCR system and diesel particulate filter

Project / Permit Information

Application/Permit No.:	418235
New Construction/Modification:	New Construction
ATC Date:	8-26-2003
PTO Date:	
Startup Date:	
Technology Status:	BACT Determination
Source Test Available:	Yes
Source Test Results:	ppmvd@15%O2 g/bhp-hr NOx 45 0.546 CO 5 NMNEOC as CH4 49 0.21 NH3 0.6 PM .009 (including condensibles) PM10 .003 (excluding condensibles) O2, % (dry) 9.3 Flow, acfm 19,379 Stack Temp., F 840

Facility / District Information

Facility Name:	Snow Summit, Inc.
Facility Zip Code:	92315
Facility County:	Los Angeles
District Name:	South Coast AQMD
District Contact:	Martin Kay
Contact Phone No.:	90...
Contact E-Mail:	mkay@aqmd.gov

Notes

Notes:	Permit limits were considered BACT except that VOC limit may be increased if engine cannot meet the 39 ppmvd@15% O2 (0.15 g/bhp-hr). The VOC BACT limit was requested by the applicant and supported by normal stack VOC estimated by the engine manufacturer and VOC removal guaranteed by the catalyst vendor. The NOx, CO and PM10 BACT limits were based on maximum emissions estimated by the catalyst vendor. The CO and .045 PM10 limits were consistent with AQMD's BACT guidelines for those pollutants. The ammonia limit of 10 ppm was guaranteed by the catalyst vendor. COMMENTS APP. NO.: 418235 AQMD's Clean Fuels Policy would normally require a stationary, non-emergency engine to be natural gas-fired. However, natural gas is not available in this mountain commumity. The applicant requested the 0.15 g/bhp-hr (39 ppmvd@15%O2) limit on VOC, which

	was below the initial BACT determination of 0.2 g/bhp-hr, to stay below 4 tpy (threshold for offsets requirement). The 0.15 limit was supported by engine test data (0.14 g/bhp-hr) and the 25% VOC removal guaranteed by Johnson Matthey. In that the source test indicated a VOC emission rate of 0.21 g/bhp-hr, the engine will be adjusted and retested. The final limit may be increased above 0.15, but no higher than 0.2 g/bhp-hr, and the limit on hrs/yr may be reduced accordingly to stay below 4 tpy.

Report Error In Determination

BACT Clearinghouse Database Lookup Results

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1 Match(s) for Code 17.10

Boilers - Oil Fired

Project Name & Description	A/C Issue Date & ARB File No.	Pollutant
Simpson Paper Co. Modification of a 60 MMBtu/hr auxiliary boiler to burn residual oil (Detailed Information)	2/24/88 (A/C no 86-176) A310-270-88 District Contact: George Heinen San Joaquin Valley Unified APCD (559) 230-5909	**SOx** (Detailed Control Information) 0.5% sulfur content 250 lbm/day ----------

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APPENDIX D

SCREEN3 Model Output for Ice Management Fleet Loads Analyses

Name_ID: Vladimir Ignatjuk_VLD2_080 (80% Load)

```
03/16/09
14:13:56
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      24.3800
    STK INSIDE DIAM (M)    =        .7900
    STK EXIT VELOCITY (M/S)=      33.2000
    STK GAS EXIT TEMP (K)  =     668.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      19.8100
    MIN HORIZ BLDG DIM (M) =      17.5100
    MAX HORIZ BLDG DIM (M) =      17.5100
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   30.942 M**4/S**3;  MOM. FLUX =   67.220 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	25.07	4	20.0	22.9	6400.0	24.43	8.20	13.65	SS
200.	20.81	4	20.0	22.9	6400.0	24.58	15.56	19.62	SS
300.	14.89	4	20.0	22.9	6400.0	24.82	22.61	22.49	SS
400.	11.40	4	20.0	22.9	6400.0	25.15	29.45	25.28	SS
500.	9.169	4	20.0	22.9	6400.0	25.22	36.15	27.99	SS
600.	7.580	4	20.0	22.9	6400.0	25.22	42.72	30.65	SS
700.	6.544	4	20.0	22.9	6400.0	25.22	49.19	31.19	SS
800.	5.638	4	20.0	22.9	6400.0	25.22	55.57	33.43	SS
900.	4.930	4	20.0	22.9	6400.0	25.22	61.88	35.42	SS
1000.	4.356	4	20.0	22.9	6400.0	25.22	68.13	37.35	SS
1100.	3.885	4	20.0	22.9	6400.0	25.22	74.31	39.22	SS
1200.	3.491	4	20.0	22.9	6400.0	25.22	80.44	41.05	SS
1300.	3.159	4	20.0	22.9	6400.0	25.22	86.52	42.83	SS
1400.	2.876	4	20.0	22.9	6400.0	25.22	92.55	44.58	SS
1500.	2.632	4	20.0	22.9	6400.0	25.22	98.54	46.28	SS
1600.	2.420	4	20.0	22.9	6400.0	25.22	104.49	47.95	SS
1700.	2.234	4	20.0	22.9	6400.0	25.22	110.41	49.59	SS
1800.	2.071	4	20.0	22.9	6400.0	25.22	116.28	51.20	SS
1900.	1.927	4	20.0	22.9	6400.0	25.22	122.13	52.79	SS
2000.	1.798	4	20.0	22.9	6400.0	25.22	127.94	54.34	SS
2100.	1.683	4	20.0	22.9	6400.0	25.22	133.73	55.88	SS
2200.	1.579	4	20.0	22.9	6400.0	25.22	139.48	57.39	SS
2300.	1.486	4	20.0	22.9	6400.0	25.22	145.21	58.88	SS
2400.	1.401	4	20.0	22.9	6400.0	25.22	150.91	60.34	SS
2500.	1.324	4	20.0	22.9	6400.0	25.22	156.59	61.79	SS
2600.	1.254	4	20.0	22.9	6400.0	25.22	162.24	63.22	SS
2700.	1.189	4	20.0	22.9	6400.0	25.22	167.88	64.63	SS
2800.	1.141	4	20.0	22.9	6400.0	25.22	173.48	65.28	SS
2900.	1.087	4	20.0	22.9	6400.0	25.22	179.07	66.59	SS
3000.	1.037	4	20.0	22.9	6400.0	25.22	184.64	67.87	SS

Vladimir Ignatjuk_VLD2_080, cont. (80% Load)

```
   3500.   .8360        4    20.0   22.9  6400.0   25.22  212.19   74.08    SS
   4000.   .6924        4    20.0   22.9  6400.0   25.22  239.31   79.96    SS
   4500.   .5856        4    20.0   22.9  6400.0   25.22  266.06   85.57    SS
   5000.   .5037        4    20.0   22.9  6400.0   25.22  292.47   90.95    SS
   5500.   .4392        4    20.0   22.9  6400.0   25.22  318.59   96.13    SS
   6000.   .3875        4    20.0   22.9  6400.0   25.22  344.44  101.14    SS
   6500.   .3451        4    20.0   22.9  6400.0   25.22  370.04  105.99    SS
   7000.   .3100        4    20.0   22.9  6400.0   25.22  395.41  110.69    SS
   7500.   .2804        4    20.0   22.9  6400.0   25.22  420.57  115.27    SS
   8000.   .2553        4    20.0   22.9  6400.0   25.22  445.53  119.74    SS
   8500.   .2337        4    20.0   22.9  6400.0   25.22  470.30  124.10    SS
   9000.   .2150        4    20.0   22.9  6400.0   25.22  494.90  128.36    SS
   9500.   .1987        4    20.0   22.9  6400.0   25.22  519.34  132.53    SS
  10000.   .1853        4    20.0   22.9  6400.0   25.22  543.62  135.89    SS
  15000.   .1037        4    20.0   22.9  6400.0   25.22  779.22  170.51    SS
  20000.   .6860E-01    4    20.0   22.9  6400.0   25.22 1004.75  200.41    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   25.07        4    20.0   22.9  6400.0   24.43    8.20   13.65    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    364.2        CONC (UG/M**3)     =    364.2
   CRIT WS @10M (M/S) =     8.83        CRIT WS @10M (M/S) =     8.83
   CRIT WS @ HS (M/S) =    10.55        CRIT WS @ HS (M/S) =    10.55
   DILUTION WS (M/S)  =     5.28        DILUTION WS (M/S)  =     5.28
   CAVITY HT (M)      =    29.86        CAVITY HT (M)      =    29.86
   CAVITY LENGTH (M)  =    28.29        CAVITY LENGTH (M)  =    28.29
   ALONGWIND DIM (M)  =    17.51        ALONGWIND DIM (M)  =    17.51
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      25.07          100.        0.
 BLDG. CAVITY-1      364.2           28.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      364.2           28.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Vladimir Ignatjuk_VLD2_057 (57% Load)

```
03/16/09
14:13:56
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      24.3800
    STK INSIDE DIAM (M)    =        .7900
    STK EXIT VELOCITY (M/S)=      25.9000
    STK GAS EXIT TEMP (K)  =     638.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      19.8100
    MIN HORIZ BLDG DIM (M) =      17.5100
    MAX HORIZ BLDG DIM (M) =      17.5100
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   23.410 M**4/S**3;  MOM. FLUX =   42.833 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	26.06	4	20.0	22.9	6400.0	24.42	8.20	13.89	SS
200.	21.07	4	20.0	22.9	6400.0	24.52	15.56	19.96	SS
300.	15.02	4	20.0	22.9	6400.0	24.70	22.61	22.82	SS
400.	11.54	4	20.0	22.9	6400.0	24.82	29.45	25.60	SS
500.	9.265	4	20.0	22.9	6400.0	24.82	36.15	28.31	SS
600.	7.634	4	20.0	22.9	6400.0	24.82	42.72	30.96	SS
700.	6.586	4	20.0	22.9	6400.0	24.82	49.19	31.53	SS
800.	5.669	4	20.0	22.9	6400.0	24.82	55.57	33.69	SS
900.	4.952	4	20.0	22.9	6400.0	24.82	61.88	35.67	SS
1000.	4.372	4	20.0	22.9	6400.0	24.82	68.13	37.59	SS
1100.	3.896	4	20.0	22.9	6400.0	24.82	74.31	39.46	SS
1200.	3.500	4	20.0	22.9	6400.0	24.82	80.44	41.28	SS
1300.	3.166	4	20.0	22.9	6400.0	24.82	86.52	43.06	SS
1400.	2.881	4	20.0	22.9	6400.0	24.82	92.55	44.79	SS
1500.	2.635	4	20.0	22.9	6400.0	24.82	98.54	46.50	SS
1600.	2.423	4	20.0	22.9	6400.0	24.82	104.49	48.16	SS
1700.	2.237	4	20.0	22.9	6400.0	24.82	110.41	49.80	SS
1800.	2.073	4	20.0	22.9	6400.0	24.82	116.28	51.41	SS
1900.	1.928	4	20.0	22.9	6400.0	24.82	122.13	52.99	SS
2000.	1.799	4	20.0	22.9	6400.0	24.82	127.94	54.54	SS
2100.	1.684	4	20.0	22.9	6400.0	24.82	133.73	56.07	SS
2200.	1.580	4	20.0	22.9	6400.0	24.82	139.48	57.58	SS
2300.	1.486	4	20.0	22.9	6400.0	24.82	145.21	59.06	SS
2400.	1.401	4	20.0	22.9	6400.0	24.82	150.91	60.53	SS
2500.	1.324	4	20.0	22.9	6400.0	24.82	156.59	61.97	SS
2600.	1.254	4	20.0	22.9	6400.0	24.82	162.24	63.40	SS
2700.	1.189	4	20.0	22.9	6400.0	24.82	167.88	64.81	SS
2800.	1.141	4	20.0	22.9	6400.0	24.82	173.48	65.44	SS
2900.	1.087	4	20.0	22.9	6400.0	24.82	179.07	66.74	SS
3000.	1.037	4	20.0	22.9	6400.0	24.82	184.64	68.02	SS

Vladimir Ignatjuk_VLD2_057, cont. (57% Load)

```
   3500.   .8361        4    20.0   22.9  6400.0   24.82  212.19   74.22    SS
   4000.   .6924        4    20.0   22.9  6400.0   24.82  239.31   80.10    SS
   4500.   .5856        4    20.0   22.9  6400.0   24.82  266.06   85.70    SS
   5000.   .5037        4    20.0   22.9  6400.0   24.82  292.47   91.08    SS
   5500.   .4392        4    20.0   22.9  6400.0   24.82  318.59   96.26    SS
   6000.   .3874        4    20.0   22.9  6400.0   24.82  344.44  101.26    SS
   6500.   .3451        4    20.0   22.9  6400.0   24.82  370.04  106.10    SS
   7000.   .3099        4    20.0   22.9  6400.0   24.82  395.41  110.81    SS
   7500.   .2804        4    20.0   22.9  6400.0   24.82  420.57  115.38    SS
   8000.   .2552        4    20.0   22.9  6400.0   24.82  445.53  119.84    SS
   8500.   .2337        4    20.0   22.9  6400.0   24.82  470.30  124.20    SS
   9000.   .2150        4    20.0   22.9  6400.0   24.82  494.90  128.46    SS
   9500.   .1986        4    20.0   22.9  6400.0   24.82  519.34  132.62    SS
  10000.   .1853        4    20.0   22.9  6400.0   24.82  543.62  135.97    SS
  15000.   .1037        4    20.0   22.9  6400.0   24.82  779.22  170.58    SS
  20000.   .6860E-01    4    20.0   22.9  6400.0   24.82 1004.75  200.47    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   26.06        4    20.0   22.9  6400.0   24.42    8.20   13.89    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    456.3        CONC (UG/M**3)     =    456.3
   CRIT WS @10M (M/S) =     7.05        CRIT WS @10M (M/S) =     7.05
   CRIT WS @ HS (M/S) =     8.42        CRIT WS @ HS (M/S) =     8.42
   DILUTION WS (M/S)  =     4.21        DILUTION WS (M/S)  =     4.21
   CAVITY HT (M)      =    29.86        CAVITY HT (M)      =    29.86
   CAVITY LENGTH (M)  =    28.29        CAVITY LENGTH (M)  =    28.29
   ALONGWIND DIM (M)  =    17.51        ALONGWIND DIM (M)  =    17.51
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      26.06          100.        0.
 BLDG. CAVITY-1      456.3           28.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      456.3           28.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Vladimir Ignatjuk_VLD2_035 (35% Load)

```
03/16/09
14:13:56
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      24.3800
    STK INSIDE DIAM (M)    =        .7900
    STK EXIT VELOCITY (M/S)=      16.3000
    STK GAS EXIT TEMP (K)  =     581.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      19.8100
    MIN HORIZ BLDG DIM (M) =      17.5100
    MAX HORIZ BLDG DIM (M) =      17.5100
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   13.732 M**4/S**3;  MOM. FLUX =   18.629 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	27.33	4	20.0	22.9	6400.0	24.40	8.20	14.20	SS
200.	21.38	4	20.0	22.9	6400.0	24.46	15.56	20.41	SS
300.	15.20	4	20.0	22.9	6400.0	24.51	22.61	23.26	SS
400.	11.66	4	20.0	22.9	6400.0	24.51	29.45	26.03	SS
500.	9.319	4	20.0	22.9	6400.0	24.51	36.15	28.73	SS
600.	7.658	4	20.0	22.9	6400.0	24.51	42.72	31.37	SS
700.	6.600	4	20.0	22.9	6400.0	24.51	49.19	31.97	SS
800.	5.681	4	20.0	22.9	6400.0	24.51	55.57	34.03	SS
900.	4.957	4	20.0	22.9	6400.0	24.51	61.88	36.00	SS
1000.	4.375	4	20.0	22.9	6400.0	24.51	68.13	37.91	SS
1100.	3.897	4	20.0	22.9	6400.0	24.51	74.31	39.77	SS
1200.	3.499	4	20.0	22.9	6400.0	24.51	80.44	41.58	SS
1300.	3.164	4	20.0	22.9	6400.0	24.51	86.52	43.35	SS
1400.	2.879	4	20.0	22.9	6400.0	24.51	92.55	45.08	SS
1500.	2.633	4	20.0	22.9	6400.0	24.51	98.54	46.78	SS
1600.	2.420	4	20.0	22.9	6400.0	24.51	104.49	48.44	SS
1700.	2.234	4	20.0	22.9	6400.0	24.51	110.41	50.07	SS
1800.	2.071	4	20.0	22.9	6400.0	24.51	116.28	51.68	SS
1900.	1.926	4	20.0	22.9	6400.0	24.51	122.13	53.25	SS
2000.	1.797	4	20.0	22.9	6400.0	24.51	127.94	54.80	SS
2100.	1.682	4	20.0	22.9	6400.0	24.51	133.73	56.33	SS
2200.	1.578	4	20.0	22.9	6400.0	24.51	139.48	57.83	SS
2300.	1.484	4	20.0	22.9	6400.0	24.51	145.21	59.31	SS
2400.	1.400	4	20.0	22.9	6400.0	24.51	150.91	60.77	SS
2500.	1.322	4	20.0	22.9	6400.0	24.51	156.59	62.22	SS
2600.	1.252	4	20.0	22.9	6400.0	24.51	162.24	63.64	SS
2700.	1.188	4	20.0	22.9	6400.0	24.51	167.88	65.05	SS
2800.	1.140	4	20.0	22.9	6400.0	24.51	173.48	65.65	SS
2900.	1.086	4	20.0	22.9	6400.0	24.51	179.07	66.95	SS
3000.	1.036	4	20.0	22.9	6400.0	24.51	184.64	68.23	SS

Vladimir Ignatjuk_VLD2_035, cont. (35% Load)

```
   3500.   .8353        4    20.0   22.9  6400.0   24.51  212.19   74.41    SS
   4000.   .6918        4    20.0   22.9  6400.0   24.51  239.31   80.28    SS
   4500.   .5851        4    20.0   22.9  6400.0   24.51  266.06   85.88    SS
   5000.   .5033        4    20.0   22.9  6400.0   24.51  292.47   91.25    SS
   5500.   .4389        4    20.0   22.9  6400.0   24.51  318.59   96.42    SS
   6000.   .3871        4    20.0   22.9  6400.0   24.51  344.44  101.42    SS
   6500.   .3448        4    20.0   22.9  6400.0   24.51  370.04  106.25    SS
   7000.   .3097        4    20.0   22.9  6400.0   24.51  395.41  110.95    SS
   7500.   .2802        4    20.0   22.9  6400.0   24.51  420.57  115.53    SS
   8000.   .2551        4    20.0   22.9  6400.0   24.51  445.53  119.99    SS
   8500.   .2335        4    20.0   22.9  6400.0   24.51  470.30  124.34    SS
   9000.   .2149        4    20.0   22.9  6400.0   24.51  494.90  128.59    SS
   9500.   .1985        4    20.0   22.9  6400.0   24.51  519.34  132.76    SS
  10000.   .1852        4    20.0   22.9  6400.0   24.51  543.62  136.07    SS
  15000.   .1036        4    20.0   22.9  6400.0   24.51  779.22  170.67    SS
  20000.   .6859E-01    4    20.0   22.9  6400.0   24.51 1004.75  200.55    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   27.33        4    20.0   22.9  6400.0   24.40    8.20   14.20    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    722.6        CONC (UG/M**3)     =    722.6
   CRIT WS @10M (M/S) =     4.45        CRIT WS @10M (M/S) =     4.45
   CRIT WS @ HS (M/S) =     5.32        CRIT WS @ HS (M/S) =     5.32
   DILUTION WS (M/S)  =     2.66        DILUTION WS (M/S)  =     2.66
   CAVITY HT (M)      =    29.86        CAVITY HT (M)      =    29.86
   CAVITY LENGTH (M)  =    28.29        CAVITY LENGTH (M)  =    28.29
   ALONGWIND DIM (M)  =    17.51        ALONGWIND DIM (M)  =    17.51
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      27.33          100.        0.
 BLDG. CAVITY-1      722.6           28.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      722.6           28.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Fennica/Nordica_FEN2_080, cont. (80% Load)

```
   3500.   .7454        4    20.0   23.8  6400.0   32.51  212.19   77.37    SS
   4000.   .6227        4    20.0   23.8  6400.0   32.51  239.31   83.10    SS
   4500.   .5303        4    20.0   23.8  6400.0   32.51  266.06   88.58    SS
   5000.   .4587        4    20.0   23.8  6400.0   32.51  292.47   93.84    SS
   5500.   .4018        4    20.0   23.8  6400.0   32.51  318.59   98.93    SS
   6000.   .3559        4    20.0   23.8  6400.0   32.51  344.44  103.84    SS
   6500.   .3180        4    20.0   23.8  6400.0   32.51  370.04  108.61    SS
   7000.   .2865        4    20.0   23.8  6400.0   32.51  395.41  113.24    SS
   7500.   .2598        4    20.0   23.8  6400.0   32.51  420.57  117.76    SS
   8000.   .2371        4    20.0   23.8  6400.0   32.51  445.53  122.16    SS
   8500.   .2174        4    20.0   23.8  6400.0   32.51  470.30  126.47    SS
   9000.   .2004        4    20.0   23.8  6400.0   32.51  494.90  130.67    SS
   9500.   .1855        4    20.0   23.8  6400.0   32.51  519.34  134.80    SS
  10000.   .1737        4    20.0   23.8  6400.0   32.51  543.62  137.65    SS
  15000.   .9797E-01    4    20.0   23.8  6400.0   32.51  779.22  172.00    SS
  20000.   .6510E-01    4    20.0   23.8  6400.0   32.51 1004.75  201.73    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   17.76        4    20.0   23.8  6400.0   32.02    8.20   17.63    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    312.0        CONC (UG/M**3)     =    276.5
   CRIT WS @10M (M/S) =     4.75        CRIT WS @10M (M/S) =     6.53
   CRIT WS @ HS (M/S) =     5.99        CRIT WS @ HS (M/S) =     8.24
   DILUTION WS (M/S)  =     3.00        DILUTION WS (M/S)  =     4.12
   CAVITY HT (M)      =    43.39        CAVITY HT (M)      =    40.23
   CAVITY LENGTH (M)  =    44.87        CAVITY LENGTH (M)  =    33.52
   ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =    26.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.76          100.        0.
 BLDG. CAVITY-1      312.0           45.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      276.5           34.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Fennica/Nordica_FEN2_057 (57% Load)

```
03/16/09
14:13:57
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      32.0000
    STK INSIDE DIAM (M)    =        .8000
    STK EXIT VELOCITY (M/S)=      30.0000
    STK GAS EXIT TEMP (K)  =     633.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      27.4300
    MIN HORIZ BLDG DIM (M) =      21.3400
    MAX HORIZ BLDG DIM (M) =      26.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   27.654 M**4/S**3;  MOM. FLUX =   59.397 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	18.28	4	20.0	23.8	6400.0	32.02	8.20	17.85	SS
200.	14.52	4	20.0	23.8	6400.0	32.07	15.56	23.72	SS
300.	11.06	4	20.0	23.8	6400.0	32.16	22.61	29.51	SS
400.	8.522	4	20.0	23.8	6400.0	32.27	29.45	31.36	SS
500.	6.940	4	20.0	23.8	6400.0	32.27	36.15	33.56	SS
600.	5.830	4	20.0	23.8	6400.0	32.27	42.72	35.55	SS
700.	5.005	4	20.0	23.8	6400.0	32.27	49.19	37.47	SS
800.	4.367	4	20.0	23.8	6400.0	32.27	55.57	39.34	SS
900.	3.859	4	20.0	23.8	6400.0	32.27	61.88	41.17	SS
1000.	3.445	4	20.0	23.8	6400.0	32.27	68.13	42.95	SS
1100.	3.101	4	20.0	23.8	6400.0	32.27	74.31	44.69	SS
1200.	2.812	4	20.0	23.8	6400.0	32.27	80.44	46.39	SS
1300.	2.566	4	20.0	23.8	6400.0	32.27	86.52	48.06	SS
1400.	2.354	4	20.0	23.8	6400.0	32.27	92.55	49.70	SS
1500.	2.169	4	20.0	23.8	6400.0	32.27	98.54	51.31	SS
1600.	2.008	4	20.0	23.8	6400.0	32.27	104.49	52.89	SS
1700.	1.865	4	20.0	23.8	6400.0	32.27	110.41	54.44	SS
1800.	1.739	4	20.0	23.8	6400.0	32.27	116.28	55.98	SS
1900.	1.626	4	20.0	23.8	6400.0	32.27	122.13	57.48	SS
2000.	1.525	4	20.0	23.8	6400.0	32.27	127.94	58.97	SS
2100.	1.434	4	20.0	23.8	6400.0	32.27	133.73	60.44	SS
2200.	1.352	4	20.0	23.8	6400.0	32.27	139.48	61.89	SS
2300.	1.277	4	20.0	23.8	6400.0	32.27	145.21	63.31	SS
2400.	1.209	4	20.0	23.8	6400.0	32.27	150.91	64.72	SS
2500.	1.158	4	20.0	23.8	6400.0	32.27	156.59	65.19	SS
2600.	1.101	4	20.0	23.8	6400.0	32.27	162.24	66.49	SS
2700.	1.049	4	20.0	23.8	6400.0	32.27	167.88	67.78	SS
2800.	1.000	4	20.0	23.8	6400.0	32.27	173.48	69.05	SS
2900.	.9556	4	20.0	23.8	6400.0	32.27	179.07	70.31	SS
3000.	.9140	4	20.0	23.8	6400.0	32.27	184.64	71.55	SS

Fennica/Nordica_FEN2_057, cont. (57% Load)

```
   3500.   .7449        4    20.0   23.8  6400.0   32.27  212.19   77.56    SS
   4000.   .6222        4    20.0   23.8  6400.0   32.27  239.31   83.28    SS
   4500.   .5299        4    20.0   23.8  6400.0   32.27  266.06   88.75    SS
   5000.   .4584        4    20.0   23.8  6400.0   32.27  292.47   94.01    SS
   5500.   .4016        4    20.0   23.8  6400.0   32.27  318.59   99.09    SS
   6000.   .3556        4    20.0   23.8  6400.0   32.27  344.44  104.00    SS
   6500.   .3178        4    20.0   23.8  6400.0   32.27  370.04  108.76    SS
   7000.   .2863        4    20.0   23.8  6400.0   32.27  395.41  113.39    SS
   7500.   .2597        4    20.0   23.8  6400.0   32.27  420.57  117.90    SS
   8000.   .2369        4    20.0   23.8  6400.0   32.27  445.53  122.30    SS
   8500.   .2173        4    20.0   23.8  6400.0   32.27  470.30  126.60    SS
   9000.   .2003        4    20.0   23.8  6400.0   32.27  494.90  130.81    SS
   9500.   .1867        4    20.0   23.8  6400.0   32.27  519.34  133.90    SS
  10000.   .1737        4    20.0   23.8  6400.0   32.27  543.62  137.76    SS
  15000.   .9795E-01    4    20.0   23.8  6400.0   32.27  779.22  172.09    SS
  20000.   .6509E-01    4    20.0   23.8  6400.0   32.27 1004.75  201.81    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   18.28        4    20.0   23.8  6400.0   32.02    8.20   17.85    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    391.6        CONC (UG/M**3)     =    342.7
   CRIT WS @10M (M/S) =     3.78        CRIT WS @10M (M/S) =     5.27
   CRIT WS @ HS (M/S) =     4.77        CRIT WS @ HS (M/S) =     6.65
   DILUTION WS (M/S)  =     2.39        DILUTION WS (M/S)  =     3.32
   CAVITY HT (M)      =    43.39        CAVITY HT (M)      =    40.23
   CAVITY LENGTH (M)  =    44.87        CAVITY LENGTH (M)  =    33.52
   ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =    26.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      18.28          100.        0.
 BLDG. CAVITY-1      391.6           45.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      342.7           34.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Fennica/Nordica_FEN2_035 (35% Load)

```
03/16/09
14:13:57
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      32.0000
    STK INSIDE DIAM (M)    =        .8000
    STK EXIT VELOCITY (M/S)=      20.3000
    STK GAS EXIT TEMP (K)  =     637.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      27.4300
    MIN HORIZ BLDG DIM (M) =      21.3400
    MAX HORIZ BLDG DIM (M) =      26.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   18.795 M**4/S**3;  MOM. FLUX =   27.026 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	18.91	4	20.0	23.8	6400.0	32.01	8.20	18.13	SS
200.	14.71	4	20.0	23.8	6400.0	32.05	15.56	24.08	SS
300.	11.11	4	20.0	23.8	6400.0	32.11	22.61	29.95	SS
400.	8.572	4	20.0	23.8	6400.0	32.11	29.45	31.89	SS
500.	6.964	4	20.0	23.8	6400.0	32.11	36.15	33.97	SS
600.	5.841	4	20.0	23.8	6400.0	32.11	42.72	35.94	SS
700.	5.010	4	20.0	23.8	6400.0	32.11	49.19	37.86	SS
800.	4.368	4	20.0	23.8	6400.0	32.11	55.57	39.72	SS
900.	3.857	4	20.0	23.8	6400.0	32.11	61.88	41.53	SS
1000.	3.442	4	20.0	23.8	6400.0	32.11	68.13	43.30	SS
1100.	3.098	4	20.0	23.8	6400.0	32.11	74.31	45.04	SS
1200.	2.808	4	20.0	23.8	6400.0	32.11	80.44	46.73	SS
1300.	2.562	4	20.0	23.8	6400.0	32.11	86.52	48.40	SS
1400.	2.350	4	20.0	23.8	6400.0	32.11	92.55	50.03	SS
1500.	2.165	4	20.0	23.8	6400.0	32.11	98.54	51.63	SS
1600.	2.004	4	20.0	23.8	6400.0	32.11	104.49	53.21	SS
1700.	1.862	4	20.0	23.8	6400.0	32.11	110.41	54.76	SS
1800.	1.736	4	20.0	23.8	6400.0	32.11	116.28	56.28	SS
1900.	1.623	4	20.0	23.8	6400.0	32.11	122.13	57.79	SS
2000.	1.522	4	20.0	23.8	6400.0	32.11	127.94	59.27	SS
2100.	1.431	4	20.0	23.8	6400.0	32.11	133.73	60.73	SS
2200.	1.349	4	20.0	23.8	6400.0	32.11	139.48	62.18	SS
2300.	1.274	4	20.0	23.8	6400.0	32.11	145.21	63.60	SS
2400.	1.206	4	20.0	23.8	6400.0	32.11	150.91	65.01	SS
2500.	1.156	4	20.0	23.8	6400.0	32.11	156.59	65.45	SS
2600.	1.099	4	20.0	23.8	6400.0	32.11	162.24	66.75	SS
2700.	1.047	4	20.0	23.8	6400.0	32.11	167.88	68.03	SS
2800.	.9987	4	20.0	23.8	6400.0	32.11	173.48	69.30	SS
2900.	.9539	4	20.0	23.8	6400.0	32.11	179.07	70.55	SS
3000.	.9124	4	20.0	23.8	6400.0	32.11	184.64	71.79	SS

Fennica/Nordica_FEN2_035, cont. (35% Load)

```
   3500.   .7437        4    20.0   23.8  6400.0   32.11  212.19   77.79    SS
   4000.   .6213        4    20.0   23.8  6400.0   32.11  239.31   83.50    SS
   4500.   .5291        4    20.0   23.8  6400.0   32.11  266.06   88.96    SS
   5000.   .4577        4    20.0   23.8  6400.0   32.11  292.47   94.22    SS
   5500.   .4011        4    20.0   23.8  6400.0   32.11  318.59   99.28    SS
   6000.   .3552        4    20.0   23.8  6400.0   32.11  344.44  104.19    SS
   6500.   .3175        4    20.0   23.8  6400.0   32.11  370.04  108.95    SS
   7000.   .2860        4    20.0   23.8  6400.0   32.11  395.41  113.57    SS
   7500.   .2594        4    20.0   23.8  6400.0   32.11  420.57  118.08    SS
   8000.   .2367        4    20.0   23.8  6400.0   32.11  445.53  122.48    SS
   8500.   .2171        4    20.0   23.8  6400.0   32.11  470.30  126.77    SS
   9000.   .2001        4    20.0   23.8  6400.0   32.11  494.90  130.97    SS
   9500.   .1866        4    20.0   23.8  6400.0   32.11  519.34  134.05    SS
  10000.   .1736        4    20.0   23.8  6400.0   32.11  543.62  137.89    SS
  15000.   .9790E-01    4    20.0   23.8  6400.0   32.11  779.22  172.20    SS
  20000.   .6506E-01    4    20.0   23.8  6400.0   32.11 1004.75  201.91    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   18.91        4    20.0   23.8  6400.0   32.01    8.20   18.13    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    570.8        CONC (UG/M**3)     =    517.8
   CRIT WS @10M (M/S) =     2.60        CRIT WS @10M (M/S) =     3.49
   CRIT WS @ HS (M/S) =     3.28        CRIT WS @ HS (M/S) =     4.40
   DILUTION WS (M/S)  =     1.64        DILUTION WS (M/S)  =     2.20
   CAVITY HT (M)      =    43.39        CAVITY HT (M)      =    40.23
   CAVITY LENGTH (M)  =    44.87        CAVITY LENGTH (M)  =    33.52
   ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =    26.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      18.91          100.        0.
 BLDG. CAVITY-1      570.8           45.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      517.8           34.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Tor Viking II_TORH_080 (80% Load)

```
03/16/09
14:13:57
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =     110.4000
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     579.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      18.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   16.405 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	17.61	4	20.0	23.5	6400.0	28.97	10.21	16.68	SS
200.	15.62	4	20.0	23.5	6400.0	29.02	16.91	22.73	SS
300.	11.49	4	20.0	23.5	6400.0	29.07	24.53	27.30	SS
400.	9.028	4	20.0	23.5	6400.0	29.07	31.33	29.97	SS
500.	7.417	4	20.0	23.5	6400.0	29.07	37.98	31.21	SS
600.	6.245	4	20.0	23.5	6400.0	29.07	44.52	33.45	SS
700.	5.366	4	20.0	23.5	6400.0	29.07	50.97	35.43	SS
800.	4.680	4	20.0	23.5	6400.0	29.07	57.33	37.36	SS
900.	4.131	4	20.0	23.5	6400.0	29.07	63.62	39.24	SS
1000.	3.682	4	20.0	23.5	6400.0	29.07	69.85	41.06	SS
1100.	3.309	4	20.0	23.5	6400.0	29.07	76.02	42.84	SS
1200.	2.996	4	20.0	23.5	6400.0	29.07	82.13	44.59	SS
1300.	2.729	4	20.0	23.5	6400.0	29.07	88.20	46.29	SS
1400.	2.499	4	20.0	23.5	6400.0	29.07	94.22	47.96	SS
1500.	2.299	4	20.0	23.5	6400.0	29.07	100.20	49.60	SS
1600.	2.125	4	20.0	23.5	6400.0	29.07	106.14	51.21	SS
1700.	1.971	4	20.0	23.5	6400.0	29.07	112.04	52.80	SS
1800.	1.835	4	20.0	23.5	6400.0	29.07	117.91	54.35	SS
1900.	1.714	4	20.0	23.5	6400.0	29.07	123.75	55.89	SS
2000.	1.605	4	20.0	23.5	6400.0	29.07	129.55	57.40	SS
2100.	1.507	4	20.0	23.5	6400.0	29.07	135.33	58.88	SS
2200.	1.419	4	20.0	23.5	6400.0	29.07	141.08	60.35	SS
2300.	1.339	4	20.0	23.5	6400.0	29.07	146.80	61.80	SS
2400.	1.266	4	20.0	23.5	6400.0	29.07	152.49	63.23	SS
2500.	1.200	4	20.0	23.5	6400.0	29.07	158.16	64.64	SS
2600.	1.151	4	20.0	23.5	6400.0	29.07	163.81	65.16	SS
2700.	1.095	4	20.0	23.5	6400.0	29.07	169.44	66.46	SS
2800.	1.044	4	20.0	23.5	6400.0	29.07	175.04	67.75	SS
2900.	.9960	4	20.0	23.5	6400.0	29.07	180.62	69.02	SS
3000.	.9520	4	20.0	23.5	6400.0	29.07	186.18	70.28	SS

Tor Viking II_TORH_080, cont. (80% Load)

```
   3500.   .7735        4    20.0   23.5  6400.0   29.07  213.70   76.35    SS
   4000.   .6445        4    20.0   23.5  6400.0   29.07  240.80   82.13    SS
   4500.   .5477        4    20.0   23.5  6400.0   29.07  267.53   87.65    SS
   5000.   .4729        4    20.0   23.5  6400.0   29.07  293.93   92.95    SS
   5500.   .4138        4    20.0   23.5  6400.0   29.07  320.03   98.06    SS
   6000.   .3660        4    20.0   23.5  6400.0   29.07  345.87  103.00    SS
   6500.   .3268        4    20.0   23.5  6400.0   29.07  371.45  107.80    SS
   7000.   .2941        4    20.0   23.5  6400.0   29.07  396.81  112.45    SS
   7500.   .2665        4    20.0   23.5  6400.0   29.07  421.96  116.99    SS
   8000.   .2430        4    20.0   23.5  6400.0   29.07  446.91  121.41    SS
   8500.   .2228        4    20.0   23.5  6400.0   29.07  471.67  125.73    SS
   9000.   .2052        4    20.0   23.5  6400.0   29.07  496.27  129.95    SS
   9500.   .1898        4    20.0   23.5  6400.0   29.07  520.69  134.09    SS
  10000.   .1776        4    20.0   23.5  6400.0   29.07  544.96  137.11    SS
  15000.   .9990E-01    4    20.0   23.5  6400.0   29.07  780.50  171.54    SS
  20000.   .6631E-01    4    20.0   23.5  6400.0   29.07 1005.98  201.32    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    113.   17.69        4    20.0   23.5  6400.0   28.98   11.15   17.52    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1519.        CONC (UG/M**3)     =    1794.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    41.69        CAVITY HT (M)      =    39.32
   CAVITY LENGTH (M)  =    36.34        CAVITY LENGTH (M)  =    28.56
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    18.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.69          113.        0.
 BLDG. CAVITY-1      1519.           36.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1794.           29.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Tor Viking II_TORH_057 (57% Load)

```
03/16/09
14:13:57
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =     101.6000
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     607.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      18.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   14.421 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   17.61        4    20.0   23.5  6400.0   28.97   10.21   16.68    SS
    200.   15.63        4    20.0   23.5  6400.0   29.01   16.91   22.73    SS
    300.   11.51        4    20.0   23.5  6400.0   29.04   24.53   27.30    SS
    400.   9.037        4    20.0   23.5  6400.0   29.04   31.33   29.97    SS
    500.   7.424        4    20.0   23.5  6400.0   29.04   37.98   31.21    SS
    600.   6.250        4    20.0   23.5  6400.0   29.04   44.52   33.45    SS
    700.   5.369        4    20.0   23.5  6400.0   29.04   50.97   35.43    SS
    800.   4.683        4    20.0   23.5  6400.0   29.04   57.33   37.36    SS
    900.   4.133        4    20.0   23.5  6400.0   29.04   63.62   39.24    SS
   1000.   3.684        4    20.0   23.5  6400.0   29.04   69.85   41.06    SS
   1100.   3.311        4    20.0   23.5  6400.0   29.04   76.02   42.84    SS
   1200.   2.997        4    20.0   23.5  6400.0   29.04   82.13   44.59    SS
   1300.   2.730        4    20.0   23.5  6400.0   29.04   88.20   46.29    SS
   1400.   2.500        4    20.0   23.5  6400.0   29.04   94.22   47.96    SS
   1500.   2.300        4    20.0   23.5  6400.0   29.04  100.20   49.60    SS
   1600.   2.125        4    20.0   23.5  6400.0   29.04  106.14   51.21    SS
   1700.   1.972        4    20.0   23.5  6400.0   29.04  112.04   52.80    SS
   1800.   1.836        4    20.0   23.5  6400.0   29.04  117.91   54.35    SS
   1900.   1.714        4    20.0   23.5  6400.0   29.04  123.75   55.89    SS
   2000.   1.606        4    20.0   23.5  6400.0   29.04  129.55   57.40    SS
   2100.   1.508        4    20.0   23.5  6400.0   29.04  135.33   58.88    SS
   2200.   1.419        4    20.0   23.5  6400.0   29.04  141.08   60.35    SS
   2300.   1.339        4    20.0   23.5  6400.0   29.04  146.80   61.80    SS
   2400.   1.266        4    20.0   23.5  6400.0   29.04  152.49   63.23    SS
   2500.   1.200        4    20.0   23.5  6400.0   29.04  158.16   64.64    SS
   2600.   1.151        4    20.0   23.5  6400.0   29.04  163.81   65.16    SS
   2700.   1.095        4    20.0   23.5  6400.0   29.04  169.44   66.46    SS
   2800.   1.044        4    20.0   23.5  6400.0   29.04  175.04   67.75    SS
   2900.   .9962        4    20.0   23.5  6400.0   29.04  180.62   69.02    SS
   3000.   .9522        4    20.0   23.5  6400.0   29.04  186.18   70.28    SS
```

Tor Viking II_TORH_057, cont. (57% Load)

```
   3500.   .7736        4    20.0   23.5  6400.0   29.04  213.70   76.35    SS
   4000.   .6445        4    20.0   23.5  6400.0   29.04  240.80   82.13    SS
   4500.   .5478        4    20.0   23.5  6400.0   29.04  267.53   87.65    SS
   5000.   .4730        4    20.0   23.5  6400.0   29.04  293.93   92.95    SS
   5500.   .4138        4    20.0   23.5  6400.0   29.04  320.03   98.06    SS
   6000.   .3660        4    20.0   23.5  6400.0   29.04  345.87  103.00    SS
   6500.   .3268        4    20.0   23.5  6400.0   29.04  371.45  107.80    SS
   7000.   .2941        4    20.0   23.5  6400.0   29.04  396.81  112.45    SS
   7500.   .2665        4    20.0   23.5  6400.0   29.04  421.96  116.99    SS
   8000.   .2430        4    20.0   23.5  6400.0   29.04  446.91  121.41    SS
   8500.   .2228        4    20.0   23.5  6400.0   29.04  471.67  125.73    SS
   9000.   .2052        4    20.0   23.5  6400.0   29.04  496.27  129.95    SS
   9500.   .1898        4    20.0   23.5  6400.0   29.04  520.69  134.09    SS
  10000.   .1776        4    20.0   23.5  6400.0   29.04  544.96  137.11    SS
  15000.   .9991E-01    4    20.0   23.5  6400.0   29.04  780.50  171.54    SS
  20000.   .6631E-01    4    20.0   23.5  6400.0   29.04 1005.98  201.32    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    113.   17.69        4    20.0   23.5  6400.0   28.98   11.15   17.52    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1519.        CONC (UG/M**3)     =    1794.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    41.69        CAVITY HT (M)      =    39.32
   CAVITY LENGTH (M)  =    36.34        CAVITY LENGTH (M)  =    28.56
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    18.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.69          113.        0.
 BLDG. CAVITY-1      1519.           36.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1794.           29.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Tor Viking II_TORH_035 (35% Load)

```
03/16/09
14:13:57
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =      74.7000
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     630.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      18.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =    8.010 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   17.62        4    20.0   23.5  6400.0   28.97   10.21   16.68    SS
    200.   15.65        4    20.0   23.5  6400.0   28.98   16.91   22.73    SS
    300.   11.53        4    20.0   23.5  6400.0   28.98   24.53   27.30    SS
    400.   9.055        4    20.0   23.5  6400.0   28.98   31.33   29.97    SS
    500.   7.437        4    20.0   23.5  6400.0   28.98   37.98   31.21    SS
    600.   6.260        4    20.0   23.5  6400.0   28.98   44.52   33.45    SS
    700.   5.377        4    20.0   23.5  6400.0   28.98   50.97   35.43    SS
    800.   4.689        4    20.0   23.5  6400.0   28.98   57.33   37.36    SS
    900.   4.138        4    20.0   23.5  6400.0   28.98   63.62   39.24    SS
   1000.   3.688        4    20.0   23.5  6400.0   28.98   69.85   41.06    SS
   1100.   3.314        4    20.0   23.5  6400.0   28.98   76.02   42.84    SS
   1200.   3.000        4    20.0   23.5  6400.0   28.98   82.13   44.59    SS
   1300.   2.732        4    20.0   23.5  6400.0   28.98   88.20   46.29    SS
   1400.   2.502        4    20.0   23.5  6400.0   28.98   94.22   47.96    SS
   1500.   2.302        4    20.0   23.5  6400.0   28.98  100.20   49.60    SS
   1600.   2.127        4    20.0   23.5  6400.0   28.98  106.14   51.21    SS
   1700.   1.973        4    20.0   23.5  6400.0   28.98  112.04   52.80    SS
   1800.   1.837        4    20.0   23.5  6400.0   28.98  117.91   54.35    SS
   1900.   1.715        4    20.0   23.5  6400.0   28.98  123.75   55.89    SS
   2000.   1.606        4    20.0   23.5  6400.0   28.98  129.55   57.40    SS
   2100.   1.509        4    20.0   23.5  6400.0   28.98  135.33   58.88    SS
   2200.   1.420        4    20.0   23.5  6400.0   28.98  141.08   60.35    SS
   2300.   1.340        4    20.0   23.5  6400.0   28.98  146.80   61.80    SS
   2400.   1.267        4    20.0   23.5  6400.0   28.98  152.49   63.23    SS
   2500.   1.200        4    20.0   23.5  6400.0   28.98  158.16   64.64    SS
   2600.   1.152        4    20.0   23.5  6400.0   28.98  163.81   65.16    SS
   2700.   1.096        4    20.0   23.5  6400.0   28.98  169.44   66.46    SS
   2800.   1.044        4    20.0   23.5  6400.0   28.98  175.04   67.75    SS
   2900.   .9966        4    20.0   23.5  6400.0   28.98  180.62   69.02    SS
   3000.   .9525        4    20.0   23.5  6400.0   28.98  186.18   70.28    SS
```

Tor Viking II_TORH_035, cont. (35% Load)

```
   3500.   .7738        4    20.0   23.5  6400.0   28.98  213.70   76.35    SS
   4000.   .6447        4    20.0   23.5  6400.0   28.98  240.80   82.13    SS
   4500.   .5479        4    20.0   23.5  6400.0   28.98  267.53   87.65    SS
   5000.   .4731        4    20.0   23.5  6400.0   28.98  293.93   92.95    SS
   5500.   .4139        4    20.0   23.5  6400.0   28.98  320.03   98.06    SS
   6000.   .3661        4    20.0   23.5  6400.0   28.98  345.87  103.00    SS
   6500.   .3268        4    20.0   23.5  6400.0   28.98  371.45  107.80    SS
   7000.   .2941        4    20.0   23.5  6400.0   28.98  396.81  112.45    SS
   7500.   .2666        4    20.0   23.5  6400.0   28.98  421.96  116.99    SS
   8000.   .2431        4    20.0   23.5  6400.0   28.98  446.91  121.41    SS
   8500.   .2228        4    20.0   23.5  6400.0   28.98  471.67  125.73    SS
   9000.   .2052        4    20.0   23.5  6400.0   28.98  496.27  129.95    SS
   9500.   .1899        4    20.0   23.5  6400.0   28.98  520.69  134.09    SS
  10000.   .1776        4    20.0   23.5  6400.0   28.98  544.96  137.11    SS
  15000.   .9991E-01    4    20.0   23.5  6400.0   28.98  780.50  171.54    SS
  20000.   .6631E-01    4    20.0   23.5  6400.0   28.98 1005.98  201.32    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    113.   17.70        4    20.0   23.5  6400.0   28.97   11.15   17.52    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1519.        CONC (UG/M**3)     =    1794.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    41.69        CAVITY HT (M)      =    39.32
   CAVITY LENGTH (M)  =    36.34        CAVITY LENGTH (M)  =    28.56
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    18.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.70          113.        0.
 BLDG. CAVITY-1      1519.           36.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1794.           29.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

APPENDIX E

SCREEN3 Model Output for Plume Rise Determinations

Name_ID: Resupply Ship_KILABUK-T

```
05/26/09
13:17:31
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      15.2400
    STK INSIDE DIAM (M)    =        .1800
    STK EXIT VELOCITY (M/S)=      40.0000
    STK GAS EXIT TEMP (K)  =     700.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      13.7200
    MIN HORIZ BLDG DIM (M) =      14.0000
    MAX HORIZ BLDG DIM (M) =      14.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
 BUOY. FLUX =    1.992 M**4/S**3;  MOM. FLUX =    4.834 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	52.13	4	20.0	21.3	6400.0	15.24	10.87	12.44	SS
200.	32.13	4	20.0	21.3	6400.0	15.24	18.29	17.03	SS
300.	22.13	4	20.0	21.3	6400.0	15.24	25.25	19.99	SS
400.	16.34	4	20.0	21.3	6400.0	15.24	32.03	22.85	SS
500.	12.63	4	20.0	21.3	6400.0	15.24	38.67	25.63	SS
600.	10.09	4	20.0	21.3	6400.0	15.24	45.20	28.34	SS
700.	8.272	4	20.0	21.3	6400.0	15.24	51.64	30.99	SS
800.	7.293	4	20.0	21.3	6400.0	15.24	58.00	31.40	SS
900.	6.243	4	20.0	21.3	6400.0	15.24	64.28	33.59	SS
1000.	5.435	4	20.0	21.3	6400.0	15.24	70.50	35.57	SS
1100.	4.785	4	20.0	21.3	6400.0	15.24	76.66	37.50	SS
1200.	4.254	4	20.0	21.3	6400.0	15.24	82.77	39.37	SS
1300.	3.813	4	20.0	21.3	6400.0	15.24	88.83	41.19	SS
1400.	3.442	4	20.0	21.3	6400.0	15.24	94.85	42.97	SS
1500.	3.127	4	20.0	21.3	6400.0	15.24	100.82	44.71	SS
1600.	2.857	4	20.0	21.3	6400.0	15.24	106.76	46.41	SS
1700.	2.623	4	20.0	21.3	6400.0	15.24	112.66	48.08	SS
1800.	2.419	4	20.0	21.3	6400.0	15.24	118.52	49.72	SS
1900.	2.240	4	20.0	21.3	6400.0	15.24	124.36	51.33	SS
2000.	2.081	4	20.0	21.3	6400.0	15.24	130.16	52.91	SS
2100.	1.941	4	20.0	21.3	6400.0	15.24	135.93	54.47	SS
2200.	1.815	4	20.0	21.3	6400.0	15.24	141.68	56.00	SS
2300.	1.702	4	20.0	21.3	6400.0	15.24	147.40	57.50	SS
2400.	1.600	4	20.0	21.3	6400.0	15.24	153.09	58.99	SS
2500.	1.508	4	20.0	21.3	6400.0	15.24	158.76	60.46	SS
2600.	1.424	4	20.0	21.3	6400.0	15.24	164.40	61.90	SS
2700.	1.348	4	20.0	21.3	6400.0	15.24	170.02	63.33	SS
2800.	1.278	4	20.0	21.3	6400.0	15.24	175.62	64.74	SS
2900.	1.225	4	20.0	21.3	6400.0	15.24	181.20	65.52	SS
3000.	1.166	4	20.0	21.3	6400.0	15.24	186.76	66.82	SS

```
  3500.   .9335        4    20.0   21.3  6400.0   15.24  214.28   73.09    SS
  4000.   .7689        4    20.0   21.3  6400.0   15.24  241.37   79.02    SS
  4500.   .6476        4    20.0   21.3  6400.0   15.24  268.09   84.67    SS
  5000.   .5552        4    20.0   21.3  6400.0   15.24  294.48   90.09    SS
  5500.   .4828        4    20.0   21.3  6400.0   15.24  320.58   95.30    SS
  6000.   .4249        4    20.0   21.3  6400.0   15.24  346.41  100.33    SS
  6500.   .3778        4    20.0   21.3  6400.0   15.24  371.99  105.21    SS
  7000.   .3388        4    20.0   21.3  6400.0   15.24  397.34  109.93    SS
  7500.   .3060        4    20.0   21.3  6400.0   15.24  422.49  114.53    SS
  8000.   .2783        4    20.0   21.3  6400.0   15.24  447.43  119.02    SS
  8500.   .2545        4    20.0   21.3  6400.0   15.24  472.19  123.39    SS
  9000.   .2339        4    20.0   21.3  6400.0   15.24  496.78  127.67    SS
  9500.   .2160        4    20.0   21.3  6400.0   15.24  521.20  131.85    SS
 10000.   .2010        4    20.0   21.3  6400.0   15.24  545.47  135.43    SS
 15000.   .1120        4    20.0   21.3  6400.0   15.24  780.98  170.13    SS
 20000.   .7398E-01    4    20.0   21.3  6400.0   15.24 1006.44  200.08    SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND    50. M:
    60.   56.89        4    20.0   21.3  6400.0   15.24    8.26   10.04    SS

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****************************************
     *** REGULATORY (Default) ***
    PERFORMING CAVITY CALCULATIONS
  WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
****************************************
 *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)     =    1955.        CONC (UG/M**3)     =    1955.
  CRIT WS @10M (M/S) =     3.26        CRIT WS @10M (M/S) =     3.26
  CRIT WS @ HS (M/S) =     3.55        CRIT WS @ HS (M/S) =     3.55
  DILUTION WS (M/S)  =     1.78        DILUTION WS (M/S)  =     1.78
  CAVITY HT (M)      =    19.55        CAVITY HT (M)      =    19.55
  CAVITY LENGTH (M)  =    20.29        CAVITY LENGTH (M)  =    20.29
  ALONGWIND DIM (M)  =    14.00        ALONGWIND DIM (M)  =    14.00
****************************************
      END OF CAVITY CALCULATIONS
****************************************
     ****************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ****************************************
 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      56.89           60.        0.
BLDG. CAVITY-1      1955.           20.       --  (DIST = CAVITY LENGTH)
BLDG. CAVITY-2      1955.           20.       --  (DIST = CAVITY LENGTH)
***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Name_ID: Oil Spill Response_OILSPL3 (Kvichaks)

```
03/16/09
12:46:21
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =       3.3500
    STK INSIDE DIAM (M)    =        .1520
    STK EXIT VELOCITY (M/S)=      32.9000
    STK GAS EXIT TEMP (K)  =     694.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =       3.0500
    MIN HORIZ BLDG DIM (M) =       3.6600
    MAX HORIZ BLDG DIM (M) =       4.8800
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =    1.162 M**4/S**3;  MOM. FLUX =    2.352 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	275.8	4	20.0	20.0	6400.0	3.38	8.20	6.01	SS
200.	98.78	4	20.0	20.0	6400.0	3.38	15.56	9.75	SS
300.	52.43	4	20.0	20.0	6400.0	3.38	22.61	12.98	SS
400.	32.81	4	20.0	20.0	6400.0	3.38	29.45	16.11	SS
500.	22.69	4	20.0	20.0	6400.0	3.38	36.15	19.10	SS
600.	16.74	4	20.0	20.0	6400.0	3.38	42.72	21.99	SS
700.	12.93	4	20.0	20.0	6400.0	3.38	49.19	24.79	SS
800.	10.33	4	20.0	20.0	6400.0	3.38	55.57	27.52	SS
900.	8.466	4	20.0	20.0	6400.0	3.38	61.88	30.19	SS
1000.	7.239	4	20.0	20.0	6400.0	3.38	68.13	32.09	SS
1100.	6.246	4	20.0	20.0	6400.0	3.38	74.31	34.12	SS
1200.	5.458	4	20.0	20.0	6400.0	3.38	80.44	36.09	SS
1300.	4.822	4	20.0	20.0	6400.0	3.38	86.52	38.00	SS
1400.	4.299	4	20.0	20.0	6400.0	3.38	92.55	39.86	SS
1500.	3.863	4	20.0	20.0	6400.0	3.38	98.54	41.67	SS
1600.	3.496	4	20.0	20.0	6400.0	3.38	104.49	43.44	SS
1700.	3.183	4	20.0	20.0	6400.0	3.38	110.41	45.17	SS
1800.	2.913	4	20.0	20.0	6400.0	3.38	116.28	46.86	SS
1900.	2.679	4	20.0	20.0	6400.0	3.38	122.13	48.52	SS
2000.	2.475	4	20.0	20.0	6400.0	3.38	127.94	50.15	SS
2100.	2.295	4	20.0	20.0	6400.0	3.38	133.73	51.75	SS
2200.	2.135	4	20.0	20.0	6400.0	3.38	139.48	53.33	SS
2300.	1.994	4	20.0	20.0	6400.0	3.38	145.21	54.87	SS
2400.	1.867	4	20.0	20.0	6400.0	3.38	150.91	56.40	SS
2500.	1.752	4	20.0	20.0	6400.0	3.38	156.59	57.90	SS
2600.	1.649	4	20.0	20.0	6400.0	3.38	162.24	59.38	SS
2700.	1.556	4	20.0	20.0	6400.0	3.38	167.88	60.84	SS
2800.	1.471	4	20.0	20.0	6400.0	3.38	173.48	62.29	SS
2900.	1.393	4	20.0	20.0	6400.0	3.38	179.07	63.71	SS
3000.	1.322	4	20.0	20.0	6400.0	3.38	184.64	65.12	SS

Oil Spill Response_OILSPL3 (Kvichaks), cont.

```
   3500.   1.048        4    20.0   20.0  6400.0    3.38  212.19   71.48    SS
   4000.   .8574        4    20.0   20.0  6400.0    3.38  239.31   77.49    SS
   4500.   .7183        4    20.0   20.0  6400.0    3.38  266.06   83.21    SS
   5000.   .6131        4    20.0   20.0  6400.0    3.38  292.47   88.69    SS
   5500.   .5314        4    20.0   20.0  6400.0    3.38  318.59   93.95    SS
   6000.   .4663        4    20.0   20.0  6400.0    3.38  344.44   99.03    SS
   6500.   .4136        4    20.0   20.0  6400.0    3.38  370.04  103.94    SS
   7000.   .3701        4    20.0   20.0  6400.0    3.38  395.41  108.71    SS
   7500.   .3337        4    20.0   20.0  6400.0    3.38  420.57  113.34    SS
   8000.   .3030        4    20.0   20.0  6400.0    3.38  445.53  117.85    SS
   8500.   .2767        4    20.0   20.0  6400.0    3.38  470.30  122.25    SS
   9000.   .2540        4    20.0   20.0  6400.0    3.38  494.90  126.56    SS
   9500.   .2343        4    20.0   20.0  6400.0    3.38  519.34  130.76    SS
  10000.   .2170        4    20.0   20.0  6400.0    3.38  543.62  134.88    SS
  15000.   .1204        4    20.0   20.0  6400.0    3.38  779.22  169.67    SS
  20000.   .7932E-01    4    20.0   20.0  6400.0    3.38 1004.75  199.67    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   275.8        4    20.0   20.0  6400.0    3.38    8.20    6.01    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    6421.        CONC (UG/M**3)     =    .0000
   CRIT WS @10M (M/S) =    13.95        CRIT WS @10M (M/S) =    99.99
   CRIT WS @ HS (M/S) =    13.95        CRIT WS @ HS (M/S) =    99.99
   DILUTION WS (M/S)  =     6.98        DILUTION WS (M/S)  =    99.99
   CAVITY HT (M)      =     4.08        CAVITY HT (M)      =     3.66
   CAVITY LENGTH (M)  =     5.93        CAVITY LENGTH (M)  =     3.76
   ALONGWIND DIM (M)  =     3.66        ALONGWIND DIM (M)  =     4.88
 CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      275.8          100.        0.
 BLDG. CAVITY-1      6421.            6.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      .0000            4.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
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Name_ID: Oil Spill Response_OILSPL4 (Nanuq)

```
03/16/09
12:46:21
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      15.2400
    STK INSIDE DIAM (M)    =        .7600
    STK EXIT VELOCITY (M/S)=      40.0000
    STK GAS EXIT TEMP (K)  =     644.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      13.7200
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      15.2400
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   33.676 M**4/S**3;  MOM. FLUX =   93.672 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   64.38        4    20.0   21.3  6400.0   15.37    8.20   11.40    SS
    200.   36.95        4    20.0   21.3  6400.0   15.76   15.56   15.81    SS
    300.   24.05        4    20.0   21.3  6400.0   16.37   22.61   18.82    SS
    400.   17.09        4    20.0   21.3  6400.0   17.17   29.45   21.71    SS
    500.   13.05        4    20.0   21.3  6400.0   17.55   36.15   24.52    SS
    600.   10.43        4    20.0   21.3  6400.0   17.55   42.72   27.26    SS
    700.   8.546        4    20.0   21.3  6400.0   17.55   49.19   29.93    SS
    800.   7.492        4    20.0   21.3  6400.0   17.55   55.57   30.37    SS
    900.   6.380        4    20.0   21.3  6400.0   17.55   61.88   32.79    SS
   1000.   5.549        4    20.0   21.3  6400.0   17.55   68.13   34.80    SS
   1100.   4.882        4    20.0   21.3  6400.0   17.55   74.31   36.75    SS
   1200.   4.336        4    20.0   21.3  6400.0   17.55   80.44   38.64    SS
   1300.   3.883        4    20.0   21.3  6400.0   17.55   86.52   40.48    SS
   1400.   3.503        4    20.0   21.3  6400.0   17.55   92.55   42.28    SS
   1500.   3.180        4    20.0   21.3  6400.0   17.55   98.54   44.03    SS
   1600.   2.904        4    20.0   21.3  6400.0   17.55  104.49   45.75    SS
   1700.   2.664        4    20.0   21.3  6400.0   17.55  110.41   47.43    SS
   1800.   2.456        4    20.0   21.3  6400.0   17.55  116.28   49.08    SS
   1900.   2.273        4    20.0   21.3  6400.0   17.55  122.13   50.70    SS
   2000.   2.111        4    20.0   21.3  6400.0   17.55  127.94   52.29    SS
   2100.   1.967        4    20.0   21.3  6400.0   17.55  133.73   53.86    SS
   2200.   1.839        4    20.0   21.3  6400.0   17.55  139.48   55.40    SS
   2300.   1.724        4    20.0   21.3  6400.0   17.55  145.21   56.92    SS
   2400.   1.620        4    20.0   21.3  6400.0   17.55  150.91   58.41    SS
   2500.   1.526        4    20.0   21.3  6400.0   17.55  156.59   59.88    SS
   2600.   1.441        4    20.0   21.3  6400.0   17.55  162.24   61.34    SS
   2700.   1.363        4    20.0   21.3  6400.0   17.55  167.88   62.77    SS
   2800.   1.292        4    20.0   21.3  6400.0   17.55  173.48   64.19    SS
   2900.   1.237        4    20.0   21.3  6400.0   17.55  179.07   65.05    SS
   3000.   1.178        4    20.0   21.3  6400.0   17.55  184.64   66.36    SS
```

Oil Spill Response_OILSPL4 (Nanuq), cont.

```
   3500.   .9414        4    20.0   21.3  6400.0   17.55  212.19   72.65    SS
   4000.   .7748        4    20.0   21.3  6400.0   17.55  239.31   78.60    SS
   4500.   .6521        4    20.0   21.3  6400.0   17.55  266.06   84.27    SS
   5000.   .5587        4    20.0   21.3  6400.0   17.55  292.47   89.71    SS
   5500.   .4856        4    20.0   21.3  6400.0   17.55  318.59   94.93    SS
   6000.   .4272        4    20.0   21.3  6400.0   17.55  344.44   99.98    SS
   6500.   .3797        4    20.0   21.3  6400.0   17.55  370.04  104.86    SS
   7000.   .3404        4    20.0   21.3  6400.0   17.55  395.41  109.60    SS
   7500.   .3074        4    20.0   21.3  6400.0   17.55  420.57  114.21    SS
   8000.   .2795        4    20.0   21.3  6400.0   17.55  445.53  118.70    SS
   8500.   .2555        4    20.0   21.3  6400.0   17.55  470.30  123.08    SS
   9000.   .2348        4    20.0   21.3  6400.0   17.55  494.90  127.36    SS
   9500.   .2168        4    20.0   21.3  6400.0   17.55  519.34  131.55    SS
  10000.   .2016        4    20.0   21.3  6400.0   17.55  543.62  135.21    SS
  15000.   .1122        4    20.0   21.3  6400.0   17.55  779.22  169.94    SS
  20000.   .7410E-01    4    20.0   21.3  6400.0   17.55 1004.75  199.91    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   64.38        4    20.0   21.3  6400.0   15.37    8.20   11.40    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    381.6        CONC (UG/M**3)     =    381.6
   CRIT WS @10M (M/S) =    15.36        CRIT WS @10M (M/S) =    15.36
   CRIT WS @ HS (M/S) =    16.71        CRIT WS @ HS (M/S) =    16.71
   DILUTION WS (M/S)  =     8.36        DILUTION WS (M/S)  =     8.36
   CAVITY HT (M)      =    18.90        CAVITY HT (M)      =    18.90
   CAVITY LENGTH (M)  =    20.65        CAVITY LENGTH (M)  =    20.65
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    15.24
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      64.38          100.        0.
 BLDG. CAVITY-1      381.6           21.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      381.6           21.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Fennica/Nordica_FENNICA2

```
03/16/09
12:46:21
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      32.0000
    STK INSIDE DIAM (M)    =        .8000
    STK EXIT VELOCITY (M/S)=      38.4000
    STK GAS EXIT TEMP (K)  =     655.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      27.4300
    MIN HORIZ BLDG DIM (M) =      21.3400
    MAX HORIZ BLDG DIM (M) =      26.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   36.232 M**4/S**3;  MOM. FLUX =   94.048 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	17.76	4	20.0	23.8	6400.0	32.02	8.20	17.63	SS
200.	14.34	4	20.0	23.8	6400.0	32.10	15.56	23.42	SS
300.	11.01	4	20.0	23.8	6400.0	32.22	22.61	29.15	SS
400.	8.497	4	20.0	23.8	6400.0	32.39	29.45	31.78	SS
500.	6.896	4	20.0	23.8	6400.0	32.51	36.15	33.23	SS
600.	5.802	4	20.0	23.8	6400.0	32.51	42.72	35.23	SS
700.	4.987	4	20.0	23.8	6400.0	32.51	49.19	37.16	SS
800.	4.356	4	20.0	23.8	6400.0	32.51	55.57	39.04	SS
900.	3.852	4	20.0	23.8	6400.0	32.51	61.88	40.87	SS
1000.	3.440	4	20.0	23.8	6400.0	32.51	68.13	42.66	SS
1100.	3.098	4	20.0	23.8	6400.0	32.51	74.31	44.41	SS
1200.	2.811	4	20.0	23.8	6400.0	32.51	80.44	46.12	SS
1300.	2.565	4	20.0	23.8	6400.0	32.51	86.52	47.79	SS
1400.	2.353	4	20.0	23.8	6400.0	32.51	92.55	49.43	SS
1500.	2.170	4	20.0	23.8	6400.0	32.51	98.54	51.05	SS
1600.	2.008	4	20.0	23.8	6400.0	32.51	104.49	52.63	SS
1700.	1.866	4	20.0	23.8	6400.0	32.51	110.41	54.19	SS
1800.	1.740	4	20.0	23.8	6400.0	32.51	116.28	55.73	SS
1900.	1.627	4	20.0	23.8	6400.0	32.51	122.13	57.24	SS
2000.	1.526	4	20.0	23.8	6400.0	32.51	127.94	58.73	SS
2100.	1.435	4	20.0	23.8	6400.0	32.51	133.73	60.20	SS
2200.	1.353	4	20.0	23.8	6400.0	32.51	139.48	61.65	SS
2300.	1.278	4	20.0	23.8	6400.0	32.51	145.21	63.08	SS
2400.	1.209	4	20.0	23.8	6400.0	32.51	150.91	64.50	SS
2500.	1.159	4	20.0	23.8	6400.0	32.51	156.59	64.97	SS
2600.	1.102	4	20.0	23.8	6400.0	32.51	162.24	66.28	SS
2700.	1.050	4	20.0	23.8	6400.0	32.51	167.88	67.57	SS
2800.	1.001	4	20.0	23.8	6400.0	32.51	173.48	68.85	SS
2900.	.9562	4	20.0	23.8	6400.0	32.51	179.07	70.11	SS
3000.	.9146	4	20.0	23.8	6400.0	32.51	184.64	71.35	SS

Fennica/Nordica_FENNICA2, cont.

```
   3500.   .7454        4    20.0   23.8  6400.0   32.51  212.19   77.37    SS
   4000.   .6227        4    20.0   23.8  6400.0   32.51  239.31   83.10    SS
   4500.   .5303        4    20.0   23.8  6400.0   32.51  266.06   88.58    SS
   5000.   .4587        4    20.0   23.8  6400.0   32.51  292.47   93.84    SS
   5500.   .4018        4    20.0   23.8  6400.0   32.51  318.59   98.93    SS
   6000.   .3559        4    20.0   23.8  6400.0   32.51  344.44  103.84    SS
   6500.   .3180        4    20.0   23.8  6400.0   32.51  370.04  108.61    SS
   7000.   .2865        4    20.0   23.8  6400.0   32.51  395.41  113.24    SS
   7500.   .2598        4    20.0   23.8  6400.0   32.51  420.57  117.76    SS
   8000.   .2371        4    20.0   23.8  6400.0   32.51  445.53  122.16    SS
   8500.   .2174        4    20.0   23.8  6400.0   32.51  470.30  126.47    SS
   9000.   .2004        4    20.0   23.8  6400.0   32.51  494.90  130.67    SS
   9500.   .1855        4    20.0   23.8  6400.0   32.51  519.34  134.80    SS
  10000.   .1737        4    20.0   23.8  6400.0   32.51  543.62  137.65    SS
  15000.   .9797E-01    4    20.0   23.8  6400.0   32.51  779.22  172.00    SS
  20000.   .6510E-01    4    20.0   23.8  6400.0   32.51 1004.75  201.73    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   17.76        4    20.0   23.8  6400.0   32.02    8.20   17.63    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    312.0        CONC (UG/M**3)     =    276.5
   CRIT WS @10M (M/S) =     4.75        CRIT WS @10M (M/S) =     6.53
   CRIT WS @ HS (M/S) =     5.99        CRIT WS @ HS (M/S) =     8.24
   DILUTION WS (M/S)  =     3.00        DILUTION WS (M/S)  =     4.12
   CAVITY HT (M)      =    43.39        CAVITY HT (M)      =    40.23
   CAVITY LENGTH (M)  =    44.87        CAVITY LENGTH (M)  =    33.52
   ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =    26.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.76          100.        0.
 BLDG. CAVITY-1      312.0           45.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      276.5           34.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Vladimir Ignatjuk_VLADIGN2

```
03/16/09
12:46:21
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      24.3800
    STK INSIDE DIAM (M)    =        .7900
    STK EXIT VELOCITY (M/S)=      33.2000
    STK GAS EXIT TEMP (K)  =     668.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      19.8100
    MIN HORIZ BLDG DIM (M) =      17.5100
    MAX HORIZ BLDG DIM (M) =      17.5100
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
 BUOY. FLUX =   30.942 M**4/S**3;  MOM. FLUX =   67.220 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   25.07        4    20.0   22.9  6400.0   24.43    8.20   13.65    SS
    200.   20.81        4    20.0   22.9  6400.0   24.58   15.56   19.62    SS
    300.   14.89        4    20.0   22.9  6400.0   24.82   22.61   22.49    SS
    400.   11.40        4    20.0   22.9  6400.0   25.15   29.45   25.28    SS
    500.   9.169        4    20.0   22.9  6400.0   25.22   36.15   27.99    SS
    600.   7.580        4    20.0   22.9  6400.0   25.22   42.72   30.65    SS
    700.   6.544        4    20.0   22.9  6400.0   25.22   49.19   31.19    SS
    800.   5.638        4    20.0   22.9  6400.0   25.22   55.57   33.43    SS
    900.   4.930        4    20.0   22.9  6400.0   25.22   61.88   35.42    SS
   1000.   4.356        4    20.0   22.9  6400.0   25.22   68.13   37.35    SS
   1100.   3.885        4    20.0   22.9  6400.0   25.22   74.31   39.22    SS
   1200.   3.491        4    20.0   22.9  6400.0   25.22   80.44   41.05    SS
   1300.   3.159        4    20.0   22.9  6400.0   25.22   86.52   42.83    SS
   1400.   2.876        4    20.0   22.9  6400.0   25.22   92.55   44.58    SS
   1500.   2.632        4    20.0   22.9  6400.0   25.22   98.54   46.28    SS
   1600.   2.420        4    20.0   22.9  6400.0   25.22  104.49   47.95    SS
   1700.   2.234        4    20.0   22.9  6400.0   25.22  110.41   49.59    SS
   1800.   2.071        4    20.0   22.9  6400.0   25.22  116.28   51.20    SS
   1900.   1.927        4    20.0   22.9  6400.0   25.22  122.13   52.79    SS
   2000.   1.798        4    20.0   22.9  6400.0   25.22  127.94   54.34    SS
   2100.   1.683        4    20.0   22.9  6400.0   25.22  133.73   55.88    SS
   2200.   1.579        4    20.0   22.9  6400.0   25.22  139.48   57.39    SS
   2300.   1.486        4    20.0   22.9  6400.0   25.22  145.21   58.88    SS
   2400.   1.401        4    20.0   22.9  6400.0   25.22  150.91   60.34    SS
   2500.   1.324        4    20.0   22.9  6400.0   25.22  156.59   61.79    SS
   2600.   1.254        4    20.0   22.9  6400.0   25.22  162.24   63.22    SS
   2700.   1.189        4    20.0   22.9  6400.0   25.22  167.88   64.63    SS
   2800.   1.141        4    20.0   22.9  6400.0   25.22  173.48   65.28    SS
   2900.   1.087        4    20.0   22.9  6400.0   25.22  179.07   66.59    SS
   3000.   1.037        4    20.0   22.9  6400.0   25.22  184.64   67.87    SS
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Vladimir Ignatjuk_VLADIGN2, cont.

```
   3500.   .8360        4    20.0   22.9  6400.0   25.22  212.19   74.08    SS
   4000.   .6924        4    20.0   22.9  6400.0   25.22  239.31   79.96    SS
   4500.   .5856        4    20.0   22.9  6400.0   25.22  266.06   85.57    SS
   5000.   .5037        4    20.0   22.9  6400.0   25.22  292.47   90.95    SS
   5500.   .4392        4    20.0   22.9  6400.0   25.22  318.59   96.13    SS
   6000.   .3875        4    20.0   22.9  6400.0   25.22  344.44  101.14    SS
   6500.   .3451        4    20.0   22.9  6400.0   25.22  370.04  105.99    SS
   7000.   .3100        4    20.0   22.9  6400.0   25.22  395.41  110.69    SS
   7500.   .2804        4    20.0   22.9  6400.0   25.22  420.57  115.27    SS
   8000.   .2553        4    20.0   22.9  6400.0   25.22  445.53  119.74    SS
   8500.   .2337        4    20.0   22.9  6400.0   25.22  470.30  124.10    SS
   9000.   .2150        4    20.0   22.9  6400.0   25.22  494.90  128.36    SS
   9500.   .1987        4    20.0   22.9  6400.0   25.22  519.34  132.53    SS
  10000.   .1853        4    20.0   22.9  6400.0   25.22  543.62  135.89    SS
  15000.   .1037        4    20.0   22.9  6400.0   25.22  779.22  170.51    SS
  20000.   .6860E-01    4    20.0   22.9  6400.0   25.22 1004.75  200.41    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    100.   25.07        4    20.0   22.9  6400.0   24.43    8.20   13.65    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    364.2        CONC (UG/M**3)     =    364.2
   CRIT WS @10M (M/S) =     8.83        CRIT WS @10M (M/S) =     8.83
   CRIT WS @ HS (M/S) =    10.55        CRIT WS @ HS (M/S) =    10.55
   DILUTION WS (M/S)  =     5.28        DILUTION WS (M/S)  =     5.28
   CAVITY HT (M)      =    29.86        CAVITY HT (M)      =    29.86
   CAVITY LENGTH (M)  =    28.29        CAVITY LENGTH (M)  =    28.29
   ALONGWIND DIM (M)  =    17.51        ALONGWIND DIM (M)  =    17.51
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      25.07          100.        0.
 BLDG. CAVITY-1      364.2           28.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      364.2           28.       --  (DIST = CAVITY LENGTH)
****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ****************************************************
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Name_ID: Talagy_TALAGY

```
03/16/09
12:46:21
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      25.9100
    STK INSIDE DIAM (M)    =        .8000
    STK EXIT VELOCITY (M/S)=      43.7000
    STK GAS EXIT TEMP (K)  =     594.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      19.8100
    MIN HORIZ BLDG DIM (M) =      13.7200
    MAX HORIZ BLDG DIM (M) =      17.2500
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
 BUOY. FLUX =   38.426 M**4/S**3;  MOM. FLUX =  134.308 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	15.91	4	20.0	23.1	6400.0	25.98	8.20	12.59	SS
200.	17.20	4	20.0	23.1	6400.0	26.19	15.56	18.11	SS
300.	13.09	4	20.0	23.1	6400.0	26.53	22.61	21.03	SS
400.	10.35	4	20.0	23.1	6400.0	26.99	29.45	23.86	SS
500.	8.431	4	20.0	23.1	6400.0	27.44	36.15	26.61	SS
600.	7.111	4	20.0	23.1	6400.0	27.44	42.72	29.30	SS
700.	6.073	4	20.0	23.1	6400.0	27.44	49.19	31.93	SS
800.	5.358	4	20.0	23.1	6400.0	27.44	55.57	32.32	SS
900.	4.718	4	20.0	23.1	6400.0	27.44	61.88	34.35	SS
1000.	4.193	4	20.0	23.1	6400.0	27.44	68.13	36.31	SS
1100.	3.755	4	20.0	23.1	6400.0	27.44	74.31	38.21	SS
1200.	3.387	4	20.0	23.1	6400.0	27.44	80.44	40.06	SS
1300.	3.073	4	20.0	23.1	6400.0	27.44	86.52	41.87	SS
1400.	2.804	4	20.0	23.1	6400.0	27.44	92.55	43.63	SS
1500.	2.571	4	20.0	23.1	6400.0	27.44	98.54	45.36	SS
1600.	2.368	4	20.0	23.1	6400.0	27.44	104.49	47.05	SS
1700.	2.189	4	20.0	23.1	6400.0	27.44	110.41	48.71	SS
1800.	2.032	4	20.0	23.1	6400.0	27.44	116.28	50.33	SS
1900.	1.892	4	20.0	23.1	6400.0	27.44	122.13	51.93	SS
2000.	1.767	4	20.0	23.1	6400.0	27.44	127.94	53.50	SS
2100.	1.655	4	20.0	23.1	6400.0	27.44	133.73	55.05	SS
2200.	1.555	4	20.0	23.1	6400.0	27.44	139.48	56.57	SS
2300.	1.463	4	20.0	23.1	6400.0	27.44	145.21	58.07	SS
2400.	1.381	4	20.0	23.1	6400.0	27.44	150.91	59.55	SS
2500.	1.305	4	20.0	23.1	6400.0	27.44	156.59	61.01	SS
2600.	1.237	4	20.0	23.1	6400.0	27.44	162.24	62.45	SS
2700.	1.173	4	20.0	23.1	6400.0	27.44	167.88	63.87	SS
2800.	1.125	4	20.0	23.1	6400.0	27.44	173.48	64.58	SS
2900.	1.072	4	20.0	23.1	6400.0	27.44	179.07	65.92	SS
3000.	1.023	4	20.0	23.1	6400.0	27.44	184.64	67.22	SS

Talagy_TALAGY, cont.

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  3500.   .8256        4    20.0   23.1  6400.0   27.44  212.19   73.46    SS
  4000.   .6843        4    20.0   23.1  6400.0   27.44  239.31   79.37    SS
  4500.   .5791        4    20.0   23.1  6400.0   27.44  266.06   85.01    SS
  5000.   .4983        4    20.0   23.1  6400.0   27.44  292.47   90.41    SS
  5500.   .4347        4    20.0   23.1  6400.0   27.44  318.59   95.61    SS
  6000.   .3835        4    20.0   23.1  6400.0   27.44  344.44  100.64    SS
  6500.   .3417        4    20.0   23.1  6400.0   27.44  370.04  105.50    SS
  7000.   .3069        4    20.0   23.1  6400.0   27.44  395.41  110.22    SS
  7500.   .2777        4    20.0   23.1  6400.0   27.44  420.57  114.81    SS
  8000.   .2528        4    20.0   23.1  6400.0   27.44  445.53  119.29    SS
  8500.   .2315        4    20.0   23.1  6400.0   27.44  470.30  123.66    SS
  9000.   .2130        4    20.0   23.1  6400.0   27.44  494.90  127.93    SS
  9500.   .1968        4    20.0   23.1  6400.0   27.44  519.34  132.10    SS
 10000.   .1834        4    20.0   23.1  6400.0   27.44  543.62  135.56    SS
 15000.   .1027        4    20.0   23.1  6400.0   27.44  779.22  170.24    SS
 20000.   .6796E-01    4    20.0   23.1  6400.0   27.44 1004.75  200.17    SS
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
   155.   17.35        4    20.0   23.1  6400.0   26.08   12.37   15.44    SS
 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
 ****************************************
     *** REGULATORY (Default) ***
    PERFORMING CAVITY CALCULATIONS
  WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
****************************************
  *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)     =    331.8        CONC (UG/M**3)     =    253.0
  CRIT WS @10M (M/S) =     9.72        CRIT WS @10M (M/S) =    16.03
  CRIT WS @ HS (M/S) =    11.76        CRIT WS @ HS (M/S) =    19.39
  DILUTION WS (M/S)  =     5.88        DILUTION WS (M/S)  =     9.70
  CAVITY HT (M)      =    32.69        CAVITY HT (M)      =    30.03
  CAVITY LENGTH (M)  =    32.18        CAVITY LENGTH (M)  =    23.02
  ALONGWIND DIM (M)  =    13.72        ALONGWIND DIM (M)  =    17.25
 ****************************************
      END OF CAVITY CALCULATIONS
****************************************
      ****************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ****************************************
 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      17.35          155.        0.
BLDG. CAVITY-1      331.8           32.       --  (DIST = CAVITY LENGTH)
BLDG. CAVITY-2      253.0           23.       --  (DIST = CAVITY LENGTH)

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Name_ID: Tor Viking II_TOR_H

```
03/16/09
12:46:22
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =     110.3786
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     579.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      18.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   16.399 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   17.61        4    20.0   23.5  6400.0   28.97   10.21   16.68    SS
    200.   15.62        4    20.0   23.5  6400.0   29.02   16.91   22.73    SS
    300.   11.49        4    20.0   23.5  6400.0   29.07   24.53   27.30    SS
    400.   9.028        4    20.0   23.5  6400.0   29.07   31.33   29.97    SS
    500.   7.417        4    20.0   23.5  6400.0   29.07   37.98   31.21    SS
    600.   6.245        4    20.0   23.5  6400.0   29.07   44.52   33.45    SS
    700.   5.366        4    20.0   23.5  6400.0   29.07   50.97   35.43    SS
    800.   4.680        4    20.0   23.5  6400.0   29.07   57.33   37.36    SS
    900.   4.131        4    20.0   23.5  6400.0   29.07   63.62   39.24    SS
   1000.   3.682        4    20.0   23.5  6400.0   29.07   69.85   41.06    SS
   1100.   3.309        4    20.0   23.5  6400.0   29.07   76.02   42.84    SS
   1200.   2.996        4    20.0   23.5  6400.0   29.07   82.13   44.59    SS
   1300.   2.729        4    20.0   23.5  6400.0   29.07   88.20   46.29    SS
   1400.   2.499        4    20.0   23.5  6400.0   29.07   94.22   47.96    SS
   1500.   2.299        4    20.0   23.5  6400.0   29.07  100.20   49.60    SS
   1600.   2.125        4    20.0   23.5  6400.0   29.07  106.14   51.21    SS
   1700.   1.971        4    20.0   23.5  6400.0   29.07  112.04   52.80    SS
   1800.   1.835        4    20.0   23.5  6400.0   29.07  117.91   54.35    SS
   1900.   1.714        4    20.0   23.5  6400.0   29.07  123.75   55.89    SS
   2000.   1.605        4    20.0   23.5  6400.0   29.07  129.55   57.40    SS
   2100.   1.507        4    20.0   23.5  6400.0   29.07  135.33   58.88    SS
   2200.   1.419        4    20.0   23.5  6400.0   29.07  141.08   60.35    SS
   2300.   1.339        4    20.0   23.5  6400.0   29.07  146.80   61.80    SS
   2400.   1.266        4    20.0   23.5  6400.0   29.07  152.49   63.23    SS
   2500.   1.200        4    20.0   23.5  6400.0   29.07  158.16   64.64    SS
   2600.   1.151        4    20.0   23.5  6400.0   29.07  163.81   65.16    SS
   2700.   1.095        4    20.0   23.5  6400.0   29.07  169.44   66.46    SS
   2800.   1.044        4    20.0   23.5  6400.0   29.07  175.04   67.75    SS
   2900.   .9960        4    20.0   23.5  6400.0   29.07  180.62   69.02    SS
   3000.   .9520        4    20.0   23.5  6400.0   29.07  186.18   70.28    SS
```

Tor Viking II_TOR_H, cont.

```
   3500.   .7735        4    20.0   23.5  6400.0   29.07  213.70   76.35    SS
   4000.   .6445        4    20.0   23.5  6400.0   29.07  240.80   82.13    SS
   4500.   .5477        4    20.0   23.5  6400.0   29.07  267.53   87.65    SS
   5000.   .4729        4    20.0   23.5  6400.0   29.07  293.93   92.95    SS
   5500.   .4138        4    20.0   23.5  6400.0   29.07  320.03   98.06    SS
   6000.   .3660        4    20.0   23.5  6400.0   29.07  345.87  103.00    SS
   6500.   .3268        4    20.0   23.5  6400.0   29.07  371.45  107.80    SS
   7000.   .2941        4    20.0   23.5  6400.0   29.07  396.81  112.45    SS
   7500.   .2665        4    20.0   23.5  6400.0   29.07  421.96  116.99    SS
   8000.   .2430        4    20.0   23.5  6400.0   29.07  446.91  121.41    SS
   8500.   .2228        4    20.0   23.5  6400.0   29.07  471.67  125.73    SS
   9000.   .2052        4    20.0   23.5  6400.0   29.07  496.27  129.95    SS
   9500.   .1898        4    20.0   23.5  6400.0   29.07  520.69  134.09    SS
  10000.   .1776        4    20.0   23.5  6400.0   29.07  544.96  137.11    SS
  15000.   .9990E-01    4    20.0   23.5  6400.0   29.07  780.50  171.54    SS
  20000.   .6631E-01    4    20.0   23.5  6400.0   29.07 1005.98  201.32    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    113.   17.69        4    20.0   23.5  6400.0   28.98   11.15   17.52    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1519.        CONC (UG/M**3)     =    1794.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    41.69        CAVITY HT (M)      =    39.32
   CAVITY LENGTH (M)  =    36.34        CAVITY LENGTH (M)  =    28.56
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    18.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.69          113.        0.
 BLDG. CAVITY-1      1519.           36.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1794.           29.       --  (DIST = CAVITY LENGTH)
****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ****************************************************
```

Name_ID: Odin Viking II_ODIN_H

```
03/16/09
12:46:22
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =      94.6102
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     579.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      16.9000
    MAX HORIZ BLDG DIM (M) =      16.9000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   12.048 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   17.88        4    20.0   23.5  6400.0   28.97   10.26   16.84    SS
    200.   15.67        4    20.0   23.5  6400.0   29.00   16.96   22.90    SS
    300.   11.51        4    20.0   23.5  6400.0   29.01   24.58   27.59    SS
    400.   9.026        4    20.0   23.5  6400.0   29.01   31.37   30.25    SS
    500.   7.410        4    20.0   23.5  6400.0   29.01   38.03   31.55    SS
    600.   6.236        4    20.0   23.5  6400.0   29.01   44.57   33.71    SS
    700.   5.356        4    20.0   23.5  6400.0   29.01   51.01   35.69    SS
    800.   4.670        4    20.0   23.5  6400.0   29.01   57.38   37.61    SS
    900.   4.121        4    20.0   23.5  6400.0   29.01   63.67   39.48    SS
   1000.   3.673        4    20.0   23.5  6400.0   29.01   69.89   41.30    SS
   1100.   3.301        4    20.0   23.5  6400.0   29.01   76.06   43.07    SS
   1200.   2.988        4    20.0   23.5  6400.0   29.01   82.17   44.81    SS
   1300.   2.722        4    20.0   23.5  6400.0   29.01   88.24   46.51    SS
   1400.   2.492        4    20.0   23.5  6400.0   29.01   94.26   48.18    SS
   1500.   2.293        4    20.0   23.5  6400.0   29.01  100.24   49.82    SS
   1600.   2.119        4    20.0   23.5  6400.0   29.01  106.18   51.42    SS
   1700.   1.966        4    20.0   23.5  6400.0   29.01  112.08   53.00    SS
   1800.   1.831        4    20.0   23.5  6400.0   29.01  117.95   54.56    SS
   1900.   1.710        4    20.0   23.5  6400.0   29.01  123.79   56.08    SS
   2000.   1.601        4    20.0   23.5  6400.0   29.01  129.59   57.59    SS
   2100.   1.504        4    20.0   23.5  6400.0   29.01  135.37   59.08    SS
   2200.   1.416        4    20.0   23.5  6400.0   29.01  141.12   60.54    SS
   2300.   1.336        4    20.0   23.5  6400.0   29.01  146.84   61.99    SS
   2400.   1.263        4    20.0   23.5  6400.0   29.01  152.53   63.42    SS
   2500.   1.197        4    20.0   23.5  6400.0   29.01  158.20   64.83    SS
   2600.   1.149        4    20.0   23.5  6400.0   29.01  163.85   65.32    SS
   2700.   1.093        4    20.0   23.5  6400.0   29.01  169.47   66.62    SS
   2800.   1.042        4    20.0   23.5  6400.0   29.01  175.08   67.91    SS
   2900.   .9943        4    20.0   23.5  6400.0   29.01  180.66   69.18    SS
   3000.   .9504        4    20.0   23.5  6400.0   29.01  186.22   70.43    SS
```

Odin Viking II_ODIN_H, cont.

```
   3500.   .7723        4    20.0   23.5  6400.0   29.01  213.74   76.50    SS
   4000.   .6435        4    20.0   23.5  6400.0   29.01  240.84   82.27    SS
   4500.   .5470        4    20.0   23.5  6400.0   29.01  267.57   87.78    SS
   5000.   .4724        4    20.0   23.5  6400.0   29.01  293.97   93.08    SS
   5500.   .4133        4    20.0   23.5  6400.0   29.01  320.07   98.19    SS
   6000.   .3656        4    20.0   23.5  6400.0   29.01  345.90  103.13    SS
   6500.   .3265        4    20.0   23.5  6400.0   29.01  371.49  107.91    SS
   7000.   .2938        4    20.0   23.5  6400.0   29.01  396.85  112.57    SS
   7500.   .2663        4    20.0   23.5  6400.0   29.01  421.99  117.10    SS
   8000.   .2428        4    20.0   23.5  6400.0   29.01  446.94  121.52    SS
   8500.   .2226        4    20.0   23.5  6400.0   29.01  471.71  125.84    SS
   9000.   .2050        4    20.0   23.5  6400.0   29.01  496.30  130.06    SS
   9500.   .1897        4    20.0   23.5  6400.0   29.01  520.72  134.19    SS
  10000.   .1775        4    20.0   23.5  6400.0   29.01  544.99  137.19    SS
  15000.   .9987E-01    4    20.0   23.5  6400.0   29.01  780.53  171.61    SS
  20000.   .6629E-01    4    20.0   23.5  6400.0   29.01 1006.01  201.38    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    109.   17.92        4    20.0   23.5  6400.0   28.97   10.93   17.45    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1618.        CONC (UG/M**3)     =    1618.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    40.22        CAVITY HT (M)      =    40.22
   CAVITY LENGTH (M)  =    32.47        CAVITY LENGTH (M)  =    32.47
   ALONGWIND DIM (M)  =    16.90        ALONGWIND DIM (M)  =    16.90
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.92          109.        0.
 BLDG. CAVITY-1      1618.           32.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1618.           32.       --  (DIST = CAVITY LENGTH)
****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ****************************************************
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Name_ID: Balder Viking_BALD_H

```
03/16/09
12:46:22
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =     110.3786
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     579.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      18.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
 BUOY. FLUX =   16.399 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   17.61        4    20.0   23.5  6400.0   28.97   10.21   16.68    SS
    200.   15.62        4    20.0   23.5  6400.0   29.02   16.91   22.73    SS
    300.   11.49        4    20.0   23.5  6400.0   29.07   24.53   27.30    SS
    400.   9.028        4    20.0   23.5  6400.0   29.07   31.33   29.97    SS
    500.   7.417        4    20.0   23.5  6400.0   29.07   37.98   31.21    SS
    600.   6.245        4    20.0   23.5  6400.0   29.07   44.52   33.45    SS
    700.   5.366        4    20.0   23.5  6400.0   29.07   50.97   35.43    SS
    800.   4.680        4    20.0   23.5  6400.0   29.07   57.33   37.36    SS
    900.   4.131        4    20.0   23.5  6400.0   29.07   63.62   39.24    SS
   1000.   3.682        4    20.0   23.5  6400.0   29.07   69.85   41.06    SS
   1100.   3.309        4    20.0   23.5  6400.0   29.07   76.02   42.84    SS
   1200.   2.996        4    20.0   23.5  6400.0   29.07   82.13   44.59    SS
   1300.   2.729        4    20.0   23.5  6400.0   29.07   88.20   46.29    SS
   1400.   2.499        4    20.0   23.5  6400.0   29.07   94.22   47.96    SS
   1500.   2.299        4    20.0   23.5  6400.0   29.07  100.20   49.60    SS
   1600.   2.125        4    20.0   23.5  6400.0   29.07  106.14   51.21    SS
   1700.   1.971        4    20.0   23.5  6400.0   29.07  112.04   52.80    SS
   1800.   1.835        4    20.0   23.5  6400.0   29.07  117.91   54.35    SS
   1900.   1.714        4    20.0   23.5  6400.0   29.07  123.75   55.89    SS
   2000.   1.605        4    20.0   23.5  6400.0   29.07  129.55   57.40    SS
   2100.   1.507        4    20.0   23.5  6400.0   29.07  135.33   58.88    SS
   2200.   1.419        4    20.0   23.5  6400.0   29.07  141.08   60.35    SS
   2300.   1.339        4    20.0   23.5  6400.0   29.07  146.80   61.80    SS
   2400.   1.266        4    20.0   23.5  6400.0   29.07  152.49   63.23    SS
   2500.   1.200        4    20.0   23.5  6400.0   29.07  158.16   64.64    SS
   2600.   1.151        4    20.0   23.5  6400.0   29.07  163.81   65.16    SS
   2700.   1.095        4    20.0   23.5  6400.0   29.07  169.44   66.46    SS
   2800.   1.044        4    20.0   23.5  6400.0   29.07  175.04   67.75    SS
   2900.   .9960        4    20.0   23.5  6400.0   29.07  180.62   69.02    SS
   3000.   .9520        4    20.0   23.5  6400.0   29.07  186.18   70.28    SS
```

Balder Viking_BALD_H, cont.

```
   3500.   .7735        4    20.0   23.5  6400.0   29.07  213.70   76.35    SS
   4000.   .6445        4    20.0   23.5  6400.0   29.07  240.80   82.13    SS
   4500.   .5477        4    20.0   23.5  6400.0   29.07  267.53   87.65    SS
   5000.   .4729        4    20.0   23.5  6400.0   29.07  293.93   92.95    SS
   5500.   .4138        4    20.0   23.5  6400.0   29.07  320.03   98.06    SS
   6000.   .3660        4    20.0   23.5  6400.0   29.07  345.87  103.00    SS
   6500.   .3268        4    20.0   23.5  6400.0   29.07  371.45  107.80    SS
   7000.   .2941        4    20.0   23.5  6400.0   29.07  396.81  112.45    SS
   7500.   .2665        4    20.0   23.5  6400.0   29.07  421.96  116.99    SS
   8000.   .2430        4    20.0   23.5  6400.0   29.07  446.91  121.41    SS
   8500.   .2228        4    20.0   23.5  6400.0   29.07  471.67  125.73    SS
   9000.   .2052        4    20.0   23.5  6400.0   29.07  496.27  129.95    SS
   9500.   .1898        4    20.0   23.5  6400.0   29.07  520.69  134.09    SS
  10000.   .1776        4    20.0   23.5  6400.0   29.07  544.96  137.11    SS
  15000.   .9990E-01    4    20.0   23.5  6400.0   29.07  780.50  171.54    SS
  20000.   .6631E-01    4    20.0   23.5  6400.0   29.07 1005.98  201.32    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    113.   17.69        4    20.0   23.5  6400.0   28.98   11.15   17.52    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1519.        CONC (UG/M**3)     =    1794.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    41.69        CAVITY HT (M)      =    39.32
   CAVITY LENGTH (M)  =    36.34        CAVITY LENGTH (M)  =    28.56
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    18.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.69          113.        0.
 BLDG. CAVITY-1      1519.           36.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1794.           29.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
```

Name_ID: Vidar Viking_VIDAR_H

```
03/16/09
12:46:22
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***
SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      28.9600
    STK INSIDE DIAM (M)    =     110.3786
    STK EXIT VELOCITY (M/S)=        .0010
    STK GAS EXIT TEMP (K)  =     579.0000
    AMBIENT AIR TEMP (K)   =     261.1000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      24.3800
    MIN HORIZ BLDG DIM (M) =      15.2400
    MAX HORIZ BLDG DIM (M) =      18.0000
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.
BUOY. FLUX =   16.399 M**4/S**3;  MOM. FLUX =     .001 M**4/S**2.
 *** STABILITY CLASS  4 ONLY ***
 *** ANEMOMETER HEIGHT WIND SPEED OF  20.00 M/S ONLY ***
 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************
 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
   DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
    100.   17.61        4    20.0   23.5  6400.0   28.97   10.21   16.68    SS
    200.   15.62        4    20.0   23.5  6400.0   29.02   16.91   22.73    SS
    300.   11.49        4    20.0   23.5  6400.0   29.07   24.53   27.30    SS
    400.   9.028        4    20.0   23.5  6400.0   29.07   31.33   29.97    SS
    500.   7.417        4    20.0   23.5  6400.0   29.07   37.98   31.21    SS
    600.   6.245        4    20.0   23.5  6400.0   29.07   44.52   33.45    SS
    700.   5.366        4    20.0   23.5  6400.0   29.07   50.97   35.43    SS
    800.   4.680        4    20.0   23.5  6400.0   29.07   57.33   37.36    SS
    900.   4.131        4    20.0   23.5  6400.0   29.07   63.62   39.24    SS
   1000.   3.682        4    20.0   23.5  6400.0   29.07   69.85   41.06    SS
   1100.   3.309        4    20.0   23.5  6400.0   29.07   76.02   42.84    SS
   1200.   2.996        4    20.0   23.5  6400.0   29.07   82.13   44.59    SS
   1300.   2.729        4    20.0   23.5  6400.0   29.07   88.20   46.29    SS
   1400.   2.499        4    20.0   23.5  6400.0   29.07   94.22   47.96    SS
   1500.   2.299        4    20.0   23.5  6400.0   29.07  100.20   49.60    SS
   1600.   2.125        4    20.0   23.5  6400.0   29.07  106.14   51.21    SS
   1700.   1.971        4    20.0   23.5  6400.0   29.07  112.04   52.80    SS
   1800.   1.835        4    20.0   23.5  6400.0   29.07  117.91   54.35    SS
   1900.   1.714        4    20.0   23.5  6400.0   29.07  123.75   55.89    SS
   2000.   1.605        4    20.0   23.5  6400.0   29.07  129.55   57.40    SS
   2100.   1.507        4    20.0   23.5  6400.0   29.07  135.33   58.88    SS
   2200.   1.419        4    20.0   23.5  6400.0   29.07  141.08   60.35    SS
   2300.   1.339        4    20.0   23.5  6400.0   29.07  146.80   61.80    SS
   2400.   1.266        4    20.0   23.5  6400.0   29.07  152.49   63.23    SS
   2500.   1.200        4    20.0   23.5  6400.0   29.07  158.16   64.64    SS
   2600.   1.151        4    20.0   23.5  6400.0   29.07  163.81   65.16    SS
   2700.   1.095        4    20.0   23.5  6400.0   29.07  169.44   66.46    SS
   2800.   1.044        4    20.0   23.5  6400.0   29.07  175.04   67.75    SS
   2900.   .9960        4    20.0   23.5  6400.0   29.07  180.62   69.02    SS
   3000.   .9520        4    20.0   23.5  6400.0   29.07  186.18   70.28    SS
```

Vidar Viking_VIDAR_H, cont.

```
   3500.   .7735        4    20.0   23.5  6400.0   29.07  213.70   76.35    SS
   4000.   .6445        4    20.0   23.5  6400.0   29.07  240.80   82.13    SS
   4500.   .5477        4    20.0   23.5  6400.0   29.07  267.53   87.65    SS
   5000.   .4729        4    20.0   23.5  6400.0   29.07  293.93   92.95    SS
   5500.   .4138        4    20.0   23.5  6400.0   29.07  320.03   98.06    SS
   6000.   .3660        4    20.0   23.5  6400.0   29.07  345.87  103.00    SS
   6500.   .3268        4    20.0   23.5  6400.0   29.07  371.45  107.80    SS
   7000.   .2941        4    20.0   23.5  6400.0   29.07  396.81  112.45    SS
   7500.   .2665        4    20.0   23.5  6400.0   29.07  421.96  116.99    SS
   8000.   .2430        4    20.0   23.5  6400.0   29.07  446.91  121.41    SS
   8500.   .2228        4    20.0   23.5  6400.0   29.07  471.67  125.73    SS
   9000.   .2052        4    20.0   23.5  6400.0   29.07  496.27  129.95    SS
   9500.   .1898        4    20.0   23.5  6400.0   29.07  520.69  134.09    SS
  10000.   .1776        4    20.0   23.5  6400.0   29.07  544.96  137.11    SS
  15000.   .9990E-01    4    20.0   23.5  6400.0   29.07  780.50  171.54    SS
  20000.   .6631E-01    4    20.0   23.5  6400.0   29.07 1005.98  201.32    SS
 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
    113.   17.69        4    20.0   23.5  6400.0   28.98   11.15   17.52    SS
  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB
  ****************************************
      *** REGULATORY (Default) ***
     PERFORMING CAVITY CALCULATIONS
   WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
 ****************************************
   *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)     =    1519.        CONC (UG/M**3)     =    1794.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.24        CRIT WS @ HS (M/S) =     1.24
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    41.69        CAVITY HT (M)      =    39.32
   CAVITY LENGTH (M)  =    36.34        CAVITY LENGTH (M)  =    28.56
   ALONGWIND DIM (M)  =    15.24        ALONGWIND DIM (M)  =    18.00
  ****************************************
       END OF CAVITY CALCULATIONS
 ****************************************
       ****************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ****************************************
  CALCULATION        MAX CONC    DIST TO   TERRAIN
   PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
 --------------    -----------   -------   -------
 SIMPLE TERRAIN      17.69          113.        0.
 BLDG. CAVITY-1      1519.           36.       --  (DIST = CAVITY LENGTH)
 BLDG. CAVITY-2      1794.           29.       --  (DIST = CAVITY LENGTH)
*****************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 *****************************************************
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APPENDIX F

Regional Source Emission Inventory

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Badami Facility	Glycol Skid Heater	BA2	0.84	0.08	0.56	1.50	0.06	0.36	496260	7782676	6.71	0.305	466	20.12
	Main Generator	BA3	49.26	3.33	1.55	82.74	3.45	19.83	496287	7782557	12.19	0.610	740	38.10
	Main Generator[2]	BA4	20.93	1.42	0.66	82.74	3.45	19.83	426012	7776884	12.19	0.610	740	38.10
	SmartAsh Waste Incinerator[3]	BA5	0.00	0.00	0.00	0.31	0.01	0.07	426012	7776884	1.50	0.300	870	2.90
	Combustion Turbine	BA6	30.27	2.11	0.00	124.45	5.19	29.83	496318	7782554	18.29	1.829	574	21.95
	Combustion Turbine	BA7	6.47	0.39	0.00	124.45	5.19	29.83	496318	7782548	18.29	1.829	574	21.95
	Waste Incinerator	BA8	0.02	0.01	0.03	0.37	0.02	0.09	496235	7782595	8.23	0.305	750	24.99
	Production Heater[4]	BA9	2.49	0.02	0.00	19.85	0.83	4.76	496276	7782586	5.49	24.980	409	0.01
	Miscible Injectant Heater[5]	BA10	0.00	0.00	0.00	8.69	0.36	2.08	496240	7782590	8.23	19.150	644	0.01
	TEG Reboiler	BA11	0.06	0.01	0.00	0.58	0.02	0.14	496240	7782584	8.23	0.305	700	2.13
	Flare	BA12	1.01	0.39	0.00	5.18	0.22	1.24	496108	7782597	36.58	5.182	1273	20.12
	Crane	BA13	0.39	0.03	0.01	0.00	0.00	0.00	496271	7782575	3.66	0.305	765	49.99
	Light Plant	BA14	0.05	0.00	0.00	0.00	0.00	0.00	496297	7782656	1.83	0.305	765	49.99
	Light Plant[2]	BA15	0.00	0.00	0.00	0.00	0.00	0.00	426012	7776884	1.83	0.305	765	49.99
	Air Compressor	BA16	0.01	0.00	0.00	0.00	0.00	0.00	496304	7782602	1.83	0.305	765	49.99
	Welder	BA17	0.02	0.00	0.00	0.00	0.00	0.00	496272	7782569	1.83	0.305	765	49.99
	Heater's IC-engine (605)	BA18	0.67	0.05	0.02	0.00	0.00	0.00	496250	7782686	1.83	0.305	765	49.99
	Heater's IC-engine (606)	BA19	0.29	0.02	0.01	0.00	0.00	0.00	496265	7782686	1.83	0.305	765	49.99
	Heaters (607)	BA20	0.20	0.02	0.13	0.00	0.00	0.00	496280	7782686	1.83	0.305	765	49.99
	Heaters (608)	BA21	0.07	0.01	0.04	0.00	0.00	0.00	496295	7782686	1.83	0.305	765	49.99
	Drilling Rig Equipment[6]	BA22	0.00	0.00	0.00	150.59	6.29	36.09	496240	7782860	12.19	0.457	461	9.14
	CTU Power Pack[6]	BA23	0.00	0.00	0.00	28.85	1.20	6.91	496265	7782860	3.70	0.150	800	55.00
	Hot Oil Tractor/Pump[6]	BA24	0.00	0.00	0.00	44.84	1.87	10.75	496280	7782860	3.70	0.250	830	55.00
	CTU Tractor/Pump[6]	BA25	0.00	0.00	0.00	30.56	1.28	7.32	496295	7782860	3.70	0.150	800	60.00

[1]Potential emissions taken from Hoefler Consulting Application for Badami Restart
[2]Exhaust temperatures for BA4 and BA15 taken from BA3 and BA14 respectively. This is based on equipment similarities.
[3]All stack parameters for BA5 taken from Hoeffler Consulting Application for Badami Restart.
[4]Exhaust Velocity for BA9 taken from Hoeffler Consulting Application for Badami Restart.
[5]Stack Diameter and Exhaust Velocity for BA10 taken from Hoeffler Consulting Application for Badami Restart.
[6]All source information for sources BA22-25 taken from Hoeffler Consulting Application for Badami Restart.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)[4]	N-S UTM NAD 27 Zone 6 (m)[4]	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Base Operations Center	GNED-410101 - Emerg Gen[2]	BOC1	1.46	0.05	0.04	See below	See below	See below	435600	7799500	16.76	0.914	727	42.98
	GNED-410102 - Emerg Gen[2]	BOC2	0.78	0.02	0.02	See below	See below	See below	435600	7799500	16.76	0.914	727	42.98
	NGED-410103 - Emerg Gen[2]	BOC3	1.28	0.04	0.03	See below	See below	See below	435600	7799500	16.76	0.914	727	42.98
	PED-100217 - Emerg Fire Pump[3]	BOC4	0.13	0.01	0.00	See below	See below	See below	435600	7799500	12.19	0.079	602	57.91
	PED-460213 - Emerg Fire Pump[3]	BOC5	0.04	0.00	0.00	See below	See below	See below	435600	7799500	12.19	0.079	602	57.91

[1]All potential emissions were modeled from ADEC files shown in the table below.
[2]All stack parameters for sources BOC1-3 were taken from CCP21. This is based on equipment similarities.
[3]All stack parameters for sources BOC4 and 5 were taken from CCP23. This is based on equipment similarities.
[4]Coordinates for all sources taken from ADEC modeling files due to the inaccuracy of coordinates from the emissions inventory.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Base Operations Center		1701	n/a	n/a	n/a	1164.52	36.99	170.93	435600	7799500	12.2	0.5	1366	6.90

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Central Compressor Plant	NGT-18-1801- Gas Compressor	CCP1	608.12	10.44	6.96	See below	See below	See below	443635	7801909	31.09	2.438	750	62.79
	NGT-18-1802- Gas Compressor	CCP2	410.59	10.47	6.98	See below	See below	See below	443642	7801866	31.09	2.438	754	63.40
	NGT-18-1803- Gas Compressor	CCP3	607.86	10.44	6.96	See below	See below	See below	443630	7801937	31.09	2.438	750	62.79
	NGT-18-1804 - Gas Compressor	CCP4	604.16	10.37	6.92	See below	See below	See below	443646	7801842	31.09	2.438	750	62.79
	NGT-18-1805 - Gas Compressor	CCP5	606.59	10.42	6.94	See below	See below	See below	443677	7801826	31.09	2.438	750	62.79
	NGT-18-1806 - Gas Compressor	CCP6	591.81	10.16	6.77	See below	See below	See below	443624	7801962	31.09	2.438	750	62.79
	NGT-18-1807 - Gas Compressor	CCP7	581.08	9.98	6.65	See below	See below	See below	443650	7801974	31.09	2.438	750	62.79
	NGT-18-1808 - Gas Compressor	CCP8	606.04	10.41	6.94	See below	See below	See below	443652	7801818	31.09	2.438	750	62.79
	NGT-18-1809 - Gas Compressor	CCP9	604.38	10.38	6.92	See below	See below	See below	443669	7801876	31.09	2.438	750	62.79
	NGT-18-1810 - Gas Compressor	CCP10	600.55	10.31	6.87	See below	See below	See below	443661	7801922	31.09	2.438	750	62.79
	NGT-18-1811 - Gas Compressor	CCP11	609.19	10.46	6.97	See below	See below	See below	443673	7801850	31.09	2.438	750	62.79
	NGT-18-1812 - Gas Compressor	CCP12	607.95	10.44	6.96	See below	See below	See below	443656	7801949	31.09	2.438	750	62.79
	NGT-18-1813 - Gas Compressor	CCP13	602.41	10.34	6.90	See below	See below	See below	443620	7801990	31.09	2.438	750	62.79
	NGT-18-1876 - Gas Compressor	CCP14	557.62	10.26	6.84	See below	See below	See below	443599	7802013	34.44	3.048	774	41.45
	NGT-18-1878 - Gas Compressor	CCP15	568.77	10.47	6.98	See below	See below	See below	443653	7802022	34.44	3.048	774	41.45
	NGH-18-1410 - Broach Glycol Heater	CCP16	3.76	0.35	0.21	See below	See below	See below	443796	7801899	42.37	1.219	422	2.13
	NGH-18-1491 - Broach Glycol Heater	CCP17	6.37	0.49	0.28	See below	See below	See below	443781	7801896	20.12	1.219	422	6.40
	NGH-18-1492 - Broach Glycol Heater	CCP18	3.57	0.27	0.16	See below	See below	See below	443790	7801896	20.12	1.219	422	6.40
	NGH-21-1501 - Eclipse Glycol Heater	CCP19	2.46	0.19	0.11	See below	See below	See below	443723	7802113	21.03	0.914	611	3.66
	NGH-21-1502 - Eclipse Glycol Heater	CCP20	0.34	0.03	0.02	See below	See below	See below	443724	7802107	21.03	0.914	611	3.66
	EDTG-18-2897 - Emergency Generator	CCP21	0.17	0.00	0.02	See below	See below	See below	443745	7801930	16.76	0.914	727	42.98
	EDTG-18-2897-01 - Emergency Generator	CCP22	0.85	0.03	0.02	See below	See below	See below	443765	7801908	12.80	0.610	616	42.06
	EGD-18-1522 - Emergency Fire Water Pump [2]	CCP23	0.25	0.02	0.01	See below	See below	See below	443765	7801908	12.19	0.079	602	57.91
	Flares	CCP24	13.38	5.47	0.86	See below	See below	See below	442604	7802667	2.13	0.610	1273	20.12

[1]All potential emissions were modeled from ADEC files shown in the table below.

[2]Stack diameter for CCP23 calculated given 600 acfm.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Central Compressor Plant		801P	n/a	n/a	n/a	957.69	23.34	9.89	443637	7802083	31.1	2.4	750	62.9
		802P	n/a	n/a	n/a	574.61	14.00	5.93	443644	7802040	31.1	2.4	754	63.3
		803P	n/a	n/a	n/a	957.69	23.34	9.89	443632	7802110	31.1	2.4	750	62.9
		804P	n/a	n/a	n/a	957.69	23.34	9.89	443648	7802015	31.1	2.4	750	62.9
		805P	n/a	n/a	n/a	957.69	23.34	9.89	443679	7801999	31.1	2.4	750	62.9
		806P	n/a	n/a	n/a	957.69	23.34	9.89	443627	7802136	31.1	2.4	750	62.9
		807P	n/a	n/a	n/a	957.69	23.34	9.89	443653	7802148	31.1	2.4	750	62.9
		808P	n/a	n/a	n/a	957.69	23.34	9.89	443654	7801991	31.1	2.4	750	62.9
		809P	n/a	n/a	n/a	957.69	23.34	9.89	443671	7802050	31.1	2.4	750	62.9
		810P	n/a	n/a	n/a	957.69	23.34	9.89	443663	7802095	31.1	2.4	750	62.9
		811P	n/a	n/a	n/a	957.69	23.34	9.89	443675	7802024	31.1	2.4	750	62.9
		812P	n/a	n/a	n/a	957.69	23.34	9.89	443658	7802123	31.1	2.4	750	62.9
		813P	n/a	n/a	n/a	957.69	23.34	9.89	443623	7802163	31.1	2.4	750	62.9
		833P	n/a	n/a	n/a	1028.60	25.07	10.62	443602	7802187	34.4	3.1	774	41.3
		834P	n/a	n/a	n/a	1028.60	25.07	10.62	443655	7802196	34.4	3.1	774	41.3
		832P	n/a	n/a	n/a	11.12	0.27	0.11	443798	7802073	42.4	1.1	422	4.3
		814P	n/a	n/a	n/a	17.73	0.43	0.18	443783	7802070	20.1	1.1	422	6.5
		815P	n/a	n/a	n/a	17.73	0.43	0.18	443792	7802070	20.1	1.1	422	6.5
		703P	n/a	n/a	n/a	5.21	0.13	0.05	443725	7802287	21.1	0.9	611	3.7
		704P	n/a	n/a	n/a	5.21	0.13	0.05	443726	7802281	21.1	0.9	611	3.7
		701P	n/a	n/a	n/a	1.95	0.05	0.02	443738	7802291	21	0.4	611	4.1
		702P	n/a	n/a	n/a	1.95	0.05	0.02	443739	7802284	21	0.4	611	4.1
		818P	n/a	n/a	n/a	1.39	0.03	0.01	443767	7802081	12.2	0.076	602	58
		816P	n/a	n/a	n/a	4.03	0.10	0.04	443728	7802142	16.8	207.4	727	0.001
		817P	n/a	n/a	n/a	8.69	0.21	0.09	443747	7802104	12.8	0.6	616	42
		819P[1]	n/a	n/a	n/a	4.00	0.10	0.04	444050	7802550				
		820P[1]	n/a	n/a	n/a	4.00	0.10	0.04	444075	7802642				
		821P[1]	n/a	n/a	n/a	3.99	0.10	0.04	444110	7802642				
		836P	n/a	n/a	n/a	1.80	0.04	0.02	444071	7802702	4.1	0.43	1273	20
		822P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802550				
		823P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802558				
		824P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802566				
		825P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802574				
		826P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802582				
		827P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802590				
		828P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802598				
		829P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802606				
		830P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802614				
		831P[1]	n/a	n/a	n/a	0.84	0.02	0.01	444046	7802622				
		835P	n/a	n/a	n/a	1.80	0.04	0.02	444097	7802582	4.4	0.43	1273	20

[1]These are modeled as area sources.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Central Gas Facility	NGI-19-1883 - Combustion Turbine Gas Compressor	CGF1	843.57	12.99	8.66	See Below	See Below	See Below	442957	7801880	36.88	3.353	786	46.33
	NGI-19-1884 - Combustion Turbine Gas Compressor	CGF2	843.34	12.98	8.66	See Below	See Below	See Below	443037	7801844	36.88	3.353	786	46.33
	NGI-19-1885 - Combustion Turbine Gas Compressor	CGF3	834.76	12.85	8.57	See Below	See Below	See Below	442968	7801827	36.88	3.353	786	46.33
	NGI-19-1886 - Combustion Turbine Gas Compressor	CGF4	845.11	13.01	8.67	See Below	See Below	See Below	443048	7801805	36.88	3.353	786	46.33
	NGI-19-1801 - Combustion Turbine Booster Compressor	CGF5	607.73	6.96	4.64	See Below	See Below	See Below	442959	7801918	31.39	2.438	752	48.77
	NGI-19-1802 - Combustion Turbine Booster Compressor	CGF6	613.97	7.03	4.69	See Below	See Below	See Below	443017	7801890	31.39	2.438	752	48.77
	NGI-19-1805 - Combustion Turbine MI Compressor	CGF7	539.12	6.17	4.11	See Below	See Below	See Below	443005	7801962	34.44	2.438	752	48.77
	NGI-19-1855 - Combustion Turbine MI Compressor	CGF8	541.92	6.20	4.14	See Below	See Below	See Below	442952	7801953	34.44	2.438	752	48.77
	NGI-19-1806 - Combustion Turbine Refrigerant Compressor	CGF9	373.15	10.25	6.83	See Below	See Below	See Below	442941	7802041	28.35	2.743	538	40.84
	NGI-19-1856 - Combustion Turbine Refrigerant Compressor	CGF10	351.54	9.66	6.44	See Below	See Below	See Below	442923	7802100	28.35	3.048	774	41.45
	NGI-19-1857 - Combustion Turbine Refrigerant Compressor	CGF11	367.77	10.10	6.74	See Below	See Below	See Below	443072	7801963	43.59	3.048	774	41.45
	NGI-19-1401 - Hot Oil Heater	CGF12	37.88	3.57	2.08	See Below	See Below	See Below	442785	7801975	49.38	2.134	541	11.89
	NGH-19-1402 - Hot Oil Heater	CGF13	39.79	3.74	2.18	See Below	See Below	See Below	442787	7801966	49.38	2.134	541	11.89
	NGH-19-1403 - Hot Oil Heater	CGF14	39.92	3.76	2.19	See Below	See Below	See Below	442788	7801964	49.38	2.134	541	11.89
	NGI-19-2890 - Emergency Generator	CGF15	1.94	0.06	0.05	See Below	See Below	See Below	443054	7802019	9.75	0.610	608	41.15
	NGI-19-2802 - Emergency Generator	CGF16	2.41	0.07	0.06	See Below	See Below	See Below	443056	7802011	9.75	0.610	608	41.15
	NGI-19-2819 - Emergency Generator	CGF17	2.36	0.07	0.06	See Below	See Below	See Below	443055	7802016	9.75	0.610	608	41.15
	NGI-19-1529 - Emergency Firewater pump [2]	CGF18	0.27	0.02	0.01	See Below	See Below	See Below	442907	7802008	13.11	0.151	685	44.20
	Flares	CGF19	35.18	7.19	1.46	See Below	See Below	See Below	442604	7802667	4.88	0.139	1273	20.12

[1]All potential emissions were modeled from ADEC files shown in the table below.
[2]Stack diameter for CGF18 calculated from 1680 acfm.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Central Gas Facility		1117P	n/a	n/a	n/a	1235.09	34.35	14.08	442960	7802054	36.8	3.2	786	46.4
		1119P	n/a	n/a	n/a	1235.09	34.35	14.08	443040	7802018	36.8	3.2	786	46.4
		1116P	n/a	n/a	n/a	1235.09	34.35	14.08	442970	7802001	36.8	3.2	786	46.4
		1118P	n/a	n/a	n/a	1235.09	34.35	14.08	443051	7801979	36.8	3.2	786	46.4
		1101P	n/a	n/a	n/a	999.06	27.78	11.39	442962	7802091	31.3	2.3	709	48.8
		1102P	n/a	n/a	n/a	999.06	27.78	11.39	443019	7802063	31.3	2.3	709	48.8
		1103P	n/a	n/a	n/a	999.06	27.78	11.39	443007	7802135	34.3	2.3	709	48.8
		1104P	n/a	n/a	n/a	999.06	27.78	11.39	442954	7802126	34.3	2.3	709	48.8
		1105P	n/a	n/a	n/a	569.40	15.83	6.49	442944	7802214	28.2	2.6	538	40.9
		1106P	n/a	n/a	n/a	569.40	15.83	6.49	442925	7802273	28.2	3.1	774	41.3
		1115P	n/a	n/a	n/a	569.40	15.83	6.49	443075	7802137	43.5	3.1	774	41.3
		1107P	n/a	n/a	n/a	84.12	2.34	0.96	442787	7802148	49.4	2.2	541	11.9
		1108P	n/a	n/a	n/a	84.12	2.34	0.96	442789	7802140	49.4	2.2	541	11.9
		1109P	n/a	n/a	n/a	84.12	2.34	0.96	442791	7802134	49.4	2.2	541	11.9
		1122P	n/a	n/a	n/a	1.04	0.03	0.01	442909	7802181	13.1	31.5	685	0.001
		1121P	n/a	n/a	n/a	14.60	0.41	0.17	443056	7802193	9.9	113.5	608	0.001
		1110P	n/a	n/a	n/a	9.73	0.27	0.11	443059	7802185	9.9	113.5	608	0.001
		1111P	n/a	n/a	n/a	9.73	0.27	0.11	443058	7802190	9.9	113.5	608	0.001
		11130P	n/a	n/a	n/a	23.19	0.64	0.26	442883	7802572	12.6	1.55	1273	20
		11131P	n/a	n/a	n/a	26.00	0.72	0.30	442878	7802572	13	1.64	1273	20

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Endicott Production Facility	GTRB-1510A Combustion Turbine Main Gas Compressor	END1	795.58	12.65	69.69	See Below	See Below	See Below	464222	7805246	39.93	3.048	515	21.64
	GTRB-1510B Combustion Turbine Main Gas Compressor	END2	799.54	12.71	70.03	See Below	See Below	See Below	464209	7805256	39.93	3.048	515	21.64
	GTRB-1405 - Combustion Turbine NGL Compressor	END3	90.57	1.81	9.96	See Below	See Below	See Below	464142	7805243	38.10	1.219	818	35.97
	GTRB-1802 Combustion Turbine Water Injection	END4	75.33	2.24	12.34	See Below	See Below	See Below	464210	7805311	38.40	1.524	745	32.61
	GTRB-1907 Combustion Turbine Water Injection	END5	82.26	2.45	13.47	See Below	See Below	See Below	464202	7805310	38.40	1.524	745	32.61
	GTRB-E3-4501 Combustion Turbine Generator	END6	12.32	0.28	1.53	See Below	See Below	See Below	464204	7805338	26.21	1.524	745	32.61
	GTRB-E3-4502 Combustion Turbine Generator	END7	52.81	1.21	6.54	See Below	See Below	See Below	464202	7805345	26.21	1.524	745	32.61
	GTRB-E3-4503 Combustion Turbine Generator	END8	50.96	1.16	6.31	See Below	See Below	See Below	464201	7805353	26.21	1.524	745	32.61
	GTRB-E3-4504 - Combustion Turbine Generator	END9	51.35	1.17	6.36	See Below	See Below	See Below	464200	7805362	26.21	1.524	745	32.61
	GTRB-E3-9210 - Combustion Turbine MI Compressor	END10	55.13	1.16	6.30	See Below	See Below	See Below	464224	7805210	18.29	1.524	806	25.91
	H-3002 - Utility/Process Heater	END11	0.00	0.00	0.00	See Below	See Below	See Below	464124	7805278	44.81	1.829	556	4.88
	H-3031 - Building Heat Medium Heater	END12	6.18	0.58	2.81	See Below	See Below	See Below	464099	7805340	19.81	1.524	380	2.74
	H-3201 - Fuel Gas Heater	END13	0.16	0.01	0.04	See Below	See Below	See Below	464146	7805279	4.57	0.305	429	11.89
	H-V-E3-1401 - TEG Reboiler	END14	1.98	0.09	0.45	See Below	See Below	See Below	464139	7805280	24.69	0.305	496	10.97
	H-E3-1404 NGL Reboiler	END15	7.66	0.38	1.86	See Below	See Below	See Below	464135	7805281	38.40	0.914	707	3.96
	SDIH - Heater	END16	0.00	0.00	0.00	See Below	See Below	See Below	464628	7801537	6.10	0.305	429	11.89
	GNED-E3-4505 - Emergency Generator	END17	1.38	0.03	0.02	See Below	See Below	See Below	464145	7805324	25.91	0.610	608	41.15
	GNED-E3-4506 - Emergency Generator	END18	1.63	0.04	0.02	See Below	See Below	See Below	464153	7805326	25.91	0.610	608	41.15
	PED-EO-4001 - Emergency Generator[2]	END19	0.12	0.00	0.00	See Below	See Below	See Below	464182	7805526	12.19	0.100	602	57.91
	Portable Emer. Generator[2]	END20	0.14	0.00	0.00	See Below	See Below	See Below	464193	7805528	12.19	0.100	602	57.91
	DO-GEC-0036 - Portable Emergency Generator[2]	END21	0.03	0.00	0.00	See Below	See Below	See Below	464142	7805217	3.96	0.100	602	57.91
	DO-KED-0041 - Portable Air Compressor[2]	END22	0.00	0.00	0.00	See Below	See Below	See Below	464143	7805221	3.96	0.100	602	57.91
	DO-IS-MUDPLT - Emergency Generator[2]	END23	0.00	0.00	0.00	See Below	See Below	See Below	464115	7805165	3.96	0.100	602	57.91
	PED-4005 - Diesel Emer. Fire Water Pump[3]	END24	0.02	0.00	0.00	See Below	See Below	See Below	463721	7805020	12.19	0.610	602	57.91
	H-1602 - HP Flare	END25	1.31	0.55	0.69	See Below	See Below	See Below	464021	7805198	68.28	15.240	1273	20.12
	H-1601 - LP Flare	END26	12.26	5.17	6.53	See Below	See Below	See Below	464021	7805198	68.28	5.486	1273	20.12
	Portable Flare	END27	0.00	0.00	0.00	See Below	See Below	See Below	464021	7805192	9.14	5.486	1273	20.12
	Portable Flare	END28	0.00	0.00	0.00	See Below	See Below	See Below	464021	7805192	15.24	3.048	1273	20.12
	Generator Turbine	END29	0.00	0.00	0.00	See Below	See Below	See Below	464103	7805089	13.41	0.914	604	64.62
	Generator Turbine	END30	0.00	0.00	0.00	See Below	See Below	See Below	464103	7805089	13.41	0.914	604	64.62
	Generator Turbine	END31	0.00	0.00	0.00	See Below	See Below	See Below	464103	7805089	13.41	0.914	604	64.62
	Apache Rig Boiler	END32	0.00	0.00	0.00	See Below	See Below	See Below	464103	7805089	13.41	0.305	429	11.89
	Apache Rig Boiler	END33	0.00	0.00	0.00	See Below	See Below	See Below	464105	7805088	13.41	0.305	429	11.89
	Power Generator	END34	0.00	0.00	0.00	See Below	See Below	See Below	464093	7805068	13.41	0.305	780	108.51
	Power Generator	END35	0.00	0.00	0.00	See Below	See Below	See Below	464098	7805066	10.36	0.305	848	59.44
	Power Generator	END36	0.00	0.00	0.00	See Below	See Below	See Below	464102	7805064	10.36	0.305	848	59.44

[1]All potential emissions were modeled from ADEC files shown in the table on the following page.
[2]Stack diameters for END19-23 calculated given 960 acfm.
[3]All stack parameters for source END24 were taken from FlowB21. This is based on equipment similarities.
[4]Exhaust temperature for source END32 was taken from END33. This is based on equipment similarities.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Endicott Production Facility		2101	n/a	n/a	n/a	1020.26	32.60	93.99	464213	7805417	39.9	3	515	21.6
		2102	n/a	n/a	n/a	0.00	0.00	0.00	464225	7805419	39.9	2.9	792	35.6
		2103	n/a	n/a	n/a	1020.26	32.60	93.99	464211	7805430	39.9	3	515	21.6
		2104	n/a	n/a	n/a	0.00	0.00	0.00	464223	7805432	39.9	2.9	792	35.6
		2105	n/a	n/a	n/a	146.35	4.68	13.48	464144	7805417	38.1	1.3	818	35.9
		2106	n/a	n/a	n/a	11.37	0.36	1.05	464100	7805513	19.9	1.5	380	2.8
		2107	n/a	n/a	n/a	191.89	6.13	17.68	464206	7805511	26.2	1.5	745	32.6
		2108	n/a	n/a	n/a	191.89	6.13	17.68	464204	7805519	26.2	1.5	745	32.6
		2109	n/a	n/a	n/a	191.89	6.13	17.68	464203	7805527	26.2	1.5	745	32.6
		2110	n/a	n/a	n/a	191.89	6.13	17.68	464201	7805535	26.2	1.5	745	32.6
		2111	n/a	n/a	n/a	191.89	6.13	17.68	464212	7805484	38.4	1.5	745	32.6
		2112	n/a	n/a	n/a	191.89	6.13	17.68	464204	7805483	38.4	1.5	745	32.6
		2113	n/a	n/a	n/a	37.44	1.20	3.45	464126	7805451	44.8	1.7	556	4.9
		2114	n/a	n/a	n/a	12.03	0.38	1.11	464147	7805498	25.9	0.56	608	41.1
		2115	n/a	n/a	n/a	12.03	0.38	1.11	464155	7805499	25.9	0.56	608	41.1
		2116	n/a	n/a	n/a	1.60	0.05	0.15	464148	7805453	35.1	0.25	429	11.9
		2117	n/a	n/a	n/a	2.95	0.09	0.27	464141	7805454	24.8	0.3	496	10.9
		2118	n/a	n/a	n/a	3.82	0.12	0.35	464137	7805454	38.3	0.9	707	4
		2119	n/a	n/a	n/a	1.74	0.06	0.16	464022	7805371	68.3	0.26	1273	20
		2120	n/a	n/a	n/a	62.22	1.99	5.73	464048	7805241	13.4	0.9	604	64.6
		2121	n/a	n/a	n/a	62.22	1.99	5.73	464046	7805238	13.4	0.9	604	64.6
		2122	n/a	n/a	n/a	62.22	1.99	5.73	464043	7805235	13.4	0.9	604	64.6
		2123	n/a	n/a	n/a	2.99	0.10	0.28	464044	7805242	13.4	0.25	429	11.9
		2124	n/a	n/a	n/a	2.99	0.10	0.28	464042	7805240	13.4	0.25	429	11.9
		2125	n/a	n/a	n/a	8.31	0.27	0.77	464038	7805226	13.4	0.2	780	108.4
		2126	n/a	n/a	n/a	4.45	0.14	0.41	464091	7805211	10.4	0.2	848	59.5
		2127	n/a	n/a	n/a	4.45	0.14	0.41	464088	7805206	10.4	0.2	848	59.5
		2128	n/a	n/a	n/a	1.81	0.06	0.17	464184	7805699	12.2	0.1	602	58
		2129	n/a	n/a	n/a	1.81	0.06	0.17	464194	7805701	12.2	0.1	602	58
		2130	n/a	n/a	n/a	0.80	0.03	0.07	464202	7805633	6.1	0.25	429	11.9
		2131	n/a	n/a	n/a	1.39	0.04	0.13	467630	7801710	6.1	0.25	429	11.9
		2132	n/a	n/a	n/a	179.02	5.72	16.49	464225	7805383	18.3	1.51	806	25.9
		2134	n/a	n/a	n/a	0.23	0.01	0.02	464117	7805338	4	0.1	602	58
		2135	n/a	n/a	n/a	0.08	0.00	0.01	464144	7805417	4	0.1	602	58
		2136	n/a	n/a	n/a	0.08	0.00	0.01	464144	7805417	4	0.1	602	58

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Flow Station #1	NGT-15-1801 - STV/IP Gas Compressor	FlowA1	78.89	2.27	1.51	109.95	3.22	1.34	445929	7794868	18.29	2.438	644	18.59
	NGT-15-1802 - STV/IP Gas Compressor	FlowA2	80.46	2.32	1.54	109.95	3.22	1.34	445906	7794864	18.29	2.438	644	18.59
	NGT-15-1803 - LPS Gas Compressor	FlowA3	569.01	9.83	3.72	1115.00	32.61	13.59	445851	7794857	32.61	3.658	470	12.50
	NGT-15-1804 - LPS Gas Compressor	FlowA4	553.07	9.56	3.62	1115.00	32.61	13.59	445834	7794914	32.61	3.658	470	12.50
	NGT-15-15107 - Prod. Water Inj. Pump	FlowA5	52.40	1.34	0.89	141.00	4.12	1.72	446033	7794985	21.64	1.219	700	32.31
	NGH-15-1431 - Glycol Process Heater	FlowA6	5.73	0.43	0.26	16.31	0.48	0.20	445975	7795032	22.86	1.219	450	5.49
	NGH-15-1433 - Glycol Process Heater	FlowA7	3.21	0.24	0.14	16.31	0.48	0.20	445981	7795024	22.86	1.219	450	5.49
	NGH-15-1481 - Glycol Utility Heater	FlowA8	3.87	0.29	0.17	11.42	0.33	0.14	445979	7795007	19.51	0.914	450	6.10
	NGH-15-1491 - Glycol Utility Heater	FlowA9	3.35	0.25	0.15	11.42	0.33	0.14	445984	7795017	19.51	0.914	450	6.10
	NGH-15-1495 - Glycol Heater	FlowA10	9.51	0.88	0.52	27.98	0.82	0.34	445859	7794922	41.45	1.524	482	6.10
	NGH-15-1496 - Glycol Heater	FlowA11	7.43	0.69	0.41	23.74	0.69	0.29	445871	7794925	41.45	1.524	482	6.10
	NGH-15-14001 - TEG Reboiler	FlowA12	1.95	0.18	0.11	5.67	0.17	0.07	446088	7794948	39.93	0.610	811	10.67
	NGH-15-2801 - TEG Reboiler	FlowA13	1.01	0.08	0.05	2.92	0.09	0.04	445928	7795055	27.13	0.610	505	4.88
	NGH-15-2811 - TEG Reboiler	FlowA14	1.01	0.08	0.05	2.92	0.09	0.04	445929	7795048	27.13	0.610	505	4.88
	EDG-15-2882 - Emergency Generator	FlowA15	0.90	0.03	0.02	8.69	0.25	0.11	445981	7794990	17.68	0.610	600	39.93
	EDG-15-1553C - Emergency Fire Water Pump	FlowA16	0.78	0.06	0.01	1.48	0.04	0.02	445963	7795055	17.68	0.610	602	57.91
	Flares	FlowA17	30.07	12.28	1.94	30.07	0.88	0.37	445869	7794539	2.74	0.914	1273	20.12

[1]Potential emissions for FlowA1-2, FlowA15-16 are calculated based on a 25% heating efficiency as well as operating hours/y limits from the title 5 permit. These are as follows:

- FlowA1-2: 12000 hrs/y combined, modeled as 6000 hrs/y each
- FlowA15-16: 200 hrs/y each

Potential emissions for FlowA3-5 were taken directly from the title 5 permit. FlowA6-14 were calculated assuming 8760 hrs/y operation at full design capacity. For FlowA17 the actual emission was greater than the potential emission calculated given the allowable MMscf/day in the title 5 permit. As a result, the potential emission was conservatively modeled as the higher actual emission.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Flow Station #2	NGT-16-1801 - Gas Compressor	FlowB1	44.50	1.28	0.85	183.24	4.55	4.15	449839	7795675	19.20	2.438	644	18.59
	NGT-16-1802 - Gas Compressor	FlowB2	93.34	2.69	1.79	183.24	4.55	4.15	449812	7795670	19.20	2.438	644	18.59
	NGI-16-1803 - Gas Compressor	FlowB3	517.32	9.01	24.56	1115.00	27.70	25.26	449757	7795664	33.22	3.658	459	12.50
	NGI-16-1804 - Gas Compressor	FlowB4	518.85	9.04	24.63	1115.00	27.70	25.26	449745	7795719	33.22	3.658	470	12.50
	NGT-16-15105 - Water Injection Turbine	FlowB5	41.16	1.05	0.70	141.00	3.50	3.19	449951	7795791	21.64	1.219	733	34.75
	NGT-16-15106 - Water Injection Turbine	FlowB6	17.03	0.43	0.29	141.00	3.50	3.19	449922	7795753	19.20	1.219	733	34.75
	NGT-16-15133 - Water Injection Turbine	FlowB7	43.62	1.11	0.74	141.00	3.50	3.19	449960	7795793	21.64	1.219	733	34.75
	NGT-16-15401 - Water Injection Turbine	FlowB8	40.81	0.82	0.55	102.70	2.55	2.33	450106	7801562	17.07	0.914	706	31.09
	NGT-16-15402 - Water Injection Turbine	FlowB9	46.11	0.93	0.62	102.70	2.55	2.33	449990	7795789	17.07	0.914	706	31.09
	NGT-16-15403 - Water Injection Turbine	FlowB10	41.68	1.13	0.75	108.29	2.69	2.45	450007	7795792	18.90	1.219	789	32.92
	NGT-16-15404 - Water Injection Turbine	FlowB11	43.82	1.18	0.79	108.29	2.69	2.45	450016	7795794	18.90	1.219	789	32.92
	NGT-16-15405 - Water Injection Turbine	FlowB12	42.79	1.16	0.77	108.29	2.69	2.45	450023	7795796	18.90	1.219	789	32.92
	NGH-16-1431 - Glycol Process Heater	FlowB13	0.17	0.01	0.01	16.31	0.41	0.37	449884	7795835	22.86	1.219	450	5.49
	NGH-16-1433 - Glycol Process Heater	FlowB14	1.36	0.10	0.06	16.31	0.41	0.37	449889	7795829	22.86	1.219	450	5.49
	NGH-16-1481 - Glycol Process Heater	FlowB15	0.00	0.00	0.00	11.42	0.28	0.26	449886	7795813	19.51	0.914	450	6.10
	NGH-16-1491 - Glycol Process Heater	FlowB16	1.03	0.08	0.05	11.42	0.28	0.26	449890	7795822	19.51	0.914	450	6.10
	NGH-16-2801 - TEG Reboiler	FlowB17	1.52	0.12	0.07	2.92	0.07	0.07	449833	7795862	27.13	0.610	505	4.88
	NGH-16-2811 - TEG Reboiler	FlowB18	1.52	0.12	0.07	2.92	0.07	0.07	449834	7795855	27.13	0.610	505	4.88
	EDG-16-2882 - Emergency Generator	FlowB19	0.03	0.00	0.00	11.16	0.28	0.25	450017	7801564	17.68	0.610	600	39.93
	EDG-16-2882-01 - Emergency Generator	FlowB20	0.04	0.00	0.00	19.03	0.47	0.43	449854	7795810	7.62	0.610	620	42.06
	EDG-16-1553C - Emergency Firewater Pump	FlowB21	0.00	0.00	0.00	1.22	0.03	0.03	449875	7795864	12.19	0.610	602	57.91
	Flares	FlowB22	7.67	3.13	0.49	10.69	0.27	0.24	450064	7795638	4.57	0.305	1273	20.12

[1]Potential emissions for FlowB1-2, FlowB8-12, FlowB19-21 were calculated based on a 15% heating efficiency with operating hours/year limits given by the title 5 permit. These are as follows:

- FlowB1-2: 12000 hrs/y combined, modeled as 6000 hrs/y each
- FlowB8-12: No limit on operation hours/year (8760 hrs/y each)
- FlowB19-21: 120 hrs/y each

Potential emissions for FlowB3-7 were taken directly from the title 5 permit. FlowB13-18 were calculated assuming 8760 hrs/y at full design capacity. FlowB22 was calculated given .9 MMscf/day for all flares combined from the title 5 permit.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Flow Station #3	NGT-14-1802 - STV/IP Compressor	FlowC1	88.37	2.54	1.66	321.04	7.58	3.18	440700	7794651	13.72	2.438	644	18.59
	NGT-14-1803 - LPS Compressor	FlowC2	588.99	10.20	5.10	1115.00	26.33	11.06	440664	7794592	28.35	3.658	470	12.50
	NGT-14-1804 - LPS Compressor	FlowC3	588.47	10.19	5.10	1115.00	26.33	11.06	440648	7794648	28.35	3.658	470	12.50
	NGT-14-1806 - Artificial Lift Compressor	FlowC4	683.11	7.09	4.73	1016.00	23.99	10.08	440794	7794767	28.35	3.048	755	28.96
	NGT-15105 - Water Injection	FlowC5	12.09	0.31	0.21	141.00	3.33	1.40	440621	7794596	19.81	1.219	700	32.31
	NGT-15106 - Water Injection	FlowC6	13.64	0.35	0.23	141.00	3.33	1.40	440731	7794758	19.81	1.219	700	32.31
	NGT-15188 - Water Injection	FlowC7	42.05	1.07	0.71	141.00	3.33	1.40	440821	7794773	19.81	1.219	700	32.31
	NGT-15189 - Water Injection	FlowC8	41.23	1.05	0.70	141.00	3.33	1.40	440829	7794775	19.81	1.219	700	32.31
	NGH-14-1431 - Glycol Process Heater	FlowC9	5.59	0.42	0.25	16.31	0.39	0.16	440742	7794804	22.86	1.219	450	5.49
	NGH-14-1481 - Glycol Utility Heater	FlowC10	5.53	0.42	0.25	11.42	0.27	0.11	440745	7794790	19.20	0.914	450	6.10
	NGH-14-1491 - Glycol Utility Heater	FlowC11	2.22	0.17	0.10	11.42	0.27	0.11	440744	7794799	19.20	0.914	450	6.10
	NGH-14-2801 - TEG Reboiler	FlowC12	1.44	0.11	0.06	2.92	0.07	0.03	440754	7794777	27.13	0.610	505	4.88
	NGH-14-2811 - TEG Reboiler	FlowC13	1.44	0.11	0.06	2.92	0.07	0.03	440756	7794767	27.13	0.610	505	4.88
	EDG-14-2882 - Emergency Generator	FlowC14	1.68	0.05	0.05	21.84	0.52	0.22	440704	7794738	16.46	0.610	616	42.06
	EDG-14-2882-01 - Emergency Generator	FlowC15	1.81	0.05	0.05	21.84	0.52	0.22	440686	7794752	8.53	0.610	616	42.06
	EDG-14-1599 - Emergency Fire Water Pump	FlowC16	0.11	0.01	0.00	2.00	0.05	0.02	440729	7794794	12.19	0.610	602	57.91
	Flares[2]	FlowC17	12.85	5.25	0.83	19.01	0.45	0.19	440943	7794717	3.05	14.935	1273	0.01

[1]Potential emissions for FlowC1, FlowC14-16 were calculated based on a 12.5% heating efficiency with operating hours/year limits given by the title 5 permit. These are as follows:

- FlowC1: No limit on operation hours/year (8760 hrs/y)
- FlowC14-16: 200 hrs/y each

Potential emissions for FlowC2-9 were taken directly from the title 5 permit. FlowC10-13 were calculated assuming 8760 hrs/y at full design capacity. FlowC17 was calculated given 1.6 MMscf/day for all flares combined from the title 5 permit.

[2]The exit velocity for FlowC17 was calculated given 360 acfm.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Gathering Center #1	GTRB-01-7000 - Compressor	GCA1	421.89	8.56	3.24	See Below	See Below	See Below	435132	7800620	42.37	3.658	763	20.12
	GTRB-01-7001 - LPS Compressor	GCA2	410.58	8.34	3.16	See Below	See Below	See Below	435118	7800593	42.37	3.658	763	20.12
	GTRB-51-3204 - Compressor	GCA3	484.72	5.55	2.10	See Below	See Below	See Below	435190	7800386	35.97	1.829	922	73.15
	GTRB-51-3304 - Compressor	GCA4	483.12	5.54	2.10	See Below	See Below	See Below	435165	7800402	35.97	1.829	922	73.15
	GTRB-01-7704A - Water Injection Pump	GCA5	145.61	1.91	0.72	See Below	See Below	See Below	434913	7800569	21.34	1.524	780	35.05
	GTRB-01-7704B - Water Injection Pump	GCA6	151.24	1.99	0.75	See Below	See Below	See Below	434907	7800559	21.34	1.524	780	35.05
	GTRB-51-8001A - Water Injection Pump	GCA7	0.00	0.00	0.00	See Below	See Below	See Below	435192	7800484	20.42	1.219	741	25.60
	GTRB-51-8001B - Water Injection Pump	GCA8	0.00	0.00	0.00	See Below	See Below	See Below	435187	7800477	20.42	1.219	741	25.60
	GTRB-51-8001C - Water Injection Pump	GCA9	0.00	0.00	0.00	See Below	See Below	See Below	435182	7800469	20.42	1.219	741	25.60
	H-51-8002A - Utility Heater	GCA10	3.41	0.32	0.11	See Below	See Below	See Below	435153	7800459	31.09	3.353	366	14.02
	H-51-8002B - Utility Heater	GCA11	23.10	2.17	0.72	See Below	See Below	See Below	435170	7800448	31.09	3.353	366	14.02
	B-01-0001 - EG Boiler	GCA12	2.16	0.13	0.04	See Below	See Below	See Below	434831	7800650	13.11	0.610	506	10.06
	B-01-0002 - EG Boiler	GCA13	7.80	0.49	0.16	See Below	See Below	See Below	434844	7800646	13.11	0.610	506	10.06
	B-01-0003 - EG Heater	GCA14	2.91	0.18	0.06	See Below	See Below	See Below	434877	7800795	8.84	0.610	506	10.06
	B-01-0004 - EG Heater	GCA15	8.33	0.52	0.17	See Below	See Below	See Below	434874	7800788	13.11	0.610	506	10.06
	B-01-0067 - TEG Reboiler	GCA16	1.82	0.14	0.05	See Below	See Below	See Below	434905	7800778	12.80	0.610	506	8.53
	B-01-0068 - TEG Reboiler	GCA17	1.82	0.14	0.05	See Below	See Below	See Below	434909	7800776	12.80	0.610	506	8.53
	B-01-9920 - TEG Reboiler[2]	GCA18	4.25	0.40	0.13	See Below	See Below	See Below	435082	7800692	40.23	0.610	506	61.62
	GNED-01-0001 - Emergency Generator	GCA19	0.22	0.01	0.00	See Below	See Below	See Below	434825	7800677	14.02	0.305	600	39.93
	GNED-01-0002 - Emergency Generator	GCA20	0.23	0.01	0.00	See Below	See Below	See Below	434820	7800681	14.02	0.305	600	39.93
	GNED-01-0011 - Emergency Generator	GCA21	0.17	0.00	0.00	See Below	See Below	See Below	434873	7800782	8.23	0.305	600	39.93
	PED-01-7004 - Emergency Firewater Pump	GCA22	0.03	0.00	0.00	See Below	See Below	See Below	434986	7800693	4.57	0.305	602	57.91
	GNED-01-8004 - Emergency Generator	GCA23	0.60	0.02	0.02	See Below	See Below	See Below	435250	7800582	8.84	0.610	660	41.15
	GTRB-51-8001 - Emergency Turbine Generator	GCA24	0.06	0.00	0.01	See Below	See Below	See Below	435238	7800607	8.53	1.524	727	42.98
	Flares[3]	GCA25	24.53	9.60	0.90	See Below	See Below	See Below	435092	7801216	22.96	2.361	1273	20.00

[1]All potential emissions were modeled from ADEC files shown in the table below.

[2]The exhaust temperature for GCA18 was taken from GCA12-17 based on equipment similarities . The Exit velocity was calculated given 3540 acfm.

[3]All stack parameters for GCA25 were calculated using EPA protocol for modeling flares as a modified point source. The actual stack height is 15.24 meters.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Gathering Center #1		1216	n/a	n/a	n/a	1115.86	24.31	10.90	435135	7800794	42.5	3.7	763	20.1
		1217	n/a	n/a	n/a	1115.86	24.31	10.90	435121	7800765	42.5	3.7	763	20.1
		1218	n/a	n/a	n/a	997.67	21.73	9.75	435193	7800560	36.1	1.8	922	73.1
		1219	n/a	n/a	n/a	997.67	21.73	9.75	435168	7800575	36.1	1.8	922	73.1
		1214_15	n/a	n/a	n/a	458.86	10.00	4.48	434913	7800737	21.3	1.6	780	34.9
		1207	n/a	n/a	n/a	18.39	0.40	0.18	435195	7800658	20.4	1.22	741	24.8
		1208	n/a	n/a	n/a	18.39	0.40	0.18	435190	7800650	20.4	1.22	741	24.8
		1209	n/a	n/a	n/a	18.39	0.40	0.18	435185	7800642	20.4	1.22	741	24.8
		1225	n/a	n/a	n/a	4.48	0.10	0.04	435241	7800781	4	311	727	0.001
		1203	n/a	n/a	n/a	3.93	0.09	0.04	434908	7800952	12.8	0.5	506	8.5
		1204	n/a	n/a	n/a	3.93	0.09	0.04	434912	7800949	12.8	0.5	506	8.5
		1201	n/a	n/a	n/a	9.98	0.22	0.10	434834	7800824	11.6	50	506	0.001
		1202	n/a	n/a	n/a	9.98	0.22	0.10	434847	7800820	11.6	50	506	0.001
		1205	n/a	n/a	n/a	9.98	0.22	0.10	434880	7800968	7.3	50	506	0.001
		1206	n/a	n/a	n/a	9.98	0.22	0.10	434877	7800962	7.3	50	506	0.001
		1240	n/a	n/a	n/a	6.29	0.14	0.06	435085	7800865	38.1	68	811	0.001
		1212A	n/a	n/a	n/a	35.80	0.78	0.35	435156	7800632	31.1	3.35	366	14.1
		1213A	n/a	n/a	n/a	35.80	0.78	0.35	435173	7800621	31.1	3.35	366	14.1
		1226	n/a	n/a	n/a	0.00	0.00	0.00	434988	7801204	15.2	1	1273	20
		1227A	n/a	n/a	n/a	2.97	0.06	0.03	435031	7801177	18.1	0.55	1273	20
		1227	n/a	n/a	n/a	1.24	0.03	0.01	435135	7801322	32.4	0.36	1273	20
		1228	n/a	n/a	n/a	0.00	0.00	0.00	435076	7801200	15.2	1	1273	20
		1229	n/a	n/a	n/a	0.00	0.00	0.00	435033	7801228	15.2	1	1273	20
		1230	n/a	n/a	n/a	7.44	0.16	0.07	434988	7801256	19.6	0.88	1273	20
		1231	n/a	n/a	n/a	5.94	0.13	0.06	435035	7801279	19.2	0.78	1273	20
		1232A	n/a	n/a	n/a	6.67	0.15	0.07	435078	7801253	19.4	0.83	1273	20
		1232	n/a	n/a	n/a	0.17	0.00	0.00	435123	7801365	31.2	0.13	1273	20
		1233A	n/a	n/a	n/a	0.05	0.00	0.00	435411	7801197	0.3	6.25	1273	0.001
		1233B	n/a	n/a	n/a	0.05	0.00	0.00	435416	7801195	0.3	6.25	1273	0.001
		1220	n/a	n/a	n/a	1.77	0.04	0.02	434828	7800850	14	0.3	600	40
		1221	n/a	n/a	n/a	1.77	0.04	0.02	434823	7800855	14	0.3	600	40
		1222	n/a	n/a	n/a	1.77	0.04	0.02	434876	7800956	7.3	60	600	0.001
		1224	n/a	n/a	n/a	8.41	0.18	0.08	435253	7800756	7.3	101	660	0.001
		1223	n/a	n/a	n/a	0.87	0.02	0.01	434989	7800866	4.6	0.2	602	58

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Gathering Center #2	GTRB-02-7000 Combustion Turbine LPS Compressor	GCB1	308.59	8.47	4.30	See Below	See Below	See Below	429944	7801291	37.80	3.658	776	29.26
	GTRB-02-7001 - Combustion Turbine LPS Compressor	GCB2	321.91	8.84	4.49	See Below	See Below	See Below	429935	7801321	37.80	3.658	776	29.26
	Solar Mars Compressor	GCB3	0.00	0.00	0.00	See Below	See Below	See Below	421142	7800110	18.59	2.438	715	20.42
	GTRB-02-7704A - Combustion Turbine Water Injection Pump	GCB4	135.38	1.78	0.90	See Below	See Below	See Below	430021	7801220	22.86	1.524	798	17.37
	GTRB-02-7704B - Combustion Turbine Water Injection Pump	GCB5	120.26	1.58	0.80	See Below	See Below	See Below	430017	7801220	22.86	1.524	798	17.37
	GTRB-02-7529 - Combustion Turbine Water Injection Pump	GCB6	29.04	0.74	0.38	See Below	See Below	See Below	430080	7801283	19.81	1.219	730	40.23
	GTRB-02-7504A - Combustion Turbine Water Injection Pump	GCB7	0.00	0.00	0.00	See Below	See Below	See Below	430081	7801279	19.81	1.219	730	40.23
	GTRB-02-7504B - Combustion Turbine Water Injection Pump	GCB8	2.45	0.04	0.02	See Below	See Below	See Below	430083	7801272	20.42	1.219	741	25.60
	B-02-7000 - EG Heater	GCB9	5.76	0.36	0.16	See Below	See Below	See Below	429999	7801261	17.68	0.610	611	42.67
	B-02-7001 - EG Heater	GCB10	4.12	0.26	0.11	See Below	See Below	See Below	430000	7801261	17.68	0.610	611	42.67
	B-02-7002 - EG Heater	GCB11	7.36	0.46	0.21	See Below	See Below	See Below	429998	7801261	17.68	0.610	611	42.67
	B-02-0001 - EG Boiler	GCB12	4.73	0.29	0.13	See Below	See Below	See Below	430165	7801416	12.19	0.610	506	10.06
	B-02-0002 - EG Boiler	GCB13	2.80	0.17	0.08	See Below	See Below	See Below	430171	7801403	12.19	0.610	506	10.06
	B-02-0003 - EG Boiler	GCB14	4.29	0.27	0.12	See Below	See Below	See Below	430235	7801291	12.19	0.610	506	10.06
	B-02-0004 - EG Boiler	GCB15	4.08	0.25	0.11	See Below	See Below	See Below	430236	7801289	12.19	0.610	506	10.06
	B-02-0067 - TEG Reboiler	GCB16	2.19	0.14	0.06	See Below	See Below	See Below	430203	7801281	9.75	0.305	666	13.11
	B-02-0068 - TEG Reboiler	GCB17	2.19	0.14	0.06	See Below	See Below	See Below	430198	7801281	9.75	0.305	666	13.11
	GNED-02-0001 - Emergency Generator	GCB18	0.07	0.00	0.00	See Below	See Below	See Below	430162	7801439	12.19	0.305	600	39.93
	GNED-02-0002 - Emergency Generator	GCB19	0.10	0.00	0.00	See Below	See Below	See Below	430169	7801432	12.19	0.305	600	39.93
	GNED-01-0011 - Emergency Generator	GCB20	0.10	0.00	0.00	See Below	See Below	See Below	430232	7801299	9.14	0.305	600	39.93
	PED-02-0049 - Emerg. Firewater Pump[2]	GCB21	0.05	0.00	0.00	See Below	See Below	See Below	429964	7801181	4.27	0.100	602	57.91
	PED-02-7004 - Emerg. Firewater Pump[2]	GCB22	0.05	0.00	0.00	See Below	See Below	See Below	429978	7801459	7.62	0.150	602	57.91
	GNED-02-7500 - Emergency Generator	GCB23	0.66	0.02	0.02	See Below	See Below	See Below	430119	7801260	19.81	0.610	660	41.15
	GTRB-02-8001 - Emergency Turbine Gen.	GCB24	0.19	0.01	0.02	See Below	See Below	See Below	430142	7801232	8.84	1.219	727	42.98
	Flares[2]	GCB25	14.69	5.65	0.72	See Below	See Below	See Below	429734	7801045	21.36	1.850	1273	20.00

[1]All potential emissions were modeled from ADEC files shown in the table below.

[2]Stack diameters for GCB21 and GCB22 were calculated given 960 acfm and 2160 acfm respectively.

[3]All stack parameters for GCB25 were calculated using the EPA protocol for modeling flares as a modified point source. Since actual stack height was not given in the emission inventory the actual stack height was taken from GCA25 based on equipment similarities.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Gathering Center #2		1301	n/a	n/a	n/a	9.91	0.35	0.16	430168.4	7801589.6	12.2	46	506	0.001
		1302	n/a	n/a	n/a	9.91	0.35	0.16	430173.8	7801577.1	12.2	46	506	0.001
		1303	n/a	n/a	n/a	3.79	0.13	0.06	430206	7801455.3	9.8	45.79	665.9	0.001
		1304	n/a	n/a	n/a	3.79	0.13	0.06	430200.7	7801453.5	9.8	45.79	665.9	0.001
		1305	n/a	n/a	n/a	9.91	0.35	0.16	430238.3	7801464.3	9.1	46	506	0.001
		1306	n/a	n/a	n/a	9.91	0.35	0.16	430239.1	7801462.5	9.1	46	506	0.001
		1307	n/a	n/a	n/a	85.86	3.04	1.38	430084.3	7801452.6	19.8	1.22	741	25.6
		1308	n/a	n/a	n/a	85.86	3.04	1.38	430086.1	7801446.4	19.8	1.22	741	25.6
		1309	n/a	n/a	n/a	141.13	5.00	2.26	430082.5	7801457.1	19.8	1.22	730	40.1
		1311	n/a	n/a	n/a	115.06	4.08	1.84	430024.3	7801394.5	22.9	1.6	797	17.4
		1312	n/a	n/a	n/a	115.06	4.08	1.84	430019.9	7801392.7	22.9	1.6	797	17.4
		1314	n/a	n/a	n/a	528.38	18.73	8.47	429947.4	7801464.3	37.8	3.66	589	30
		1315	n/a	n/a	n/a	528.38	18.73	8.47	429937.5	7801494.7	37.8	3.66	589	30
		1318	n/a	n/a	n/a	21.00	0.74	0.34	430002	7801433.9	17.7	0.46	611.5	42.6
		1319	n/a	n/a	n/a	21.00	0.74	0.34	430002.9	7801433.9	17.7	0.46	611.5	42.6
		1320	n/a	n/a	n/a	21.00	0.74	0.34	430001.1	7801433.9	17.7	0.46	611.5	42.6
		1321	n/a	n/a	n/a	1.77	0.06	0.03	430164.9	7801612.9	12.2	60	600	0.001
		1322	n/a	n/a	n/a	1.77	0.06	0.03	430171.6	7801606	12.2	60	600	0.001
		1323	n/a	n/a	n/a	1.77	0.06	0.03	430234.7	7801473.2	9.1	60	600	0.001
		1324	n/a	n/a	n/a	0.87	0.03	0.01	429967.1	7801355.1	4.3	24.08	602	0.001
		1325	n/a	n/a	n/a	0.87	0.03	0.01	429980.8	7801633	7.6	36.12	602	0.001
		1326	n/a	n/a	n/a	8.66	0.31	0.14	430121.9	7801433.9	19.8	93.26	660	0.001
		1327	n/a	n/a	n/a	5.08	0.18	0.08	430145.2	7801406.1	8.8	248.84	727	0.001
		1328	n/a	n/a	n/a	399.76	14.17	6.41	421145.1	7800283.4	18.5	2.36	715	20.4
		1331	n/a	n/a	n/a	13.73	0.49	0.22	430025.2	7801077.6	21.1	1.19	1273	20
		1332	n/a	n/a	n/a	0.31	0.01	0.00	430039.6	7801124.2	16.2	0.18	1273	20
		1333	n/a	n/a	n/a	0.31	0.01	0.00	430089	7801142.3	16.2	0.18	1273	20
		1334	n/a	n/a	n/a	0.31	0.01	0.00	430114.7	7801059.7	16.2	0.18	1273	20
		1335	n/a	n/a	n/a	0.31	0.01	0.00	430068.2	7801042.7	16.2	0.18	1273	20
		1336	n/a	n/a	n/a	0.31	0.01	0.00	429420.2	7800966.7	0.9	3.14	1273	0.001
		1337	n/a	n/a	n/a	230.12	8.16	3.69	430018.1	7801407	22.9	2.37	394.3	8.1

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Gathering Center #3	GTRB-03-7000 - LPS Compressor	GCC1	434.39	8.69	4.41	See Below	See Below	See Below	436649	7798273	40.84	3.658	763	20.12
	GTRB-03-7001 - LPS Compressor	GCC2	418.50	8.38	4.25	See Below	See Below	See Below	436618	7798262	40.84	3.658	763	20.12
	GTRB-03-7704A - Water Injection Pump	GCC3	62.51	0.82	0.41	See Below	See Below	See Below	436769	7797947	21.34	1.524	780	35.05
	GTRB-03-7704B - Water Injection Pump	GCC4	97.83	1.28	0.65	See Below	See Below	See Below	436772	7797939	21.34	1.524	780	35.05
	B-03-0001 - EG Heater	GCC5	2.58	0.16	0.07	See Below	See Below	See Below	436804	7798116	9.14	0.610	506	10.06
	B-03-0002 - EG Heater	GCC6	7.03	0.43	0.20	See Below	See Below	See Below	436799	7798131	9.14	0.610	506	10.06
	B-03-0003 - EG Heater	GCC7	2.03	0.12	0.06	See Below	See Below	See Below	436865	7798004	9.14	0.610	506	10.06
	B-03-0004 - EG Heater	GCC8	9.19	0.56	0.26	See Below	See Below	See Below	436864	7798010	9.14	0.610	506	10.06
	B-03-0067 - TEG Reboiler	GCC9	3.66	0.22	0.10	See Below	See Below	See Below	436834	7797996	9.75	0.305	506	8.53
	B-03-0068 - TEG Reboiler	GCC10	3.55	0.22	0.10	See Below	See Below	See Below	436828	7797995	9.75	0.305	506	8.53
	B-03-7000 - EG Heater	GCC11	0.86	0.05	0.02	See Below	See Below	See Below	436722	7798177	9.45	0.610	611	24.99
	B-03-7001 - EG Heater	GCC12	0.24	0.01	0.01	See Below	See Below	See Below	436720	7798181	9.45	0.610	611	24.99
	B-03-7002 - EG Heater	GCC13	7.25	0.45	0.20	See Below	See Below	See Below	436718	7798186	9.45	0.610	611	24.99
	B-03-7003 - EG Heater	GCC14	0.00	0.00	0.00	See Below	See Below	See Below	436717	7798192	9.45	0.610	611	24.99
	B-03-7004 - EG Heater	GCC15	4.77	0.30	0.13	See Below	See Below	See Below	436715	7798196	9.45	0.610	611	24.99
	GNED-03-0001 - Emergency Generator	GCC16	0.18	0.01	0.00	See Below	See Below	See Below	436796	7798149	11.28	0.305	600	39.93
	GNED-03-0002 - Emergency Generator	GCC17	0.17	0.00	0.00	See Below	See Below	See Below	436793	7798156	11.28	0.305	600	39.93
	GNED-03-0011 - Emergency Generator	GCC18	0.16	0.00	0.00	See Below	See Below	See Below	436862	7798016	9.14	0.305	600	39.93
	PED-03-7004 - Emerg. Firewater Pump	GCC19	0.09	0.01	0.00	See Below	See Below	See Below	436813	7797932	6.10	0.150	602	57.91
	GNED-03-7500 - Emergency Generator	GCC20	1.94	0.06	0.06	See Below	See Below	See Below	436724	7797914	5.79	0.610	660	41.15
	GTRB-03-8001 - Emergency Turbine Gen.	GCC21	0.59	0.04	0.07	See Below	See Below	See Below	436735	7797905	8.53	1.219	727	42.98
	Flares	GCC22	8.62	3.34	0.44	See Below	See Below	See Below	437438	7798077	20.42	1.556	1273	20.00

[1]All potential emissions were modeled from ADEC files shown in the table below.
[2]Stack diameter for GCC19 was calculated given 2160 acfm.
[3]All stack parameters for GCC22 were calculated using the EPA protocol for modeling flares as a modified point source. Since actual stack height was not given in the emission inventory the actual stack height was taken from GCA25 based on equipment similarities.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Gathering Center #3		1401_2	n/a	n/a	n/a	18.08	0.43	0.21	436797	7798299	12	0.5	506	10
		1403_4	n/a	n/a	n/a	4.87	0.12	0.06	436819	7798044	16.6	0.5	506	8.6
		1405_6	n/a	n/a	n/a	18.08	0.43	0.21	436853	7798026	12	0.5	506	10
		1407	n/a	n/a	n/a	130.70	3.14	1.50	436874	7798075	18.6	1.2	755	14.9
		1408_0	n/a	n/a	n/a	735.56	17.67	8.45	436756	7798096	21.8	1.5	694	32.1
		1411_2	n/a	n/a	n/a	1865.32	44.80	21.43	436606	7798452	40.7	3.7	450	17.3
		1413_7	n/a	n/a	n/a	73.00	1.75	0.84	436704	7798386	7.6	0.9	623	10.6

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1,3]	Potential SO2 Emissions (tpy)[1,3]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Liberty		49	0	0	0	25.79	0.83	7.68	467671	7801868	13.72	0.4	750	64
		50	0	0	0	25.79	0.83	7.68	467671	7801872	13.72	0.4	750	64
		51	0	0	0	25.79	0.83	7.68	467671	7801875	13.72	0.4	750	64
		52	0	0	0	25.79	0.83	7.68	467670	7801879	13.72	0.4	750	64
		53	0	0	0	25.79	0.83	7.68	467670	7801883	13.72	0.4	750	64
		54	0	0	0	25.79	0.83	7.68	467669	7801886	13.72	0.4	750	64
		55	0	0	0	25.79	0.83	7.68	467669	7801890	13.72	0.4	750	64
		56	0	0	0	25.79	0.83	7.68	467668	7801894	13.72	0.4	750	64
		58	0	0	0	61.36	0.80	0.03	467709	7801607	7.62	0.2	807	69.57
		57	0	0	0	47.80	0.31	0.07	467732	7801797	19.81	0.2	688	64
		61	0	0	0	1.95	0.45	5.14	467732	7801794	19.81	0.51	476	5.84
		62	0	0	0	1.95	0.45	5.14	467734	7801793	19.81	0.51	476	5.84
		63	0	0	0	1.95	0.45	5.14	467727	7801786	12.19	0.51	476	5.84
		59	0	0	0	0.59	0.17	0.00	467736	7801747	19.81	0.067	807	69.57
		64	0	0	0	1.01	0.14	1.70	467775	7801734	19.81	0.27	446	5.84
		65	0	0	0	1.01	0.14	1.70	467777	7801720	13.72	0.27	446	5.84
		66	0	0	0	1.01	0.14	1.70	467670	7801763	13.72	0.27	446	5.84
		60	0	0	0	34.14	1.84	0.02	467668	7801774	10.66	0.2	807	69.57
		67	0	0	0	14.50	0.73	0.03	467709	7801608	7.62	0.3	750	40
		68	0	0	0	14.50	0.73	0.03	467709	7801605	7.62	0.3	750	40
		libturb	0	0	0	40.67	2.09	20.16	464240	7805523	21.3	3	650	21.6
		libcamp1	0	0	0	14.50	0.73	0.03	464158	7805011	8.53	0.3	750	40
		libcamp2	0	0	0	14.50	0.73	0.03	464195	7804974	8.53	0.3	750	40

[1]All potential emissions were modeled from ADEC files shown in the table above.
[2]BP Liberty has no actual emissions since it has not been fully constructed yet.
[3]Potential SO2 and PM10 emissions were taken from ADEC modeling files. They were not scaled from NOx using Title 5 potentials to emit.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Lisburne Production Center	42-1800 - STV/IP Compressor	LPC1	33.99	0.88	1.09	91.33	2.32	10.72	446075	7798174	33.22	1.219	700	31.09
	42-1801 - STV/IP Compressor	LPC2	18.71	0.48	0.60	91.33	2.32	10.72	446075	7798159	33.22	1.219	700	31.09
	42-1826 - Refrigeration Turbine	LPC3	56.23	1.45	1.81	91.33	2.32	10.72	446024	7798165	33.22	1.219	463	9.14
	52-1807 - Combustion Turbine Gas Compressor	LPC4	469.89	13.00	16.20	531.50	13.52	62.38	446141	7798125	30.48	3.658	609	31.70
	52-1808 - Combustion Turbine Gas Compressor	LPC5	491.11	13.58	16.93	531.50	13.52	62.38	446121	7798200	30.48	3.658	609	31.70
	42-0101 - Solar Mars Turbine Generator Set	LPC6	184.43	2.51	3.13	186.25	4.74	21.86	446094	7798067	23.77	2.134	669	19.81
	42-0102 - Solar Mars Turbine Generator Set	LPC7	158.52	2.16	2.69	186.25	4.74	21.86	446096	7798061	23.77	2.134	669	19.81
	42-0103 - Solar Mars Turbine Generator Set	LPC8	42.34	0.58	0.72	186.25	4.74	21.86	446097	7798055	23.77	2.134	669	19.81
	42-0114 - Solar Mars Turbine Generator Set	LPC9	139.87	1.90	2.37	186.25	4.74	21.86	446097	7798048	23.77	2.134	669	19.81
	42-1411 - TEG Reboiler	LPC10	1.47	0.11	0.12	3.50	0.09	0.41	446110	7798122	34.44	0.305	644	9.45
	42-1412 - TEG Reboiler	LPC11	1.54	0.12	0.13	3.50	0.09	0.41	446115	7798122	34.44	0.305	644	9.45
	42-1400 - Process Heater (Stanby Unit)	LPC12	0.00	0.00	0.00	11.33	0.29	1.33	446073	7798099	28.65	1.829	661	9.45
	42-1403 - Utility Heater (Stanby Unit)	LPC13	0.00	0.00	0.00	11.33	0.29	1.33	446071	7798112	28.65	1.219	594	9.45
	42-1404 - Utility Heater (Stanby Unit)	LPC14	0.00	0.00	0.00	11.33	0.29	1.33	446072	7798106	28.65	1.219	594	9.45
	41-1410 - Drill Site Heater (LPC Drill Site 1)	LPC15	3.18	0.29	0.33	11.33	0.29	1.33	444814	7803401	16.15	0.914	728	9.14
	41-1420 - Drill Site Heater (LPC Drill Site 2)	LPC16	0.64	0.06	0.07	11.33	0.29	1.33	445817	7799862	16.76	0.914	728	9.14
	41-1430 - Drill Site Heater (LPC Drill Site 3)	LPC17	2.34	0.22	0.24	11.33	0.29	1.33	450254	7799591	16.15	0.914	728	9.14
	41-1440 - Drill Site Heater (LPC Drill Site 4)	LPC18	0.97	0.09	0.10	11.33	0.29	1.33	454251	7798705	16.46	0.914	728	9.14
	41-1450 - Drill Site Heater (LPC Drill Site 5)	LPC19	5.94	0.55	0.61	11.33	0.29	1.33	453557	7802950	16.46	0.914	728	9.14
	41-1460 - Drill Site Heater (Pt. Mac. Drill Site 1)	LPC20	4.47	0.41	0.46	11.33	0.29	1.33	440770	7809790	15.85	0.914	728	9.14
	42-104 - Emergency Generator	LPC21	0.72	0.02	0.02	15.63	0.40	1.83	446072	7798067	8.84	0.610	608	41.45
	42-1529 - Emerg. Fire Water Pump [2]	LPC22	0.12	0.00	0.03	0.90	0.02	0.11	446118	7798057	12.19	0.100	602	57.91
	42-1589 - Emerg. Fire Water Pump [2]	LPC23	0.12	0.00	0.00	0.90	0.02	0.11	446124	7798057	12.19	0.100	602	57.91
	80-808 - Emergency Generator LPC DS 1 [2]	LPC24	0.38	0.01	0.01	0.95	0.02	0.11	444796	7803383	24.69	0.100	602	57.91
	80-802 - Emergency Generator LPC DS 2 [2]	LPC25	0.64	0.02	0.02	0.76	0.02	0.09	445808	7799897	3.96	0.149	685	35.97
	80-804 - Emergency Generator LPC DS 3 [2]	LPC26	0.48	0.02	0.01	0.76	0.02	0.09	450243	7799614	3.66	0.151	685	44.20
	80-806 - Emergency Generator LPC DS 4 [2]	LPC27	0.18	0.01	0.00	0.76	0.02	0.09	454251	7798740	3.96	0.151	685	44.20
	80-875 - Emergency Generator LPC DS 5	LPC28	0.54	0.02	0.02	0.92	0.02	0.11	453510	7802932	4.57	0.305	711	35.97
	80-891 - Emergency Generator Pt. Mac DS 1	LPC29	0.22	0.01	0.01	2.65	0.07	0.31	440690	7809834	15.54	0.305	711	35.97
	80-892 - Emergency Generator Pt. Mac DS 2	LPC30	0.07	0.00	0.00	2.65	0.07	0.31	442941	7810950	4.27	0.305	711	35.97
	80-859 - Emergency Generator Niakuk DS 1	LPC31	0.02	0.00	0.00	1.58	0.04	0.18	454870	7804649	3.96	0.610	600	39.93
	80-614 - Emergency Generator West Dock Staging Area [3]	LPC32	0.02	0.00	0.00	0.46	0.01	0.05	442450	7807883	3.96	0.089	685	21.58
	Flares	LPC33	75.44	14.21	9.08	25.25	0.64	2.96	445883	7798794	23.13	2.412	1273	20.00

[1]Potential emissions for LPC1-3, LPC4-5, LPC6-9, LPC10-11, LPC12-20 are all taken from combined totals given by the title 5 permit split evenly among each of the sources. Potential emissions for LPC21-32 were calculated based on a 25% heating efficiency with operation limits on hours/year given by the title 5 permit. These are as follows:

- LPC24-26: 240 hrs/y each
- LPC27-32: 140 hrs/y each

Potential emissions for LPC33 are calculated given 1.96 MMscf/day combined for all flares from the title 5 permit

[2]Stack diameters for LPC22-27 were calculated given acfm values from the emissions inventory. These values are as follows:

- LPC22-24: 960 acfm
- LPC25: 1320 acfm
- LPC26-27: 1680 acfm

[3]All stack parameters for LPC32 taken from LPC25. The diameter and exit velocity were adjusted by the ratio of the design capacities of the two sources. This was based on equipment similarites.

[4]All stack parameters for LPC33 were calculated using the EPA protocol for modeling flares as a modified point source. Since actual stack height was not given in the emission inventory the actual stack height was taken from GCA25 based on equipment similarities.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Northstar Production Facility	GE LM2500 Turbine (compressor)	NORTH1	98.73	15.00	5.48	See Below	See Below	See Below	436744	7820906	35.05	3.048	803	23.47
	GE LM2500 Turbine (compressor)	NORTH2	94.84	14.32	5.19	See Below	See Below	See Below	436744	7820911	35.05	3.048	803	23.47
	Solar Mars 90 Turbine (Generator)	NORTH3	31.56	9.46	0.96	See Below	See Below	See Below	436787	7820891	35.05	1.524	685	49.07
	Solar Mars 90 Turbine (Generator)	NORTH4	67.80	14.40	1.51	See Below	See Below	See Below	436787	7820885	35.05	1.524	569	49.07
	Solar Mars 90 Turbine (Generator)	NORTH5	62.30	13.02	1.36	See Below	See Below	See Below	436788	7820876	35.05	1.524	569	37.80
	Cummins QSK 60-G6(2003) Emergency Generator	NORTH6	0.77	0.02	0.02	See Below	See Below	See Below	436741	7820853	35.05	0.610	663	57.91
	Cummins QSK 60-G6(2003) Emergency Generator	NORTH7	0.60	0.02	0.01	See Below	See Below	See Below	436741	7820849	35.05	0.610	663	57.91
	Fire water pump - Cummins KTA19	NORTH8	0.14	0.00	0.00	See Below	See Below	See Below	436775	7820821	19.81	0.305	785	43.89
	Incinerator - solid waste part	NORTH9	0.38	3.86	0.54	See Below	See Below	See Below	436761	7820840	19.81	0.610	750	20.12
	Incinerator - fuel gas part	NORTH10	4.32	0.31	0.19	See Below	See Below	See Below	436761	7820840	19.81	0.610	750	20.12
	Smart Ash Incinerator	NORTH11	0.00	0.00	0.00	See Below	See Below	See Below	436761	7820840	19.81	0.610	750	20.12
	Waste Heat Receovery Supplemental Burner	NORTH12	0.11	0.01	0.01	See Below	See Below	See Below	436787	7820882	35.05	1.524	541	77.72
	Waste Heat Receovery Supplemental Burner	NORTH13	0.00	0.00	0.00	See Below	See Below	See Below	436787	7820882	19.81	1.524	380	2.74
	High Pressure Flare	NORTH14	4.74	1.51	0.30	See Below	See Below	See Below	436705	7820953	52.12	2.438	1273	20.12
	Low Pressure Flare	NORTH15	2.02	0.64	0.13	See Below	See Below	See Below	436705	7820894	52.12	2.438	1273	20.12
	Glycol Reboiler	NORTH16	6.78	0.54	0.28	See Below	See Below	See Below	436787	7820894	35.05	0.610	820	4.27
	Warehouse Space Heater	NORTH17	0.00	0.00	0.00	See Below	See Below	See Below	436766	7820834	10.06	0.305	390	2.13
	Warehouse Space Heater	NORTH18	0.00	0.00	0.00	See Below	See Below	See Below	436766	7820831	10.06	0.305	390	2.13
	Warehouse Space Heater	NORTH19	0.00	0.00	0.00	See Below	See Below	See Below	436765	7820824	10.06	0.305	390	2.13
	Rig Engine Cat. G399	NORTH20	1.81	0.00	0.02	See Below	See Below	See Below	436808	7820925	14.94	0.305	560	16.46
	Rig Engine Cat. G399	NORTH21	1.78	0.00	0.02	See Below	See Below	See Below	436808	7820924	14.94	0.305	820	36.27
	Rig Engine Cat. G399	NORTH22	1.82	0.00	0.02	See Below	See Below	See Below	436808	7820924	14.94	0.305	820	36.27
	Rig Engine Cat. G399	NORTH23	1.69	0.00	0.01	See Below	See Below	See Below	436808	7820923	14.94	0.305	820	36.27
	Rig Engine Cat. G399	NORTH24	1.57	0.00	0.01	See Below	See Below	See Below	436808	7820926	14.94	0.305	820	36.27
	Cold Start Engine Cat D379	NORTH25	0.52	0.09	0.02	See Below	See Below	See Below	436812	7820916	14.94	0.305	780	20.12
	Rig Boiler #1	NORTH26	1.99	0.15	0.08	See Below	See Below	See Below	436808	7820919	14.94	0.610	461	11.58
	on diesel	NORTH27	0.00	0.00	0.00	See Below	See Below	See Below	436808	7820919	14.94	0.610	461	11.58
	Rig Boiler #2	NORTH28	1.89	0.14	0.08	See Below	See Below	See Below	436811	7820919	14.94	0.610	461	11.58
	on diesel	NORTH29	0.00	0.00	0.00	See Below	See Below	See Below	436811	7820919	14.94	0.610	461	11.58
	Air Heater	NORTH30	1.43	4.74	0.06	See Below	See Below	See Below	436808	7820918	14.94	0.610	461	13.11
	on diesel	NORTH31	0.00	0.00	0.00	See Below	See Below	See Below	436808	7820918	14.94	0.610	461	13.11
	Dust Collector	NORTH32	0.00	0.00	0.00	See Below	See Below	See Below	436819	7820804	10.67	0.305	273	15.54
	IC engine <600 hp	NORTH33	0.29	0.02	0.00	See Below	See Below	See Below	436793	7820904	3.66	0.305	750	49.99
	Crane	NORTH34	12.46	0.00	0.00	See Below	See Below	See Below	436783	7820790	4.57	0.305	765	45.11
	Portable Heaters	NORTH35	0.45	0.88	0.07	See Below	See Below	See Below	436783	7820898	3.66	0.305	750	49.99
	Snowmelter	NORTH36	0.00	0.02	0.26	See Below	See Below	See Below	436774	7820939	3.66	0.305	765	49.99

[1]All potential emissions were modeled from ADEC files shown in the table on the following page.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Northstar Production Facility		rig3991	n/a	n/a	n/a	13.87	8.17	1.39	438031	7821033	14.8	0.3	560	16.50
		rig3992	n/a	n/a	n/a	0.00	0.00	0.00	438031	7821032	14.8	0.3	820	36.30
		rig3993	n/a	n/a	n/a	0.00	0.00	0.00	438031	7821031	14.8	0.3	820	36.30
		rig3994	n/a	n/a	n/a	0.00	0.00	0.00	438031	7821030	14.8	0.3	820	36.30
		rig3995	n/a	n/a	n/a	0.00	0.00	0.00	438031	7821035	14.8	0.3	820	36.30
		rigcold	n/a	n/a	n/a	1.44	0.85	0.14	438034	7821025	14.8	0.2	780	20.00
		rigblr1	n/a	n/a	n/a	3.11	1.83	0.31	438031	7821027	14.8	0.46	461	11.50
		rigblr2	n/a	n/a	n/a	3.11	1.83	0.31	438034	7821027	14.8	0.46	461	11.50
		righeat	n/a	n/a	n/a	2.07	1.22	0.21	438031	7821026	14.8	0.36	461	13.10
		wireline	n/a	n/a	n/a	0.11	0.07	0.01	438037	7821004	3.7	0.23	810	25.00
		uoilhtr	n/a	n/a	n/a	0.00	0.00	0.00	438037	7821004	3.7	0.23	810	25.00
		dwsphtr	n/a	n/a	n/a	0.00	0.00	0.00	438037	7821004	3.7	0.23	810	25.00
		bulkhndl	n/a	n/a	n/a	0.00	0.00	0.00	438042	7820912	10.7	0.15	0	15.60
		turb45	n/a	n/a	n/a	117.15	69.00	11.78	437967	7821013	35.1	2.96	803	23.40
		turb1	n/a	n/a	n/a	83.08	48.93	8.35	438011	7820999	35.1	1.52	685	49.20
		turb2	n/a	n/a	n/a	0.00	0.00	0.00	438011	7820993	35.1	1.52	569	37.80
		turb3	n/a	n/a	n/a	0.00	0.00	0.00	438011	7820984	35.1	1.52	569	37.80
		glreboil	n/a	n/a	n/a	2.38	1.40	0.24	438011	7821002	35.1	0.61	820	4.20
		whru	n/a	n/a	n/a	189.10	111.38	19.01	438011	7820990	35.1	1.52	541	77.80
		noflare	n/a	n/a	n/a	20.93	12.33	2.10	437928	7821062	52.1	2.5	1273	20.00
		campge1	n/a	n/a	n/a	5.63	3.32	0.57	437964	7820962	35	0.46	663	58.00
		campge2	n/a	n/a	n/a	5.63	3.32	0.57	437964	7820957	35	0.46	663	58.00
		firepump	n/a	n/a	n/a	0.85	0.50	0.09	437998	7820928	19.8	0.2	785	44.00
		incin	n/a	n/a	n/a	1.57	0.93	0.16	437984	7820947	19.8	0.5	750	20.00
		turb452	n/a	n/a	n/a	117.15	69.00	11.78	437967	7821019	35.1	2.96	803	23.40
		sphtr1	n/a	n/a	n/a	0.34	0.20	0.03	437995	7820957	10	0.2	390	2.00
		sphtr2	n/a	n/a	n/a	0.34	0.20	0.03	437989	7820942	10	0.2	390	2.00
		sphtr3	n/a	n/a	n/a	0.52	0.31	0.05	437989	7820939	10	0.2	390	2.00
		sphtr4	n/a	n/a	n/a	0.52	0.31	0.05	437988	7820932	10	0.2	390	2.00
		incinlet	n/a	n/a	n/a	0.00	0.00	0.00	438007	7821006	3.7	3.16	765	0.01
		snwmelt	n/a	n/a	n/a	1.43	0.84	0.14	437997	7821047	3.7	0.25	765	50.00
		crane	n/a	n/a	n/a	20.27	11.94	2.04	438007	7820897	4.6	0.34	765	45.00
		portabl1	n/a	n/a	n/a	4.59	2.70	0.46	438007	7821047	3.7	0.25	750	50.00
		portabl2	n/a	n/a	n/a	4.59	2.70	0.46	438007	7821006	3.7	0.25	750	50.00
		portabl3	n/a	n/a	n/a	4.59	2.70	0.46	438007	7820955	3.7	0.25	750	50.00
		portabl4	n/a	n/a	n/a	1.36	0.80	0.14	437955	7821034	3.7	0.25	750	50.00
		portabl5	n/a	n/a	n/a	1.36	0.80	0.14	437955	7821020	3.7	0.25	750	50.00
		portabl6	n/a	n/a	n/a	1.36	0.80	0.14	437955	7821007	3.7	0.25	750	50.00
		portabl7	n/a	n/a	n/a	1.36	0.80	0.14	437958	7821042	3.7	0.25	750	50.00
		portabl8	n/a	n/a	n/a	1.37	0.81	0.14	437965	7821042	3.7	0.25	750	50.00
		portabl9	n/a	n/a	n/a	1.37	0.81	0.14	437971	7821042	3.7	0.25	750	50.00
		portab10	n/a	n/a	n/a	1.37	0.81	0.14	437977	7821042	3.7	0.25	750	50.00
		fracturb	n/a	n/a	n/a	0.87	0.51	0.09	438057	7821037	6.1	0.9	604	64.60
		ice600	n/a	n/a	n/a	17.03	10.03	1.71	438057	7821037	3.7	0.25	750	50.00
		heaters[2]	n/a	n/a	n/a	3.31	1.95	0.33	438057	7821037	3.7	0.2	390	49.99
		ice600ws	n/a	n/a	n/a	7.75	4.57	0.78	438057	7821037	3.7	0.25	750	50.00

[2]Exhaust velocity for heaters was modified to match heaters in the emissions inventory.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP PBU Central Power Station	GTRB-17-1101 - Gas Turbine	CPS1	243.19	3.91	2.60	739.12	18.70	7.85	437413	7797142	15.54	2.743	778	40.23
	GTRB-17-2101 - Gas Turbine	CPS2	316.54	5.08	3.39	739.12	18.70	7.85	437381	7797123	15.54	2.743	778	34.44
	GTRB-17-3101 - Gas Turbine	CPS3	396.95	6.80	4.53	936.43	23.69	9.95	437395	7797191	14.94	2.438	736	56.39
	GTRB-17-4101 - Gas Turbine	CPS4	454.02	7.78	5.18	936.43	23.69	9.95	437361	7797180	14.94	2.438	736	56.39
	GTRB-17-5101 - Gas Turbine	CPS5	468.72	8.03	5.35	936.43	23.69	9.95	437435	7797081	14.94	2.438	736	56.39
	GTRB-17-6101 - Gas Turbine	CPS6	353.46	8.30	5.53	683.36	17.28	7.26	437400	7797069	14.94	2.438	736	56.39
	GTRB-17-7101 - Gas Turbine	CPS7	321.26	5.50	3.67	936.43	23.69	9.95	437378	7797246	14.94	2.438	736	56.39
	H-17-0601 - Gas Fired Heater	CPS8	2.46	0.19	0.11	1.72	0.04	0.02	437412	7797347	12.19	0.305	666	13.11
	H-17-0602 - Gas Fired Heater	CPS9	2.74	0.21	0.12	1.72	0.04	0.02	437415	7797358	12.19	0.305	666	13.11
	H-17-0603 - Gas Fired Heater	CPS10	2.76	0.21	0.12	1.93	0.05	0.02	437422	7797360	12.19	0.305	562	14.02
	H-17-1101 - Gas Fired Heater	CPS11	0.00	0.00	0.00	2.24	0.05	0.02	437402	7797131	14.94	0.305	562	15.27
	H-17-2101 - Gas Fired Heater	CPS12	2.98	0.23	0.13	2.11	0.05	0.02	437389	7797129	14.94	0.305	562	15.27
	GNED-17-0101 - Emergency Generator Diesel Engine	CPS13	0.27	0.01	0.01	2.12	0.05	0.02	437322	7797149	15.24	0.305	600	17.07
	GNED-17-0102 - Emergency Generator Diesel Engine	CPS14	0.27	0.01	0.00	2.24	0.05	0.02	437323	7797145	15.24	0.305	600	39.93

[1]Potential emissions for CPS1-7 were calculated based on a 16.5% heating efficiency assuming 8760 hours/year of operation. CPS8-12 were calculated assuming 8760 hours/year operating at full design capacity. CPS13-14 were calculated based on a 30% heating efficiency with 200 hours/year operation given by the title 5 permit.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Prudhoe Bay Operations Center	Prudhoe Bay Operation Centers (All sources)	PBOC1	3.99	0.17	0.11	See Below	See Below	See Below	448997.531	7794435.5	Modeled as a volume source			

[1]All potential emissions were modeled from ADEC files shown in the table below.
[2]All actual emissions were modeled as a single volume source due to lack of stack parameters.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Prudhoe Bay Operations Center		101	n/a	n/a	n/a	1.39	0.07	0.07	448190	7794490	15.2	1	623	10.6
		203	n/a	n/a	n/a	28.50	1.10	1.24	449430	7794700	13.7	1	623	10.6
		204	n/a	n/a	n/a	1.04	0.21	0.23	449430	7794780	13.8	0.3	623	10.6
		305	n/a	n/a	n/a	1.04	2.96	3.33	449590	7794780	8.9	0.3	623	10.6
		306	n/a	n/a	n/a	14.95	3.45	3.88	449600	7794780	9.9	1.1	1241	6.9
		201_2	n/a	n/a	n/a	17.38	5.65	6.36	449430	7794770	13.8	1.2	623	10.6
		301_4	n/a	n/a	n/a	5.56	0.21	0.23	449650	7794860	8.9	0.3	623	10.6

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Seawater Injection Plant East	NGT-31-15101 - Water Inj. Turbine	SEAINJ1	399.13	4.57	3.05	885.00	17.09	8.14	445605	7795161	32.00	3.048	469	18.59
	NGT-31-15102 - Water Inj. Turbine	SEAINJ2	408.70	4.68	3.12	885.00	17.09	8.14	445602	7795174	32.00	3.048	469	18.59
	NGT-31-15301 - Pressure Booster Turbine	SEAINJ3	35.94	0.64	0.43	86.00	1.66	0.79	445619	7795184	22.25	1.524	554	12.50
	NGT-31-15302 - Pressure Booster Turbine	SEAINJ4	36.18	0.65	0.43	86.00	1.66	0.79	445619	7795184	22.25	1.524	554	12.50
	NGT-31-15303 - Pressure Booster Turbine	SEAINJ5	35.64	0.64	0.42	86.00	1.66	0.79	445635	7795187	22.25	1.524	554	12.50
	NGT-31-15304 - Pressure Booster Turbine	SEAINJ6	29.26	0.52	0.35	86.00	1.66	0.79	445635	7795187	22.25	1.524	554	12.50
	NGH-31-1401 - Broach Hot Water Heater	SEAINJ7	0.39	0.04	0.02	26.00	0.50	0.24	445580	7795102	27.74	1.219	448	7.92
	NGH-31-1402 - Broach Hot Water Heater	SEAINJ8	1.10	0.10	0.06	26.00	0.50	0.24	445575	7795100	27.74	1.219	448	7.92
	EDG-31-2813 - EMD Penske Emergency Generator	SEAINJ9	1.21	0.04	0.04	15.36	0.30	0.14	445634	7795163	14.33	0.610	600	39.93
	EDG-31-1501- Emerg. Fire Water Pump	SEAINJ10	0.09	0.01	0.00	0.99	0.02	0.01	445618	7795212	12.19	0.305	602	14.63

[1]Potential emissions for SEAINJ1-8 were taken directly from the title 5 permit. SEAINJ9-10 were calculated based on a 35% heating efficiency with 400 hours/years operation given by the title 5 permit.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Seawater Treatment Plant	NGT-11-1602 - Emergency Generator	STP1	0.07	0.00	0.00	See Below	See Below	See Below	442801	7812319	27.43	0.914	727	42.98
	NGT-11-1603 - Emergency Generator	STP2	0.07	0.00	0.00	See Below	See Below	See Below	442801	7812316	27.43	0.914	727	42.98
	NGH-11-14401 - Lummus Hot Water Heater	STP3	0.00	0.00	0.00	See Below	See Below	See Below	442837	7812185	25.60	1.524	467	10.67
	NGT-11-14402 - Lummus Hot Water Heater	STP4	30.15	2.79	1.65	See Below	See Below	See Below	442837	7812178	25.60	1.524	467	10.67
	NGH-11-14403 - Lummus Hot Water Heater	STP5	29.53	2.74	1.62	See Below	See Below	See Below	442838	7812171	25.60	1.524	467	10.67
	NGH-11-14404 - Lummus Hot Water Heater	STP6	0.00	0.00	0.00	See Below	See Below	See Below	442800	7812186	25.60	1.524	467	10.67
	NGT-11-14405 - Lummus Hot Water Heater	STP7	31.65	2.93	1.74	See Below	See Below	See Below	442800	7812180	25.60	1.524	467	10.67
	NGH-11-14406 - Lummus Hot Water Heater	STP8	19.77	1.83	1.08	See Below	See Below	See Below	442799	7812173	25.60	1.524	467	10.67
	FWP-11-15802 - Emergency Fire Water Pump [2]	STP9	0.07	0.00	0.00	See Below	See Below	See Below	442819	7812190	24.38	0.147	602	14.94
	EDG-11-1601 - Emergency Generator	STP10	1.29	0.04	0.04	See Below	See Below	See Below	442804	7812319	27.43	0.610	616	42.06

[1]All potential emissions were modeled from ADEC files shown in the table below.
[2]Stack diameter for STP9 was calculated given 540 acfm.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
BP Seawater Treatment Plant		1001_6	n/a	n/a	n/a	394.90	34.99	27.99	442890	7812350	34	1.5	450	14.4

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)[3]	N-S UTM NAD 27 Zone 6 (m)[3]	Stack Height (m)[2]	Stack Diameter (m)[2]	Exhaust Temp. °K[2]	Exhaust Velocity (m/s)[2]
BP Transportable drilling rigs	Doyon 14 Rig Generators	DR12	119.39	3.73	8.49	195.10	7.98	20.49	432248	7793153	Modeled as an area source.			
	Doyon 14 Boiler/Heaters		2.40	0.24	3.64	3.00	0.12	0.31	432248	7793153				
	Doyon 16 Rig Generators		104.58	3.27	6.41	195.10	7.98	20.49	432248	7793153				
	Doyon 16 Boiler/Heaters		2.10	0.21	2.75	3.00	0.12	0.31	432248	7793153				
	Nabors 2ES Rig Generators		106.68	3.33	6.59	195.10	7.98	20.49	432248	7793153				
	Nabors 2ES Boiler/Heaters		2.15	0.21	2.82	3.00	0.12	0.31	432248	7793153				
	Nabors 4ES Rig Generators		79.78	2.49	4.95	195.10	7.98	20.49	432248	7793153				
	Nabors 4ES Boiler/Heaters		1.61	0.16	2.12	3.00	0.12	0.31	432248	7793153				
	Nabors 9ES Rig Generators		106.70	3.33	6.54	195.10	7.98	20.49	432248	7793153				
	Nabors 9ES Boiler/Heaters		2.15	0.21	2.80	3.00	0.12	0.31	432248	7793153				
	Nordic 1 Rig Generators		71.01	2.22	4.40	195.10	7.98	20.49	432248	7793153				
	Nordic 1 Boiler/Heaters		1.43	0.14	1.89	3.00	0.12	0.31	432248	7793153				
	Nordic 2 Rig Generators		79.99	2.50	4.94	195.10	7.98	20.49	432248	7793153				
	Nordic 2 Boiler/Heaters		1.07	0.11	1.41	3.00	0.12	0.31	432248	7793153				

[1]Potential emissions for BP Transportable drilling rigs were taken from a total potential to emit of 198.1 per rig given by the title 5 permit.
[2]BP Transportable Drilling Rigs were modeled as a 10x10km area source due to uncertaintity of location.
[3]Coordinates for these reflect the bottom left hand corner of the area source.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
Alyeska TAPS Pump Station 01	Avon Gas Generator 31-P-2AT	ALYESK1	50.14	2.00	1.33	See Below	See Below	See Below	439013	7795195	15.85	2.438	611	22.25
	Avon Gas Generator 31-P-2BT	ALYESK2	63.97	2.53	1.69	See Below	See Below	See Below	439013	7795195	15.85	2.438	611	22.25
	Avon Gas Generator 31-P-2CT	ALYESK3	44.92	1.75	1.17	See Below	See Below	See Below	439013	7795195	15.85	2.438	611	22.25
	Solar Turbine Elec. Gen. 31-G-4A	ALYESK4	0.09	0.00	0.05	See Below	See Below	See Below	439013	7795195	5.18	0.610	653	16.76
	Solar Turbine Elec. Gen. 31-G-4B	ALYESK5	0.00	0.00	0.05	See Below	See Below	See Below	439013	7795195	5.18	0.610	653	16.76
	Solar Turbine Gas Comp. 31-C-10-1802T	ALYESK6	11.66	0.30	0.02	See Below	See Below	See Below	439013	7795195	16.15	0.610	653	16.76
	Solar Turbine Gas Comp. 31-C-10-1803T	ALYESK7	0.03	0.00	0.00	See Below	See Below	See Below	439013	7795195	16.15	0.610	653	16.76
	Solar Turbine Booster Pumps 31-P-1AT	ALYESK8	0.64	0.02	0.01	See Below	See Below	See Below	439013	7795195	9.75	0.610	653	16.76
	Solar Turbine Booster Pumps 31-P-1BT	ALYESK9	6.95	0.18	0.12	See Below	See Below	See Below	439013	7795195	9.75	0.610	653	16.76
	Solar Turbine Booster Pumps 31-P-1CT	ALYESK10	11.31	0.29	0.19	See Below	See Below	See Below	439013	7795195	9.75	0.610	653	16.76
	Garret Turbine Elec. Gen. 31-G-1AT	ALYESK11	12.91	0.27	0.18	See Below	See Below	See Below	439013	7795195	10.67	0.610	700	39.62
	Garret Turbine Elec. Gen. 31-G-1BT	ALYESK12	12.60	0.26	0.17	See Below	See Below	See Below	439013	7795195	10.67	0.610	700	39.62
	Garret Turbine Elec. Gen. 31-G-1CT	ALYESK13	12.20	0.25	0.17	See Below	See Below	See Below	439013	7795195	10.67	0.610	700	39.62
	Garret Turbine Elec. Gen. 31-G-2AT	ALYESK14	10.24	0.21	0.14	See Below	See Below	See Below	439013	7795195	10.67	0.610	700	39.62
	Garret Turbine Elec. Gen. 31-G-3AT	ALYESK15	2.43	0.05	0.03	See Below	See Below	See Below	439013	7795195	10.67	0.610	700	39.62
	Eclipse Therminol Heater 31-H-1A	ALYESK16	9.76	0.19	0.10	See Below	See Below	See Below	439013	7795195	19.20	0.610	583	9.75
	Eclipse Therminol Heater 31-H-1B	ALYESK17	5.95	0.45	0.25	See Below	See Below	See Below	439013	7795195	19.20	0.610	583	9.75
	Eclipse Therminol Heater 31-H-1C	ALYESK18	2.76	0.21	0.12	See Below	See Below	See Below	439013	7795195	19.20	0.610	583	9.75
	Broach Heater 31-H-10-1401	ALYESK19	0.33	0.02	0.01	See Below	See Below	See Below	439013	7795195	21.34	0.610	505	2.44
	Cummins N-855F Firewater Pump; 31-FP-2PK	ALYESK20	0.02	0.00	0.00	See Below	See Below	See Below	439013	7795195	5.18	0.305	602	142.03
	Therm-Tec Solid Waste Incin. 31-IN-1	ALYESK21	0.04	0.10	0.04	See Below	See Below	See Below	439013	7795195	10.36	0.610	1216	10.06
	Zink Flare/Airfoil Flaregas Flare; 31-FS-1 (purge)	ALYESK22	13.00	5.07	0.84	See Below	See Below	See Below	439013	7795195	35.66	1.219	1273	19.81

[1]All potential emissions were modeled from ADEC files shown in the table below.

[2]Exhaust Velocity for ALYESK20 was calculated given 2040 acfm.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
Alyeska TAPS Pump Station 01		P_2AT	n/a	n/a	n/a	213.09	33.63	10.75	439011	7795218	15.7	3.07	608.2	22.23
		P_2BT	n/a	n/a	n/a	213.09	33.63	10.75	439018	7795211	15.7	3.07	608.2	22.23
		P_2CT	n/a	n/a	n/a	213.09	33.63	10.75	439024	7795203	15.7	3.07	608.2	22.23
		G_1AT	n/a	n/a	n/a	2.43	0.38	0.12	438996	7795179	10.6	0.46	742	50.85
		G_1BT	n/a	n/a	n/a	2.43	0.38	0.12	438994	7795177	10.6	0.46	742	50.85
		G_1CT	n/a	n/a	n/a	2.43	0.38	0.12	438992	7795175	10.6	0.46	742	50.85
		G_2AT	n/a	n/a	n/a	2.43	0.38	0.12	438940	7795164	10.9	0.46	742	50.85
		G_3AT	n/a	n/a	n/a	2.43	0.38	0.12	438937	7795167	10.4	0.46	742	50.85
		G_4A	n/a	n/a	n/a	13.70	2.16	0.69	439001	7795170	5	0.61	652	16.87
		G_4B	n/a	n/a	n/a	13.70	2.16	0.69	438933	7795169	5.1	0.61	652	16.87
		C1802	n/a	n/a	n/a	1.01	0.16	0.05	438921	7795131	16.1	0.61	652	16.87
		C1803	n/a	n/a	n/a	1.01	0.16	0.05	438923	7795129	16.1	0.61	652	16.87
		P_1AT	n/a	n/a	n/a	1.01	0.16	0.05	438987	7795244	9.8	0.61	652	16.87
		P_1BT	n/a	n/a	n/a	1.01	0.16	0.05	438982	7795250	9.8	0.61	652	16.87
		P_1CT	n/a	n/a	n/a	1.01	0.16	0.05	438977	7795256	9.8	0.61	652	16.87
		H_1A	n/a	n/a	n/a	12.31	1.94	0.62	438954	7795179	19	0.76	583.2	9.87
		H_1B	n/a	n/a	n/a	12.31	1.94	0.62	438956	7795176	19	0.76	583.2	9.87
		H_1C	n/a	n/a	n/a	12.31	1.94	0.62	438959	7795173	19	0.76	583.2	9.87
		H1401	n/a	n/a	n/a	1.78	0.28	0.09	438937	7795107	19.6	76	700	0.001
		INC1	n/a	n/a	n/a	2.28	0.36	0.11	439165	7795272	10.2	0.66	1216	9.95
		FP2PK	n/a	n/a	n/a	0.77	0.12	0.04	438979	7795154	5.2	0.18	602	10.34
		BURN1	n/a	n/a	n/a	0.21	0.03	0.01	439170	7795315	9.6	11.7	528.2	0.001
		BURN2	n/a	n/a	n/a	0.00	0.00	0.00	439170	7795315	9.6	11.7	528.2	0.001
		North	n/a	n/a	n/a	1.14	0.18	0.06	439165	7795165	4.3	83	700	0.001
		psFlare	n/a	n/a	n/a	5.46	0.86	0.28	438772	7795373	35.5	1	1273	20

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
Deadhorse Soil Remediation Unit	Soil remediation unit[2]	DHSOIL1	0.96	0.53	3.60	43.20	9.00	155.60	445838	7789785	6.10	0.914	533	15.68
	Backup generator[2]	DHSOIL2	0.00	0.00	0.00	63.80	4.50	7.20	445838	7789785	3.66	0.152	589	15.24

[1]Potential emissions were taken directly from the title 5 permit.
[2]Stack parameters were estimated from similar equipment.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
Haliburton Deadhorse Facility	Cat 3408 a	HALIBUR1	42.50	0.00	0.00	See Below	See Below	See Below	449469	7794321	4.27	0.126	704	24.99
	Cat 3408 b	HALIBUR2	42.73	0.00	0.00	See Below	See Below	See Below	449469	7794321	4.27	0.126	704	24.99
	Cummins KTA 1150 a	HALIBUR3	0.52	0.04	0.03	See Below	See Below	See Below	449469	7794321	3.66	0.128	766	121.92
	Cummins KTA 1150 b	HALIBUR4	0.38	0.03	0.03	See Below	See Below	See Below	449469	7794321	3.66	0.128	766	121.92
	Compressor #1 John Deere 4045D	HALIBUR5	0.21	0.02	0.02	See Below	See Below	See Below	449469	7794321	5.18	0.101	561	26.21
	Compressor #2 John Deere 4045D	HALIBUR6	0.19	0.02	0.02	See Below	See Below	See Below	449469	7794321	5.18	0.101	561	26.21
	Cat 3408 N2 Plant	HALIBUR7	29.57	0.00	0.00	See Below	See Below	See Below	449469	7794321	4.27	0.126	704	24.99

[1]All potential emissions were modeled from ADEC files shown in the table below.

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)	Potential PM10 Emissions (tpy)	Potential SO2 Emissions (tpy)	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)	Stack Diameter (m)	Exhaust Temp. °K	Exhaust Velocity (m/s)
Haliburton Deadhorse Facility		HALL	n/a	n/a	n/a	249.24	2.30	1.50	446603	7791227	13.72	0.75	750	27

Facility	Emission Source	Model ID	Actual NOx Emissions (tpy)	Actual PM10 Emissions (tpy)	Actual SO2 Emissions (tpy)	Potential NOx Emissions (tpy)[1]	Potential PM10 Emissions (tpy)[1]	Potential SO2 Emissions (tpy)[1]	E-W UTM NAD 27 Zone 6 (m)	N-S UTM NAD 27 Zone 6 (m)	Stack Height (m)[2]	Stack Diameter (m)[2]	Exhaust Temp. °K[2]	Exhaust Velocity (m/s)[2]
TDX Deadhorse Power Plant	Cat. 3516	DHPP1	0.00	0.00	0.00	34.75	2.40	1.27	444607	7788078	15	0.31	711.89	38.88
	Cat. 3516	DHPP2	5.99	0.00	0.04	37.40	2.58	1.37	444607	7788078	14	0.31	683.15	36.55
	Cat. 3516	DHPP3	6.05	0.00	0.04	37.40	2.58	1.37	444605	7788078	14	0.31	683.15	36.55
	Cat. 3516	DHPP4	0.00	0.00	0.00	34.75	2.40	1.27	444605	7788078	15	0.31	711.89	38.88
	EMD V20-645E	DHPP5	45.46	0.00	1.89	34.75	2.40	1.27	444586	7788078	16	0.76	683.15	23.93
	Cat. 3616	DHPP6	2.51	0.00	0.44	32.50	2.25	1.19	444587	7788073	13.72	0.61	683.15	56.35
	Cat. D343	DHPP7	0.01	0.00	0.00	34.75	2.40	1.27	444606	7788056	14	0.15	766.48	49.02

[1]Potential emissions were taken directly from the title 5 permit.
[2]All stack parameters taken from ADEC modeling files.

APPENDIX G

Incinerator Exemption Letter

Shell Offshore Inc.
3601 C Street, Suite 1314
Anchorage, AK 99503

March 13, 2009

Ms. Nancy Helm, Manager
Federal and Delegated Air Programs Unit
Office of Air, Waste, and Toxics
USEPA Region 10
1200 Sixth Avenue, M/S OAQ-107
Seattle, Washington 98101

Subject: 40 CFR 60 Subpart CCCC - Standards of Performance for Commercial and Industrial Solid Waste Incineration Units. Federal Exemption Notification for a Ship Waste Incinerator on the Beaufort Sea

Dear Ms. Helm:

Shell Offshore Inc. (Shell) plans to install and operate a small ship waste incinerator on its Discoverer Drill vessel, to be operated in the Beaufort Sea. The new (manufactured in 2006 or later) incineration unit will be a two-stage (primary chamber and afterburner), batch feed, modular unit, capable of burning up to 1,000 pounds of waste per day. The unit does not include energy recovery. The wastes to be incinerated are primarily residential-type refuse from the living quarters and cafeteria facilities (in total amounts greater than 30 percent by weight of all material burned in the unit), but will also include some miscellaneous industrial packaging, waste oil, and other non-hazardous waste materials from the drilling support activities on ship. Shell believes that this incineration unit is classified as a combustion unit that combusts municipal-type solid waste (MSW) and commercial or industrial solid waste according to definitions and references in 40 CFR 60 Subpart CCCC, and meets the exemption criteria under 40 CFR § 60.2020(c)(2), therefore must only follow the notification and reporting requirements of 40 CFR § 60.2020(c)(2)(i) and (ii).

This letter serves as the notification, required in 40 CFR § 60.2020(c)(2)(i), that this incineration unit is exempt from the provisions of 40 CFR 60 Subpart CCCC. The less than 35-ton rated daily capacity and the disposal of more than 30 percent of the waste defined as municipal-type solid waste in accordance with 40 CFR 60 Subpart Ea qualifies this unit for such an exemption.

Shell acknowledges its obligation to keep records on a calendar quarter basis of the weight of municipal-type solid waste burned and the weight of all other fuels and wastes burned in the unit, to qualify for the exemption as per 40 CFR § 60.2020(c)(2)(ii).

Shell appreciates your review of this exemption notification and, for our records, requests your concurrence that the incineration unit is appropriately exempted from the requirements of 40 CFR 60 Subpart CCCC, except for this notification and the recordkeeping noted above.

Sincerely,

Shell Exploration & Production Company

Susan Childs
Regulatory Affairs Manager, Alaska Venture

Attachments:

cc: *Alaska Department of Environmental Conservation – Title V Programs*
Marc Stone, Shell
Cam Toohey, Shell
Keith Craik, Shell
Lance Tolson, Shell
Alan Schuler, ADEC, DAQ
Gene Pavia, UIC
Susan Mathiascheck, Patton Boggs
Mark Schindler, Octane, LLC
Rodger Steen, Air Sciences Inc.

APPENDIX H

Potential Emissions Without ORRs

For OCS exploration drilling, PSD is triggered if the source has potential emissions exceeding 250 tons per year of any regulated pollutant. Table 3-1 indicates the Beaufort Sea Project is subject to PSD because potential emissions of NO_x and CO exceed the threshold. The next step in the applicability process is to compare potential emissions to the "significant emission rates" (SERs) to determine whether additional analysis for a particular pollutant is required. Table 3-1 shows that potential emissions of NO_x, CO, PM_{10}, $PM_{2.5}$, and VOCs from the *Discoverer* and its associated fleet combined each exceed the corresponding SER. Therefore, this application includes Best Available Control Technology (BACT) analyses, and a source impact analysis, addressing emissions from the *Discoverer* and its associated fleet for NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC emissions.

As under the federal PSD rules, the Alaska PSD rules allow the PSD permit to include physical or operational limitations, including those voluntarily assumed by the permittee, to limit potential emissions. Alaska's regulations contain several provisions on "owner-requested limits" that contain unique processing requirements. But these provisions were designed for use with minor sources, not PSD sources. ADEC has confirmed to ENVIRON that the owner-requested limits provision in 18 AAC 50.225 is used to keep applicants out of the permit process (e.g., to avoid PSD, Title V, and Title I minor permits). This explains why it imposes detailed processing requirements. And the other AAC provisions using the phrase "owner-requested limits" clearly apply only to minor sources. Each of the three – 18 AAC 50.508(5), 50.540(j), and 50.544(h) – have the phrase "minor source" in the provision heading. The Shell requested limitations in this application are, therefore, appropriately not "owner-requested limits" under Alaska's regulations.

Nonetheless, Region 10 has asked Shell to submit PTE calculations that exclude any limits requested by Shell. Even though Shell believes the requested calculations are not required and irrelevant to determining PSD applicability, they are provided here in Appendix H in order to satisfy the Region's request. The calculations include consideration of BACT because it is required regardless of applicant proposed restrictions and include the 168 day limit on drilling because that is believed to be a physical limitation on drilling in the Arctic Ocean.

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 1	OF: 10
	SUBJECT: Discoverer Emissions-AK OCS	DATE: January 15, 2010	

	Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Maximum Emissions (ton/yr) PM	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC	Lead	HAPs
Frontier Discoverer Stationary Source	418,483	3,144,173	17.00	10.24	9.91	153.07	0.33	34.62	25.71	6.47E-02	0.78
Associated Fleets	1,147,687	8,622,870	86	70	62	1,863	1	443	79	5.21E-02	1.74
	1,566,170	11,767,043	103	80	72	2,016	2	478	105	1.17E-01	2.52

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 2 OF: 10
	SUBJECT: Discoverer Emissions-AK OCS	DATE: January 15, 2010

PM Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	PM10 Emissions Factor	Reference	PM10/PM Ratio	Maximum Emissions (ton/yr) PM
Frontier Discoverer									
FD-1	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.68
FD-2	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.68
FD-3	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.68
FD-4	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.68
FD-5	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.68
FD-6	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.68
FD-7	Propulsion Engine	7,200	hp	0	0	0.0573 lb/MMBtu	AP42 Table 3.4-2, 10/96	82% AP42 Table 3.4-2, 10/96	0.00
FD-8	Em Generator	131	hp	3,697	27,779	2.21 g/bhp-hr	Max of 13 test from EPA/600/8-90/057F	82% AP42 Table 3.4-2, 10/96	1.57
FD-9	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.22
FD-10	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.22
FD-11	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.22
FD-12	HPU Engine	250	hp	7,868	59,118	1.26 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	82% AP42 Table 3.4-2, 10/96	0.26
FD-13	HPU Engine	250	hp	7,868	59,118	1.26 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	82% AP42 Table 3.4-2, 10/96	0.26
FD-14	Port Deck Crane	365	hp	11,149	83,765	129.8 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.11
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	129.8 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	82% AP42 Table 3.4-2, 10/96	0.11
FD-16	Cementing Unit	335	hp	10,544	79,218	1.92 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.52
FD-17	Cementing Unit	335	hp	10,544	79,218	1.92 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.52
FD-18	Cementing Unit	147	hp	4,627	34,761	1.92 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.23
FD-19	Logging Winch	250	hp	6,683	50,213	1.92 g/kW-hr	Tier 3 emission limit	82% AP42 Table 3.4-2, 10/96	0.39
FD-20	Logging Winch	35	hp	988	7,422	1.92 g/kW-hr	Tier 2 emission limit	82% AP42 Table 3.4-2, 10/96	0.05
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	4.5 lb/day	Clayton Industries, 8/2001	61% AP42, Table 1.3-1 & 2, 9/98	0.62
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	4.5 lb/day	Clayton Industries, 8/2001	61% AP42, Table 1.3-1 & 2, 9/98	0.62
FD-23	Incinerator	276	lb/hr	0	0	2.51E+01 lb/ton	AP42-Table 2.1-2-For Mass Burn And Modular Excess Air Combustors 10/96		6.98
FD-31	Resupply Ship - docked	0	0	196	1,474	0.31 lb/MMBtu	AP42 Table 3.3-1, 10/96	82% AP42 Table 3.4-2, 10/96	0.04
Discoverer Total				**418,483**	**3,144,173**				**17.00**

PM Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference		Maximum Emissions (ton/yr) PM
Ice Breaker								
IB IC Engines			334,624	2,514,115	1.06 g/kW-hr	generic factors consistent w/Ice breaker ORR	82% AP42 Table 3.4-2, 10/96	51
IB Boiler			40,320	302,935	3.3 lb/10^3 gal	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98		0.50
IB Incinerators	154	lb/hr	0	0	2.51E+01 lb/ton	AP42-Table 2.1-2-For Mass Burn And Modular Excess Air Combustors 10/96		3.90
Ice Breaker Total			*374,944*	*2,817,050*				*55*
Anchor Handler								
AH ICE Engines			345,044	2,592,407	0.25 g/kW-hr	generic factors consistent w/Ice breaker ORR	82% AP42 Table 3.4-2, 10/96	12
AH Boiler			16,128	121,174	3.3 lb/10^3 gal	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98		0.20
AH Incinerator	151	lb/hr	0	0	2.51E+01 lb/ton	AP42-Table 2.1-2-For Mass Burn And Modular Excess Air Combustors 10/96		1.45
Anchor Handler Total			*361,172*	*2,713,581*				*14*
Resupply Ship - in Transit			*1,421*	*10,677*	1.92 g/kW-hr	Corbett, Koehler. Revised: 05/03	82% AP42 Table 3.4-2, 10/96	*0.39*
OSR Fleet								
Nanuq ICE Propulsion Engines			185,503	1,393,734	0.17 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	82% AP42 Table 3.4-2, 10/96	1
Nanuq ICE Generators			72,536	544,979	1.92 g/kW-hr	Corbett, Koehler. Revised: 05/03	82% AP42 Table 3.4-2, 10/96	3
Other Main Ship ICE Propulsion Engines			53,637	402,991	0.17 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	82% AP42 Table 3.4-2, 10/96	1
Other Main Ship ICE Generators			24,160	181,518	1.92 g/kW-hr	Corbett, Koehler. Revised: 05/03	82% AP42 Table 3.4-2, 10/96	7
OSR Main Ship Incinerator	125	lb/hr	0	0	2.51E+01 lb/ton	AP42-Table 2.1-2-For Mass Burn And Modular Excess Air Combustors 10/96		3.16
OSR Main Ship Total			*335,836*	*2,523,223*				15
OSR Work Boat ICE Propulsion Engines			73,382	551,341	0.077 g/hp-hr	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06	82% AP42 Table 3.4-2, 10/96	1.08
OSR Work Boat ICE Generators			931	6,998	0.31 lb/MMBtu	AP42 Table 3.3-1, 10/96	82% AP42 Table 3.4-2, 10/96	0.18
OSR Work Boats Total			*74,314*	*558,339*				1
OSR Total			*410,150*	*3,081,562*				*16*
Fleet Total			**1,147,687**	**8,622,870**				**86**
Total			**1,566,170**	**11,767,043**				**103**

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 3	OF: 10
	SUBJECT: Discoverer Emissions-AK OCS	DATE: January 15, 2010	

PM_{10} Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) PM_{10}
Frontier Discoverer								
FD-1	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-2	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-3	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-4	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-5	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-6	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-7	Propulsion Engine	7,200	hp	0	0	0.0573 lb/MMBtu	AP42 Table 3.4-2, 10/96	0.00
FD-8	Em Generator	131	hp	3,697	27,779	2.21 g/bhp-hr	Max of 13 test from EPA/600/8-90/057F	1.29
FD-9	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	0.18
FD-10	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	0.18
FD-11	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	0.18
FD-12	HPU Engine	250	hp	7,868	59,118	1.26 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	0.21
FD-13	HPU Engine	250	hp	7,868	59,118	1.26 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	0.21
FD-14	Port Deck Crane	365	hp	11,149	83,765	129.8 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.09
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	129.8 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.09
FD-16	Cementing Unit	335	hp	10,544	79,218	1.92 g/kW-hr	Tier 3 emission limit	0.43
FD-17	Cementing Unit	335	hp	10,544	79,218	1.92 g/kW-hr	Tier 3 emission limit	0.43
FD-18	Cementing Unit	147	hp	4,627	34,761	1.92 g/kW-hr	Tier 3 emission limit	0.19
FD-19	Logging Winch	250	hp	6,683	50,213	1.92 g/kW-hr	Tier 3 emission limit	0.32
FD-20	Logging Winch	35	hp	988	7,422	1.92 g/kW-hr	Tier 2 emission limit	0.04
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	4.5 lb/day	Clayton Industries, 8/2001	0.38
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	4.5 lb/day	Clayton Industries, 8/2001	0.38
FD-23	Incinerator	276	lb/hr	0	0	8.2 lb/ton	ORR	2.28
FD-31	Resupply Ship - docked	0	0	196	1,474	0.31 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.03
Discoverer Total				**418,483**	**3,144,173**			**10.24**

PM_{10} Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) PM_{10}
Ice Breaker							
IB IC Engines			334,624	2,514,115	1.06 g/kW-hr	generic factors consistent w/Ice breaker ORR	42
IB Boiler			40,320	302,935	3.3 lb/10^3 gal	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98	0.50
IB Incinerators	154	lb/hr	0	0	13.3 lb/ton	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1	2.06
Ice Breaker Total			*374,944*	*2,817,050*			*44*
Anchor Handler							
AH ICE Engines			345,044	2,592,407	Varies based on Anchor Handler		11.95
AH Boiler			16,128	121,174	3.3 lb/10^3 gal	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98	0.20
AH Incinerator	151	lb/hr	0	0	13.3 lb/ton	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1	0.77
Anchor Handler Total			*361,172*	*2,713,581*			*12.92*
Resupply Ship - in Transit			1,421	10,677	1.92 g/kW-hr	Corbett, Koehler. Revised: 05/03	*0.32*
OSR Fleet							
Nanuq ICE Propulsion Engines			185,503	1,393,734	0.17 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	1
Nanuq ICE Generators			72,536	544,979	1.92 g/kW-hr	Corbett, Koehler. Revised: 05/03	2
Other Main Ship ICE Propulsion Engines			53,637	402,991	0.17 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	1
Other Main Ship ICE Generators			24,160	181,518	1.92 g/kW-hr	Corbett, Koehler. Revised: 05/03	5
OSR Main Ship Incinerator	125	lb/hr	0	0	13.3 lb/ton	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1	1.68
OSR Main Ship Total			*335,836*	*2,523,223*			*11*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	0.077 g/hp-hr	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/	0.89
OSR Work Boat ICE Generators			931	6,998	0.31 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.14
OSR Work Boats Total			*74,314*	*558,339*			*1*
OSR Total			*410,150*	*3,081,562*			*12*
Fleet Total			**1,147,687**	**8,622,870**			**70**
Total			**1,566,170**	**11,767,043**			**80**

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 4 OF: 10
	SUBJECT: Discoverer Emissions-AK OCS	DATE: January 15, 2010

$PM_{2.5}$ Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) $PM_{2.5}$
Frontier Discoverer								
FD-1	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-2	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-3	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-4	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-5	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-6	Generator Engine	1,325	hp	39,265	295,011	251.2 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.56
FD-7	Propulsion Engine	7,200	hp	0	0	0.0573 lb/MMBtu	AP42 Table 3.4-2, 10/96	0.00
FD-8	Em Generator	131	hp	3,697	27,779	2.21 g/bhp-hr	Max of 13 test from EPA/600/8-90/057F	1.29
FD-9	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	0.18
FD-10	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	0.18
FD-11	MLC Compressor	540	hp	14,436	108,461	0.2 g/kW-hr	Tier 3 emission limit	0.18
FD-12	HPU Engine	250	hp	7,868	59,118	1.26 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	0.21
FD-13	HPU Engine	250	hp	7,868	59,118	1.26 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	0.21
FD-14	Port Deck Crane	365	hp	11,149	83,765	129.8 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.09
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	129.8 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.09
FD-16	Cementing Unit	335	hp	10,544	79,218	1.92 g/kW-hr	Tier 3 emission limit	0.43
FD-17	Cementing Unit	335	hp	10,544	79,218	1.92 g/kW-hr	Tier 3 emission limit	0.43
FD-18	Cementing Unit	147	hp	4,627	34,761	1.92 g/kW-hr	Tier 3 emission limit	0.19
FD-19	Logging Winch	250	hp	6,683	50,213	1.92 g/kW-hr	Tier 3 emission limit	0.32
FD-20	Logging Winch	35	hp	988	7,422	1.92 g/kW-hr	Tier 2 emission limit	0.04
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	4.5 lb/day	Clayton Industries, 8/2001	0.38
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	4.5 lb/day	Clayton Industries, 8/2001	0.38
FD-23	Incinerator	276	lb/hr	0	0	7 lb/ton	ORR	1.95
FD-31	Resupply Ship - docked	0	0	196	1,474	0.31 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.03
Discoverer Total				**418,483**	**3,144,173**			**9.91**

$PM_{2.5}$ Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) PM2.5
Ice Breaker							
IB IC Engines			334,624	2,514,115	0.22 lb/MMBtu	generic factors consistent w/Ice breaker ORR	37
IB Boiler			40,320	302,935	3.3 lb/10^3 gal	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98	0.50
IB Incinerators	154	lb/hr	0	0	9.1 lb/ton	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1	1.41
Ice Breaker Total			*374,944*	*2,817,050*			*39*
Anchor Handler							
AH ICE Engines			345,044	2,592,407	Varies based on Anchor Handler		11.95
AH Boiler			16,128	121,174	3.3 lb/10^3 gal	AP42 Table 1.3-1, 9/98 & AP42 Table 1.3-2, 9/98	0.20
AH Incinerator	151	lb/hr	0	0	9.1 lb/ton	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1	0.53
Anchor Handler Total			*361,172*	*2,713,581*			*12.68*
Resupply Ship - in Transit			1,421	10,677	1.54 g/kW-hr	EPA Ref: IVL	*0.26*
OSR Fleet							
Nanuq ICE Propulsion Engines			185,503	1,393,734	0.17 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	1
Nanuq ICE Generators			72,536	544,979	1.54 g/kW-hr	EPA Ref: IVL	2
Other Main Ship ICE Propulsion Engines			53,637	402,991	0.17 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	1
Other Main Ship ICE Generators			24,160	181,518	1.54 g/kW-hr	EPA Ref: IVL	4
OSR Main Ship Incinerator	125	lb/hr	0	0	9.1 lb/ton	AP42 Table 2.1-12, 10/96 & Appendix B.1 2.1	1.15
OSR Main Ship Total			*335,836*	*2,523,223*			*9*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	0.077 g/hp-hr	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/	0.89
OSR Work Boat ICE Generators			931	6,998	0.31 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.14
OSR Work Boats Total			*74,314*	*558,339*			*1*
OSR Total			*410,150*	*3,081,562*			*10*
Fleet Total			**1,147,687**	**8,622,870**			**62**
Total			**1,566,170**	**11,767,043**			**72**

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor	
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 5	OF: 10
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NO_x Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) NO_x
Frontier Discoverer								
FD-1	Generator Engine	1,325	hp	39,265	295,011	0.5 g/kW-hr	D.E.C. Marine AB letter, 10/9/08	2.20
FD-2	Generator Engine	1,325	hp	39,265	295,011	0.5 g/kW-hr	D.E.C. Marine AB letter, 10/9/08	2.20
FD-3	Generator Engine	1,325	hp	39,265	295,011	0.5 g/kW-hr	D.E.C. Marine AB letter, 10/9/08	2.20
FD-4	Generator Engine	1,325	hp	39,265	295,011	0.5 g/kW-hr	D.E.C. Marine AB letter, 10/9/08	2.20
FD-5	Generator Engine	1,325	hp	39,265	295,011	0.5 g/kW-hr	D.E.C. Marine AB letter, 10/9/08	2.20
FD-6	Generator Engine	1,325	hp	39,265	295,011	0.5 g/kW-hr	D.E.C. Marine AB letter, 10/9/08	2.20
FD-7	Propulsion Engine	7,200	hp	0	0	3.2 lb/MMBtu	AP42 Table 3.4-1, 10/96	0.00
FD-8	Em Generator	131	hp	3,697	27,779	11.28 g/bhp-hr	Max of 13 test from EPA/600/8-90/057F	6.57
FD-9	MLC Compressor	540	hp	14,436	108,461	4.0 g/kW-hr	Tier 3 emission limit	7.16
FD-10	MLC Compressor	540	hp	14,436	108,461	4.0 g/kW-hr	Tier 3 emission limit	7.16
FD-11	MLC Compressor	540	hp	14,436	108,461	4.0 g/kW-hr	Tier 3 emission limit	7.16
FD-12	HPU Engine	250	hp	7,868	59,118	9.81 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	10.90
FD-13	HPU Engine	250	hp	7,868	59,118	9.81 g/bhp-hr	Max of 4 test from EPA/600/8-90/057F	10.90
FD-14	Port Deck Crane	365	hp	11,149	83,765	2810.9 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	12.49
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	2810.9 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	12.49
FD-16	Cementing Unit	335	hp	10,544	79,218	11.72 g/bhp-hr	Max of 8 test from EPA/600/8-90/057F	17.45
FD-17	Cementing Unit	335	hp	10,544	79,218	11.72 g/bhp-hr	Max of 8 test from EPA/600/8-90/057F	17.45
FD-18	Cementing Unit	147	hp	4,627	34,761	11.72 g/bhp-hr	Max of 8 test from EPA/600/8-90/057F	7.66
FD-19	Logging Winch	250	hp	6,683	50,213	11.72 g/bhp-hr	Max of 8 test from EPA/600/8-90/057F	13.02
FD-20	Logging Winch	35	hp	988	7,422	7.5 g/kW-hr	Tier 2 emission limit	1.17
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	38.5 lb/day	Clayton Industries, 8/2001	3.23
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	38.5 lb/day	Clayton Industries, 8/2001	3.23
FD-23	Incinerator	276	lb/hr	0	0	5 lb/ton	AP42 Table 2.2-1, multiple hearth	1.39
FD-31	Resupply Ship - docked	0	0	196	1,474	4.41 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.43
Discoverer Total				**418,483**	**3,144,173**			**153.07**

NO_x Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) NO_x
Ice Breaker							
IB IC Engines			334,624	2,514,115	25.4 g/kW-hr	generic factors consistent w/Ice mgmt fleet ORRs	999
IB Boiler			40,320	302,935	20 lb/103 gal	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98	3
IB Incinerators	154	lb/hr	0	0	3 lb/ton	AP42 Table 2.1-12, 10/96	0.47
Ice Breaker Total			*374,944*	*2,817,050*			*1,002*
Anchor Handler							
AH ICE Engines			345,044	2,592,407	Varies based on Anchor Handler		87.89
AH Boiler			16,128	121,174	Varies based on Anchor Handler		0.42
AH Incinerator	151	lb/hr	0	0	3 lb/ton	AP42 Table 2.1-12, 10/96	0.17
Anchor Handler Total			*361,172*	*2,713,581*			*88.48*
Resupply Ship - in Transit			1,421	10,677	25.4 g/kW-hr	EPA Memo, D. Meyer, June 12, 2008	*4.24*
OSR Fleet							
Nanuq ICE Propulsion Engines			185,503	1,393,734	13.62 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	328
Nanuq ICE Generators			72,536	544,979	25.4 g/kW-hr	EPA Memo, D. Meyer, June 12, 2008	217
Other Main Ship ICE Propulsion Engines			53,637	402,991	13.62 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	95
Other Main Ship ICE Generators			24,160	181,518	25.4 g/kW-hr	EPA Memo, D. Meyer, June 12, 2008	72
OSR Main Ship Incinerator	125	lb/hr	0	0	3 lb/ton	AP42 Table 2.1-12, 10/96	0.38
OSR Main Ship Total			*335,836*	*2,523,223*			*712*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	4.644 g/hp-hr	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/	53.66
OSR Work Boat ICE Generators			931	6,998	4.41 lb/MMBtu	AP42 Table 3.3-1, 10/96	2.05
OSR Work Boats Total			*74,314*	*558,339*			*56*
OSR Total			*410,150*	*3,081,562*			*768*
Fleet Total			**1,147,687**	**8,622,870**			**1,863**
Total			**1,566,170**	**11,767,043**			**2,016**

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 6 OF: 10
	SUBJECT: Discoverer Emissions-AK OCS	DATE: January 15, 2010

SO_2 Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor		Reference	Maximum Emissions (ton/yr) SO_2
Frontier Discoverer									
FD-1	Generator Engine	1,325	hp	39,265	295,011	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-2	Generator Engine	1,325	hp	39,265	295,011	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-3	Generator Engine	1,325	hp	39,265	295,011	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-4	Generator Engine	1,325	hp	39,265	295,011	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-5	Generator Engine	1,325	hp	39,265	295,011	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-6	Generator Engine	1,325	hp	39,265	295,011	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-7	Propulsion Engine	7,200	hp	0	0	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.00
FD-8	Em Generator	131	hp	3,697	27,779	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.00
FD-9	MLC Compressor	540	hp	14,436	108,461	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-10	MLC Compressor	540	hp	14,436	108,461	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-11	MLC Compressor	540	hp	14,436	108,461	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-12	HPU Engine	250	hp	7,868	59,118	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-13	HPU Engine	250	hp	7,868	59,118	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-14	Port Deck Crane	365	hp	11,149	83,765	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-16	Cementing Unit	335	hp	10,544	79,218	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-17	Cementing Unit	335	hp	10,544	79,218	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-18	Cementing Unit	147	hp	4,627	34,761	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.00
FD-19	Logging Winch	250	hp	6,683	50,213	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.01
FD-20	Logging Winch	35	hp	988	7,422	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.00
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	0.0015% by wt.	0.0016 lb/MMBtu	Calculation	0.03
FD-23	Incinerator	276	lb/hr	0	0		2.5 lb/ton	ORR	0.00
FD-31	Resupply Ship - docked	0	0	196	1,474	0.00% by wt.	0.0016 lb/MMBtu	Calculation	0.00
Discoverer Total				**418,483**	**3,144,173**				**0.33**

SO_2 Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor		Reference	Maximum Emissions (ton/yr) SO_2
Ice Breaker								
IB IC Engines			334,624	2,514,115	0.00% by wt.	1.42E+02 S lb/103 gal	AP42 Table 1.3-1, < 100 MME	0.27
IB Boiler			40,320	302,935	0.00% by wt.	142 S lb/103 gal	AP42 Table 1.3-1, < 100 MME	0.03
IB Incinerators	154	lb/hr	0	0		2.5 lb/ton	AP42 Table 2.1-12, 10/96	0.15
Ice Breaker Total			*374,944*	*2,817,050*				*0*
Anchor Handler								
AH ICE Engines			345,044	2,592,407	0.00% by wt.	8.09E-03 S lb/hp-hr	AP42 Table 3.4-1, 10/96	0.35
AH Boiler			16,128	121,174	0.00% by wt.	142 S lb/10^3 gal	AP42 Table 1.3-1, 9/98	0.01
AH Incinerator	151	lb/hr	0	0	0.00% by wt.	2.5 lb/ton	AP42 Table 2.1-12, 10/96	0.14
Anchor Handler Total			*361,172*	*2,713,581*				*0.51*
Resupply Ship - in Transit			1,421	10,677	0.00% by wt.	1.42E+02 S lb/103 gal	AP42 Table 1.3-1, < 100 MME	*0.00*
OSR Fleet								
Nanuq ICE Propulsion Engines			185,503	1,393,734	0.00% by wt.	0.0016 lb/MMBtu	Calculation	0.15
Nanuq ICE Generators			72,536	544,979	0.00% by wt.	1.42E+02 S lb/103 gal	AP42 Table 1.3-1, < 100 MME	0.06
Other Main Ship ICE Propulsion Engines			53,637	402,991	0.00% by wt.	0.0016 lb/MMBtu	Calculation	0.04
Other Main Ship ICE Generators			24,160	181,518	0.00% by wt.	1.42E+02 S lb/103 gal	AP42 Table 1.3-1, < 100 MME	0.02
OSR Main Ship Incinerator	125	lb/hr	0	0		2.5 lb/ton	AP42 Table 2.1-12, 10/96	0.12
OSR Main Ship Total			*335,836*	*2,523,223*				*0*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	0.00% by wt.	0.0016 lb/MMBtu	Calculation	0.06
OSR Work Boat ICE Generators			931	6,998	0.00% by wt.	0.0016 lb/MMBtu	Calculation	0.00
OSR Work Boats Total			*74,314*	*558,339*				*0*
OSR Total			*410,150*	*3,081,562*				*0*
Fleet Total			**1,147,687**	**8,622,870**				**1**
Total			**1,566,170**	**11,767,043**				**2**

Air Sciences Inc.	PROJECT TITLE: Shell Offshore, Inc.	BY: S. Pryor
ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 7 OF: 10
	SUBJECT: Discoverer Emissions-AK OCS	DATE: January 15, 2010

CO Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) CO
Frontier Discoverer								
FD-1	Generator Engine	1,325	hp	39,265	295,011	882.7 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.78
FD-2	Generator Engine	1,325	hp	39,265	295,011	882.7 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.78
FD-3	Generator Engine	1,325	hp	39,265	295,011	882.7 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.78
FD-4	Generator Engine	1,325	hp	39,265	295,011	882.7 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.78
FD-5	Generator Engine	1,325	hp	39,265	295,011	882.7 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.78
FD-6	Generator Engine	1,325	hp	39,265	295,011	882.7 g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.78
FD-7	Propulsion Engine	7,200	hp	0	0	5.50E-03 lb/hp-hr	AP42 Table 3.4-1, 10/96	0.00
FD-8	Em Generator	131	hp	3,697	27,779	6.2 g/bhp-hr	Max of 13 test from EPA/600/8-90/057F	3.61
FD-9	MLC Compressor	540	hp	14,436	108,461	3.5 g/kW-hr	Tier 3 emission limit	3.32
FD-10	MLC Compressor	540	hp	14,436	108,461	3.5 g/kW-hr	Tier 3 emission limit	3.32
FD-11	MLC Compressor	540	hp	14,436	108,461	3.5 g/kW-hr	Tier 3 emission limit	3.32
FD-12	HPU Engine	250	hp	7,868	59,118	2.99 g/bhp-hr	Max of 2 test from EPA/600/8-90/057F	0.33
FD-13	HPU Engine	250	hp	7,868	59,118	2.99 g/bhp-hr	Max of 2 test from EPA/600/8-90/057F	0.33
FD-14	Port Deck Crane	365	hp	11,149	83,765	593.6 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.26
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	593.6 g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.26
FD-16	Cementing Unit	335	hp	10,544	79,218	6.55 g/kW-hr	Tier 3 emission limit	0.98
FD-17	Cementing Unit	335	hp	10,544	79,218	6.55 g/kW-hr	Tier 3 emission limit	0.98
FD-18	Cementing Unit	147	hp	4,627	34,761	6.55 g/kW-hr	Tier 3 emission limit	0.43
FD-19	Logging Winch	250	hp	6,683	50,213	6.55 g/kW-hr	Tier 3 emission limit	1.46
FD-20	Logging Winch	35	hp	988	7,422	6.55 g/kW-hr	Tier 2 emission limit	0.10
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	14.8 lb/day	Clayton Industries, 8/2001	1.24
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	14.8 lb/day	Clayton Industries, 8/2001	1.24
FD-23	Incinerator	276	lb/hr	0	0	31 lb/ton	AP42 Table 2.2-1, multiple hearth	8.62
FD-31	Resupply Ship - docked	0	0	196	1,474	0.95 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.09
Discoverer Total				**418,483**	**3,144,173**			**34.62**

CO Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	Reference	Maximum Emissions (ton/yr) CO
Ice Breaker							
IB IC Engines			334,624	2,514,115	5.50E-03 lb/hp-hr	AP42 Table 3.4-1, 10/96	131.46
IB Boiler			40,320	302,935	5 lb/103 gal	AP42 Table 1.3-1, < 100 MMBtu/hr, Distillate oil fired , 9/98	0.76
IB Incinerators	154	lb/hr	0	0	300 lb/ton	AP42 Table 2.1-12, 10/96	17.70
Ice Breaker Total			*374,944*	*2,817,050*			*150*
Anchor Handler							
AH ICE Engines			345,044	2,592,407	Varies based on Anchor Handler		239.00
AH Boiler			16,128	121,174	5 lb/10^3 gal	AP42 Table 1.3-1, 9/98	0.30
AH Incinerator	151	lb/hr	0	0	300 lb/ton	AP42 Table 2.1-12, 10/96	17.38
Anchor Handler Total			*361,172*	*2,713,581*			*256.68*
Resupply Ship - in Transit			1,421	10,677	5.50E-03 lb/hp-hr	AP42 Table 3.4-1, 10/96	*0.56*
OSR Fleet							
Nanuq ICE Propulsion Engines			185,503	1,393,734	0.73 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	1.76
Nanuq ICE Generators			72,536	544,979	0.0055 lb/hp-hr	AP42 Table 3.4-1, 10/96	2.85
Other Main Ship ICE Propulsion Engines			53,637	402,991	0.73 g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	5.08
Other Main Ship ICE Generators			24,160	181,518	0.0055 lb/hp-hr	AP42 Table 3.4-1, 10/96	9.49
OSR Main Ship Incinerator	125	lb/hr	0	0	300 lb/ton	AP42 Table 2.1-12, 10/96	14.36
OSR Main Ship Total			*335,836*	*2,523,223*			*34*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	0.155 g/hp-hr	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06	1.79
OSR Work Boat ICE Generators			931	6,998	0.95 lb/MMBtu	AP42 Table 3.3-1, 10/96	0.44
OSR Work Boats Total			*74,314*	*558,339*			*2*
OSR Total			*410,150*	*3,081,562*			*36*
Fleet Total			**1,147,687**	**8,622,870**			**443**
Total			**1,566,170**	**11,767,043**			**478**

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ENGINEERING CALCULATIONS	PROJECT NO: 180-15-1	PAGE: 8 OF: 10
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VOC Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor		Reference	Maximum Emissions (ton/yr) VOC
Frontier Discoverer									
FD-1	Generator Engine	1,325	hp	39,265	295,011	75.5	g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.10
FD-2	Generator Engine	1,325	hp	39,265	295,011	75.5	g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.10
FD-3	Generator Engine	1,325	hp	39,265	295,011	75.5	g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.10
FD-4	Generator Engine	1,325	hp	39,265	295,011	75.5	g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.10
FD-5	Generator Engine	1,325	hp	39,265	295,011	75.5	g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.10
FD-6	Generator Engine	1,325	hp	39,265	295,011	75.5	g/hr	Caterpillar D399 SCAC Engine Data Sheet, 05/95	0.10
FD-7	Propulsion Engine	7,200	hp	0	0	0.09	lb/MMBtu	AP42 Table 3.4-1, 10/96	0.00
FD-8	Em Generator	131	hp	3,697	27,779	1.163	g/bhp-hr	Max of 13 test from EPA/600/8-90/057F	0.68
FD-9	MLC Compressor	540	hp	14,436	108,461	4.0	g/kW-hr	Tier 3 emission limit	7.16
FD-10	MLC Compressor	540	hp	14,436	108,461	4.0	g/kW-hr	Tier 3 emission limit	7.16
FD-11	MLC Compressor	540	hp	14,436	108,461	4.0	g/kW-hr	Tier 3 emission limit	7.16
FD-12	HPU Engine	250	hp	7,868	59,118	1.48	g/bhp-hr	Max of 2 test from EPA/600/8-90/057F	0.16
FD-13	HPU Engine	250	hp	7,868	59,118	1.48	g/bhp-hr	Max of 2 test from EPA/600/8-90/057F	0.16
FD-14	Port Deck Crane	365	hp	11,149	83,765	172.6	g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.08
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	172.6	g/hr	Caterpillar D343 Engine Data Sheet, 05/95	0.08
FD-16	Cementing Unit	335	hp	10,544	79,218	3.00	g/bhp-hr	Tier 3 emission limit	0.45
FD-17	Cementing Unit	335	hp	10,544	79,218	3.00	g/bhp-hr	Tier 3 emission limit	0.45
FD-18	Cementing Unit	147	hp	4,627	34,761	3.00	g/bhp-hr	Tier 3 emission limit	0.20
FD-19	Logging Winch	250	hp	6,683	50,213	3.00	g/bhp-hr	Tier 3 emission limit	0.33
FD-20	Logging Winch	35	hp	988	7,422	7.5	g/kW-hr	Tier 2 emission limit	0.12
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	0.27	lb/day	Clayton Industries, 8/2001	0.02
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	0.27	lb/day	Clayton Industries, 8/2001	0.02
FD-23	Incinerator	276	lb/hr	0	0	3	lb/ton	AP42 Table 2.1-12, 10/96	0.83
FD-31	Resupply Ship - docked	0	0	196	1,474	0.35	lb/MMBtu	AP42 Table 3.3-1, 10/96	0.03
Discoverer Total				**418,483**	**3,144,173**				**25.71**

VOC Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	100%	of	168 days/yr	4032 hrs/yr
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor		Reference	Maximum Emissions (ton/yr) VOC
Ice Breaker								
IB IC Engines			334,624	2,514,115	0.60	g/kW-hr	Corbett, Koehler. Revised: 05/03	23.59
IB Boiler			40,320	302,935	0.34	lb/10^3 gal	AP42 Table 1.3-3, 9/98	0.05
IB Incinerators	154	lb/hr	0	0	100	lb/ton	AP42 Table 2.1-12, 10/96	5.90
Ice Breaker Total			*374,944*	*2,817,050*				*30*
Anchor Handler								
AH ICE Engines			345,044	2,592,407	Varies based on Anchor Handler			18.35
AH Boiler			16,128	121,174	0.34	lb/10^3 gal	AP42 Table 1.3-3, 9/98	0.01
AH Incinerator	151	lb/hr	0	0	100	lb/ton	AP42 Table 2.1-12, 10/96	5.79
Anchor Handler Total			*361,172*	*2,713,581*				*24.15*
Resupply Ship - in Transit			1,421	10,677	0.60	g/kW-hr	Corbett, Koehler. Revised: 05/03	*0.10*
OSR Fleet								
Nanuq ICE Propulsion Engines			185,503	1,393,734	0.99	g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	2.38
Nanuq ICE Generators			72,536	544,979	0.60	g/kW-hr	Corbett, Koehler. Revised: 05/03	0.51
Other Main Ship ICE Propulsion Engines			53,637	402,991	0.99	g/kW-hr	Caterpillar 3608 Specification Sheet, DM5529, 10/06	6.90
Other Main Ship ICE Generators			24,160	181,518	0.60	g/kW-hr	Corbett, Koehler. Revised: 05/03	1.70
OSR Main Ship Incinerator	125	lb/hr	0	0	100	lb/ton	AP42 Table 2.1-12, 10/96	12.60
OSR Main Ship Total			*335,836*	*2,523,223*				*24*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	0.078	g/hp-hr	Cummins Engine Model: QSB5.9-305 MCD Spec Sheet, 10/06	0.90
OSR Work Boat ICE Generators			931	6,998	0.35	lb/MMBtu	AP42 Table 3.3-1, 10/96	0.16
OSR Work Boats Total			*74,314*	*558,339*				*1*
OSR Total			*410,150*	*3,081,562*				*25*
Fleet Total			**1,147,687**	**8,622,870**				**79**
Total			**1,566,170**	**11,767,043**				**105**

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Lead Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	References See Below	Maximum Emissions (ton/yr) Lead
Frontier Discoverer								
FD-1	Generator Engine	1,325	hp	39,265	295,011	2.90E-05 lb/MMBtu		5.69E-04
FD-2	Generator Engine	1,325	hp	39,265	295,011	2.90E-05 lb/MMBtu		5.69E-04
FD-3	Generator Engine	1,325	hp	39,265	295,011	2.90E-05 lb/MMBtu		5.69E-04
FD-4	Generator Engine	1,325	hp	39,265	295,011	2.90E-05 lb/MMBtu		5.69E-04
FD-5	Generator Engine	1,325	hp	39,265	295,011	2.90E-05 lb/MMBtu		5.69E-04
FD-6	Generator Engine	1,325	hp	39,265	295,011	2.90E-05 lb/MMBtu		5.69E-04
FD-7	Propulsion Engine	7,200	hp	0	0	2.90E-05 lb/MMBtu		0.00E+00
FD-8	Em Generator	131	hp	3,697	27,779	2.90E-05 lb/MMBtu		5.36E-05
FD-9	MLC Compressor	540	hp	14,436	108,461	2.90E-05 lb/MMBtu		2.09E-04
FD-10	MLC Compressor	540	hp	14,436	108,461	2.90E-05 lb/MMBtu		2.09E-04
FD-11	MLC Compressor	540	hp	14,436	108,461	2.90E-05 lb/MMBtu		2.09E-04
FD-12	HPU Engine	250	hp	7,868	59,118	2.90E-05 lb/MMBtu		1.14E-04
FD-13	HPU Engine	250	hp	7,868	59,118	2.90E-05 lb/MMBtu		1.14E-04
FD-14	Port Deck Crane	365	hp	11,149	83,765	2.90E-05 lb/MMBtu		1.62E-04
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	2.90E-05 lb/MMBtu		1.62E-04
FD-16	Cementing Unit	335	hp	10,544	79,218	2.90E-05 lb/MMBtu		1.53E-04
FD-17	Cementing Unit	335	hp	10,544	79,218	2.90E-05 lb/MMBtu		1.53E-04
FD-18	Cementing Unit	147	hp	4,627	34,761	2.90E-05 lb/MMBtu		6.71E-05
FD-19	Logging Winch	250	hp	6,683	50,213	2.90E-05 lb/MMBtu		9.69E-05
FD-20	Logging Winch	35	hp	988	7,422	2.90E-05 lb/MMBtu		1.43E-05
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	9.00 lb/10^{12} Btu		1.45E-04
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	9.00 lb/10^{12} Btu		1.45E-04
FD-23	Incinerator	276	lb/hr	0	0	2.13E-01 lb/ton		5.93E-02
FD-31	Resupply Ship - docked	0	0	196	1,474	2.90E-05 lb/MMBtu		2.85E-06
Discoverer Total				**418,483**	**3,144,173**			**6.47E-02**

Lead Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	38%	of	168 days/yr	1532 hrs/yr		
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr		
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr		

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	References See Below	Maximum Emissions (ton/yr) Lead
Ice Breaker							
IB IC Engines			334,624	2,514,115	2.90E-05 lb/MMBtu		4.85E-03
IB Boiler			40,320	302,935	9.00 lb/10^{12} Btu		1.81E-04
IB Incinerators	154	lb/hr	0	0	2.13E-01 lb/ton		1.26E-02
Ice Breaker Total			*374,944*	*2,817,050*			*1.76E-02*
Anchor Handler							
AH ICE Engines			345,044	2,592,407	2.90E-05 lb/MMBtu		5.90E-03
AH Boiler			16,128	121,174	9.00 lb/10^{12} Btu		7.26E-05
AH Incinerator	151	lb/hr	0	0	2.13E-01 lb/ton		1.23E-02
Anchor Handler Total			*361,172*	*2,713,581*			*1.83E-02*
Resupply Ship - in Transit			1,421	10,677	2.90E-05 lb/MMBtu		*2.06E-05*
OSR Fleet							
Nanuq ICE Propulsion Engines			185,503	1,393,734	2.90E-05 lb/MMBtu		2.69E-03
Nanuq ICE Generators			72,536	544,979	2.90E-05 lb/MMBtu		1.05E-03
Other Main Ship ICE Propulsion Engines			53,637	402,991	2.90E-05 lb/MMBtu		7.78E-04
Other Main Ship ICE Generators			24,160	181,518	2.90E-05 lb/MMBtu		3.50E-04
OSR Main Ship Incinerator	125	lb/hr	0	0	2.13E-01 lb/ton		1.02E-02
OSR Main Ship Total			*335,836*	*2,523,223*			*1.51E-02*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	2.90E-05 lb/MMBtu		1.06E-03
OSR Work Boat ICE Generators			931	6,998	2.90E-05 lb/MMBtu		1.35E-05
OSR Work Boats Total			74,314	558,339			1.08E-03
OSR Total			*410,150*	*3,081,562*			*1.61E-02*
Fleet Total			**1,147,687**	**8,622,870**			**5.E-02**
Total			**1,566,170**	**11,767,043**			**1.E-01**

Emission Factor References

ICE engines	AP42 Table 3.3-2, Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines
Boilers	Table 1.3-10. Emission Factors For Trace Elements From Distillate Fuel Oil Combustion Sourc
Incinerators	Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

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HAPs Yearly Discoverer Maximum Emissions

Time at Drill Site	168 days/yr	4032 hrs/yr	Units FD-14 & 15	63 days/year	1512 hrs/yr	
Unit FD-8	120 min/week	48 hrs/yr	Unit FD-23	300 lb/trash per day		
Units FD-9-11	63 days/yr	1512 hrs/yr	Unit FD-31	12 hr/day	8 days/year	96 hrs/yr
Units FD-12-13	63 days/yr	1512 hrs/yr				

Unit ID	Description	Rating		Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	References See Below	Maximum Emissions (ton/yr) HAPs
Frontier Discoverer								
FD-1	Generator Engine	1,325	hp	39,265	295,011	3.93E-03 lb/MMBtu		7.72E-02
FD-2	Generator Engine	1,325	hp	39,265	295,011	3.93E-03 lb/MMBtu		7.72E-02
FD-3	Generator Engine	1,325	hp	39,265	295,011	3.93E-03 lb/MMBtu		7.72E-02
FD-4	Generator Engine	1,325	hp	39,265	295,011	3.93E-03 lb/MMBtu		7.72E-02
FD-5	Generator Engine	1,325	hp	39,265	295,011	3.93E-03 lb/MMBtu		7.72E-02
FD-6	Generator Engine	1,325	hp	39,265	295,011	3.93E-03 lb/MMBtu		7.72E-02
FD-7	Propulsion Engine	7,200	hp	0	0	3.93E-03 lb/MMBtu		0.00E+00
FD-8	Em Generator	131	hp	3,697	27,779	3.93E-03 lb/MMBtu		7.27E-03
FD-9	MLC Compressor	540	hp	14,436	108,461	3.93E-03 lb/MMBtu		2.84E-02
FD-10	MLC Compressor	540	hp	14,436	108,461	3.93E-03 lb/MMBtu		2.84E-02
FD-11	MLC Compressor	540	hp	14,436	108,461	3.93E-03 lb/MMBtu		2.84E-02
FD-12	HPU Engine	250	hp	7,868	59,118	3.93E-03 lb/MMBtu		1.55E-02
FD-13	HPU Engine	250	hp	7,868	59,118	3.93E-03 lb/MMBtu		1.55E-02
FD-14	Port Deck Crane	365	hp	11,149	83,765	3.93E-03 lb/MMBtu		2.19E-02
FD-15	Starbd Deck Crane	365	hp	11,149	83,765	3.93E-03 lb/MMBtu		2.19E-02
FD-16	Cementing Unit	335	hp	10,544	79,218	3.93E-03 lb/MMBtu		2.07E-02
FD-17	Cementing Unit	335	hp	10,544	79,218	3.93E-03 lb/MMBtu		2.07E-02
FD-18	Cementing Unit	147	hp	4,627	34,761	3.93E-03 lb/MMBtu		9.09E-03
FD-19	Logging Winch	250	hp	6,683	50,213	3.93E-03 lb/MMBtu		1.31E-02
FD-20	Logging Winch	35	hp	988	7,422	3.93E-03 lb/MMBtu		1.94E-03
FD-21	Heat Boiler	8	MMBtu/hr	32,135	241,439	3.31E-04 lb/MMBtu		5.32E-03
FD-22	Heat Boiler	8	MMBtu/hr	32,135	241,439	3.31E-04 lb/MMBtu		5.32E-03
FD-23	Incinerator	276	lb/hr	0	0	2.51E-01 lb/ton		6.97E-02
FD-31	Resupply Ship - docked	0	0	196	1,474	3.93E-03 lb/MMBtu		3.86E-04
Discoverer Total				**418,483**	**3,144,173**			**0.78**

HAPS Yearly Fleet Maximum Emissions

Ice Breaker and Anchor Handler IC engines	38%	of	168 days/yr	1532 hrs/yr	
IB & AH - For all remaining pollutants	38%	of	168 days/yr	1532 hrs/yr	
Resupply - in Transit	8	trips/yr	4 hr/trip	32 hrs/yr	

			Max fuel consumpt. (MMBtu/yr)	Fuel Use gal/yr	Emissions Factor	References See Below	Maximum Emissions (ton/yr) HAPS
Ice Breaker							
IB IC Engines			334,624	2,514,115	3.93E-03 lb/MMBtu		6.58E-01
IB Boiler			40,320	302,935	3.31E-04 lb/MMBtu		6.68E-03
IB Incinerators	154	lb/hr	0	0	2.51E-01 lb/ton		1.48E-02
Ice Breaker Total			*374,944*	*2,817,050*			*6.79E-01*
Anchor Handler							
AH ICE Engines			345,044	2,592,407	3.93E-03 lb/MMBtu		6.78E-01
AH Boiler			16,128	121,174	3.31E-04 lb/MMBtu		2.67E-03
AH Incinerator	151	lb/hr	0	0	2.51E-01 lb/ton		1.45E-02
Anchor Handler Total			*361,172*	*2,713,581*			*6.95E-01*
Resupply Ship - in Transit			1,421	10,677	3.93E-03 lb/MMBtu		*2.79E-03*
OSR Fleet							
Nanuq ICE Propulsion Engines			185,503	1,393,734	3.93E-03 lb/MMBtu		3.65E-02
Nanuq ICE Generators			72,536	544,979	3.93E-03 lb/MMBtu		1.43E-02
Other Main Ship ICE Propulsion Engines			53,637	402,991	3.93E-03 lb/MMBtu		1.05E-01
Other Main Ship ICE Generators			24,160	181,518	3.93E-03 lb/MMBtu		4.75E-02
OSR Main Ship Incinerator	125	lb/hr	0	0	2.51E-01 lb/ton		1.20E-02
OSR Main Ship Total			*335,836*	*2,523,223*			*2.16E-01*
OSR Work Boat ICE Propulsion Engines			73,382	551,341	3.93E-03 lb/MMBtu		1.44E-01
OSR Work Boat ICE Generators			931	6,998	3.93E-03 lb/MMBtu		1.83E-03
OSR Work Boats Total			74,314	558,339			1.46E-01
OSR Total			*410,150*	*3,081,562*			*3.62E-01*
Fleet Total			**1,147,687**	**8,622,870**			**1.74E+00**
Total			**1,566,170**	**11,767,043**			**2.52**

Emission Factor References

ICE engines	AP42 Table 3.3-2, Speciated Organic Compound Emission Factors For Uncontrolled Diesel Engines
Boilers	Table 1.3-10. Emission Factors For Trace Elements From Distillate Fuel Oil Combustion Sourc
Incinerators	Table 2.2-2 - Metals Emission Factors for Mass Burn and Modular Excess Air Combustors

APPENDIX I

OCS Source Definition

Appendix I

Issue: When does a vessel become an “OCS Source” under the Outer Continental Shelf (OCS) Air Regulations in 40 CFR Part 55?

Analysis:

The OCS Air Regulations define “OCS Source" as follows:

> OCS source means any equipment, activity, or facility which:
>
> (1) Emits or has the potential to emit any air pollutant;
>
> (2) Is regulated or authorized under the Outer Continental Shelf Lands Act (“OCSLA”) (43 U.S.C. §1331 et seq.); and
>
> (3) Is located on the OCS or in or on waters above the OCS.
>
> *This definition shall include vessels only when they are:*
>
> *(1) Permanently or temporarily attached to the seabed and erected thereon and used for the purpose of exploring, developing or producing resources therefrom, within the meaning of section 4(a)(1) of OCSLA (43 U.S.C. §1331 et seq.)*; or
>
> (2) Physically attached to an OCS facility, in which case only the stationary sources aspects of the vessels will be regulated.

40 C.F.R. § 55.2 (emphasis added). The referenced section 4(a)(1) of OCSLA states:

> The Constitution and laws and civil and political jurisdiction of the United States are hereby extended to the subsoil and seabed of the outer Continental Shelf and to all artificial islands, and all installations and other devices permanently or temporarily attached to the seabed, which may be erected thereon for the purpose of exploring for, developing, or producing resources therefrom, or any such installation or other device (other than a ship or vessel) for the purpose of transporting such resources, to the same extent as if the outer Continental Shelf were an area of exclusive Federal jurisdiction located within a State.

43 U.S.C. § 1333(a)(1).

As interpreted by the federal courts, OCSLA section 4(a)(1) covers "any artificial island, installation, or other device if (a) it is permanently or temporarily attached to the seabed of the OCS, and (b) it has been erected on the seabed of the OCS, and (c) its presence on the OCS is to explore for, develop, or produce resources from the OCS." *See, e.g.*, *Diamond Offshore Company v. A&B Builders, Inc.*, 302 F.3d 531, 541 (5th Cir. 2002). The Fifth Circuit Court of Appeals has made it clear that OCSLA applies to a vessel only when it is both “attached to” *and* “erected on” the seabed. *DeMette v. Falcon Drilling Co., Inc.*, 280 F.3d 492 (5th Cir. 2002). Under this analysis, a jack-up rig that has been jacked-up on the OCS is within this definition, because it is literally both "attached" and "erected." 280 F.3d at 502.

In *Diamond Offshore*, the Court of Appeals denied summary judgment to a welder, the plaintiff, injured by drilling mud on the *Ocean Concorde* submersible. Plaintiff contended that the vessel had become an OCSLA "situs" by the time he was injured. The court noted that:

> After the *Ocean Concorde* was towed to its ultimate location, it would then be anchored to the seabed. The evidence does not indicate whether [plaintiff] was welding . . . during towing or while the *Ocean Concorde* was attached to the seabed by its *anchors*. . . . Since there is no evidence that the *Ocean Concorde* was connected to the ocean floor by its *anchors* or through its drilling mechanism, and there is no evidence of *any other contact* with the seabed, the second requirement that the *Ocean Concorde* was “erected” on the OCS at the time of [plaintiff’s] alleged injury is clearly not satisfied.

302 F.3d at 541 (emphasis added).

It’s clear from this analysis, involving a drilling vessel that used multiple anchors to be in position to “explore” for resources, that the court did not consider the vessel subject to OCSLA until those anchors were in place. The case further indicates that some “other contact” besides anchors (which “attach” the vessel to the seabed), may be a prerequisite to also being “erected” on the seabed (e.g., drilling equipment).

Conclusion:

The *Discoverer* is in precisely the same situation as was the submersible drilling vessel in *Diamond Offshore*. Shell cannot and will not begin the drilling process until the *Discoverer* is sufficiently anchored such that the vessel is secure and stable in a position to commence exploratory activity at a drilling location. It is only at this point that the vessel is in position to use its drilling equipment. In other words, it is only at this point that the *Discoverer* ceases to be a moving vessel and becomes a stationary source that can be “used for the purpose of exploring.”

Similarly, when it is time to detach the *Discoverer* from the seabed at a drill site, Shell must cease all drilling activity and remove all physical connections through the drill stem to the seabed before the first anchor can be removed. To begin or continue drilling when the *Discoverer* is not fully

stabilized would risk severe damage to the drill stem and the *Discoverer*, and jeopardize crew safety.

The permit, therefore, should treat the Discoverer as an “OCS Source” during all times when it is sufficiently anchored such that the vessel is secure and stable in a position to commence exploratory activity at a drilling location and ending when it is no longer sufficiently stable to conduct exploratory activity at a drill site.

APPENDIX J

BPX 2007 Monitoring Review

Meteorological and Pollutant Data Review
BPXA 2007 Prudhoe Bay Unit Data

Submitted to:
Alaska Department of Environmental Conservation

Submitted By:
Enviroplan Consulting
81 Two Bridges Road
Fairfield, NJ 07004

January 5, 2009

Executive Summary: This document provides the results of the data quality review performed by Enviroplan Consulting, of BPXA's Prudhoe Bay Unit ambient air pollutant and meteorological data for the 2007 calendar year. Enviroplan has determined that the 2 meter and 10 meter temperature and the 10-2 meter delta temperature at the A-Pad site, and the PM_{10} data at the CCP site does not comply with the data quality criteria set forth by the U.S. Environmental Protection Agency (EPA) under the Prevention of Significant Deterioration (PSD) program. Specifically, BPXA has failed to comply with the 90% minimum data capture requirement for calendar year 2007 for the 2 meter and 10 meter temperature data and the corresponding 10-2 meter delta temperature meteorological data. Additionally, the PM_{10} sample data for the 2007 calendar year does not meet the 80% data capture requirement. Review of all other air quality and meteorological parameters were found to meet PSD data quality criteria.

Discussion of Data Review:
This data review includes data reported from the BPXA's Prudhoe Bay Unit air quality and meteorological monitoring network, consisting of the A-Pad and CCP monitoring sites. Both stations continuously monitor sulfur dioxide (SO_2), nitrogen oxides (NO-NO_2-NO_x) and ozone (O_3). The CCP site also collects integrated PM_{10} samples on a once per 3-day schedule. Meteorological data is measured at the A-Pad site only. Monitored meteorological parameters include 10 meter wind speed, 10 meter horizontal wind direction and standard deviation of the horizontal wind direction (σ_θ), 10 meter vertical wind speed and standard deviation of the vertical wind speed (σ_w), 10 meter total solar radiation, 2 meter and 10 meter temperature, and 10-2 meter delta temperature.

The following discussion provides Enviroplan's substantive findings associated with our review of the A-Pad and CCP monitoring sites. All of Enviroplan's findings associated with this review can be found in Tables 1 through 4.

A-Pad Monitoring Data: The review found that although the +/- 2% shelter temperature daily fluctuation requirement was exceeded on several occasions, these fluctuations did not affect the quality of the data as evidenced by bracketing quality control check results.

The review did find instances during which the shelter temperature exceeded the operating range of 20-30ºC for Thermo Environmental 43i (SO_2) and 49 (O_3) analyzers, as specified in EPA's "List of Designated Reference and Equivalent Method" designation requirements. As such, the

pollutant data for these periods, which are listed in Table 1, should have been determined by BPXA to be invalid. While Enviroplan has determined this data to be invalid, the data capture for these parameters will remain above the 80% requirement after these hours are invalidated.

Enviroplan did not find any discrepancies associated with precision checks, calibrations and audits; and there are no specific findings other than noted above for hourly data for SO_2, NO-NO_2-NO_x and O_3. In addition to the ambient temperature data noted above, there are a few hours where numerical values of Total Radiation are absent from the cells in BPXA's meteorological data spreadsheet, and instead BPXA has specified the otherwise numeric Total Radiation value as "# Value". These "# Value"hours are considered by Enviroplan to be missing and they must be re-coded in the spreadsheet as "MISSING". Table 2 below identifies the affected hours. A re-classification of these "# Value" hours to "MISSING" will not cause the total data capture to decrease below 80%.

CCP Monitoring Data: Enviroplan has reviewed the BPXA CCP monitoring site data and we have determined that data capture for continuous pollutants met the 80% requirement. However, the following specific issues relating to invalid data are identified.

PM_{10} sample data for the primary and collocated samples for October 30 are found to be invalid due to "dirty scuff marks on filter", as noted by BPXA on their PM10 data spreadsheet. As a result of this invalid data reading, data capture for the 4th quarter will fall below the 80% requirement due to this finding. This issue is cited in detailed findings Table 3.

In addition to the above, Enviroplan has determined that the primary sample collected on June 23 is invalid. It has been determined that the CCP site samplers did not have flow recorders installed on them. This would have been positive proof that the pump operated for the 24-hour period. Although BPXA has provided the filter envelope information for this sample run, and the field technician noted on the envelope that the "timer counter stuck in zero position, filters did run their 24-hour course", this alone is not enough evidence to support the pump operated for the duration of the sample run. This issue is cited in detailed findings Table 3.

Our review has also found that although the shelter temperature +/- 2% daily fluctuation requirement was exceeded on several occasions, these fluctuations did not affect the quality of the data as evidenced by bracketing quality control check results.

The review did find instances during which the shelter temperature exceeded the operating range of 20-30ºC for Thermo Environmental 43i (SO_2) and 49 (O_3) analyzers, as specified in EPA's "List of Designated Reference and Equivalent Method" designation requirements. As such, the pollutant data for these periods, which are listed in Table 1 should have been determined by BPXA to be invalid. While this data is determined by Enviroplan to be invalid, total data capture for these parameters will remain above 80% after these hours are invalidated.

Enviroplan did not find any discrepancies associated with precision checks, calibrations and audits. There were no specific findings other than noted above for hourly data for SO_2, NO-NO2-NOx and O_3.

Details of All Findings:

Table 1: A-Pad Continuous Pollutants	
Completeness	Data capture for all of the A-Pad continuously measured pollutants were greater than the EPA's 80% data capture requirement. The data capture for these pollutants ranged from 94% to greater than 98%.
Shelter Temperature	EPA's "List of Designated Reference and Equivalent Method" designation requirements state that the shelter temperature for SO_2 and O_3 analyzers must be maintained within a range of 20-30ºC. There were a few instances where the shelter temperatures dropped below the stated range for SO_2 and O_3 analyzers, and this data must be invalidated. The lowest shelter temperature found was 16.0ºC recorded on March 10. The data capture for SO_2 and O_3 will still meet PSD requirements even with invalidation of these hours. Periods where the shelter temperature dropped below 20ºC are as follows: **Date (Hour)** 1/1 (16) -1/2 (8) 2/20 (21)-2/21 (11) 2/23 (2-15) 2/23 (18)-2/24 (8) 2/24 (10-11) 3/ 4 (4-12) 3/ 4 (22)-3/5 (9) 3/10 (4-11) 3/10 (23)-3/11 (13) 3/11 (22)-3/12 (4) 3/24 (5, 8) 3/25 (5-8) 3/26 (5-7) 7/15 (23)-7/16 (8) 7/24 (1-7) 7/24 (23)-7/25 (8) 7/26 (2-8) 7/27 (1-9) 8/28 (5-7) 8/29 (7) 9/14 (1-8) 9/15 (5-8, 14-20) 9/15 (22)-9/16 (9) 12/17 (13) 12/22 (1-3)
Precision	All precision checks were performed on the continuous pollutant analyzers on a weekly basis. All checks were within the +/- 20% requirement

Table 1: A-Pad Continuous Pollutants	
Calibration	Multipoint calibrations on the continuous pollutant analyzers were performed at least once per quarter and all with satisfactory results.
Audit	Audits of the continuous pollutant analyzers were performed once per quarter, and all with satisfactory results.
SO_2 Hourly Data	No discrepancies
O_3 Hourly Data	No discrepancies
NO-NO2-NOx Hourly Data	No discrepancies
Forms	Each of the audit forms has space at the bottom for Project Manager and Field Ops Manager Review Dates. No dates are entered in these spaces.

Table 2: A-Pad Meteorological Data	
Completeness	With the exception of the 2 meter and 10 meter temperature and corresponding 10-2 meter temperature difference, all other meteorological parameters met the EPA's 90% data capture requirement. Data capture rates for the 10 meter temperature and 10-2 meter delta temperature failed to meet the 90% data capture requirement for both the 3rd and 4th quarter data reporting periods.
Calibration	Meteorological calibrations were performed in July and December. The first calibration should have occurred within the first six months of the year.
Audit	Meteorological audits were performed twice during the year reviewed; once in the first six months of the year and then in the second six months of the year.
Wind Speed Hourly Data	No discrepancies
Wind Direction Hourly Data	No discrepancies
Standard Deviation σ_θ Hourly Data	No discrepancies
10 m Temperature Hourly Data	3rd Quarter data recovery is out of spec due to the invalid data sustained between July 13 and September 12.
2 m Temperature Hourly Data	4th Quarter data recovery is out of spec due to the invalid data sustained between September 14 and December 31
10-2 m Delta Temperature Hourly Data	3rd and 4th Quarter data recovery is out of spec due to the invalid data sustained for the 2 meter and 10 meter temperature sensors between July 13 and December 31
Total Radiation Hourly Data	Hourly data for the following time periods appear as "# Value" on the meteorological data spreadsheet: • April 30, hour 17; • May 7, hour 5; and • May 21, hour 5. These hours are considered as missing and must be re-coded as "MISSING". Total data capture remains above 90%.
Vertical Wind Speed Hourly Data	No discrepancies
Standard Deviation σ_w	No discrepancies

Forms	Each of the audit forms has space at the bottom for Project Manager and Field Ops Manager Review Dates. No dates are entered in these spaces.

Table 3: CCP – PM10	
Completeness	Data recovery rates equaled or exceeded the EPA's requirement of 80 percent for the 1st, 2nd and 3rd quarter.
Run Dates	The NAAQS-designated run dates for September 2007 are 3, 9, 15, 21, 27. The 3-day run days should include September 6, 12, 18, 24, 30. There was a run on September 23. Is this the actual run date or a possible typographical error? If this was the actual run date, it should be noted on the CCP Validated Data spreadsheet as an off-schedule day.
Run Times	All run times for valid samples were between 1380 and 1500 minutes (i.e., 24 hours ±1 hour).
Starting and Ending Times	All samples started and ended within a half hour of midnight of the sample day.
Sample Flow Rates between 36 cfm and 44 cfm	All Actual Flow Rates were between 36 cfm and 44 cfm with the exception of the January 15 Primary sample. The recorded flow rate for this sample was 35.9 cfm.

Table 3: CCP – PM10	
Sample Validity	June 23 Primary and Collocated samples. The "Notes" section of Table B-1 in the CCP validated data spreadsheet states (for the primary sample), that the timer did not run but the pump ran for 24 hours. It has been confirmed by BPXA's contractor that flow recorders were not installed on the PM_{10} samplers at the CCP site. The information provided by a flow chart would indicate positive proof of a successful sample run. BPXA has provided filter envelope information for this sample as well as the collocated sample for this date. The field technician noted that the timer for both of these runs was stuck in zero position, but that the samples ran. This information alone does not provide enough information to validate either sample. Therefore, Enviroplan has determined that both the primary and collocated samples are invalid. It is noted that the quarterly data capture would remain above 80% for the 2nd quarter with the invalidation of these samples. October 30 Primary and Collocated samples: The "Notes" section of Table B-1 in the CCP validated data spreadsheet indicated there were "dirty scuff marks on the filter".The scuff marks would have compromised the sample and therefore are considered to be invalid. The data capture will drop below 80% for the 4th quarter due to this finding. October 21 Primary, October 24 Collocated, November 8 Primary samples: The concentrations reported for these samples were negative values. However, the run times and flow rates are all within range, and these samples likely represent particulates were not present in the ambient air. While these data values are not unrealistic for the monitoring area, BPXA should have noted the negative values for these samples in their report and provided comments that would support sample validity. Support for these samples would include in-range QC flow check information bracketing these sample runs, a re-check to ensure that all weighing procedures were followed correctly and evidence that the laboratory environment at the time of the pre-and post- sample weighing periods were within EPA-designated temperature and humidity requirements.
Audits	No discrepancies
Calibrations	No discrepancies
Miscellaneous Comments	The first few runs of the year (January 3, 6, and 9) were TSP sample runs. This is noted in the "Notes" section of Table B-1 in the CCP validated data spreadsheet. Add "TSP" in the descriptive header information of the table, as it presently describes the table as just having PM_{10} results.
Forms	Each of the audit forms has space at the bottom for Project Manager and Field Ops Manager Review Dates. No dates are entered in these spaces.

Table 4: CCP Continuous Pollutants	
Completeness	Data capture for all of the CCP continuously measured pollutants exceeded the EPA's 80 percent data capture requirement. The data capture for these pollutants ranged from 96% to greater than 98%.
Shelter Temperature	EPA's "List of Designated Reference and Equivalent Method" designation requirements state that the shelter temperature for SO_2 and O_3 analyzers must be maintained within a range of 20-30ºC. There were a few instances where the shelter temperatures dropped below the stated range for SO_2 and O_3 analyzers and these data must be invalidated. The lowest shelter temperature found was 16.8ºC, recorded on January 10. It should be noted that the data capture for SO_2 and O_3 will still meet PSD requirements even with invalidation of these hours. Periods where the shelter temperature dropped below 20ºC are as follows: **Date (Hour)** 1/10 (13-15), 2/23 (20)-2/24 (4), 3/11 (10-12, 23) 12/17 (7-19, 21-23), 12/18 (2-5, 12-13, 17), 12/19 (6-7, 9-11), 12/19 (14)-12/20 (13), 12/20 (15) 12/21 (2)
Precision	All precision checks were performed on the continuous pollutant analyzers on a weekly basis. All checks were within the +/- 20% requirement
Calibration	Multipoint calibrations were performed on the continuous pollutant analyzers at least once each calendar quarter. All calibration results were satisfactory.
Audit	Audits of the continuous pollutant analyzers were performed once each calendar quarter. All calibration results were satisfactory.
SO2 Hourly Data	No discrepancies
O3 Hourly Data	No discrepancies
NO-NO2-NOx Hourly Data	No discrepancies
Forms	Each of the audit forms has space at the bottom for Project Manager and Field Ops Manager Review Dates. No dates are entered in these spaces.

APPENDIX K

ADEC Stationary Source Identification Form

Alaska Department of Environmental Conservation Air Quality Minor Permit Application	**ADEC USE ONLY** Receiving Date: ADEC Control Number AQ MSS :

STATIONARY SOURCE IDENTIFICATION FORM

Section 1 Stationary Source Information

Stationary Source Name: **Frontier Discoverer Beaufort Sea Exploration Drilling Program**			SIC:
Project Name (if different):	Stationary Source Contact: **Shell Offshore Inc.**		
Source Physical Address: Beaufort Sea OCS waters	City: Anchorage	State: AK	Zip: 99503
	Telephone:		
	E-Mail Address:		
UTM Coordinates (m) or Latitude/Longitude:	Northing:	Easting:	Zone:
	Latitude: 70.1-70.8	Longitude: 143.7-146.4	

Section 2 Legal Owner			**Section 3 Operator** *(if different from owner)*		
Name: Shell Offshore Inc.			Name:		
Mailing Address: 3601 C Street, Suite 1314			Mailing Address:		
City: Anchorage	State: AK	Zip: 99503	City:	State:	Zip:
Telephone #: 907-646-7112			Telephone #:		
E-Mail Address: Susan.Childs@shell.com			E-Mail Address:		

Section 4 Designated Agent *(for service of process)*			**Section 5 Billing Contact Person** *(if different from owner)*		
Name: CT Corporation			Name:		
Mailing Address: 9360 Glacier Hwy, Ste 202			Mailing Address:		
City: Juneau	State: AK	Zip: 99801	City:	State:	Zip:
Physical Address: (same)			Telephone #:		
City:	State:	Zip:	E-Mail Address:		
Telephone #: 907-586-3340					
E-Mail Address:					

Section 6 Application Contact

Name: : Eric Hansen, ENVIRON			
Mailing Address: 19020 33rd Avenue West	City: Lynnwood	State: WA	Zip: 98036
	Telephone: 425-412-1811		
	E-Mail Address: ehansen@environcorp.com		

Section 7 Desired Process Method *(Check only one – see 18 AAC 50.542(a) for process descriptions and restrictions)*

☐ Fast Track [18 AAC 50.542(b)] ☐ Public Comment [18 AAC 50.542(d)]

Section 8 Project Description

Provide/attach a short narrative describing the project. Discuss the purpose for conducting this project, what emission units/activities will be added/modified under this project (i.e., project scope), and the project timeline. If the project is a modification to an existing stationary source, describe how this project will affect the existing process. Include any other discussion that may assist the Department in understanding your project or processing your application. Include a schedule of construction and the desired date for permit issuance.

If this application includes an Owner Requested Limit or a request to revise an existing permit term or condition, describe the intent of the limit, and provide sample language for the limit, and for monitoring, record keeping, and reporting for showing compliance with the limit.

Add additional pages if necessary.

The project is to mobilize and operate the Frontier Discoverer drillship and its associated fleet at various drill sites in the Beaufort Sea outer continental shelf of the North Slope of Alaska in connection with an exploratory oil and gas drilling program. This form is being submitted as part of an Owner Requested Limit request to limit PTE of sulfuric acid mist from the associated fleet. The required information is provided in the application to which this form is attached.

Section 9 Source Classification(s) *(Check all that apply)*

[18 AAC 50.502(b)]

- ☐ Asphalt Plant [≥ 5 ton per hour]
- ☐ Thermal Soil Remediation Unit [≥ 5 ton per hour]
- ☐ Rock Crusher [≥ 5 ton per hour]
- ☐ Incinerator(s) [total rated capacity ≥ 1000 lb/hour]
- ☐ Coal preparation plant
- ☐ Port of Anchorage Facility

If you checked any of the above, is (are) the emission unit(s) ☐ new, ☐ relocated*, or ☐ existing?

[18 AAC 50.502(c)(1)]

New or relocated* stationary source with potential emissions greater than:

- ☐ 40 tons per year (TPY) NOx
- ☐ 40 tons per year SO_2
- ☐ 15 tons per year PM-10
- ☐ 0.6 tons per year lead
- ☐ 100 tons per year CO in a nonattainment area

[18 AAC 50.502(c)(2)]

Construction or relocation* of a:

- ☐ Portable oil and gas operation
- ☐ 10 MMBtu/hr fuel burning equipment in a SO_2 special protection area

**Relocation does NOT include moving equipment from one place to another within your current stationary source boundary.*

Section 10 Modification Classification(s) (*Check all that apply)*

[18 AAC 50.502(c)(3)]

- ☐ NO_x Increase > 10 TPY [and existing PTE > 40 tons per year]
- ☐ SO_2 Increase > 10 TPY [and existing PTE > 40 tons per year]
- ☐ PM-10 Increase > 10 TPY [and existing PTE > 15 tons per year]
- ☐ CO Increase > 100 TPY [and existing PTE > 100 tons per year in a nonattainment area]

Basis for calculating modification:

- ☐ Projected actual emissions - baseline actual emissions
- ☐ New potential emissions - existing potential emissions

Section 11 Permit Action Request (*Check all that apply)*

[18 AAC 50.508]

- ☐ ~~Clean Unit designation~~ *(vacated by Court)*
- ☐ ~~Pollution Control Project designation~~ *(vacated by Court)*
- ☐ Establish Plantwide Applicability Limitation
- ☐ Establish emission reductions to offset nonattainment pollutant
- ☒ Owner Requested Limit*
- ☐ Revise or Rescind Title I Permit Conditions*

Permit Number: Date: Condition #:

**Which to use? See* http://www.dec.state.ak.us/air/ap/docs/orlrtc.pdf

Section 12 Existing Permits and Limits

For an existing stationary source, do you have an existing:

(Check any that apply)

- ☐ Air quality permit Number(s)*:
- ☐ Owner Requested Limit Number(s):
- ☐ Pre Approved (Emission) Limit Number(s)**:

** All valid construction, Title V, and minor permit numbers.*
***Optional. Please provide this number if possible.*
See http://www.state.ak.us/dec/air/ap/pals.htm

Section 13 Other Application Material

The information listed below must be included in your air quality control minor permit application. *Note: These must be attached in order for your application to be complete.*

If required to submit an analysis of ambient air quality under 18 AAC 50.540(c)(2), or if otherwise requested by the department:

☐ Attached are maps, plans, and/or aerial photographs as necessary to show the locations and distances of emissions units, buildings, emitting activities and boundaries of the associated with the stationary source, and nearby or adjacent residences, roads, other occupied structures and general topography within 15 kilometers. (Indicate compass direction and scale on each.)

☐ Attached is a document (eg., spreadsheet) showing coordinates and elevations of each modeled unit, along with parameters necessary to characterize each unit for dispersion modeling.

☐ Attached is an electronic copy of all modeling files.

If located within an approved coastal district:

☐ Attached is a completed Coastal Project Questionnaire (CPQ) for the stationary source

Section 14 Certification

This certification applies to the Air Quality Control Minor Permit Application for the **Frontier Discoverer Beaufort Sea Exploration Drilling Program**

submitted to the department on: 1/18/10 .

Type of Application

☐ Initial Application

☐ Change to Initial Application

The application is **NOT** complete unless the certification of truth, accuracy, and completeness on this form bears the **signature of a responsible official** of the firm making the application. (18 AAC 50.205)

CERTIFICATION OF TRUTH, ACCURACY, AND COMPLETENESS

"Based on information and belief formed after reasonable inquiry, I certify that the statements and information in and attached to this document are true, accurate, and complete."

Signature: Susan Childs	Date: January 16, 2010
Printed Name: Susan Childs	Title: Regulatory Affairs Manager, Alaska Venture

Section 15 Attachments

☐ Attachments Included. List attachments: This ADEC Stationary Source Identification Form is an attachment to revised Air Permit Application for the Frontier Discoverer Beaufort Sea Exploration Drilling Program.

Section 16 Mailing Address

Submit the minor permit application to the Construction Permit Supervisor in the department's Juneau office. Submitting to a different office will delay processing. The mailing address and phone number for the Juneau office is:

ADEC, Air Permits Program
410 Willoughby Ave., Suite 303
P.O. Box 111800
Juneau, AK 99811-1800

(907) 465-5100

APPENDIX L

Beaufort Sea Ice Statistics

Shell has conservatively assumed that icebreakers would be needed approximately 38 percent of the 168-day drilling season. That assumption is based on observations at two locations in representative of conditions in the Beaufort Sea exploration lease area. Hammerhead is a prospect near Sivulliq; Olympia is approximately 25 miles farther east. The following table identifies the date and ice coverage in the vicinity of the observation point.

Hammerhead and Olympia Ice Concentration						
Year	**Month**	**Day**	**Date**	**Exact Conc (x/10)**	**Exact Loads**	**Exact / Near / Medium / Far Ice Edge**
1996	9	3	9/3/96	8	Heavy	E
1996	9	10	9/10/96	3	Moder ate	E
1996	9	17	9/17/96	8	Heavy	E
1996	9	24	9/24/96	8	Heavy	E
1996	10	1	10/1/96	9	Heavy	E
1996	10	8	10/8/96	9	Heavy	E
1996	10	15	10/15/96	9	Heavy	E
1996	10	22	10/22/96	9	Heavy	E
1996	10	29	10/29/96	9	Heavy	E
1997	9	4	9/4/97	0	Light	F
1997	9	11	9/11/97	0	Light	F
1997	9	18	9/18/97	0	Light	F
1997	9	25	9/25/97	0	Light	F
1997	10	2	10/2/97	0	Light	F
1997	10	9	10/9/97	0	Light	F
1997	10	16	10/16/97	9	Heavy	E
1997	10	23	10/23/97	9	Heavy	E
1997	10	30	10/30/97	9	Heavy	E
1998	8	31	8/31/98	0	Light	F
1998	9	7	9/7/98	0	Light	F
1998	9	14	9/14/98	0	Light	F
1998	9	21	9/21/98	0	Light	F
1998	9	28	9/28/98	0	Light	F
1998	10	5	10/5/98	0	Light	F
1998	10	12	10/12/98	0	Light	M
1998	10	19	10/19/98	0	Light	M
1998	10	26	10/26/98	0	Light	M
1999	8	30	8/30/99	0	Light	F
1999	9	6	9/6/99	0	Light	F
1999	9	13	9/13/99	0	Light	F
1999	9	20	9/20/99	0	Light	F
1999	9	27	9/27/99	0	Light	F
1999	10	4	10/4/99	0	Light	M
1999	10	11	10/11/99	0	Light	M
1999	10	18	10/18/99	9	Heavy	E
1999	10	25	10/25/99	9	Heavy	E

Hammerhead and Olympia Ice Concentration						
Year	**Month**	**Day**	**Date**	**Exact Conc (x/10)**	**Exact Loads**	**Exact / Near / Medium / Far Ice Edge**
2000	9	4	9/4/00	0	Light	M
2000	9	11	9/11/00	0	Light	F
2000	9	18	9/18/00	0	Light	F
2000	9	25	9/25/00	0	Light	M
2000	10	2	10/2/00	0	Light	N
2000	10	9	10/9/00	0	Light	N
2000	10	16	10/16/00	8	Heavy	E
2000	10	23	10/23/00	9	Heavy	E
2000	10	30	10/30/00	9	Heavy	E
2001	9	3	9/3/01	3	Moder ate	E
2001	9	10	9/10/01	2	Light	E
2001	9	17	9/17/01	0	Light	M
2001	9	24	9/24/01	0	Light	M
2001	10	1	10/1/01	0	Light	M
2001	10	8	10/8/01	8	Heavy	E
2001	10	15	10/15/01	9	Heavy	E
2001	10	22	10/22/01	9	Heavy	E
2001	10	29	10/29/01	9	Heavy	E
2002	9	2	9/2/02	2	Light	E
2002	9	9	9/9/02	0	Light	F
2002	9	16	9/16/02	0	Light	M
2002	9	23	9/23/02	0	Light	F
2002	9	30	9/30/02	0	Light	F
2002	10	7	10/7/02	0	Light	F
2002	10	14	10/14/02	0	Light	N
2002	10	21	10/21/02	9	Heavy	E
2002	10	28	10/28/02	9	Heavy	E
2003	9	1	9/1/03	0	Light	M
2003	9	8	9/8/03	0	Light	M
2003	9	15	9/15/03	0	Light	F
2003	9	22	9/22/03	0	Light	M
2003	9	29	9/29/03	0	Light	M
2003	10	6	10/6/03	0	Light	N
2003	10	13	10/13/03	0	Light	N
2003	10	20	10/20/03	0	Light	N
2003	10	27	10/27/03	9	Heavy	E
2004	8	30	8/30/04	0	Light	F
2004	9	6	9/6/04	0	Light	F
2004	9	13	9/13/04	0	Light	F
2004	9	20	9/20/04	0	Light	F
2004	9	27	9/27/04	0	Light	F
2004	10	4	10/4/04	0	Light	F

Hammerhead and Olympia Ice Concentration						
Year	**Month**	**Day**	**Date**	**Exact Conc (x/10)**	**Exact Loads**	**Exact / Near / Medium / Far Ice Edge**
2004	10	11	10/11/04	0	Light	F
2004	10	18	10/18/04	0	Light	N
2004	10	25	10/25/04	10	Heavy	E
2005	9	5	9/5/05	0	Light	N
2005	9	12	9/12/05	0	Light	M
2005	9	19	9/19/05	0	Light	M
2005	9	26	9/26/05	0	Light	F
2005	10	3	10/3/05	0	Light	F
2005	10	10	10/10/05	0	Light	N
2005	10	17	10/17/05	8	Heavy	E
2005	10	24	10/24/05	10	Heavy	E

Based on September 1st - October 31st

	Type	Number Wks	Percent
Last 10 Years	Heavy	26	29
	Moderate	2	2
	Light	61	69

	Type	Number Wks	Percent
Last 5 Years	Heavy	10	23
	Moderate	1	2
	Light	33	75

	Type	Number Wks	Percent
Last 3 Years	Heavy	4	15
	Moderate	0	0
	Light	22	85

	Ice edge	Number Weeks	Frequency
Last 3 years	At Location	4	15%
	Near	6	23%
	Moderate	6	23%
	Far	10	38%

E Ice Edge on location
N Within 30 miles
M Between 30-60 miles
F Greater than 60 miles

APPENDIX M

Memorandum, Absence of Justification for Source Redefinition in BACT Analysis

MEMORANDUM

December 9. 2009 (rev. December 11, 2009)

Absence of Justification for Source Redefinition in BACT Analysis For Shell Chukchi Sea Air Permit

Introduction

Commenters on the proposed permit suggest that, in analyzing BACT for the Generator Diesel IC Engines and the smaller Diesel IC Engines on the Discoverer, Shell must consider in its Step 1 analysis the alternative of "repowering," i.e., replacing some or all of those engines with Tier 3 engines. *See* Comments of AWEC et al. at 18.[1] In addition, Commenters assert that:

> The fact that Shell has elected to pursue its operations using an old drill ship – rather than incurring the cost of utilizing or constructing a new one – cannot result in the automatic conclusion that retrofitting or replacing certain engines as part of the application of BACT is not economical or technologically feasible. This is not defensible without at least a discussion of the costs associated with using the Discoverer versus a newer or newly constructed drill ship and/or engines as compared to the costs of retrofitting or updating engines on the Discoverer.

Id. at 17.

However, in step 4 of the BACT process, the cost-effectiveness of replacing engines on the Discoverer with newer units must be analyzed under the same BACT methodology that applies to all control technologies. The relevant measure is how much it would cost to achieve a given reduction in emissions from the source, as that source is defined by the PSD permit applicant.

Discussion

Even if it were somehow possible to compare those emissions-reduction costs with the costs associated with using a "newer or newly-constructed drill ship," the latter cost is not relevant to the Step 4 analysis to determine BACT. This is because Shell has properly defined the OCS source for which it seeks a permit as the Discoverer, a specific drillship with specific characteristics. The Clean Air Act would not require consideration of using a different drillship as potential BACT at

[1] In fact, the Discoverer's main generator engines and several of its other smaller engines are already Tier 3 engines.

Step 1. Using another drillship for the proposed exploration program is not a candidate control technology under EPA's BACT guidance or under relevant legal rulings. Commenters' contention that the costs of a different drillship are relevant to the cost-effectiveness of candidate control technologies – e.g., engine replacement on the Discoverer – would be tantamount to requiring Shell to fundamentally redesign the source. That would be contrary to strong EPA policies allowing the permit applicant to define the source to which a BACT analysis is then applied

The EAB has recently reiterated that, in determining what BACT is for a source, EPA does not generally require a source to change its basic design. *In re Desert Rock Energy Company, LLC,* PSD Appeal Nos. 08-03 et al., September 24, 2009, at 59 (*citing In re Knauf Fiber Glass GMBH,* 8 E.A.D. 121, 136 (EAB 1999)). The EAB noted that: "'Historically, EPA has not considered the BACT requirement as a means to redefine the design of the source when considering available control alternatives'." *Id.* at 59-60 (*quoting* NSR Manual at B.13-.14).

Certainly, Region 10 had broad discretion not to require Shell to evaluate other drillships as potential control technologies at step 1 of the BACT process. It is "clear that the permitting authority is entitled to wide latitude in how broad a BACT analysis it wishes to conduct in this regard." *In re Hawaiian Commercial & Sugar Co.* 4 E.A.D. 95, 100 (EAB 1992); *see also Sierra Club v. Prairie State* (7th Cir. 2007). EPA's brief to the Board in *Prairie State* explained that the policy "reflects the Agency's longstanding judgment that there should be limits on the degree to which permitting authorities can dictate the design and scope of a proposed facility through BACT analysis." *See Prairie State* at 24. The touchstone of EPA's approach to BACT is a "policy against redefining the basic design of the source in the BACT analysis." *Id.*

As the Board and the Seventh Circuit affirmed in the *Prairie State* case, it is clear that BACT does not require that a source be "redesigned from the ground up." *See Sierra Club v. U.S. EPA*, 499 F.3d 653 (7th Cir. 2007) (explaining that "EPA's position is that 'best available control technology' does not include redesigning the plant proposed by the permit applicant" and that "a difference between this case and our nuclear hypothetical is that a plant designed to burn coal cannot run on nuclear fuel without being redesigned from the ground up," and concluding, that even a lesser redesign was beyond the BACT Step 1 analysis). Instead, permit conditions are imposed on the source as the applicant defines it. *Desert Rock* at 60; *Prairie State* at 29. "Looking in the first instance to how the permit applicant defines the proposed facility's purpose or basic design in its application not only harmonizes the BACT definition with the permit application process . . . but also is consistent" with the policy against redefining the source." *Prairie State* at 29.

The applicant's design of the source includes the "applicant's purpose or basic design of the proposed facility." *Desert Rock* at 64 n. 61 (*quoting Prairie State* at

28). Here, however, commenters are proposing a "redesign" of the source in which literally absolutely nothing of the original proposed source would remain. Requiring consideration of a completely different drill vessel would be the equivalent of defining the purpose and basic design as "drilling for oil" – the equivalent of the *reductio ad absurdum* hypotheticals in *Prairie State* and *Sierra Club* in which the source is redefined by identifying the purpose of the facility as "the production of electricity, from coal," *Prairie State* at 28, or by imposing "clean fuel" requirements so as to require construction of a nuclear or hydroelectric facility instead, *see Sierra Club*. If there is such a thing as "source redefinition" – and EPA's policy, the Board's decisions, and the relevant affirming federal case law makes clear that there is – something must remain of the original proposed source. *See Sierra Club* ("We find it significant that all parties here, including Petitioners, agree that Congress intended the permit applicant to have the prerogative to define certain aspects of the proposed facility that may not be redesigned through application of BACT and that other aspects must remain open to redesign through the application of BACT.")

Neither *Desert Rock* nor any other EAB decision would support consideration of a different drill ship as potential BACT. In *Desert Rock* the Board found that the record did not support the Region's decision not to consider integrated gasification combined cycle (IGCC) technology in step 1 of its BACT analysis for the applicant's proposed coal-fired power plant. EAB noted that IGCC had been considered a potentially applicable control technique under step 1 for "coal-fired electric generating plants" in two prior permits the Board had reviewed. *Id*. at 57. Additionally, the applicant itself identified IGCC as one of several technologies that would be "consistent with the proposed facility's purpose, objective, or basic design," and thus would not improperly "redefine the source." *Id*. at 65.[2] (The applicant instead omitted IGCC from its BACT analysis because the technology is not "available" or "commercially viable." *Id*. at 67.) The Board found that, in light of the applicant's admission that IGCC would be consistent with the basic design of the power plant, and IGCC's consideration in prior BACT analyses for power plants, the Region did not adequately explain why IGCC would be redefining the source. *Id*.

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[2] "To determine whether the Region properly concluded that IGCC would redefine the source in this case, keeping in mind that the Region has broad discretion on this issue, the Board first looks at the administrative record to see how the applicant defined its 'goal, objectives, purpose, or basic design' for the proposed Facility in its application. The Board then looks at whether the Region took a 'hard look' at the applicant's stated purpose to determine which design elements were inherent to the applicant's basic purpose or objective and which elements could be changed to achieve pollutant emissions reductions without disrupting the purpose." *Id*. at 65.

Unlike the applicant in *Desert Rock*, Shell has consistently defined the proposed source as the Discoverer--not a different drillship – throughout the process. *See e.g.* Shell's Initial Application and EPA's Statement of Basis. EPA's Statement of Basis (at 20) explains: "Shell intends to implement their Chukchi Sea exploration drilling program through the use of the Frontier Discoverer drillship and the Associated Fleet." Moreover, even if one were to use the absurd extreme purpose of "drilling for oil" as the basis for a BACT analysis, another drillship would not qualify as BACT. Shell's application explains in detail the unique attributes of the Discoverer for the proposed drilling operations, including mobility, stability, drilling capability, ability to rotate to face into the wind while anchored, fuel capacities, accommodations, deck layout, and countless other features. [3] EPA can appropriately conclude, after taking a hard look at the issue, that requiring Shell to use a different drill ship, with different characteristics, would not be consistent with BACT requirements.

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[3] Shell specified the Frontier Discoverer as the drillship for use in the Arctic waters off the coast of Alaska because of two key features: its ice reinforced hull and its turret mooring system. There are very few rig choices for drilling activities in the Arctic, because of the lack of rigs that can operate in open water where ice is present. The Discoverer has an ice reinforced hull, which was accomplished by the addition of sponsons.

Moored drilling rigs have a proven record for executing drilling operations in a manner that is safe and efficient in Arctic waters at the depths found at Shell's planned drilling locations. Some other drillships can operate in these sea ice conditions, but they are dynamically positioned and are designed to operate in deeper water than is present at Shell's planned drilling locations. The use of dynamic positioning in these shallower waters is not a proven technology. Some bottom-founded drillships also can operate in sea ice, but the water at these locations is too deep for any bottom founded arctic drilling rig to set down. Moreover, the fact that Discoverer is moored also allows for departure off of a drilling location in the event that ice or weather has the potential to cause harm to the vessel.

Turret mooring, which is also a proven technology, further reduces the risk to the vessel because it allows the bow of the vessel to be turned into the wind while the mooring system, blowout preventer (BOP) and marine riser system maintain a constant orientation with respect to the seafloor. This reduces hull exposure to maximum wave features which, in turn, reduces heel, pitch, and roll. This feature also provides the minimum hull cross-section exposure to ice that may be driven by wind and currents toward the vessel. Because of hull configuration, heave may be reduced as well due to compensating sea conditions (e.g., roll or chop from another direction). Finally this puts the mooring wires below the water free surface to lower the potential of ice impact or accretion.

Thus the Discoverer is uniquely suitable among drillships for the drilling operations under specific conditions and at specific locations that would be authorized by the OCS air permit that Shell seeks.

Conclusion

Commenters contend that Shell should be required to compare the per-ton costs of emissions reductions from replacing some engines on the Discoverer with per-ton costs of reductions resulting from using a hypothetical alternate drill ship that has such engines. But to require this comparison would effectively require Shell to consider a fundamentally altered design for the proposed source. Region 10 can properly reject this contention and in its review of Shell's BACT analysis can properly rely on cost data provided below for re-powering the Discoverer to determine in step 4 whether this potential control technology is cost-effective.