Petitioner's Exhibit 2

Shell Offshore Inc.
3601 C Street, Suite 1334
Anchorage, AK 99503

December 29, 2006

Daniel L. Meyer
Office of Air, Waste and Toxics
U.S. EPA, Region 10
1200 Sixth Avenue, OAQ-107
Seattle, WA 98101

Re: Shell Kulluk 40 CFR Part 55 Preconstruction Permit Application for the 2007 – 2009 Beaufort Sea OCS Exploration Drilling Program

Frontier Discoverer 40 CFR Part 55 Preconstruction Permit Application for the 2007 – 2009 Beaufort Sea OCS Exploration Drilling Program

Dear Mr. Meyer:

Please find enclosed two minor source air permit applications for the Shell Kulluk and the Frontier Discoverer exploratory drilling programs. The applications are a follow-up on Shell Offshore, Inc.'s March 22, 2006, notice of intent (NOI) letter to EPA to conduct exploratory drilling activity on its OCS lease-holding blocks located on the Beaufort Sea, Alaska. As you recall, EPA and Shell Offshore, Inc. (SOI) previously discussed the air permitting requirements for these two exploratory drilling programs this past September. Shell believes the two air permit applications comport with our mutual understanding of the EPA permitting requirements, including the ambient air quality impact analysis required under Alaska regulation for minor sources.

Shell will need a pre-construction permit by April 2007 to meet its anticipated August 1, 2007, project start date. As you can imagine, the ice conditions in the Beaufort Sea can significantly affect the project start date and the potential length of each drilling season, and thus any significant delay beyond April 2007 could threaten the 2007 drilling season. Representatives from AES Regulatory & Technical Services (AES RTS), Shell, and AES RTS's sub-contractor, Air Sciences Inc., will be available to assist the EPA in any way to process the air permitting documents. If you have any questions regarding this submittal, please contact Wayne Wooster, Air Sciences Inc., at (503) 525-9394 or at wwooster@airsci.com. For any questions regarding the project, please contact me (907) 770-3700 or at susan.childs@shell.com

Sincerely yours,

Shell Offshore, Inc.

Susan Childs

Susan Childs
Regulatory Coordinator, Alaska

Enclosures

cc: Anita Frankel, EPA Region 10
Rick Fox, Shell
Susan Childs, Shell
Keith Craik, Shell
Brad Boschetto, Shell
Kate Marstall, Shell
Bill Walker, ADEC, DAQ
Jeff Walker, MMS
Rance Wall, MMS
Don Perrin, ADNR, OPMP
Kyle Parker, Patton & Boggs
John Iani, VanNess Feldman
Gene Pavia, AES RTS
Greg Horner, AES RTS
Wayne Wooster, Air Sciences Inc.

Outer Continental Shelf Pre-Construction Air Permit Application

Frontier Discoverer 2007 – 2009 Beaufort Sea Exploratory Drilling Program

Prepared for:

SHELL OFFSHORE, INC.

PROJECT NO. 180-15
DECEMBER 29, 2006

CONTENTS

Page

Tables

Figures

CONTENTS - continued

Page

Appendices

SECTION 1

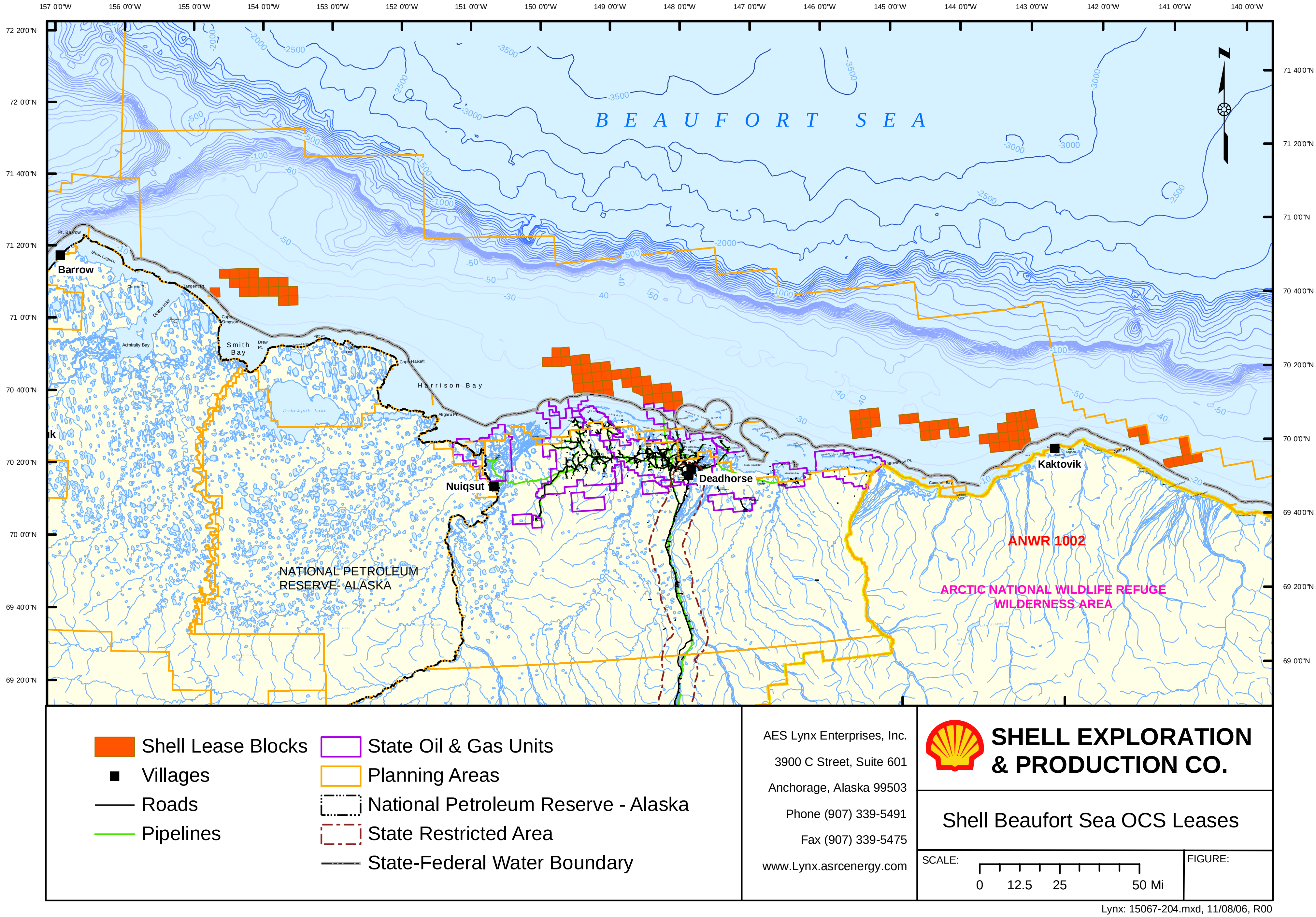
INTRODUCTION AND PROJECT DESCRIPTION

This application is submitted to U.S. EPA's Region 10 (EPA) office, pursuant to the requirements of Outer Continental Shelf Air Regulations, 40 CFR Part 55. Shell Offshore, Inc. (SOI) wishes to conduct exploratory drilling activity at its oil and gas lease blocks on Outer Continental Shelf (OCS) waters in the Beaufort Sea using the Frontier Discoverer drilling vessel and associated support vessels. Because of the distance from the Alaska shore, the drilling activities will be regulated by the U.S. EPA rather than the Alaska Department of Environmental Conservation (ADEC). Figure 1 shows the locations of SOI's Beaufort Sea OCS lease blocks. SOI intends to conduct a three-year exploratory drilling program, 2007 through 2009, although drilling activity may occur in 2010 and 2011 if ice conditions prevent significant exploratory drilling activity in 2007, 2008, or 2009.

SOI believes that the available drilling season will range up to 120 days per calendar year, weather and ice conditions permitting. SOI anticipates that drilling operations per drill site will range between 30 and 60 days. SOI, therefore, anticipates drilling up to three drill site locations per year. The drilling season is projected to run from approximately August 1 through November 30 each year, again weather and ice conditions permitting. Ice conditions in the Beaufort Sea were particularly heavy in 2006 resulting in a significantly less than an expected 90-day drilling season. Pursuant to the 40 CFR 55.2 OCS source definition, each drill site is a stationary source, so the Frontier Discoverer drilling activities could consist of a maximum of three sequential stationary sources per year. This application is, in fact, a single application for multiple portable stationary sources, all of which will be equal to or smaller than the hypothetical stationary source described herein.

SOI intends to conduct drilling operations in 2007 at its OCS lease block locations in Camden Bay, located in the central Beaufort Sea. SOI may conduct exploratory drilling operations at its other OCS lease block locations in the Beaufort Sea in 2008 and 2009. The proposed 2007 drilling sites are located approximately 13 to 16 miles from the state of Alaska shoreline. Drilling activities will be curtailed in the event that large ice flows force the drilling vessel off of the drilling site. For example, SOI experienced seven days and fifteen days of "force offs," respectively, during its 1985 and 1986 Beaufort Sea exploration drilling program. In the event of an ice flow caused "force off," drilling activities will resume once favorable ice conditions allow the drilling vessel to safely return to the drilling site.

Each drill site will carry with it a safety exclusion zone around the Frontier Discoverer, established by the U.S. Coast Guard, protecting ocean traffic from possible entanglement with the Frontier Discoverer anchors and any close-in related anchor and ice management. This safety exclusion zone establishes the ambient air boundary around the stationary source.


157 0'0"W
156 0'0"W
155 0'0"W
154 0'0"W
153 0'0"W
152 0'0"W
151 0'0"W
150 0'0"W
149 0'0"W
148 0'0"W
147 0'0"W
146 0'0"W
145 0'0"W
144 0'0"W
143 0'0"W
142 0'0"W
141 0'0"W
140 0'0"W
72 20'0"N
72 0'0"N
71 40'0"N
71 20'0"N
71 0'0"N
70 40'0"N
70 20'0"N
70 0'0"N
69 40'0"N
69 20'0"N
71 40'0"N
71 20'0"N
71 0'0"N
70 40'0"N
70 20'0"N
70 0'0"N
69 40'0"N
69 20'0"N
69 0'0"N
N
B E A U F O R T S E A
Barrow
Smith Bay
Harrison Bay
Nuiqsut
Deadhorse
Kaktovik
NATIONAL PETROLEUM RESERVE- ALASKA
ANWR 1002
ARCTIC NATIONAL WILDLIFE REFUGE WILDERNESS AREA
Shell Lease Blocks
Villages
Roads
Pipelines
State Oil & Gas Units
Planning Areas
National Petroleum Reserve - Alaska
State Restricted Area
State-Federal Water Boundary
AES Lynx Enterprises, Inc.
3900 C Street, Suite 601
Anchorage, Alaska 99503
Phone (907) 339-5491
Fax (907) 339-5475
www.Lynx.asrcenergy.com
SHELL EXPLORATION & PRODUCTION CO.
Shell Beaufort Sea OCS Leases
SCALE:
0 12.5 25 50 Mi
FIGURE:
Lynx: 15067-204.mxd, 11/08/06, R00

SECTION 2

SOURCE DESCRIPTION AND EMISSIONS EVALUATION

This section provides a description of the Frontier Discoverer fleet configuration; a description of the project vessels emission units, and a project vessel-wide emission estimate. This section also includes SOI's request for an owner requested limit (ORL) to maintain synthetic minor permit status.

2.1 Frontier Discoverer Fleet Configuration

The Frontier Discoverer Exploratory Drilling Program exploration drilling activities will be conducted from the Frontier Discoverer, a self-propelled drilling vessel, and assisted by a number of associated support vessels. The associated support vessels will include two icebreakers, a re-supply vessel, and an oil spill response (OSR) fleet. The Kapitan Dranitsyn will perform primary ice management duty (ice breaking). The Fennica (or its identical sister vessel the Nordica) will assist the Kapitan Dranitsyn with ice management duty in 2007 through 2009. The Jim Kilabuk will serve as the re-supply vessel. The Frontier Discoverer OSR fleet will consist of one larger vessel and a number of smaller craft. Photographs and diagrams of the Frontier Discoverer and associated support vessels are provided in Appendix A.

The exploratory drilling process consists of three phases, drilling vessel placement, drilling operations, and drilling vessel removal, all of which are considered part of the stationary sources to be permitted.

Drilling vessel placement: Prior to the rig placement and anchoring to the seabed in federal OCS waters, the Frontier Discoverer is simply a self-propelled marine vessel and as such is not triggering the definition of an OCS source. Pursuant to 40 CFR 55.2, the Frontier Discoverer becomes an OCS source once it is placed and anchored to the seabed on OCS waters. The Frontier Discoverer will sail to the Beaufort Sea along with its supporting icebreaker vessels to the SOI lease-holding OCS drill site. One of the icebreakers will assist the Frontier Discoverer to anchor to the seabed. The Frontier Discoverer anchor pattern consists of eight anchors, and each anchor will reach approximately 500 meters away from the Frontier Discoverer. The entire anchor setting process is estimated to take less than 24 hours. SOI has contacted the U.S. Coast Guard to obtain a Safety Exclusion Zone around the Frontier Discoverer pursuant to 33 CFR Part 147 to help ensure that the public remains at a safe distance from the drilling platform and marine support vessels. A copy of the Safety Exclusion Zone Application will be submitted to the EPA under a separate cover. The U.S. Coast Guard routinely authorizes Safety Exclusion Zones up to 500 meters away from an OCS source, and thus SOI anticipates receiving a Safety Exclusion Zone of at least 500 meters from the edge of the Frontier Discoverer drilling vessel. Following the rig placement and anchoring to the seabed, the two icebreakers will move away from the Frontier

Discoverer typically three to twelve miles (five to twenty kilometers) upwind to perform ice management activity.

Drilling vessel drilling operations: Following the rig placement and anchor setting, the Frontier Discoverer will commence exploratory drilling operations (and become an OCS source as defined in 40 CFR 55.2). SOI expects exploratory drilling operations to last about 30 days per site. Under ideal ice conditions and unanticipated drilling issues the drilling program could possibly continue for up to 60 days per lease block drill site location, but SOI considers a 43-day drilling program to represent a conservatively long estimate, and maximum emissions are based on a 43-day drilling program. When the exploratory drilling operation is completed, the two icebreakers will assist in retrieving the Frontier Discoverer anchors. This task will be completed in about 24 hours. The Frontier Discoverer will then sail to the next OCS lease-holding drill site location where the process is repeated. SOI will station its OSR fleet adjacent (typically within one to two kilometers) to the Frontier Discoverer during periods of potential penetration into hydrocarbon bearing strata. The OSR fleet will be standing by in the case of a spill and will also conduct oil spill response drill exercises. The Frontier Discoverer will be fully outfitted prior to the beginning of each drilling season. Personnel and some provisions will be shuttled to the Frontier Discoverer from shore by helicopter. Diesel fuel and other provisions will be provided to the Frontier Discoverer by the Jim Kilabuk every two to three weeks during the drilling season.

Drilling vessel removal: At the end of each drilling season, the two icebreakers will assist the Frontier Discoverer to pull anchors and then sail out of the Arctic theater to Southeast Asia or other off-season operating location.

2.2 Frontier Discoverer Fleet Emission Sources and Emission Estimate

The Frontier Discoverer Exploratory Drilling Program consists of the Frontier Discoverer drilling vessel, two icebreaker vessels, a re-supply vessel, and an oil spill response (OSR) fleet. The sources of emissions for the Frontier Discoverer and its associated marine support vessels consist primarily of internal combustion engines and heaters. There will be no flares or other industrial sources, except for one incinerator located on an icebreaker. The combustion sources consist of marine / non-road compression-ignition internal combustion engines, electrical generators, and boilers and heaters. All of these combustion sources will be fired by diesel fuel. The engines will have the purpose of generating electricity, pumping, compressing, providing direct drive mechanical power, and for powering mobile machinery. The Frontier Discoverer Exploratory Drilling Program Project emissions are generated from a relatively few large emissions sources: the Frontier Discoverer propulsion engine and main drilling engines and the support vessels propulsion engines. For example, the Frontier Discoverer propulsion engine, main drilling engines, and deck cranes engines account for 95 percent to more than 98 percent of the vessel emissions. In addition, the support vessels main propulsion engines / electrical generators and auxiliary engines account for 98 percent to more than 99 percent of the support vessel emissions.

SOI estimates the Frontier Discoverer drilling vessel will account for approximately 10 percent to 20 percent of the combined fleet emissions; the icebreaker vessels (the Kapitan Dranitsyn and the Nordica) will account for approximately 70 percent to 80 percent of the combined fleet emissions; and the OSR fleet vessels will account for approximately 1 to 2 percent of the combined fleet emissions. SOI estimates the re-supply vessel, the Jim Kilabuk, will account for less than 1 percent of the combined fleet emissions. The Frontier Discoverer Exploratory Drilling Program vessels, combustion sources identification, size rating, emission factor, hourly emissions, and project site yearly emissions are provided in Appendix B.

Below, SOI presents its maximum expected emissions from the stationary source so that the approximate split in emissions among all of the sources and the largest source units are apparent. The proposed compliance equation estimates emissions for these sources based on fuel consumption. As a practical matter of avoiding the tracking of inconsequential source units, the emissions for the smaller sources are proposed to be held constant. Any imprecision in these is assumed to be less than 5 tons per year so that even if the estimate is off by nearly 5 tons per year, the total NO_x emissions will remain below the 250-ton-per-year major new source review threshold value.

Frontier Discoverer Drilling Vessel: SOI believes the drilling vessel operations and thus emissions per drill site location will be fairly consistent irrespective of the Beaufort Sea ice conditions, and thus SOI can reasonably predict maximum emissions from the Frontier Discoverer drilling vessel and can therefore estimate the drilling vessel emissions with a high degree of certainty. For example, SOI estimates the Frontier Discoverer drilling vessel NO_x emissions from a 43-day drilling site will be approximately 52 tons or about 21 percent of the Prevention of Significant Deterioration (PSD) 250-ton-per-year major source review threshold.

Frontier Discoverer Associated Support Vessels: SOI's prediction of maximum emissions from the associated support vessels, primarily the two icebreaker vessels, is imprecise; however, it is expected to account for 70 percent to 80 percent of the combined fleet emissions. The icebreaker vessels emissions will depend greatly on the ice conditions experienced in the Beaufort Sea with light ice conditions resulting in lesser engine load factor and lower emissions, and heavy ice conditions resulting in a higher engine load factor and higher emissions.

SOI, in an attempt to estimate potential icebreaker vessels emissions, evaluated the ice conditions in the Beaufort for the past three years and determined a weighted average of "open water," "moderate ice," and "heavy ice" conditions. For this permit application SOI assumed open water, moderate ice, and heavy ice conditions at 62 percent, 23 percent, and 15 percent, respectively. SOI applied a varying engine usage / load factor for each open water / ice condition to determine a weighted engine horsepower-hours factor for all of the associated vessel emission units. SOI obtained engine load factors from the support vessels owner and / or operator for each open water / ice condition. SOI then determined an "equivalent operating days" of operation for each emission unit using the engine load factors for each open water / ice condition. SOI applied the applicable engine emission factor (e.g., vendor specification, EPA AP42, etc.) to each of the emission units "equivalent operating days" to calculate the Frontier Discoverer Exploratory Drilling Program Project estimated emissions (tons per year) per drill site. SOI believes the emissions from the Frontier Discoverer drilling vessel will not be as dependent on open water / ice conditions except in the case of very heavy ice that the icebreaker vessels cannot safely and effectively manage and thus forces the drilling vessel off of the drill site. Likewise, SOI believes the emissions from the OSR fleet and the re-supply vessel will be unaffected by open water / ice conditions. The OSR fleet emission estimates conservatively assume that the OSR fleet would be with the drilling vessel for the duration of the drilling activity even though the potential days of a hydrocarbon release is less than the number of drilling days, i.e., drilling the mud line cellar, installing piping / casing, plugging the well.

SOI intends to collect generated on-site trash from the Frontier Discoverer for off-site disposal / management and / or for incineration on one of the icebreaker vessels incinerators. SOI will not incinerate trash on the Frontier Discoverer. Nor does SOI intend to flare drilling well off-gases during the project.

With a stationary source such as this, which includes large machinery that only operates at capacity for short periods of time, maximum emissions are based on an assemblage of reasonable maximum activity level assumptions, none of which are absolute maxima. These assumptions include length of drilling program, number of engines needed for drilling, time of icebreaker activity at maximum power, etc. Using these assumptions (listed in Appendix B) the maximum emissions for NO_x, CO, PM_{10}, SO_2, and VOC for the combined fleet per drill site per calendar year are estimated and the estimates presented in Table 1. The estimated diesel fuel consumption for this emission estimate is presented in Table 2. The emissions from all vessels associated with the drilling project have been calculated and included, following the requirements of 40 CFR 55.4(b)(3). The annual emissions of hazardous air pollutants ("HAPs") from the Frontier Discoverer and its associated support vessels are less than 10 tons for each HAP and less than 25 tons for all HAPs. All emission calculations are provided in Appendix B.

Table 1: Frontier Discoverer Fleet 2007-2009 Emissions Estimate

Emissions	NO_x (tpy)	CO (tpy)	PM_{10} (tpy)	VOC (tpy)	SO_2 (tpy)
Frontier Discoverer	51.8	6.7	1.7	0.9	4.7
Kapitan Dranitsyn	107.6	37.1	3.4	7.5	7.4
Fennica / Nordica	80.5	2.9	1.7	2.8	5.4
Jim Kilabuk	1.2	0.3	0.03	0.06	0.07
Frontier Discoverer OSR Fleet	3.9	1.0	0.08	0.8	0.4
Total	245.0	47.9	7.0	11.8	17.7

Table 2: Frontier Discoverer Fleet Diesel Fuel Consumption Estimate

Material	Quantity gallons	Quantity cubic meters
Frontier Discoverer drilling vessel	357,743	1,354
Kapitan Dranitsyn	587,867	2,225
Fennica / Nordica	458,345	1,735
Jim Kilabuk	5,046	19
Frontier Discoverer OSR Fleet	23,800	90
Total Diesel Fuel Consumption	1,432,801	5,424

2.3 Frontier Discoverer Owner Requested Limit (ORL)

The drilling operation (stationary source) carries with it uncertainties in length of drilling at each site, and weather and ice conditions associated in support of drilling at each site. Therefore, it is impossible to estimate precisely the quantity of emissions associated with each stationary source. The drilling emissions may be above expectation, while ice management vessel use might be below expectation. The emissions defined in Table 1 are considered to represent a reasonable maximum, and SOI is confident that it will be able to execute each drilling program within these limits. In order to demonstrate synthetic minor source status, SOI proposes a facility-wide emissions cap, tracked by fuel consumption of the largest emitters, using an equation for determination of compliance with a 245-ton-per-year NO_x threshold. Diesel fuel consumption of the largest source units would be measured every day, and the equation would be tested every 30 days to demonstrate an annual emission rate within the 245-ton-per-year threshold. Since all other combustion related criteria pollutants will be well below this quantity, and they track with the combustion related NO_x emissions, no other compliance tracking will be necessary.

SOI proposes to group the sources by applicable emission factor (all CAT 399 engines as one group, Mitsubishi 6UEC65 as a second group, etc.) and calculate emissions from each group by multiplying that group's fuel consumption by the applicable source-type emission factor, multiplied by the appropriate heat rates and unit conversions. There are several small sources with emissions below 4 tons per year that SOI proposes to not track, but to use the drill site NO_x emission estimate as a constant in the compliance equation. SOI will then sum each source group's emissions to determine the project fleet-wide emissions running total. SOI proposes to implement fuel consumption monitoring on each project vessel on a 30-day basis, to ensure that the project-wide annual NO_x emissions (for each drill site) remain less than 245 tons per drill site per year.

SOI proposes the following compliance equation:

$$K_{RICE}*((F_{A1}*EF_{A1})+(F_{A2}*EF_{A2})+(F_{B1}*EF_{B1})+(F_{C1}*EF_{C1}))+K_{HEAT}*((F_{A3}*EF_{A3})+(F_{B2}*EF_{B2})+(F_{C2}*EF_{C2})) + 2.6 + 1.2 + 3.9 < 245 \text{ tpy}$$

Where:

K_{RICE} = 137,000 (Btu / gal) / 7,000 (Btu / hp-hr) / 2000 (lb / ton) = 0.00979 Hp-hr-ton / gal-lb

K_{HEAT} = 137,000 (Btu / gal) / 1,000,000 (Btu / mmBtu) / 2,000 (lb / ton) = 0.0000685 mmBtu -ton / gal-lb

Fi = fuel consumption per source group (i)

Efi = emission factor per source group (i)

2.6 = FD remaining emissions (tons)

1.2 = Jim Kilabuk emissions (tons)

3.9 = OSR Fleet emissions (tons)

Table 3: Frontier Discoverer Project ORL Variables

Source Group	Vessel Source Identification	NO_x Emission Factor (EF)
FD six Caterpillar 399 main drilling engines	A1	0.0162 lb / hp-hr
FD Mit. 6UEC65 main propulsion engine	A2	0.024 lb / hp-hr
FD boilers	A3	0.201 lb / mmBtu
KD main and auxiliary propulsion engines	B1	0.024 lb / hp-hr
KD boilers	B2	0.143 lb / mmBtu
F / N four main propulsion engines	C1	0.0189 lb / hp-hr
F / N two boilers	C2	0.143 lb / mmBtu

SOI has included vessel diesel fuel monitoring and resulting emission calculation as an ORL in the permit application forms in Appendix C. The applicable NO_x emission factors are included in Table 3. An example calculation of the compliance equation from fuel consumption is presented in Appendix B.

SOI proposes to begin fuel consumption monitoring and record-keeping once the Frontier Discoverer and the icebreaker vessels are on OCS waters and within 25 miles of the project drilling site. SOI will also begin fuel consumption monitoring and record-keeping for the re-supply vessel and the OSR fleet vessels once these vessels are on OCS waters and within 25 miles of the project drilling site.

SECTION 3

REGULATORY APPLICABILITY

This section provides the applicable regulatory administrative history prior to the submittal of this application;a description on the EPA's guidance in permitting this project; a brief discussion on the Notice of Intent requirements contained in 40 CFR Part 55; the roles of the respective regulatory agencies, EPA and the Alaska Department of Environmental Conservation (ADEC); and a discussion of the Corresponding Onshore Area (COA) air quality designation, and applicable federal and state regulatory requirements.

3.1 EPA Guidance and 40 CFR Part 55 NOIs

SOI met with the EPA in September 2006 to discuss the air quality permitting requirements and applicable guidance documents pertaining to this project. Following this meeting the EPA confirmed that the Frontier Discoverer drilling vessel, when anchored or otherwise attached to the seabed at each drill site, was a separate "stationary source." The EPA's position is consistent with the requirements of 40 CFR 55.2 whereby the Frontier Discoverer becomes an OCS source once it is placed and anchored to the seabed on OCS waters. The EPA's guidance further required that the emissions from the project's associated support vessels be included in the "source" potential-to-emit (PTE) when the support vessels are within 25 miles of the anchored drilling vessel. These guidance interpretations are consistent with the OCS source definition found in 40 CFR 55.2.

SOI submitted the required Notice of Intent (NOI) for the Pre-Construction Air Permit for OCS activities (specifically a proposed 2006 Mud Line Cellar project) to the EPA on March 22, 2006. A copy of the NOI was also submitted to the ADEC as required by 40 CFR 55.4(a). The EPA pursuant to 40 CFR 55.12(c)(1) and section 328(a)(1) of the Clean Air Act published a proposed Part 55 OCS Consistency Determination for ADEC's current air quality regulations (18 AAC 50 Air Quality Control as amended through December 3, 2005) in the August 22, 2006, Federal Register (V.71, No. 162, p. 48879 – 48883) to ensure that the part 55 requirements were consistent with the corresponding onshore area (COA) state of Alaska requirements. ADEC recently amended its 18 AAC 50 Air Quality Control regulations through December 14, 2006. However, ADEC made no changes to its December 3, 2005, regulations. SOI nevertheless updated its March 2006 NOI and attached it to this application in Appendix D. A second EPA consistency determination is unnecessary since the December 14, 2006, ADEC regulations were not changed from the December 3, 2005, ADEC regulations. SOI therefore believes it has satisfied all of the applicable administrative requirements pursuant to 40 CFR 55.12(f) prior to submitting this permit application.

3.2 EPA and ADEC Agency Permitting Roles

The Frontier Discoverer Exploratory Drilling Program will be an exploration project conducting exploratory oil and gas drilling operations (North American Industry Classification System [NAICS] code 211111 Crude Petroleum and Natural Gas Extraction) on SOI's oil and gas lease-holdings located on federal OCS waters on the Beaufort Sea. SOI's OCS lease blocks are located between longitude 141 degrees W to longitude 155 degrees W. SOI's lease holdings are located outside the jurisdiction of the state of Alaska's three mile seaward boundary but are within 25 miles of Alaska's seaward boundary. Therefore, the project is subject to the requirements of 40 CFR Part 55 with the U.S. EPA as the regulatory approval agency. 40 CFR 55.1 requires the EPA to review and approve the project pursuant to the part 55 requirements including the corresponding onshore area (COA) (Alaska) requirements in 40 CFR 55.14 and 18 AAC 50. ADEC has no direct regulatory authority over the review and approval of this application and thus will serve as an interested member of the public. The EPA may of course confer with ADEC with potential interpretation issues pertaining to the applicable COA regulatory requirements.

3.3 Synthetic Minor Source Permitting

SOI intends to operate (and permit) the Frontier Discoverer and its associated support vessels as a synthetic minor source that will not exceed 250 tons of any new source review regulated air contaminant per drilling site per year. The project's primary air contaminant is nitrogen oxides (NO_2) with lesser quantities of carbon monoxide (CO), small-diameter particulate matter (PM_{10}), volatile organic compounds (VOC), and sulfur dioxide (SO_2). SOI will seek federally enforceable requirements to ensure that the project retains a minor source permit status. It is SOI's intent that the ORL described in Section 2.3 above will satisfy the federal enforceability requirement.

3.4 Area Designation

The Outer Continental Shelf (OCS) permitting requirements of 40 CFR Part 55.14 require that a permit application address the Corresponding Onshore Area (COA) requirements, which for the Frontier Discoverer Exploratory Drilling Program project are the ADEC requirements for the Northern Alaska Intrastate Air Quality Control Region (AQCR) 9. This region is designated attainment or unclassifiable for all criteria pollutants pursuant to 40 CFR 81.302. This area is designated as a Prevention of Significant Deterioration (PSD) Class II Area per 18 AAC 50.015. There are no Class I areas within 300 kilometers of the project location. The nearest Class I area (Denali National Park) is located approximately 700 kilometers to the south of the project location.

3.5 State Requirements Applicable to OCS Sources

Pursuant to 40 CFR 55.14(e), the applicable state of Alaska (the COA) requirements has been promulgated by the EPA as being applicable to the Frontier Discoverer project. The following describes the Alaska Administrative Code (AAC) emissions standards and limitations of ADEC that are applicable to the Frontier Discoverer Exploratory Drilling Program's air emission sources. The relevant portions of ADEC's permit application forms have been completed and provided in Appendix C. The ambient air quality analysis, pursuant to 18 AAC 50.540(c)(2)(B) is presented in Section 4.

The following ADEC emissions standards and limitations apply to industrial processing and fuel burning equipment on the Frontier Discoverer drilling vessel:

- Visible emissions, excluding condensed water vapor, from each stationary IC engine and each boiler, may not reduce visibility through the exhaust effluent by greater than 20 percent averaged over any six consecutive minutes, per 18 AAC 50.055(a)(1).
- Particulate matter emitted from each stationary IC engine and each boiler may not exceed, per cubic foot of exhaust gas corrected to standard conditions and averaged over three hours, 0.05 grains, per 18 AAC 50.055(b)(1).
- Sulfur-compound emissions, expressed as sulfur dioxide, from each stationary IC engine and each boiler, may not exceed 500 ppm averaged over a period of three hours, per 18 AAC 50.055(c).

SOI proposes to limit the Frontier Discoverer Exploratory Drilling Program emissions to less than 250 tons per drill site per year by limiting the project's diesel fuel consumption by the owner requested limit (ORL), per 18 AAC 50.540(j), and described in Section 2.3.

3.6 Federal Requirements Applicable to OCS Sources

The federal requirements pursuant to 40 CFR 55.13 have been promulgated by the EPA as being applicable to the Frontier Discoverer project. This section addresses the requirements of New Source Performance Standards (NSPS), Prevention of Significant Deterioration (PSD), and Hazardous Air Pollutants (HAPs) pursuant to 40 CFR 55.13(c), (d) and (e).

New Source Performance Standards (NSPS): With the possible exception of NSPS Subpart CCCC Standards of Performance for Commercial and Industrial Solid Waste Incineration Units for Which Construction Is Commenced After November 30, 1999, or for Which Modification or Reconstruction Is Commenced on or After June 1, 2001; the Frontier Discoverer drilling vessel and its associated support vessels are not subject to any 40 CFR Part 60 NSPS. The Frontier Discoverer Exploratory Drilling Program vessel incinerators due to their small size (less than 35 tons per day of municipal solid waste) are exempt from federal requirements aside from an initial notification to the EPA administrator and quarterly record-keeping of the waste material burned. 40 CFR 60.2020 (NSPS Subpart CCCC) requirements apply to the project incinerator(s) that commenced construction after November 30, 1999, whereas federal requirements 40 CFR 62.14525 apply to the project incinerator(s) that commenced construction before November 30, 1999.

Prevention of Significant Deterioration (PSD): The applicable potential emissions threshold under the PSD requirements of 40 CFR 52.21 for the construction of a new source is 250 tons per year for each pollutant. SOI proposes to limit the Frontier Discoverer Exploratory Drilling Program potential emissions to less than 250 tons per drill site per year (for each pollutant) so that the Frontier Discoverer drilling vessel and its associated support vessels are not subject to review under the PSD rules. Emission calculations are provided in Appendix B. The requested limitation on the project's fuel use is provided on ADEC permit forms in Appendix C and is discussed in Section 2.3 of this application.

National Emission Standards for Hazardous Air Pollutants (NESHAPs) and National Emission Standards for Hazardous Air Pollutants for Source Categories - Maximum Achievable Control Technology (MACT) Requirements: The Frontier Discoverer Exploratory Drilling Program and its combustion sources are not subject to a national emissions standard for hazardous air pollutants of 40 CFR Part 61 and are not subject to a national emissions standard for hazardous air pollutants for source categories under 40 CFR Part 63, subparts A, and C through to the end. The calculations provided in Appendix B show that the Frontier Discoverer Exploratory Drilling Program combined vessel fleet potential emissions of each hazardous air pollutant is less than 10 tons per year, and the aggregate of all hazardous air pollutant emissions is less than 25 tons per, and thus it is not a major source of HAPs and therefore not subject to the control technology determination requirements of 40 CFR 63 Subpart B.

AMBIENT IMPACT ANALYSIS (DISPERSION MODELING)

This section describes the ambient standards to be addressed for the exploration drilling activities, the model selected for use in addressing these standards, and the selection of inputs to the model in a manner believed to be consistent with acceptable EPA and ADEC modeling methods.

The Outer Continental Shelf (OCS) permitting requirements of 40 CFR Part 55.14 require that a permit application address the Corresponding Onshore Area (COA) requirements, which for the project are the ADEC requirements for the Northern Alaska Intrastate Air Quality Control Region (AQCR) 9. This AQCR is unclassifiable / in attainment for all pollutants. In addition, there are no Class I areas within 300 kilometers of the project location.

Thus, expected impacts from the exploration drilling activities were evaluated in relation to the National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS). Because this project is a temporary minor source, it would not consume increment under ADEC's rules. Therefore, the impacts are not compared with the Class II PSD increments.

Emissions from the project will not exceed the 250-ton-per-year Prevention of Significant Deterioration (PSD) major source review threshold. However, because the project is considered a portable oil and gas operation by ADEC, a minor permit is required per ADEC Regulation 18 AAC 50.502(c)(2)(A). As a result, a National Ambient Air Quality Standards (NAAQS) modeling analysis for SO_2, NO_x, and PM_{10} is required per ADEC Regulation 18 AAC 50.540(c)(2)(B). For the impact analysis, emissions from the stationary source (the Frontier Discoverer) and mobile sources (i.e., icebreakers, oil spill response vessels, and a re-supply vessel) were modeled for impact.

4.1 Source Characterization

SOI has defined the worst-case modeling impact scenario as the Frontier Discoverer drill rig operating at maximum emissions. During maximum Frontier Discoverer operations, impacts from the OSR fleet and the Jim Kilabuk re-supply vessel, both operating adjacent to the Frontier Discoverer, are considered. In addition, primary and secondary icebreaker impacts are also included. The icebreakers are assumed to operate at their maximum capacities in heavy ice (worst-case emissions), and their impacts are calculated at the Frontier Discoverer's point of maximum impact. The emissions from propulsion engines on the Frontier Discoverer and the Jim Kilabuk are not considered in the assessment, since these propulsion engines will be used very briefly to maneuver the Frontier Discoverer when it is being anchored or to maneuver the Jim Kilabuk when it is near the Frontier Discoverer drill rig. The propulsion engines will not be operated concurrently with the drill rig and support vessels when they are operating at maximum emissions levels.

SOI has estimated the duration at a given drill site is expected to be less than 45 days. Even though the Frontier Discoverer Exploratory Drilling Program will be permitted as a minor source and does not trigger PSD requirements, the modeling analysis conservatively considers sources operating 24 hours per day and 45 days per year. These assumptions combined with the use of the conservative SCREEN3 model (which incorporates worst-case assumptions) are expected to greatly overestimate real-world impacts from the project.

Frontier Discoverer Drill Rig

For modeling, some sources on the Frontier Discoverer were merged together because of size and location considerations. Many identical sources / stacks are located near each other and were collocated so that single-source stack parameters were used with combined emissions. The locations of the collocated stacks were conservatively placed at the actual stack location nearest the ambient air boundary.

The following sources on the Frontier Discoverer were collocated: six main drilling engines (stack #1), two air compressors (stack #2), two HPP engines (stack #3), three diesel crane engines (stack #4), and two heat boilers (stack #5). Because stack parameters for the two cementing units are unknown at this time, the emissions from two cementing units (which are similar in size to the HPP engines) were modeled out of the HPP engine stack (stack #3). A logging winch emits to the atmosphere via a single stack (stack #6). These six stacks were considered as point sources in the modeling analysis.

The diesel crane engine stack emits to the atmosphere horizontally. This stack was modeled in accordance with ADEC's recommendations. ADEC'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}) to an adjusted stack exit velocity ($V_{adjusted}$) of 0.001 meters per second.
- To conserve volumetric flow, determine an adjusted stack diameter ($D_{adjusted}$) by adjusting the actual stack inside diameter (D_{actual}) to account for buoyancy of the plume by using the following equation:

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

- Use the adjusted parameters, $V_{adjusted}$ and $D_{adjusted}$ in the modeling analysis.

The physical characteristics of the stacks on the Frontier Discoverer are provided in Table 4. Photographs and diagrams of the Frontier Discoverer are provided in Appendix A.

Table 4: Frontier Discoverer Source Stack Parameters

Source Description	Model Source ID	Source Type	Vertical or Horizontal?	Release Ht. [1] (ft)	(m)	Stack Dia. (ft)	(m)	Exit Temp. (deg. F)	(deg. K)	Exit Vel. (m / s)
Drill Rig: Frontier Discoverer										
Stack #1: 6 Main Drilling Engines	MAINENGS	Point	vertical	42.1	12.83	1.15	0.35	437	498	63.3
Stack #2: 2 Air Compressors	COMPENGS	Point	vertical	8.0	2.44	0.69	0.21	800	700	40.0
Stack #3: 2 HPP Engines [2]	HPPENGS	Point	vertical	8.0	2.44	0.60	0.18	800	700	40.0
Stack #4: 2 Crane Engines [A]	DECKCRNS	Point	horizontal	45.0	13.72	117.95	35.95	750	672	0.001
Stack #5: 2 Heat Boilers	HEATBOIL	Point	vertical	42.1	12.83	1.50	0.46	200	366	7.3
Stack #6: 1 Logging Winch	LOGWNCH	Point	vertical	10.3	3.12	0.33	0.10	820	711	53.0

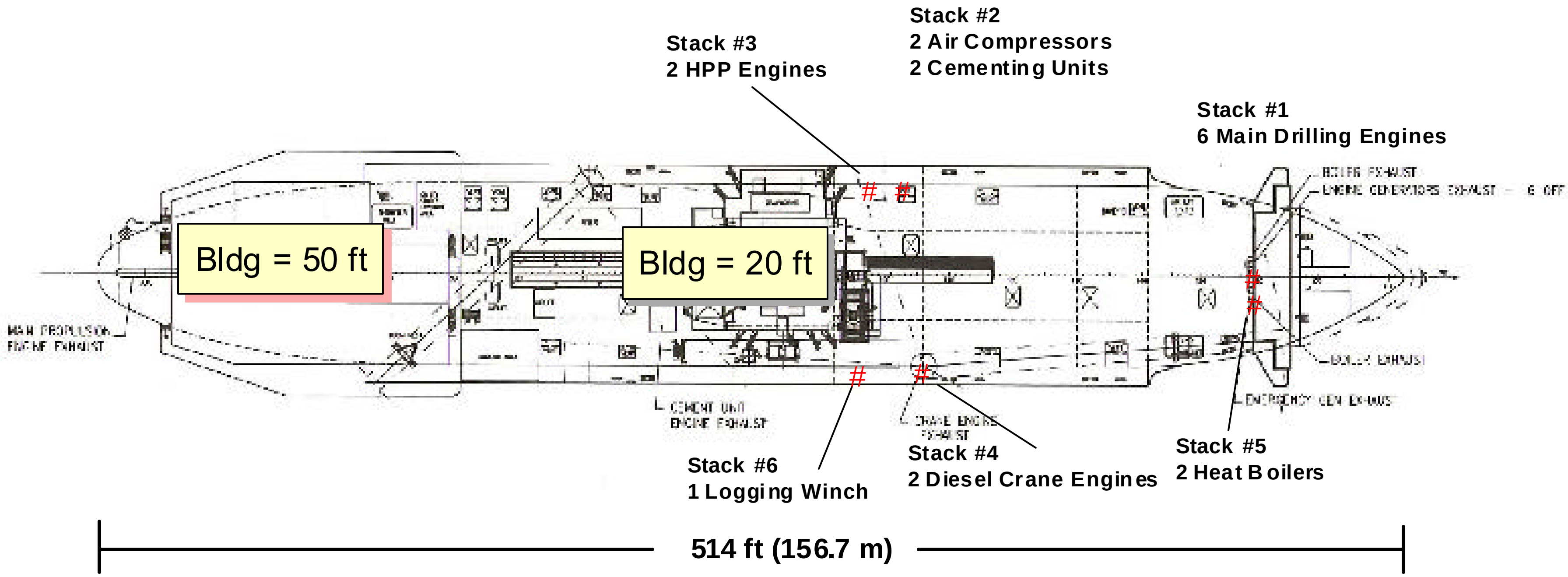
[A] Diameter and exit velocity is adjusted since stack emits horizontally.
Non-adjusted stack diameter is 0.83 feet (0.25 meters), and non-adjusted exit velocity is 20.1 m / sec.

[1] Above main deck that is approximately 4.57 meters (15 feet) above the water surface.

[2] Also includes emissions from two cementing units.

The configuration of the sources on the Frontier Discoverer deck is shown on Figure 2.

Figure 2: Configuration of Platform Equipment



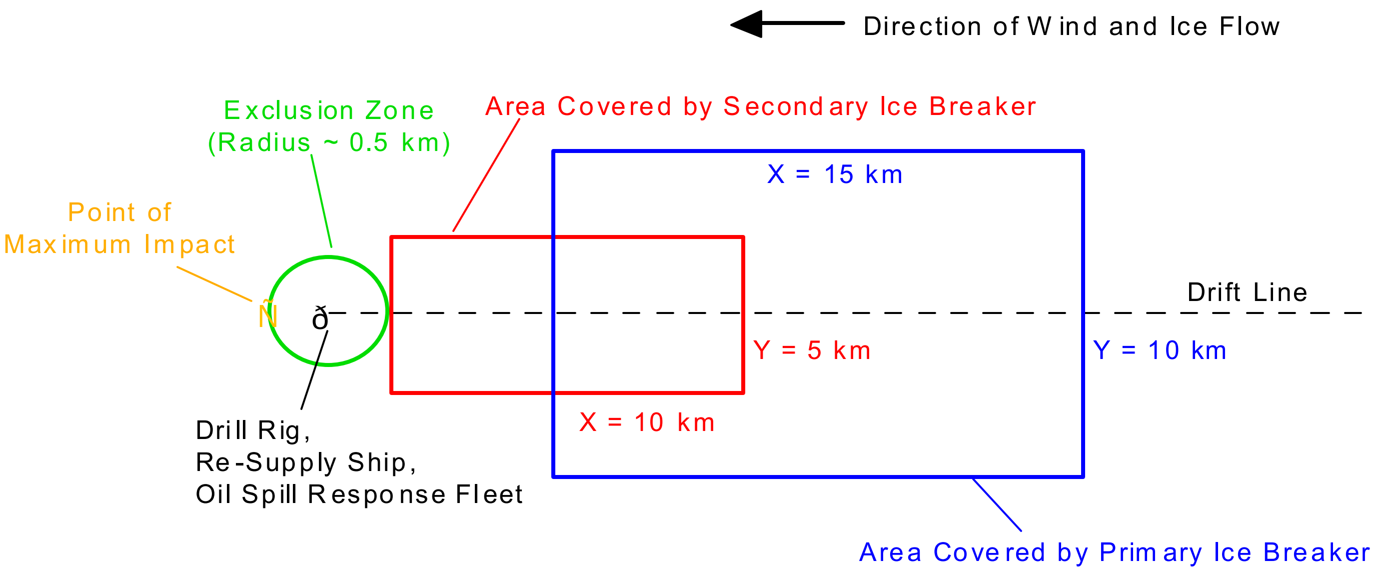
Given the configuration of the stacks and structures on the Frontier Discoverer, it is expected that the plumes will be down-washed and pulled into the wake of the Frontier Discoverer. In SCREEN3, the dimensions of buildings in proximity to the stacks are needed to simulate building downwash. For this analysis, the "building" length and width are assumed to be the length and width of the Frontier Discoverer. The building height for downwash is assumed to be 20 feet above main deck. This height accounts for miscellaneous structures and objects located at the middle of the ship near the stacks.

Frontier Discoverer Support Vessels

The OSR vessels assigned to the rig will stay very close to the rig at all times. Periodically, the workboats will do response exercises, but it is not expected that any of the OSR vessels will travel more than 2 miles away from the rig. To be conservative, the OSR vessels are considered adjacent to the drill rig in the modeling assessment. In addition, the Jim Kilabuk re-supply vessel is also assumed to be considered adjacent to the drill rig. For the Jim Kilabuk, emissions from the two main engines and a generator are considered for modeling. The emissions from the Bow Thruster Diesel engine (propulsion engine) are not considered in the assessment since the propulsions engines will be used very briefly to maneuver the Kilabuk near the drill rig. For the project, maximum emissions of any pollutant for the propulsion engines on the Jim Kilabuk will be approximately 1.2 tons of NO_x per year and less than 0.1 tons per year of either PM_{10} or SO_2.

Figure 3 displays the configuration of the worst-case modeling scenario for the drill rig and associated support vessels.

Figure 3: Modeling Configuration for Drill Rig and Support Vessels



For the worst-case modeling scenario, the primary and secondary icebreakers are assumed to be operating in heavy ice, which results in maximum emissions from these vessels. The distance the icebreakers operate from the drill rig is variable based on the character of the ice, the drift rate of the ice, and the weather forecast / conditions. In general, the icebreakers will break ice directly upstream from the drill rig. The line directly upstream from the drill rig is called the drift line.

The primary icebreaker (Kapitan Dranitsyn) will range from approximately 5 km to 20 km upstream from the drill rig. The primary icebreaker will move back and forth perpendicular to the drift line approximately 5 km either side of the drift line to the rig. The secondary icebreaker will range from the buoy pattern of the drill rig up to 10 km upstream of the rig. The secondary icebreaker will move back and forth perpendicular to the drift line approximately 2.5 km either side of the drift line to the rig. Secondary ice management for the Frontier Discoverer will be performed by the Fennica / Nordica.

The icebreakers are constantly moving to break ice upstream of the drill rig. To account for the movement of the icebreakers, the sources were modeled as elevated area sources rather than point sources. Each icebreaker was initially modeled as a point source to account for mechanical and buoyant lift from the ship's stacks. The final plume rise for the icebreakers was determined, and the emissions from each icebreaker were then modeled as an elevated area source (based on the final plume heights) covering the ice management areas for each icebreaker.

For the support vessels, stack heights were estimated from photographs and ship diagrams. Other stack parameters were determined using ship-specific information, engineering judgment, and data for comparable sources. Emissions from each ship are assumed to be released to the atmosphere via a single stack.

The physical characteristics of the stacks on the support vessels are provided in Table 5. Photographs and diagrams of the support vessels are provided in Appendix A.

Table 5: Support Vessel Source Stack Parameters

Source Description	Model Source ID	Source Type	Ship Type	Release Ht.[1] (ft)	Release Ht.[1] (m)	Stack Dia. (ft)	Stack Dia. (m)	Exit Temp. (deg. F)	Exit Temp. (deg. K)	Exit Vel. (m/s)
Kapitan Dranitsyn [3, 4]	KAPITAN/KAP_BIG	Point/Area	Primary Icebreaker	115.0	35.05	1.05	0.32	482	523	41.5
Fennica/Nordica [3, 5]	FENNICA/FEN_SM	Point/Area	Secondary Icebreaker	105.0	32.00	0.87	0.27	572	573	36.0
Oil Response Ships - Discoverer [2]	KILABUK	Point	Oil Spill Response Fleet	50.0	15.24	0.60	0.18	800	700	40.0
Jim Kilabuk - Discoverer	KILABUK	Point	Re-supply Ship	50.0	15.24	0.60	0.18	800	700	40.0

[1] Absolute height above water.

[2] Assume same stack parameters as the Jim Kilabuk re-supply ship.

[3] These sources are constantly moving to break ice upstream of the drill rig. To account for movement of the vessels, the plume rise for each icebreaker was determined by modeling each ship as a point source. Then, the emissions for each icebreaker were modeled as an elevated area source (based on plume rise) covering the ice management area for each ship.

[4] Kapitan Dranitsyn ice management activity covers 150,000,000 sq. meters; final plume rise used for area source release height is 67.7 meters.

[5] Fennica/Nordica ice management activity covers 50,000,000 sq. meters; final plume rise used for area source release height is 60.9 meters.

4.2 Modeled Emissions

The modeling analysis conservatively considers all emission sources operating 24 hours per day and 45 days per year even though actual durations at a given drill site will be significantly less.

Tables 6, 7, and 8 present the modeled emissions for NO_x, PM_{10}, and SO_2, respectively.

Table 6: Modeled NO_x Emissions

				Emissions			
	#	Operations		Max. 1-Hour		Max. 24-Hour	Max. Annual
Source ID	Stacks	hr/day	hr/yr	(lb/hr)	(g/sec)	(g/sec)	(g/sec) [1]
Drill Rig: Frontier Discoverer							
Stack #1: 6 Main Drilling Engines	1	24	1,080	124.30	1.57E+01	1.57E+01	1.93E+00
Stack #2: 2 Air Compressors	1	24	1,080	6.58	8.29E-01	8.29E-01	1.02E-01
Stack #3: 2 HPP Engines [2]	1	24	1,080	35.65	4.49E+00	4.49E+00	5.54E-01
Stack #4: 2 Diesel Crane Engines	1	24	1,080	22.63	2.85E+00	2.85E+00	3.52E-01
Stack #5: 2 Heat Boilers	1	24	1,080	3.20	4.04E-01	4.04E-01	4.98E-02
Stack #6: 1 Logging Winch	1	24	1,080	4.34	5.47E-01	5.47E-01	6.74E-02
Support Vessels: Frontier Discoverer Fleet							
Kapitan Dranitsyn	1	24	1,080	699.77	8.82E+01	8.82E+01	1.09E+01
Fennica/Nordica	1	24	1,080	523.07	6.59E+01	6.59E+01	8.13E+00
Oil Response Ships - Discoverer	1	24	1,080	151.20	1.91E+01	1.91E+01	2.35E+00
Jim Kilabuk - Discoverer	1	24	1,080	181.85	2.29E+01	2.29E+01	2.82E+00

[1] Emission rate (in g/s) for annual periods is adjusted to account for a maximum of 45 days at each drill site.

[2] Also includes emissions from two cementing units.

Table 7: Modeled PM_{10} Emissions

Source ID	# Stacks	Operations hr/day	hr/yr	Emissions Max. 1-Hour (lb/hr)	(g/sec)	Max. 24-Hour (g/sec)	Max. Annual (g/sec) [1]
Drill Rig: Frontier Discoverer							
Stack #1: 6 Main Drilling Engines	1	24	1,080	3.91	4.92E-01	4.92E-01	6.07E-02
Stack #2: 2 Air Compressors	1	24	1,080	0.33	4.15E-02	4.15E-02	5.11E-03
Stack #3: 2 HPP Engines [2]	1	24	1,080	2.53	3.19E-01	3.19E-01	3.93E-02
Stack #4: 2 Diesel Crane Engines	1	24	1,080	1.61	2.02E-01	2.02E-01	2.49E-02
Stack #5: 2 Heat Boilers	1	24	1,080	0.37	4.72E-02	4.72E-02	5.82E-03
Stack #6: 1 Logging Winch	1	24	1,080	0.31	3.88E-02	3.88E-02	4.78E-03
Support Vessels: Frontier Discoverer Fleet							
Kapitan Dranitsyn	1	24	1,080	14.76	1.86+00	1.86E+00	2.29E-01
Fennica/Nordica	1	24	1,080	11.27	1.42E+00	1.42E+00	1.75E-01
Oil Response Ships - Discoverer	1	24	1,080	3.22	4.06E-01	4.06E-01	5.00E-02
Jim Kilabuk - Discoverer	1	24	1,080	3.53	4.45E-01	4.45E-01	5.48E-02

[1] Emission rate (in g/s) for annual periods is adjusted to account for a maximum of 45 days at each drill site

[2] Also includes emissions from two cementing units

Table 8: Modeled SO_2 Emissions

Source ID	# Stacks	Operations hr/day	hr/yr	Emissions Max. 1-Hour (lb/hr)	(g/sec)	Max. 24-Hour (g/sec)	Max. Annual (g/sec) [1]
Drill Rig: Frontier Discoverer							
Stack #1: 6 Main Drilling Engines	1	24	1,080	11.82	1.49E+00	1.49E+00	1.84E-01
Stack #2: 2 Air Compressors	1	24	1,080	1.54	1.94E-01	1.94E-01	2.39E-02
Stack #3: 2 HPP Engines [2]	1	24	1,080	1.77	2.23E-01	2.23E-01	2.75E-02
Stack #4: 2 Diesel Crane Engines	1	24	1,080	1.12	1.41E-01	1.41E-01	1.74E-02
Stack #5: 2 Heat Boilers	1	24	1,080	0.44	5.49E-02	5.49E-02	6.77E-03
Stack #6: 1 Logging Winch	1	24	1,080	0.22	2.71E-02	2.71E-02	3.34E-03
Support Vessels: Frontier Discoverer Fleet							
Kapitan Dranitsyn	1	24	1,080	45.32	5.71E+00	5.71E+00	7.04E-01
Fennica/Nordica	1	24	1,080	34.74	4.38E+00	4.38E+00	5.40E-01
Oil Response Ships - Discoverer	1	24	1,080	15.30	1.93E+00	1.93E+00	2.38E-01
Jim Kilabuk - Discoverer	1	24	1,080	11.52	1.45E+00	1.45E+00	1.79E-01

[1] Emission rate (in g/s) for annual periods is adjusted to account for a maximum of 45 days at each drill site.

[2] Also includes emissions from two cementing units.

4.3 Model Selection

After research into the availability of meteorological data for use in modeling, it was determined that representative meteorological data meeting U.S. EPA's requirements is not available for the project location. This issue was discussed with both ADEC and the EPA. On March 30, 2006, the EPA approved the use of the SCREEN3 model for the project. SCREEN3 is a U.S. EPA-approved model, which incorporates worst-case assumptions. As a result, modeled impacts using SCREEN3 are expected to overestimate real-world impacts from the project.

For this analysis, the most recent version of the SCREEN3 model (version 96043) was used. SCREEN3 is a steady-state, single-source, Gaussian dispersion model developed to provide an easy–to-use method of obtaining pollutant concentration estimates. SCREEN3 is a U.S EPA-approved screening model for estimating impacts at receptors located in simple terrain and complex terrain due to emissions from simple sources. The model is capable of calculating downwind ground-level concentrations due to point, area, and volume sources. In addition, SCREEN3 incorporates algorithms for the simulation of aerodynamic downwash induced by buildings. The model utilizes a range of worst-case meteorological data rather than using site-specific meteorological conditions.

4.4 Meteorological Data

For this analysis, SCREEN3's full array of screening meteorological data was used. Screening meteorological data are the meteorological categories listed in U.S. EPA's "SCREEN3 Model User's Guide" (EPA-454/B-95-004) and as shown in Table 9. A total of 36 wind directions, at 10-degree intervals, are used. Thus, the screening meteorological file contains all combinations of meteorological conditions and wind directions. This meteorological data considers theoretical worst-case conditions regardless if these conditions will actually occur at the project locations.

Table 9: Wind Speed and Stability Class Combinations Used by the SCREEN3 Model

	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	*	*	*	*	*	*	*						

Based on a review of the meteorological data in the vicinity of the project location, an ambient temperature of 273 K was utilized. This temperature is more representative of the project location and duration than SCREEN3's default ambient temperature of 293 K.

4.5 Background Concentrations

When comparing a project's impact to the ambient air quality standards, an ambient background concentration is needed. For the project, ADEC recommended ambient background concentrations from BP's Arctic North Slope Eastern Region (ANSER) monitoring program, which took place east of BP's Badami facility in 1999. The data is considered representative of the SOI project locations and has been reviewed and approved by ADEC. ADEC considers this data the best available regional data set for a North Slope project located 10 to 20 km or further offshore. Table 10 presents the background concentrations for use in the modeling analysis.

Table 10: Background Concentrations

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)
NO_2	Annual	3.0
PM_{10}	24-hour	7.9
	Annual	1.8
SO_2	3-hour	9.8
	24-hour	7.2
	Annual	2.6

ADEC was also consulted regarding existing industrial sources in the vicinity of the project. Because of the remote offshore location of the project, impacts from other sources are anticipated to be insignificant and are not included in the modeling assessment.

4.6 Evaluation Methodology

The SCREEN3 model can only be used to predict maximum 1-hour concentrations from a single source. When screening models are utilized for multiple sources, it is necessary to model each source separately and then add maximum impacts from each model run to determine an overall impact value. Results utilizing this methodology are expected to be conservative since the maximum impacts from each modeled source (regardless of different impact locations at different times) are summed together for a total impact value from a facility.

Conversion factors, also referred to as persistence factors, are needed to convert maximum 1-hour values to other averaging periods of concern. Table 11 presents the U.S. EPA's recommended conversion factors for SCREEN3.

Table 11: Conversion Factors for Screen3 Modeling

	Desired Averaging Period						
Model Output	1-hr	3-hr	8-hr	24-hr	Month	Quarter	Annual
Simple Terrain	1	0.9	0.7	0.4	0.18	0.13	0.08

The maximum short-term emissions (i.e., maximum hourly and maximum daily emissions) from the project were compared to the short-term ambient air quality standards. Annual impacts consider the totality of emissions over a 45-day project duration. Because emissions used in the analysis are based on a 45-day operating period, the annual emissions from the project are distributed over 45 days (rather than 365) and a factor of 0.1233 (45 days / 365 days) is applied to annualize the subsequent impacts.

SCREEN3 modeling was performed using a methodology referred to as X/Q, which assumes that concentration impacts (X) are proportional to the emissions (Q) from a source. Under this approach, each collocated source was modeled with a 1 gram/second emission rate. The resulting X/Q impacts were converted to appropriate averaging times using the factors in Table 9 and then multiplied by the actual emission rate of each pollutant to determine a modeled impact.

Flat terrain and rural dispersion coefficients were used in the modeling analysis. For the SCREEN3 modeling analysis, it was assumed that the ambient air boundary for the Frontier Discoverer is a 500-meter safety exclusion zone measured from the side of the Frontier Discoverer. SOI expects to obtain a 500-meter radius Safety Exclusion Zone (SEZ) from the United States Coast Guard by March or April 2007. A copy of the SEZ Application will be submitted to EPA under a separate cover. SOI will implement institutional controls to maintain the SEZ. Such controls will include buoys marking the SEZ and anchor chains, and using shipboard and on-shore communication systems and support vessels to patrol the SEZ to keep unauthorized persons at a safe distance away from the Frontier Discoverer drilling vessel.

The calculations and modeled impacts associated with this modeling analysis are provided in Appendix E.

4.7 Modeling Results

Table 12 summarizes the results of the SCREEN3 modeling analysis. Based on the modeling analysis results in Table 12, the predicted impacts from the SOI project comply with the National Ambient Air Quality Standards.

Table 12: Modeling Analysis Results

Pollutant	Averaging Period	Concentration (µg / m³) Max. Discoverer	Max. Vessels	Background	Total	NAAQS (µg / m³)	Comply?
NO_2 [A]	Annual	19.5	18.4	3.0	40.9	100	Yes
PM_{10}	24-hour	69.1	20.2	7.9	97.2	150	Yes
	Annual	1.7	0.5	1.8	4.0	50	Yes
SO_2	3-hour	163.1	179.0	9.8	352.0	1,300	Yes
	24-hour	72.5	79.6	7.2	159.3	365	Yes
	Annual	1.8	2.0	2.6	6.4	80	Yes

[A] Assume that all NO_2 = NOx * 0.75

APPENDIX A

Drawings and Photographs

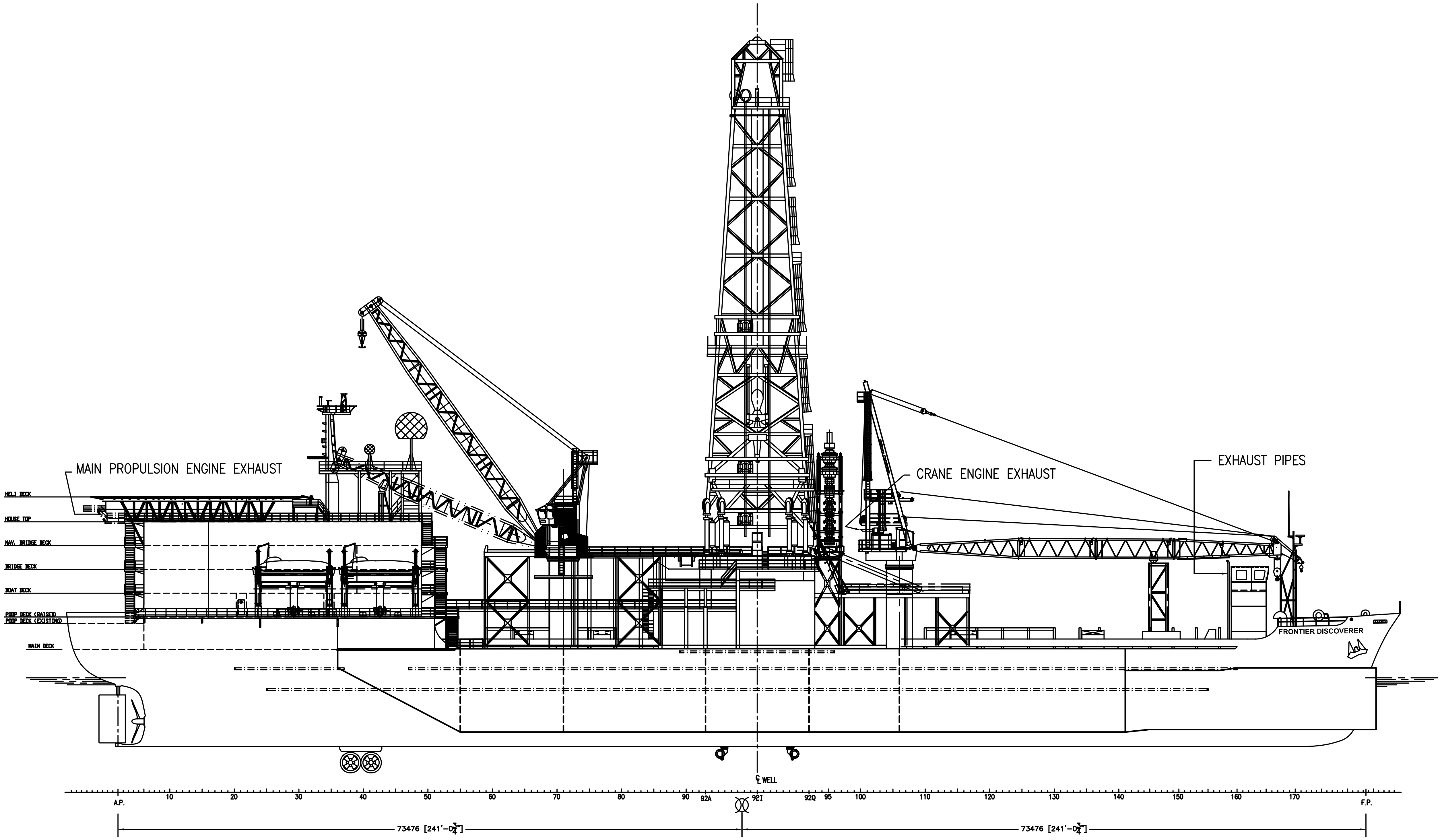
Frontier Discoverer

Kapitan Dranitsyn

Fennica/Nordica

Jim Kilabuk

Supporting Information – Frontier Discoverer



OUTBOARD PROFILE

DRAWING №	DRAWING TITLE
REFERENCE DRAWINGS	

THIRD ANGLE PROJECTION UNLESS OTHERWISE NOTED

NOTES:

REV.	DATE	REVISION DESCRIPTION	DRAWN BY	CHECKED BY	CONTRACTOR APPROVAL	FRONTIER APPROVAL

"CONFIDENTIAL"

FRONTIER DRILLING ASA
DIS-L-103-SK002

SHEET NO. 001
TOTAL SHEETS 002
REV. P

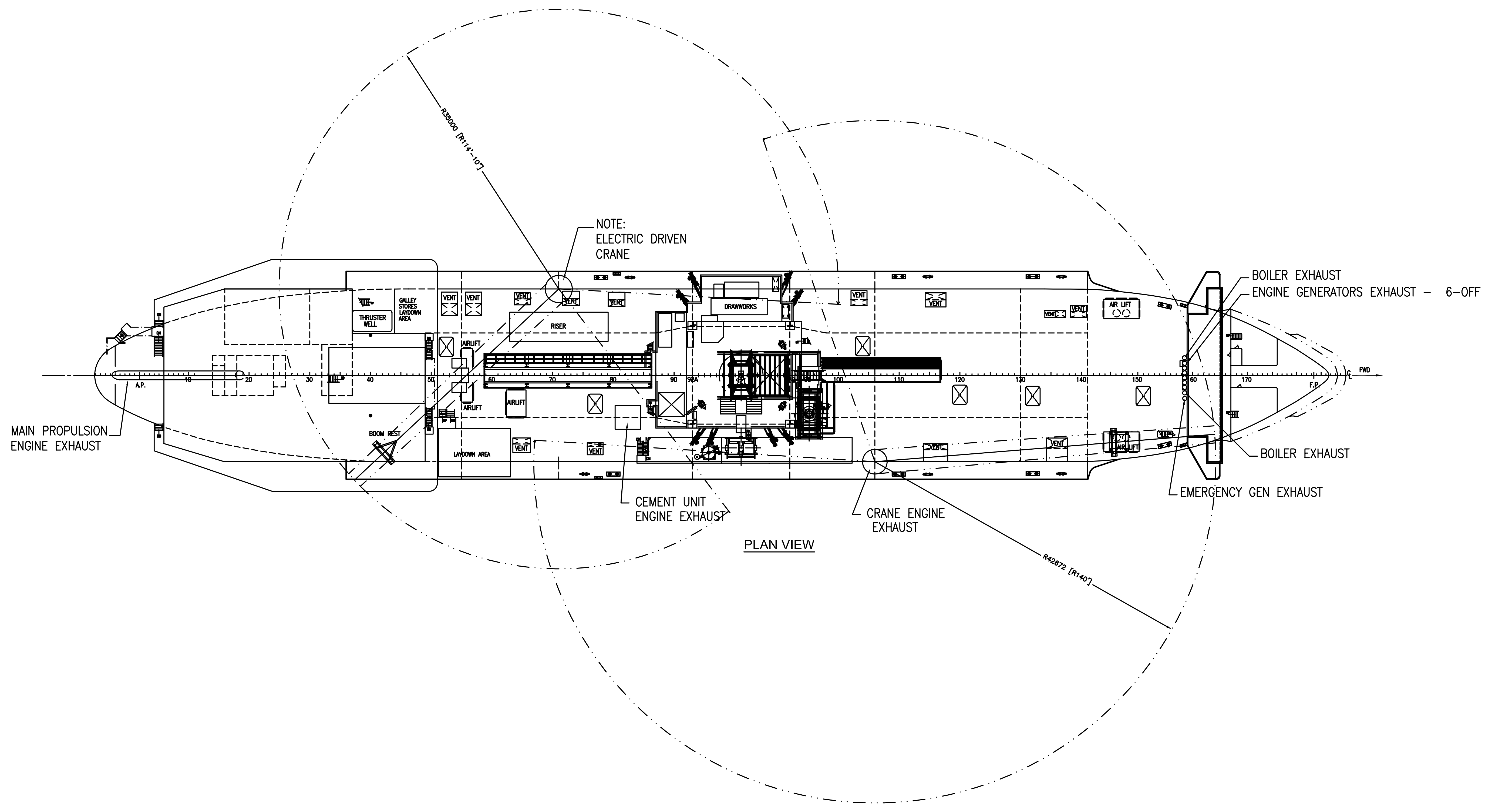
FRONTIER DRILLING ASA
1000 LOUISIANA
HOUSTON, TEXAS 77002 USA

DOCUMENT CLASS K2

FRONTIER DISCOVERER

TITLE
VESSEL EMISSION STUDY
PROFILE

SCALE	CONTRACTOR'S PROJECT/ORDER N	CONTRACTOR'S DRAWING №	REV.
1:250	P26991	L-103-SK002	P



PLAN VIEW

"CONFIDENTIAL"

FRONTIER DRILLING ASA	DIS-L-103-SK002	SHEET NO. 002 / TOTAL SHEETS 002	REV. P

FRONTIER DRILLING ASA
1000 LOUISIANA
HOUSTON, TEXAS 77002 USA

DOCUMENT CLASS: K2

FRONTIER DISCOVERER

TITLE: VESSEL EMISSION STUDY PLAN VIEW

SCALE	CONTRACTOR'S PROJECT/ORDER N	CONTRACTOR'S DRAWING №	REV.
1:250	P26991	L-103-SK002	P

REV.	DATE	REVISION DESCRIPTION	DRAWN BY	CHECKED BY	CONTRACTOR APPROVAL	FRONTIER APPROVAL

NOTES:

THIRD ANGLE PROJECTION UNLESS OTHERWISE NOTED

DRAWING №	DRAWING TITLE

REFERENCE DRAWINGS

DRILL SHIP FRONTIER DISCOVERER

PARTICULARS		
NAME	FRONTIER DISCOVERER	
FORMERLY	Discoverer 511	
REGISTRATION	Repub lic of Panama	
YEAR BUILT	Converted 1976	
DESIGN	Sonat Offshore Drilling Discoverer Class, Turret Moored w/ thrusters	
CLASSIFICATION	ABS A1, E, M, Drilling Unit AMS	

PRINCIPLE DIMENSIONS		
LENGTH	514.1´	156.7 m
BREADTH (mld)	70.9´	21.6 m
DEPTH (mld @ CL)	38.1´	11.6 m
MAX HEIGHT ABOVE KEEL	273.0´	83.2 m
RKB TO SEA LEVEL	45.9´	14.0 m
MOONPOOL (D)	22.0´	6.7 m
HELIDECK	74.0´ x 65.5´	Rated for S-61

DRAU		
AT LOADLINE	26.9´	8.2m
TRANSIT DRAFT	26.3´	8.0m
DISPLACEMENT FULL LOAD		19,885 mt

CAPACITIES		
ACCOMMODATION		120 Beds + 2 Hospital b eds, all Air Conditioned
VARIABLE LOAD		9,063 mt
LIQUID MUD 100%	2,000 b b ls	318 m^3
BULK MUD	6,400 f3	181 m^3
BULK CEMENT	6,400 f3	181 m^3
SACK STORAGE		4,250 f3
DRILL WATER (AFT PEAK INCL)	8,000 b b ls	1272 m^3
POTABLE WATER	1,670 b b ls	266 m^3
FUEL	8,255 b b ls	1313 m^3
HELI-FUEL		1000 gallons

RIG POWER	
MAIN POWER	6 x Caterpillar D-399 1325 HP
POWER DISTRIBUTION	6 x Ross Hill 1600 SCR Modules rated at 1650 amps 750 VDC
EMERGENCY POWER	1 X Caterpillar 3304 TD

O.P.		
WATER DEPTH	Min : 125 ´ Actual : 1000 ´ Upgrade : 2,000 ´	Min : 38 m Actual : 305 m Upgrade : 610 m
DRILLING DEPTH	20,000´	6096m
TRANSIT SPEED		10.0 knots approximate

MISC.	
LIFE BOATS	2 x 66 man Watercraft
LIFE RAFTS	Capacity for 141 persons
CRANES	3 x Houston Systems, 25 tons
SEWAGE PLANT	Demco WT-7000

DRILLING EQUIPMENT		
	DERRICK	Pyramid 170´ x 40´ x 40´ GNC 1,330,000 pounds
	DRAW WORKS	Ideco E2100, 2,000HP with 2 x GE752 electric motors
	AUXILIARY BRAKE	Baylor Model 7838
	CROWN BLOCK	Pyramid, 9 x 60" sheaves for 1-1/2" drill line rated to 1,330,000 pounds
	TRAVELING BLOCK	Continental Emsco MA60-6, 600 tons rating with 6 x 60" sheaves for 1-1/2" drill line
	HOOK	BJ 550 Dynaplex, 500 tons rating
	ROTARY TABLE	National C-495, 49-1/2", with GE752 electric motor
	MOTION COMPENSATOR:	Houston Drilling Systems 20´ stroke, (6.1m) rated to 400,000 lb s working capacity, 1,200,000 static capacity
	TOP DRIVE	Varco TDS-3
	DRILL PIPE HANDLING	Byron Jackson 3 arm racking system
	MUD PUMPS	2 x Continental Emsco FA1600 each with 2 x GE 752 electric motors c/w 5 x 6 centrifugal charging pumps
	SCALPING SHAKERS	2 x Brandt Dual Tandem
	SHALE SHAKERS	4 x Derrick Model 48 Flo-line Cleaner
	DEGASSER	Swaco vacuum
	MUD CLEANERS	2 x Sweco 48 – 8 x 4" cones
	MANUAL DEGASSER	Upright type with 6" crown vent line
	INSTRUMENTATION	Martin Decker & Geolograph - 8 pens

TUBULARS		
	PIPE RACK CAPACITY:	708 m^2 for b oth rig and client
	PIPE RACK LOADING	5,370 kg/m^2
	DRILL PIPE	5" Grade S-135
	HEAVY WEIGHT DP	5" OD
	DRILL COLLARS	DC Dimensions : 9-½", 8", 6-½"

SUBSEA EQUIPMENT		
	DIVERTER	Regan KFDS
	BOP EQUIPMENT	2 x 18-¾" 10K Cameron Doub le U
		2 x 18-¾" 5K Hydril GL Annular
		2 X 18-¾" Vetco H-4 Connectors
		1 x 18-¾" Regan CR-1 5K Ball Joint
	BOP CONTROL	Stewart & Stevenson control unit, 400 gallon, 2 x triplex pumps 20 GPM at 3,000 psi
	C & K MANIFOLD	Cameron 3-1/8" with 2 x manual and 1 x Sweco auto chokes
	MARINE RISER	National and Vetco MR6C
		1 x Vetco Telescopic Joint, and 1 x National Telescopic Joint
	RISER TENSIONING	8 x Houston Systems each with 80,000 pounds capacity – 50´ line travel
	G/L TENSIONING	4 x Houston Systems each with 16,000 pounds capacity – 40´ line travel

PROPULSION AND MOORING		
	PROPULSION ENGINE:	UBE Mitsub ishi UEC Marine Diesel 7,200 HP @135 RPM
	MOORING PATTERN	8 point from mid-ships rotating turret
	MOORING WINCHES	Smatco Model 90-HTD-150
	MOORING LINES	Chain - Wire comb ination
	ANCHOR CHAIN	8 each Approx. 1,000´ x 2-1/2" Grade 3
	WIRE LINES	Approx. 2,500´ x 2-3/4" 6 x 36 IWRC
	FAIRLEADS	8 x Skagit, vertically mounted
	ANCHORS	8 x LWT 30,000 pounds
	BUOYS	8
	PENDENT WIRE	2-¼", 6 x 36 per water depth req uirement
	INSTRUMENTATION	Martin-Decker tension recorders

Supporting Information - Kapitan Dranitsyn

Description of the Vessel

"KAPITAN DRANITSYN"

1. General

a) Owner Name: JS Murmansk Shipping Company, Russia
b) Owner Address: 15, Kominterna street, 183038, Murmansk, Russia
c) Operator Name: as above
d) Operator Address: as above
e) Vessel Name : “Kapitan Dranitsyn”
f) Builder: "Wartsila" shipyard, Helsinki, Finland
g) Where Built:
h) Year Built: 1980
i) Type: Icebreaker/passenger
j) Classification: Icebreaker (КМ ЛЛ7), passenger class
k) Classification Society: RUSSIAN MARITIME REGISTER OF SHIPPING
l) Flag : RUSSIA
m) Date of next scheduled docking: may 2006

2. Performance

a) Certified Bollard Pull: 120 tn
b) Maximum Speed (non-towing in fair weather): about 18,5 knt
c) Fuel Consumption at Maximum Speed: IFO30- 103 mt + MGO- 7 mt
d) Service Speed on two engines (non-towing in fair weather): abt 12,0 knt
e) Fuel Consumption at Service Speed: IFO30- 28,0 mt + MGO- 7 mt
f) Fuel Consumption for 1 engine (at 70% load): n/a
g) Fuel Consumption at port: IFO30- 5 mt + MGO- 3 mt
h) Approx. Towing/Heavy ice condition (engine power at 100%): 110 mt + 7 mt
i) Types & Grades of fuel used: IFO30/RMA10 and MDO/DMB All according to ISO 8217 1996(E). To ensure work of ME and ADG when starting and stopping and to ensure work of emergency DG aboard motor vessel the supplies of diesel oil (gasoil DMA) are provided in amount of 5% of fuel oil demand without of daily consumption extension.
j) Maximum Endurance (days): 29

k) LOA: 132,4 m
l) Beam: 26,5 m
m) Draft: 8,5 m
n) Keel to Masthead: 48,7 m
o) Masthead Height: n/a
p) Deadweight: 4515 t
q) Liquid Cargo Capacity: none
r) Fuel Delivery Capacity: 2950 mt IFO30/ 600 mt MDO
s) Cargo Pump Type: Nil
t) Cargo Pumping Rate & Pressure: Nil
u) Fuel Pump Type: ACF 100 – 3 N3F x 2
v) Fuel Pumping Rate & Pressure: 72m^3 / 3-4 kg/cm^2
w) Fresh Water Capacity: 466 mt
x) Fresh Water Pump Type: KLHP - 70
y) Fresh Water Pumping Rate & Pressure: 50 m^3/2,5 kg/cm^2
z) Oil Spill Recovery Tank Capacity: 81.00 m^3 + 352 m^3 + 78,9 m^3
aa) Cargo Deck Area (aft): Helicopter hangar with L/B/H 11.5/5.5/4.0 mtrs
bb) Cargo Deck strength (helicopter deck): 2,5 mt/sq.m
cc) Icebreaking capability: 1,5 m no jam ice in the continuous mode.

3. Machinery

a) BHP of Main Engines: 6x4140 Hp
b) Engine Builder: WARTSILA ZULTZER
c) Number of Engines & type: 6 Pcs Type 9ZL 40/48
d) Generators: HSSUL and YSPTL
e) Generator Builder: STROMBERG
f) Number of Generators & type: 6 pcs HSSUL 18/1057 D1; 5 pcs YSPTL 11/554 B16
g) Generator Capacity: HSSUL – 3800 Kwt; YSPTL – 1025 Kwt
h) Bow Thruster – Manufacturer: nil
i) Bow thruster rating (tons): nil
j) Stern Thruster – Manufacturer: nil
k) Stern thruster rating (tons): nil
l) Propellers / Rudders type: 3 fixed pitch screws, 4,3 m in diameter with 4 steel vanes of hardened steel. Max. speed of rotation 185 o\min.
m) Propellers / Rudders Manufacturer: Russia – Finland
n) Number & Pressure rating of air compressors: 2 pcs WP 370-30 kg/cm^2; 1 pc EK-16-2 8 kg/cm^2; 1pc WP – 25L100 – 35 kg/cm^2
o) Fuel Oil Metering system – Type & Manufacturer: KONTRAM
p) Pusher bow capable: nil
q) Water Makers Type of system installed: D 5U x 2 pcs; Osmos – RORO 3560 1 pcs
r) Water Maker Manufacturer: Russia; Germany
s) Total Daily Water Making Capacity: 40 m^3
t) Daily water consumption: 10-20 m^3

4. Towing & Anchor Handling Equipment

a) Stern Roller Dimension: Diam. 500 mm
b) Stern Roller SWL: 120 tn.
c) c) Towing Winch Manufacturer: RAUMA-REPOLA HV 60E-1 J
d) Winch Locations: stern towing winch accommodation
e) Drum Capacity: 500 m.
f) Brake Holding Capacity: 130 tn.
g) Bollard Pull: 120 tn
h) Towing Wires Construction: standard seal-Warrington
i) Towing Wire Diameters: 60 mm

j) Wire End Termination Details: LOOP
k) Spare Towing Wire Details: 240 m 60 mm
l) Tugger Winch Manufacturer: Nil
m) Winch Locations: - stern
n) Drum Capacity: - pls clarify
o) SWL: - pls clarify
p) Work Wires Construction: - pls clarify
q) Work Wires Diameter: - pls clarify
r) Work Wires & Termination Details: - pls clarify
s) Spare Working wire details: - pls clarify
t) Other Anchor Handling Equipment Details: Anchor "Holla" 3 pcs (1 spare)
u) Sharks Jaws SWL: pls clarify
v) Sharks Jaws Maximum Operational diameter: 63 mm pls clarify
w) Sharks Jaws Minimum Operational diameter: 63 mm pls clarify
x) Sharks Jaws Remote Operating Location: Forecast pls clarify
y) Towing Pins SWL: pls clarify
z) Towing Pins Maximum Operational diameter: pls clarify
aa) Towing Pins Minimum Operational diameter: pls clarify
bb) Remote Operating Location: Stern towing room

5. Deck Crane for Cargo Hose Handling - NIL

a) Crane SWL: bow port 2,4 tn: bow strbd 3,0 tn: helicopter deck port 10 tn
b) Crane reach & SWL Limitation details: bow 2,8-12,5 m: helicopter deck 3,2-16 m
c) Crane Location: 2 bow port/strbd: 1 helicopter deck port

6. Communication & Navigational Equipment

a) Single Joystick control & automatic heading control installed: No
b) GMDSS system installed: Yes
c) GMDSS System details and supporting equipment information: Skanti Combibridge 9250
d) TRP-9000 HF SSB: DSC-9000 MF/HF DSC: DSC 3000 VHF DSC
e) VHF marine band radio installed: Yes
f) VHF Locations: bridre port/strbd
g) Radar installation details: bridge port/strbd
h) Radar operating band: X-band S-band
i) Radar Maximum Range: 96 nm
j) Identification Radar transponder Installed: No
k) Radar operating bands: VHF – see point g)
l) Echo Sounder Installed: Yes
m) Gyrocompass installed: Yes
n) Gyro Type: KURS-4 x 2 pcs: VEGA 1 pcs
o) Number of independent systems: (Gyros ?) 3
p) Can Vessel send & receive email massages: Yes
q) Can vessel send & receive fax massage: Yes
r) Has the vessel got an auto pilot installation: Yes
s) Details of Electronic Navigational Equipment Installed: GPS FURUNO GP 80: MAGNAVOX MX 200: SHIPMATE RS 5300

7. Fire Fighting Equipment

a) Class (FiFi 1, FiFi 2 or FiFi 3):
b) Number of Fixed Fire Monitors: 2 pcs
c) Location of Fixed fire monitors: Bridge, watch room

d) Number of portable fire monitors: NIL
e) Foam tank Capacity: 7,5 cub.m
f) Engine room fire fighting system details: CO2 - 2790 kg

8. Accommodation Details

a) Crew + staff Berths: 72
b) Normal Total Complement: ?
c) Passenger Berths: 120
d) Total persons on board: 192

9. Gallery

a) Freezer Space: 124 cub. m
b) Cooler Room Space: 353 cub. m

10. Pollution Response Materials and Equipment

a) Oil Dispersant Type: none
b) Oil Spill Dispersant tank capacity: none
c) Spray Equipment: none
d) Spray Booms: none
e) Skimmer Units: none
f) Pumps: none
g) Manifolds: none
h) Nozzles: none

11. Miscellaneous

a) Rescue & Stand by capability for 24-hour continuous operations: Yes
b) Oil spill drip tray and oil containment system installed to prevent pollution during hose breaking operations: No
c) Location and details of oil spill containment system for hose breaking operations: no
d) Addition storage space available 500M of floating oil spill recovery boom and skimmer units: No
e) Crew trained and capable of deployment of the oil spill recovery boom in 10 minutes: No
f) Vessel capable of supporting Diving and ROV maintenance work from the support vessel: No
g) Brief details of diving support and ROV capability: NIL
h) Vessel bunker consumption figures at sea provided of the absence of coming current and good weather conditions, i.e. winds maximum Beaufort force 3 (max 12 knots) and not exceeding Douglass Sea state 2.

ALL ABOVE DETAILS GIVEN FOR GOOD ORDER AND IN ACCORDANCE WITH BUILDING PLANS BUT ABOUT AND WOG.

12. Vessel Management and Operation

Vessel shall be managed and operated during the Charter Term By:

JSC MURMANSK SHIPPING COMPANY (DU), acting as manager of state owned icebreakers, registered at 15 Kominterna Street, Murmansk, 183038, Russia.

Supporting Information – Fennica/Nordica

Powerful, high-tech, multipurpose vessels for global underwater oil field construction

Designed for the management, maintenance and service of offshore oil wells, the 97-metre Botnica is a multipurpose vessel specialised in marine construction and icebreaking, as are the 116-metre vessels Fennica and Nordica. They are equipped with diesel-electric propulsion systems and their innovative combination of capabilities, based on extensive design and engineering work, facilitates their use in both arctic and tropical conditions. All three of these multipurpose vessels are highly advanced, powerful and extremely well designed and built.

Unique technology for demanding conditions

These vessels are ideal for offshore operations. The working deck is about 1,000 m^2, making it exceptionally large and level for ships of this length. The deck was designed for fast equipment changes. Depending on the ship, such equipment may range from simple deck cranes to a 160-tonne pedestal active heave compensated crane, or from deepwater installation equipment to pipe-laying systems, underwater machinery control or the towing and installation of large pipelines.

With their 15,000 kW power output and 230-tonne bollard pull, the Nordica and the Fennica are ideal for seabed ploughing and towing, and they are also fully equipped for anchor-handling operations. The ships' main engine and generator solution makes it possible to perform heavy-duty maintenance tasks without affecting their operating ability.

Both the Fennica and the Nordica are also equipped with a stern roller.

Accurate, safe and highly suitable

The Botnica's moon pool and the large size of its working deck make this ship highly suitable for a variety of offshore operations. Different types of special tools and structures can be installed on the working deck. The attributes of the Botnica, a class 3 DP ship, are in keeping with the strict rules and stipulations demanded in oil well management, as well as the requirements on oil fields set by the Norwegian Maritime Directorate.

The multipurpose icebreakers are equipped with Kongsberg Simrad's Dynamic Positioning (DP) system, which has five independent control units operating their main propellers and three bow thrusters. Even in a sector in which ocean vessels equipped with DP systems are a normal sight, these vessels have performed their tasks exceptionally well in terms of manoeuvrability and accuracy. Their unusual asymmetrical and spacious navigation bridge was designed with an eye to the requirements placed on the ship's multiple applications, both on the open sea and in icebreaking and towing operations.

The vessels have a separate deck for the clients' use, with cabins and offices and a separate data network. The high quality facilities accommodate a total of 45-47 guests, depending on the ship.

Fennica

Dimensions

Length	116.00 m
Beam	26.00 m
Draught	8.40 m max.
Built	1993
Max. speed	16 knots

Class
DnV + 1A1 – Tug Supply Vessel – SF – EO – Icebreaker polar – 10, Dynpos, AUTR, Helideck

Dynpos
Simrad ADP 702

Accommodation
82 persons
24 cabins for client use (47 persons)
Client's offices: 1 operation centre on 4th bridge deck, 1 x 20 m^2 office

Helideck
Superpuma or similar

Deck
Working deck area 1090 m^2
Anchor handling/winch
Aquamaster TAW 3000/3000 E

Machinery
Main engines
2 x Wärtsilä Diesel, Vasa 16V 32, each 6000 kW
2 x Wärtsilä Diesel, Vasa 12V 32, each 4500 kW
Generators
ABB Strömberg Drives
2 x HSG 1120 MP8, power 8.314 kVA, Volt 6.3 KV, speed750 rpm
2 x HSG 900 LR8, power 6.235 kVA, Volt 6.3 KV, speed 750 rpm
Propellers
2 x HSSOL 18/1654, output 7.500 kW each, ABB Strömberg Drives
2x Aquamater-Rauma US ARC 1, 7500 kW each,
FP propellers, variable RPM
Bow thrusters
3 x Brunvoll FV-80 LTC-2250, VP propellers 1.050 kW each

Bollard pull 234 tons

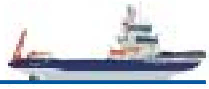
Crane(s) (optional)

Stb	30 tons/38 metre jib
Port	15 tons
A-frame	120 tons

Navigation Equipment
Robertson ECDIS Navigation System
Doppler speed log
Loran C
GPS
Fiber optic gyros
Differential GPS Gyro.
Navintra Ecdis
Direction finder
Echo sounder
Facsimile recorder

Communication Equipment
1 x Skanti TRP 8400D MF/HF SSB, including all GMDSS requirements
1 x Watch receiver
1 x Aero VHF. Helicopter communication
6 x VHF
1 x Navtex receiver
1 x Inmarsat B satellite comm. system
VSAT online satellite comm. system
3 x UHF walkie-talkie
3 x VHF walkie-talkie
2 x Freefloat EPRIB, 121,5 and 406 MHz
2 x Distress transponders, 96 Hz
Call signal OJAD

Nordica



Dimensions

Length	116.00 m
Beam	26.00 m
Draught	8.40 m max.
Built	1994
Max. speed	16 knots

Class
DnV + 1A1 – Tug Supply Vessel – SF – EO – Icebreaker polar – 10, Dynpos, AUTR, Helideck

Dynpos
Simrad ADP 702

Accommodation
82 persons
24 cabins for client use (47 persons)
Client's offices: 1 operation centre on 4th bridge deck, 1 x 20 m^2 office

Helideck
Superpuma or similar

Deck
Working deck area 1090 m^2
Anchor handling/towing winch
Aquamaster TAW 3000/3000 E

Machinery
Main engines
2 x Wärtsilä Diesel, Vasa 16V 32, each 6000 kW
2 x Wärtsilä Diesel, Vasa 12V 32, each 4500 kW
Generators
ABB Strömberg Drives
2 x HSG 1120 MP8, power 8.314 kVA, Volt 6.3 KV, speed750 rpm
2 x HSG 900 LR8, power 6.235 kVA, Volt 6.3 KV, speed 750 rpm
Propellers
2 x HSSOL 18/1654, output 7.500 kW each, ABB Strömberg Drives
2x Aquamater-Rauma US ARC 1, 7500 kW each,
FP propellers, variable RPM
Bow thrusters
3 x Brunvoll FV-80 LTC-2250, VP propellers 1.050 kW each

Bollard pull 234 tons

Main crane (optional)

Lifting capacity	160 T/9 m 30 T/32 m
Main winch	Active Heave Compensated Constant Tension
Heave amplitude	+ 3,5 m double part + 7 m single part
Operating depth	500 m–160 T (double part) 1000 m–80 T (single part)
Aux winch	10 T, 33 m, Constant Tension
Tugger winches	2 x 4 T Constant Tension
Port	15 tons

A-frame (optional) 120 tons

Navigation Equipment
Navintra ECDIS Navigation System
Doppler speed log
Loran C
GPS
Fiber Optic Gyros
Differential GPS Gyro.
Direction finder
Echo sounder
Facsimile recorder

Communication Equipment
1 x Skanti TRP 8400D MF/HF SSB, including all GMDSS requirements
1 x Watch receiver
1 x Aero VHF. Helicopter communication
6 x VHF
1 x Navtex receiver
1 x Inmarsat B satellite comm. system
VSAT online satellite comm. system
3 x UHF walkie-talkie
3 x VHF walkie-talkie
2 x Freefloat EPRIB, 121,5 and 406 MHz
2 x Distress transponders, 96 Hz
Call signal OJAE

Botnica

Dimensions

Length	96.70 m
Beam	24.00 m
Draught	7.2 to 8.5 m
Built	1998
Max. speed	15 knots

Class
DnV + 1A1 – Supply Vessel – SF – EO – Icebreaker Ice – 10,
Dynpos AUTRO, RPS
NMD Mobile offshore Units, DP UNIT, with equipment class 3

Dynpos
Simrad SDP22 + SDP12 backup
2 x HIPAP combined SSBL/MULBL hydroacoustic system
2 x Seatex DPS DGPS combined GPS/Glonass

Accommodation
72 persons
24 cabins for client use (45 pers.)
2 x client's office

Helideck
Superpuma or similar

Deck
Working deck area 1000 m^2

Machinery
Main engines
12 x Caterpillar 3512B, 1257 kW, 1500 rpm
Main generators
6 x ABB-AMG 560, 2850 kVA, 3,3 kV 3 N, 50 Hz
Emergency generators
1 x Caterpillar 3406, 200 kW, 400 V, 3 N, 50 Hz
Main propulsion
Stern 2 x 5000 kW Azipod, FP
Bow thrusters
3 x Brunvol tunnel, variable pitch á 1150 kW

Bollard pull 117 tons

Crane(s) (optional)
1 x Hydralift, 160 tons
1 x 15 tons

Main cranes

Lifting capacity	160 T/9 m 30 T/32 m
Main winch	Active Heave Compensated Constant Tension
Heave amplitude	+ 4 m double part + 8 m single part
Operating Depth	550 m–160 T (double part) 1100 m– 80 (single part)
Aux winch	10 T, 33 m, Constant Tension

Moonpool 6.5 x 6.5 metres

Navigation and communication equipment
GMDSS
Inmarsat B
VSAT online satellite comm. system
Call signal OJAK

FINSTASHIP

Shipping Enterprise
Valimotie 16
FI-00380 Helsinki, Finland
Phone +358 30 620 7000, fax +358 30 620 7030
e-mail: shipping@finstaship.fi
www.finstaship.fi

GDV Maritime AS
Brygga Næringssenter
Vikaveien 31, N-4817 His, Norway
Phone +47 3701 2260, fax +47 3701 2862
e-mail: maritime@gdv.no
www.gdv.no

APPENDIX B

Emission Calculations

AIR SCIENCES INC. DENVER • PORTLAND	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 1 OF 3 / SHEET 1
		SUBJECT: Emissions Summary	DATE: 12/21/2006

Discoverer Rig and Associated Vessels

EMISSIONS SUMMARY @ EXPECTED MAXIMUM

	Yearly Emissions at any location				
	NOx	CO	PM10	VOC	SO2
Rig / Vessel	tons	tons	tons	tons	tons
Discoverer Rig	51.8	6.7	1.7	0.9	4.7
Kapitan Dranitsyn	107.6	37.1	3.4	7.3	7.1
Fennica/Nordica	80.5	2.9	1.7	2.8	5.4
Jim Kilabuk (resupply vessel)	1.2	0.3	0.0	0.1	0.1
Discoverer's OSR Fleet	3.9	1.0	0.1	0.8	0.4
	245.0	47.9	7.0	11.8	17.7

Each Source

Discoverer Rig			Yearly Emissions at any location				
	Rated Capacity		NOx	CO	PM10	VOC	SO2
			tons	tons	tons	tons	tons
Drilling Engine Cat. 399	1,282	Hp	7.51	0.83	0.24	0.07	0.71
Drilling Engine Cat. 399	1,282	Hp	7.51	0.83	0.24	0.07	0.71
Drilling Engine Cat. 399	1,282	Hp	7.46	0.82	0.23	0.07	0.71
Drilling Engine Cat. 399	1,282	Hp	7.46	0.82	0.23	0.07	0.71
Drilling Engine Cat. 399	1,282	Hp	7.46	0.82	0.23	0.07	0.71
Drilling Engine Cat. 399	1,282	Hp	7.46	0.82	0.23	0.07	0.71
Prop. Engine Mit. 6UEC65	7,063	Hp	3.73	0.85	0.06	0.11	0.24
Emergency Generator Cat. 3304	131	Hp					
Air Compressor	500	Hp	0.094	0.082	0.005	0.094	0.022
Air Compressor	500	Hp	0.039	0.035	0.002	0.039	0.009
Air Compressor	500	Hp					
HPP Engine	250	Hp	0.093	0.02	0.007	0.008	0.005
HPP Engine	250	Hp	0.093	0.02	0.007	0.008	0.005
Port Fwd Deck Crane Cat. D343	365	Hp	0.88	0.19	0.06	0.07	0.04
Stbd Fwd Deck Crane Cat. D343	365	Hp	0.88	0.19	0.06	0.07	0.04
Cementing Unit Engine 1	325	Hp	0.15	0.03	0.01	0.01	0.01
Cementing Unit Engine 2	325	Hp	0.15	0.03	0.01	0.01	0.01
Logging Winch Detroit 471	140	Hp	0.18	0.04	0.01	0.01	0.01
Well Log Back Genset, Detroit 471	120	Hp					
Heat Boiler	7.97	mmBtu	0.332	0.128	0.039	0.002	0.045
Heat Boiler	7.97	mmBtu	0.332	0.128	0.039	0.002	0.045
			51.81	6.68	1.71	0.85	4.74

AIR SCIENCES INC. DENVER • PORTLAND	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 2 OF 3
			SHEET 1
		SUBJECT: Emissions Summary	DATE: 12/22/2006

Discoverer Rig and Associated Vessels - Each Source, continued

Kapitan Dranitsyn			Yearly Emissions at any location				
	Rated Capacity		NOx	CO	PM10	VOC	SO2
			tons	tons	tons	tons	tons
Main Engine	4,140	Hp	23.45	5.37	0.39	0.69	1.5
Main Engine	4,140	Hp	23.45	5.37	0.39	0.69	1.5
Main Engine	4,140	Hp	23.45	5.37	0.39	0.69	1.5
Main Engine	4,140	Hp	5.02	1.15	0.08	0.15	0.32
Main Engine	4,140	Hp	5.02	1.15	0.08	0.15	0.32
Main Engine	4,140	Hp	5.02	1.15	0.08	0.15	0.32
Auxiliary Engine	1,050	Hp	6.45	1.48	0.11	0.19	0.41
Auxiliary Engine	1,050	Hp	6.45	1.48	0.11	0.19	0.41
Auxiliary Engine	1,050	Hp	6.45	1.48	0.11	0.19	0.41
Auxiliary Engine	1,050	Hp	1.37	0.31	0.02	0.04	0.09
Auxiliary Engine	1,050	Hp					
Diesel Compressor	1,380	Hp					
Diesel Compressor	1,380	Hp					
Emergency Generator	438	Hp					
Heat Boiler	18	mmBtu	1.33	0.33	0.22	0.04	0.25
Heat Boiler	18	mmBtu					
Incinerator	0.077	ton/hr	0.12	12.47	1.46	4.16	0.1
			107.58	37.11	3.44	7.33	7.13

Fennica/Nordica			Yearly Emissions at any location				
	Rated Capacity		NOx	CO	PM10	VOC	SO2
			tons	tons	tons	tons	tons
Main Engine	7,884	Hp	18.86	0.66	0.4	0.66	1.25
Main Engine	7,884	Hp	21.69	0.75	0.46	0.75	1.43
Main Engine	5,913	Hp	23.43	0.82	0.5	0.82	1.55
Main Engine	5,913	Hp	16.27	0.57	0.34	0.57	1.08
Auxiliary Engine	710	Hp					
Emergency Generator	300	Hp					
Heat Boiler	4.44	mmBtu	0.164	0.041	0.027	0.005	0.031
Heat Boiler	4.44	mmBtu	0.077	0.019	0.013	0.002	0.015
Incinerator		N/A					
			80.49	2.86	1.74	2.81	5.36

AIR SCIENCES INC. DENVER • PORTLAND	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 3 OF 3
			SHEET 1
		SUBJECT: Emissions Summary	DATE: 12/21/2006

Discoverer Rig and Associated Vessels - Each Source, continued

Jim Kilabuk (resupply vessel)			Yearly Emissions at any location				
	Rated Capacity		NOx	CO	PM10	VOC	SO2
			tons	tons	tons	tons	tons
Main Engine EMD V20 645	3,600	Hp	0.52	0.12	0.01	0.02	0.03
Main Engine EMD V20 645	3,600	Hp	0.52	0.12	0.01	0.02	0.03
Generator, Cat. D3406	292	Hp	0.14	0.03	0.01	0.01	0.01
Generator, Cat. D3406	292	Hp					
HPP, Cat. D343	300	Hp					
Bow Thruster Cat. D343	300	Hp	0.056	0.012	0.004	0.005	0.003
			1.24	0.28	0.03	0.06	0.07

Discoverer's OSR Fleet			Yearly Emissions at any location				
	Rated Capacity		NOx	CO	PM10	VOC	SO2
			tons	tons	tons	tons	tons
Engine 1 on Pt. Barrow tug	1,502	Hp	0.34	0.19	0.01	0.34	0.05
Engine 2 on Pt. Barrow tug	1,502	Hp	0.34	0.19	0.01	0.34	0.05
Generator 1 on Pt. Barrow	150	Hp	1.21	0.23	0.03	0.02	0.1
Emergency generator on Pt. Barrow	150	Hp					
Kvichak 47' skimming vessel	700	Hp	0.111	0.007	0.003	0.005	0.012
Kvichak 47' skimming vessel	700	Hp	0.111	0.007	0.003	0.005	0.012
Kvichak 34' work boat #3	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #3	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #4	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #4	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #5	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #5	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #6	300	Hp	0.034	0.001	0.001	0.001	0.005
Kvichak 34' work boat #6	300	Hp	0.034	0.001	0.001	0.001	0.005
Engine 1 on tug for supply barge	1,500	Hp	0.77	0.18	0.01	0.02	0.05
Engine 2 on tug for supply barge	1,500	Hp	0.77	0.18	0.01	0.02	0.05
			3.92	0.99	0.08	0.76	0.36

AIR SCIENCES INC. DENVER • PORTLAND	PROJECT TITLE: Frontier Discoverer	BY: D. Young
CALCULATIONS	PROJECT NO: 180-15	PAGE 1 OF 1
		SHEET 2
	SUBJECT: Fuel Use Summary	DATE: 12/21/2006

Drill Rig and Vessel Diesel Fuel Use Summary

Fuel use for Discoverer at any location
Year 2007, 2008, or 2009

Rig/Vessel	gallons	cu meter
DISCOVERER RIG	357,743	1,354
KAPITAN DRANITSYN	587,867	2,225
FENNICA/NORDICA (2007-2009)	458,345	1,735
JIM KILABUK	5,046	19
Discoverer's OSR Fleet	23,800	90
	1,432,801	5,424

Conversion factor: 264.1721 gal/cubic meter

Air Sciences Inc.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 1 OF 3
			SHEET 3
		SUBJECT: Fuel Use & Operating Hours	DATE: 12/21/2006

Fuel Use & Operating Hours

Discoverer Rig	Rated Capacity		Equivalent Operating Hours	Fuel Use* Gallons
Drilling Engine Cat. 399	1,282	Hp	725	47,490
Drilling Engine Cat. 399	1,282	Hp	725	47,490
Drilling Engine Cat. 399	1,282	Hp	720	47,163
Drilling Engine Cat. 399	1,282	Hp	720	47,163
Drilling Engine Cat. 399	1,282	Hp	720	47,163
Drilling Engine Cat. 399	1,282	Hp	720	47,163
Prop. Engine Mit. 6UEC65	7,063	Hp	44	15,879
Emergency Generator Cat. 3304	131	Hp		
Air Compressor	500	Hp	57	1,456
Air Compressor	500	Hp	24	613
Air Compressor	500	Hp		
HPP Engine	250	Hp	24	307
HPP Engine	250	Hp	24	307
Port Fwd Deck Crane Cat. D343	365	Hp	155	2,891
Stbd Fwd Deck Crane Cat. D343	365	Hp	155	2,891
Cementing Unit Engine 1	325	Hp	30	498
Cementing Unit Engine 2	325	Hp	30	498
Logging Winch Detroit 471	140	Hp	84	601
Well Log Back Genset, Detroit 471	120	Hp		
Heat Boiler	7.97	mmBtu	414	24,085
Heat Boiler	7.97	mmBtu	414	24,085
				357,743

*Based on unit capacity, operating hours and diesel fuel heat content of 137,000 mmBtu/gal (AP42). Additionally for an engine the average brake-specific fuel consumption value of 7,000 btu/hp-hr (AP42) was used.

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 2 OF 3
			SHEET 3
		SUBJECT: Fuel Use & Operating Hours	DATE: 12/21/2006

Fuel Use & Operating Hours - continued

Kapitan Dranitsyn

	Rated Capacity		Equivalent Operating Hours	Fuel Use* Gallons
Main Engine	4,140	Hp	472	99,844
Main Engine	4,140	Hp	472	99,844
Main Engine	4,140	Hp	472	99,844
Main Engine	4,140	Hp	101	21,365
Main Engine	4,140	Hp	101	21,365
Main Engine	4,140	Hp	101	21,365
Auxiliary Engine	1,050	Hp	512	27,469
Auxiliary Engine	1,050	Hp	512	27,469
Auxiliary Engine	1,050	Hp	512	27,469
Auxiliary Engine	1,050	Hp	109	5,848
Auxiliary Engine	1,050	Hp		
Diesel Compressor	1,380	Hp		
Diesel Compressor	1,380	Hp		
Emergency Generator	438	Hp		
Heat Boiler	18	mmBtu	1,035	135,985
Heat Boiler	18	mmBtu		
Incinerator	0.077	ton/hr	1,080	
				587,867

Fennica/Nordica

	Rated Capacity		Equivalent Operating Hours	Fuel Use* Gallons
Main Engine	7,884	Hp	253	101,917
Main Engine	7,884	Hp	291	117,224
Main Engine	5,913	Hp	419	126,590
Main Engine	5,913	Hp	291	87,918
Auxiliary Engine	710	Hp		
Emergency Generator	300	Hp		
Heat Boiler	4.44	mmBtu	518	16,788
Heat Boiler	4.44	mmBtu	244	7,908
Incinerator		N/A		
				458,345

*Based on unit capacity, operating hours and diesel fuel heat content of 137,000 mmBtu/gal (AP42). Additionally for an engine the average brake-specific fuel consumption value of 7,000 btu/hp-hr (AP42) was used.

Fuel Use & Operating Hours - continued

Jim Kilabuk (resupply vessel)	Rated Capacity		Equivalent Operating Hours	Fuel Use* Gallons
Main Engine EMD V20 645	3,600	Hp	12	2,207
Main Engine EMD V20 645	3,600	Hp	12	2,207
Generator, Cat. D3406	292	Hp	30	448
Generator, Cat. D3406	292	Hp		
HPP, Cat. D343	300	Hp		
Bow Thruster Cat. D343	300	Hp	12	184
				5,046

Discoverer's OSR Fleet	Rated Capacity		Equivalent Operating Hours	Fuel Use* Gallons
Engine 1 on Pt. Barrow tug	1,502	Hp	43	3,300
Engine 2 on Pt. Barrow tug	1,502	Hp	43	3,300
Generator 1 on Pt. Barrow	150	Hp	827	6,338
Emergency generator on Pt. Barrow	150	Hp		
Kvichak 47' skimming vessel	700	Hp	22	787
Kvichak 47' skimming vessel	700	Hp	22	787
Kvichak 34' work boat #3	300	Hp	22	337
Kvichak 34' work boat #3	300	Hp	22	337
Kvichak 34' work boat #4	300	Hp	22	337
Kvichak 34' work boat #4	300	Hp	22	337
Kvichak 34' work boat #5	300	Hp	22	337
Kvichak 34' work boat #5	300	Hp	22	337
Kvichak 34' work boat #6	300	Hp	22	337
Kvichak 34' work boat #6	300	Hp	22	337
Engine 1 on tug for supply barge	1,500	Hp	43	3,296
Engine 2 on tug for supply barge	1,500	Hp	43	3,296
				23,800

*Based on unit capacity, operating hours and diesel fuel heat content of 137,000 mmBtu/gal (AP42). Additionally for an engine the average brake-specific fuel consumption value of 7,000 btu/hp-hr (AP42) was used.

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 1 OF 3
			SHEET 4
		SUBJECT: Emission Factors (EF)	DATE: 12/21/2006

Emission Factors (EF)

Discoverer Rig	rating	unit	EF category	NOx	CO	PM10	VOC	SO2
				(lb/hp-hr or lb/mmBtu)				
Drilling Engine Cat. 399	1,282	Hp	Discoverer Cat. D399 (adj.)	0.01616	0.00178	0.000508	0.0001526	0.0015371
Drilling Engine Cat. 399	1,282	Hp	Discoverer Cat. D399 (adj.)	0.01616	0.00178	0.000508	0.0001526	0.0015371
Drilling Engine Cat. 399	1,282	Hp	Discoverer Cat. D399 (adj.)	0.01616	0.00178	0.000508	0.0001526	0.0015371
Drilling Engine Cat. 399	1,282	Hp	Discoverer Cat. D399 (adj.)	0.01616	0.00178	0.000508	0.0001526	0.0015371
Drilling Engine Cat. 399	1,282	Hp	Discoverer Cat. D399 (adj.)	0.01616	0.00178	0.000508	0.0001526	0.0015371
Drilling Engine Cat. 399	1,282	Hp	Discoverer Cat. D399 (adj.)	0.01616	0.00178	0.000508	0.0001526	0.0015371
Prop. Engine Mit. 6UEC65	7,063	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Emergency Generator Cat. 3304	131	Hp	ICE <=600 hp AP42					
Air Compressor	500	Hp	Air compressors	0.00658	0.00575	0.000329	0.00658	0.0015371
Air Compressor	500	Hp	Air compressors	0.00658	0.00575	0.000329	0.00658	0.0015371
Air Compressor	500	Hp	Air compressors					
HPP Engine	250	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
HPP Engine	250	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Port Fwd Deck Crane Cat. D343	365	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Stbd Fwd Deck Crane Cat. D343	365	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Cementing Unit Engine 1	325	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Cementing Unit Engine 2	325	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Logging Winch Detroit 471	140	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Well Log Back Genset, Detroit 471	120	Hp	ICE <=600 hp AP42					
Heat Boiler	7.97	mmBtu	Boiler on Discoverer	0.201	0.0774	0.0235	0.00141	0.02736
Heat Boiler	7.97	mmBtu	Boiler on Discoverer	0.201	0.0774	0.0235	0.00141	0.02736

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 2 OF 3
			SHEET 4
		SUBJECT: Emission Factors (EF)	DATE: 12/22/2006

Emission Factors (EF) - continued

Kapitan Dranitsyn		rating unit	EF category	NOx	CO	PM10	VOC	SO2
					(lb/hp-hr or lb/mmBtu)			
Main Engine	4,140	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Main Engine	4,140	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Main Engine	4,140	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Main Engine	4,140	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Main Engine	4,140	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Main Engine	4,140	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Auxiliary Engine	1,050	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Auxiliary Engine	1,050	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Auxiliary Engine	1,050	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Auxiliary Engine	1,050	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Auxiliary Engine	1,050	Hp	ICE >600 hp AP42					
Diesel Compressor	1,380	Hp	ICE >600 hp AP42					
Diesel Compressor	1,380	Hp	ICE >600 hp AP42					
Emergency Generator	438	Hp	ICE <=600 hp AP42					
Heat Boiler	18	mmBtu	Boiler <100 mmBtu AP42	0.143	0.0357	0.0236	0.00397	0.02736
Heat Boiler	18	mmBtu	Boiler <100 mmBtu AP42					
Incinerator	0.077	ton/hr	Shipboard incinerator. AP42	3	300	35	100	2.5

Fennica/Nordica		rating unit	EF category	NOx	CO	PM10	VOC	SO2
					(lb/hp-hr or lb/mmBtu)			
Main Engine	7,884	Hp	Fennica/Nordica main engines	0.01891	0.000658	0.000401	0.000658	0.0012502
Main Engine	7,884	Hp	Fennica/Nordica main engines	0.01891	0.000658	0.000401	0.000658	0.0012502
Main Engine	5,913	Hp	Fennica/Nordica main engines	0.01891	0.000658	0.000401	0.000658	0.0012502
Main Engine	5,913	Hp	Fennica/Nordica main engines	0.01891	0.000658	0.000401	0.000658	0.0012502
Auxiliary Engine	710	Hp	ICE >600 hp AP42					
Emergency Generator	300	Hp	ICE <=600 hp AP42					
Heat Boiler	4.44	mmBtu	Boiler <100 mmBtu AP42	0.143	0.0357	0.0236	0.00397	0.02736
Heat Boiler	4.44	mmBtu	Boiler <100 mmBtu AP42	0.143	0.0357	0.0236	0.00397	0.02736
Incinerator		N/A	Not Applicable					

PROJECT TITLE: Frontier Discoverer	BY: D. Young
PROJECT NO: 180-15	PAGE 3 OF 3
	SHEET 4
SUBJECT: Emission Factors (EF)	DATE: 12/22/2006

AIR SCIENCES INC.

CALCULATIONS

Emission Factors (EF) - continued

Jim Kilabuk (resupply vessel)		rating unit	EF category	NOx	CO	PM10	VOC	SO2
				(lb/hp-hr or lb/mmBtu)				
Main Engine EMD V20 645	3,600	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Main Engine EMD V20 645	3,600	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Generator, Cat. D3406	292	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371
Generator, Cat. D3406	292	Hp	ICE <=600 hp AP42					
HPP, Cat. D343	300	Hp	ICE <=600 hp AP42					
Bow Thruster Cat. D343	300	Hp	ICE <=600 hp AP42	0.031	0.00668	0.0022	0.00251	0.0015371

Discoverer's OSR Fleet		rating unit	EF category	NOx	CO	PM10	VOC	SO2
				(lb/hp-hr or lb/mmBtu)				
Engine 1 on Pt. Barrow tug	1,502	Hp	Pt Barrow Tug main engines	0.0105	0.00575	0.000329	0.0105	0.0015371
Engine 2 on Pt. Barrow tug	1,502	Hp	Pt Barrow Tug main engines	0.0105	0.00575	0.000329	0.0105	0.0015371
Generator 1 on Pt. Barrow	150	Hp	Pt. Barrow Tug generators	0.0195	0.00366	0.000414	0.000387	0.0015371
Emergency generator on Pt. Barrow	150	Hp	Pt. Barrow Tug generators					
Kvichak 47' skimming vessel	700	Hp	Kvic. 47' vessel engine	0.0144	0.00097	0.000401	0.000705	0.0015371
Kvichak 47' skimming vessel	700	Hp	Kvic. 47' vessel engine	0.0144	0.00097	0.000401	0.000705	0.0015371
Kvichak 34' work boat #3	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #3	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #4	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #4	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #5	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #5	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #6	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Kvichak 34' work boat #6	300	Hp	Kvic. 34' vessel engine	0.01024	0.000171	0.000169	0.000342	0.0015371
Engine 1 on tug for supply barge	1,500	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371
Engine 2 on tug for supply barge	1,500	Hp	ICE >600 hp AP42	0.024	0.0055	0.000401	0.000705	0.0015371

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 1 OF 3
			SHEET 5
		SUBJECT: Hourly Emission Rate	DATE: 12/21/2006

Hourly Emissions

Discoverer Rig	Rated Capacity		NOx lb/hr	CO lb/hr	PM10 lb/hr	VOC lb/hr	SO2 lb/hr
Drilling Engine Cat. 399	1,282	Hp	20.71712	2.28196	0.651256	0.1956332	1.9705622
Drilling Engine Cat. 399	1,282	Hp	20.71712	2.28196	0.651256	0.1956332	1.9705622
Drilling Engine Cat. 399	1,282	Hp	20.71712	2.28196	0.651256	0.1956332	1.9705622
Drilling Engine Cat. 399	1,282	Hp	20.71712	2.28196	0.651256	0.1956332	1.9705622
Drilling Engine Cat. 399	1,282	Hp	20.71712	2.28196	0.651256	0.1956332	1.9705622
Drilling Engine Cat. 399	1,282	Hp	20.71712	2.28196	0.651256	0.1956332	1.9705622
Prop. Engine Mit. 6UEC65	7,063	Hp	169.512	38.8465	2.832263	4.979415	10.8565373
Emergency Generator Cat. 3304	131	Hp					
Air Compressor	500	Hp	3.29	2.875	0.1645	3.29	0.76855
Air Compressor	500	Hp	3.29	2.875	0.1645	3.29	0.76855
Air Compressor	500	Hp					
HPP Engine	250	Hp	7.75	1.67	0.55	0.6275	0.384275
HPP Engine	250	Hp	7.75	1.67	0.55	0.6275	0.384275
Port Fwd Deck Crane Cat. D343	365	Hp	11.315	2.4382	0.803	0.91615	0.5610415
Stbd Fwd Deck Crane Cat. D343	365	Hp	11.315	2.4382	0.803	0.91615	0.5610415
Cementing Unit Engine 1	325	Hp	10.075	2.171	0.715	0.81575	0.4995575
Cementing Unit Engine 2	325	Hp	10.075	2.171	0.715	0.81575	0.4995575
Logging Winch Detroit 471	140	Hp	4.34	0.9352	0.308	0.3514	0.215194
Well Log Back Genset, Detroit 471	120	Hp					
Heat Boiler	7.97	mmBtu	1.60197	0.616878	0.187295	0.0112377	0.2180592
Heat Boiler	7.97	mmBtu	1.60197	0.616878	0.187295	0.0112377	0.2180592

PROJECT TITLE: Frontier Discoverer	BY: D. Young
PROJECT NO: 180-15	PAGE 2 OF 3
	SHEET 5
SUBJECT: Emission Factors (EF)	DATE: 12/21/2006

AIR SCIENCES INC.

DENVER • PORTLAND

CALCULATIONS

Hourly Emissions - continued

Kapitan Dranitsyn	Rated Capacity		NOx lb/hr	CO lb/hr	PM10 lb/hr	VOC lb/hr	SO2 lb/hr
Main Engine	4,140	Hp	99.36	22.77	1.66014	2.9187	6.363594
Main Engine	4,140	Hp	99.36	22.77	1.66014	2.9187	6.363594
Main Engine	4,140	Hp	99.36	22.77	1.66014	2.9187	6.363594
Main Engine	4,140	Hp	99.36	22.77	1.66014	2.9187	6.363594
Main Engine	4,140	Hp	99.36	22.77	1.66014	2.9187	6.363594
Main Engine	4,140	Hp	99.36	22.77	1.66014	2.9187	6.363594
Auxiliary Engine	1,050	Hp	25.2	5.775	0.42105	0.74025	1.613955
Auxiliary Engine	1,050	Hp	25.2	5.775	0.42105	0.74025	1.613955
Auxiliary Engine	1,050	Hp	25.2	5.775	0.42105	0.74025	1.613955
Auxiliary Engine	1,050	Hp	25.2	5.775	0.42105	0.74025	1.613955
Auxiliary Engine	1,050	Hp					
Diesel Compressor	1,380	Hp					
Diesel Compressor	1,380	Hp					
Emergency Generator	438	Hp					
Heat Boiler	18	mmBtu	2.574	0.6426	0.4248	0.07146	0.49248
Heat Boiler	18	mmBtu					
Incinerator	0.077	ton/hr	0.231	23.1	2.695	7.7	0.1925

Fennica/Nordica	Rated Capacity		NOx lb/hr	CO lb/hr	PM10 lb/hr	VOC lb/hr	SO2 lb/hr
Main Engine	7,884	Hp	149.08644	5.187672	3.161484	5.187672	9.8565768
Main Engine	7,884	Hp	149.08644	5.187672	3.161484	5.187672	9.8565768
Main Engine	5,913	Hp	111.81483	3.890754	2.371113	3.890754	7.3924326
Main Engine	5,913	Hp	111.81483	3.890754	2.371113	3.890754	7.3924326
Auxiliary Engine	710	Hp					
Emergency Generator	300	Hp					
Heat Boiler	4.44	mmBtu	0.63492	0.158508	0.104784	0.0176268	0.1214784
Heat Boiler	4.44	mmBtu	0.63492	0.158508	0.104784	0.0176268	0.1214784
Incinerator		N/A					

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 3 OF 3 / SHEET 5
		SUBJECT: Emission Factors (EF)	DATE: 12/21/2006

Hourly Emissions - continued

Jim Kilabuk (resupply vessel)	Rated Capacity		NOx lb/hr	CO lb/hr	PM10 lb/hr	VOC lb/hr	SO2 lb/hr
Main Engine EMD V20 645	3,600	Hp	86.4	19.8	1.4436	2.538	5.53356
Main Engine EMD V20 645	3,600	Hp	86.4	19.8	1.4436	2.538	5.53356
Generator, Cat. D3406	292	Hp	9.052	1.95056	0.6424	0.73292	0.4488332
Generator, Cat. D3406	292	Hp					
HPP, Cat. D343	300	Hp					
Bow Thruster Cat. D343	300	Hp	9.3	2.004	0.66	0.753	0.46113

Discoverer's OSR Fleet	Rated Capacity		NOx lb/hr	CO lb/hr	PM10 lb/hr	VOC lb/hr	SO2 lb/hr
Engine 1 on Pt. Barrow tug	1,502	Hp	15.771	8.6365	0.494158	15.771	2.3087242
Engine 2 on Pt. Barrow tug	1,502	Hp	15.771	8.6365	0.494158	15.771	2.3087242
Generator 1 on Pt. Barrow	150	Hp	2.925	0.549	0.0621	0.05805	0.230565
Emergency generator on Pt. Barrow	150	Hp					
Kvichak 47' skimming vessel	700	Hp	10.08	0.679	0.2807	0.4935	1.07597
Kvichak 47' skimming vessel	700	Hp	10.08	0.679	0.2807	0.4935	1.07597
Kvichak 34' work boat #3	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #3	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #4	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #4	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #5	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #5	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #6	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Kvichak 34' work boat #6	300	Hp	3.072	0.0513	0.0507	0.1026	0.46113
Engine 1 on tug for supply barge	1,500	Hp	36	8.25	0.6015	1.0575	2.30565
Engine 2 on tug for supply barge	1,500	Hp	36	8.25	0.6015	1.0575	2.30565

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 1 OF 1
			SHEET 6
		SUBJECT: List of Emission Factors	DATE: 12/22/2006

Emissions Unit	Emission Factors							Reference
	EF Unit	NOx	CO	PM10	VOC	SO2 value x S	SO2^ 0.19 = S	
Air compressors	lb/hp-hr	0.00658	0.00575	0.000329	0.00658	0.0015371	0.00809 S	Tier 3, (planned). 225 to 450kw range. 500hp = 373kW: NOx & VOC use NOX+NMHC value, CO, & PM. AP42: SO2.
Boiler <100 mmBtu AP42	lb/mmBtu	0.143	0.0357	0.0236	0.00397	0.02736	*0.144 S*	AP42 Tbl 1.3-1: NOx, CO, & SO2, Tbls 1.3-1 & 1.3-2; PM, and Tbl 1.2-3; VOC. 9/98
Boiler on Discoverer	lb/mmBtu	0.201	0.0774	0.0235	0.00141	0.02736	*0.144 S*	Clayton Industries: NOx, CO, PM, & VOC. AP42: SO2.
Fennica/Nordica main engines	lb/hp-hr	0.01891	0.000658	0.000401	0.000658	0.0012502	0.00658 S	Client provided data: NOx, CO, VOC, & SO2. AP42: PM.
ICE <=600 hp AP42	lb/hp-hr	0.031	0.00668	0.0022	0.00251	0.0015371	0.00809 S	AP42 Tbl 3.3-1, 10/96
ICE >600 hp AP42	lb/hp-hr	0.024	0.0055	0.000401	0.000705	0.0015371	0.00809 S	AP42 Tbls 3.4-1 & 3.4-2 10/96
Discoverer Cat. D399 (adj.)	lb/hp-hr	0.01616	0.00178	0.000508	0.0001526	0.0015371	0.00809 S	Spec from client, adjusted by 1.2: NOx, CO, PM10, & VOC. AP42: SO2.
Kvic. 34' vessel engine	lb/hp-hr	0.01024	0.000171	0.000169	0.000342	0.0015371	0.00809 S	Cummins data: NOx, CO, PM10, & VOC. AP42: SO2.
Kvic. 47' vessel engine	lb/hp-hr	0.0144	0.00097	0.000401	0.000705	0.0015371	0.00809 S	Lugger data: NOx & CO. AP42 700 hp: PM10, VOC, CO, & SO2.
Not Applicable		0	0	0	0	0		
Pt Barrow Tug main engines	lb/hp-hr	0.0105	0.00575	0.000329	0.0105	0.0015371	0.00809 S	Tier 2 model year 2006 (vendor Cat info): NOx, CO, PM10, & VOC . AP42: SO2.
Pt. Barrow Tug generators	lb/hp-hr	0.0195	0.00366	0.000414	0.000387	0.0015371	0.00809 S	Spec. from client (Cat 3304B): NOx, CO, PM10, & VOC. AP42: SO2.
Shipboard incinerator. AP42	lb/ton	3	300	35	100	2.5		AP42 Tbl 2.1-12, Industrial/commercial and Domestic single chamber (largest factor of four) 10/96.

^ SO2 emission factor is based on S; the percent sulfur by weight in the fuel. For example the value of S would be 0.5 if the sulfur content is 0.5%. AP42 Tbl 3.4-1, 10/96

Sulfur in fuel by wgt. 1900 ppm is 0.19 % S

Frontier Discoverer Owner Requested Limit (ORL) - Fleet wide Diesel Fuel Consumption

General ORL NOx Compliance Equation: $E_A + E_B + E_C + E_D + E_E$ < 245 tons NOx

Where:

E_A =	Emissions from Frontier Discoverer	Vessel A
E_B =	Emissions from Kapitan Dranitsyn	Vessel B
E_C =	Emissions from Fennica/Nordica	Vessel C
E_D =	Emissions from Jim Kilabuk	Vessel D
E_E =	Emissions from Frontier Discoverer OSR Fleet	Vessel E

Specific ORL NOx Compliance Equation:

$$K_{RICE}*((F_{A1}*EF_{A1})+(F_{A2}*EF_{A2})+(F_{B1}*EF_{B1})+(F_{C1}*EF_{C1}))+K_{HEAT}*((F_{A3}*EF_{A3})+(F_{B2}*EF_{B2})+(F_{C2}*EF_{C2}))+ 2.6+1.2+3.9 < 245 \text{ tons}$$

where

K_{RICE} = 137,000 / 7,000 / 2,000 = 0.00979 Hp-hr-ton / gal-lb

K_{HEAT} = 137,000 / 1,000,000 / 2,000 = 0.0000685 mmBtu-ton / gal-lb

F_i =	Fuel consumption by source group i (gallons)
EF_i =	Emission factor by source group i
2.6 tons	FD remaining emissions
1.2 tons	Jim Kilabuk emissions
3.9 tons	OSR Fleet emissions

137,000	Btu/gallon	AP42 diesel fuel heat content
7,000	Btu/hp-hr	AP42 average brake-specific fuel consumption
2,000	lb/ton	Conversion factor
1,000,000	Btu/mmBtu	Conversion factor

Example Calculation of NOx Emissions and Comparison with ORL

ORL Equation Variables:	Vessel Source Identification	NOx Emission Factor (EF)	Assumed Diesel Fuel Consumption (F)
FD six Caterpillar 399 main drilling engines	A1	0.0162 lb/hp-hr	250,000 gallons
FD Mit. 6UEC65 main propulsion engine	A2	0.024 lb/hp-hr	12,000 gallons
FD boilers	A3	0.201 lb/mmBtu	40,000 gallons
KD main & auxiliary propulsion engines	B1	0.024 lb/hp-hr	400,000 gallons
KD boilers	B2	0.143 lb/mmBtu	120,000 gallons
F/N four main propulsion engines	C1	0.0189 lb/hp-hr	350,000 gallons
F/N two boilers	C2	0.143 lb/mmBtu	20,000 gallons

ORL Equation Constants:	Source ID	Tons of NOx
FD remaining sources	A4	2.6
Jim Kilabuk sources	D	1.2
OSR Fleet sources	E	3.9

Find: (where A1 = Vessel Source Identification EF x fuel consumption value; A2 etc.)

Is 245.0 tons >
$$\frac{137{,}000 \text{ Btu}}{\text{gallon}} \left| \frac{\text{hp-hr}}{7{,}000 \text{ Btu}} \right| \frac{\text{ton}}{2{,}000 \text{ lb}} \times ((F_{A1}*EF_{A1})+(F_{A2}*EF_{A2})+(F_{B1}*EF_{B1})+(F_{C1}*EF_{C1}))$$

$$+ \frac{137{,}000 \text{ Btu}}{\text{gallon}} \left| \frac{\text{mmBtu}}{10^6 \text{ Btu}} \right| \frac{\text{ton}}{2{,}000 \text{ lb}} \times ((F_{A3}*EF_{A3})+(F_{B2}*EF_{B2})+(F_{C2}*EF_{C2})) + 2.6 + 1.2 + 3.9 =$$

210.7 tons NOx

Yes, 245 tons is greater than 210.7 tons NOx

Therefore, equation demonstrates compliance with this hypothetical example

AIR SCIENCES INC.	CALCULATIONS	PROJECT TITLE: Frontier Discoverer	BY: D. Young
		PROJECT NO: 180-15	PAGE 1 OF 2 / SHEET 7
		SUBJECT: HAPs	DATE: 12/12/2006

HAZARDOUS AIR POLLUTANTS (HAPs), as defined pursuant to Section 112(b) of the Clean Air Act.

To simplify the estimate of emission; a yearly fuel use value is set at a more than the proposed total fuel use limitation and conservatively applied to each set of emission factors.

HAPs - Fuel Oil Combustion; Engines

The estimated maximum amount of diesel fuel combusted by the engines larger than 600 hp, expressed in units of heat input:

$$\frac{2{,}000{,}000 \text{ gallons}}{\text{year}} \left| \frac{137{,}000 \text{ Btu*}}{\text{gallons}} \right| \frac{\text{MMBtu}}{1{,}000{,}000 \text{ Btu}} = 274{,}000 \text{ MMBtu/Yr}$$

*AP-42 Appendix A, Diesel heating value, 9/85.

The estimated HAP emissions from IC engines with >600 hp output:

HAP	Emission Factor lb/MMBtu*	Emissions lb/yr	Emissions ton/yr
Benzene	7.76E-04	212.6	0.106
Toluene	2.81E-04	77.0	0.038
Xylenes	1.93E-04	52.9	0.026
Formaldehyde	7.89E-05	21.6	0.011
Acetaldehyde	2.52E-05	6.9	0.003
Acrolein	7.88E-06	2.2	0.001
Naphthalene	1.30E-04	35.6	0.018
Total PAH**	8.20E-05	22.5	0.011
			0.216

*AP-42, Stationary IC sources, Table 3.4-3.

**Emission factor excludes the already accounted for naphthalene.

The estimated maximum amount of diesel fuel combusted by the engines equal to or less than 600 hp, expressed in units of heat input:

$$\frac{2{,}000{,}000 \text{ gallons}}{\text{year}} \left| \frac{137{,}000 \text{ Btu*}}{\text{gallons}} \right| \frac{\text{MMBtu}}{1{,}000{,}000 \text{ Btu}} = 274{,}000 \text{ MMBtu/Yr}$$

*AP-42 Appendix A, Diesel heating value, 9/85.

The estimated HAP emissions from IC engines with $\leq$600 hp output:

HAP	Emission Factor lb/MMBtu*	Emissions lb/yr	Emissions ton/yr
Benzene	9.33E-04	255.6	0.1278
Toluene	4.09E-04	112.1	0.0560
Xylenes	2.85E-04	78.1	0.0390
Propylene	2.58E-03	706.9	0.3535
1,3-Butadiene	3.91E-05	10.7	0.0054
Formaldehyde	1.18E-03	323.3	0.1617
Acetaldehyde	7.67E-04	210.2	0.1051
Acrolein	9.25E-05	25.3	0.0127
Naphthalene	8.48E-05	23.2	0.0116
Total PAH**	8.32E-05	22.8	0.0114
			0.884

*AP-42, Stationary IC sources, Table 3.3-2.

**Emission factor excludes the already accounted for naphthalene.

HAZARDOUS AIR POLLUTANTS (HAPs), as defined pursuant to Section 112(b) of the Clean Air Act. - continued

HAPs - Fuel Oil Combustion; Boilers

The estimated maximum amount of diesel fuel combusted by boilers, expressed in units of heat input:

2,000,000 gallons	137,000 Btu*	MMBtu	=	274,000	MMBtu/Yr
year	gallons	1,000,000 Btu			

*AP-42 Appendix A, Diesel heating value, 9/85.

The estimated HAP emissions from boilers:

HAP	Emission Factor lb/1000 gal*	Emissions lb/yr	Emissions ton/yr
POM	3.30E-03	6.6	0.0033
Formaldehyde	6.10E-02	122.0	0.0610
	$lb/10^{12}$ Btu**		
Arsenic	4	1.1	0.00055
Beryllium	3	0.8	0.00041
Cadmium	3	0.8	0.00041
Chromium	3	0.8	0.00041
Lead	9	2.5	0.00123
Mercury	3	0.8	0.00041
Manganese	6	1.6	0.00082
Nickel	3	0.8	0.00041
Selenium	15	4.1	0.00206
			0.071

*AP-42, External Combustion Sources, Table 1.3-8, Distillate Oil, 9/98.
**AP-42, External Combustion Sources, Table 1.3-10, Distillate Oil, 9/98.

HAPs - Summary

1.171 TPY. Total emissions of all HAPs from all diesel fueled sources.

Frontier Discoverer Caterpillar D399 Emission Factors

CATERPILLAR®

ENGINE DATA SHEET

EDS 82.0
Date 5-95

Caterpillar Diesel Prechamber and Selected D.I. Engines

The passage of the 1990 Clean Air Act Amendments will increase the requests for emission data from both current engines and previously purchased engines. The information in this publication is intended to assist in answering the emission related questions on previously purchased engines. Your source of data for new engines is the TMI system. In some cases data is presented for turbocharged, turbocharged jacket water aftercooled (JWAC) and turbocharged separate circuit aftercooled (SCAC) configurations. The SCAC engines all had watercooled exhaust manifolds. The emission levels obtained on a SCAC engine with non-watercooled exhaust manifolds would be similar to the emissions on an engine with watercooled manifolds except the exhaust stack temperatures could be as much as 75°C higher at the rated point for non-watercooled manifolds.

List of Prechamber Engines Included in This Document
D315 PC D330A 4.5 x 5.5 I4 2V NA, T
D318 PC D333A 4.5 x 5.5 I6 2V NA, T
3304 PCNA I4 4.75 x 6.0 2V
3304 PCT I4 4.75 x 6.0 2V
3306 PCNA I6 4.75 x 6.0 2V
3306 PCT I6 4.75 x 6.0 2V
3306 PCTA I6 4.75 x 6.0 2V
D334 PCTA I6 4.75 x 6.0 4V
D337 PCT 5 1/8 x 6.5 I6 2V
3406 PCT I6 5.4 x 6.5 4V
3406 PCTA I6 5.4 x 6.5 4V
3408 PCTA V8 5.4 x 6.0 4V
3412 PCTA V12 5.4 x 6.0 4V
D343 PCT I6 5.4 x 6.5 4SV (SIMILAR TO 1693 TRUCK)
D343 PCTA I6 5.4 x 6.5 4SV (SIMILAR TO 1693 TRUCK)
D348 PCTA V12 5.4 x 6.5 4V
D349 PC SCAC V16 5.4 x 6.5 4V
D353 PCTA I6 6.25 x 8 2V
D353 PC SCAC 110 F I6 6.25 x 8.0 2V
D353 PC SCAC 85 F I6 6.25 x 8.0 2V
D379 PCTA V8 6.25 x 8.0 2V
D398 PC SCAC 85 F V12 6.25 x 8.0 2V
D398 PCTA V12 6.25 x 8.0 2V
D399 PCTA V16 6.25 x 8.0 2V
D399 PC SCAC 85 F 6.25 x 8.0 2V

SV = SLANT VALVE
TA = JACKET WATER AFTERCOOLED
SCAC = SEPARATE CIRCUIT AFTERCOOLED
4V = 4 VERTICAL VALVES
TT = TWIN TURBOCHARGERS
TTA = TWIN TURBO AFTERCOOLED

List of DI Engines
3306 DINA I6 4.75 x 6.0 2V
3306 DIT I6 4.75 x 6.0 2V
3406 DIT I6 5.4 x 6.5 GEN SET
3406 DITA I6 5.4 x 6.5 GEN SET
3406 DIT I6 5.4 x 6.5 INDUSTRIAL
3406 DITA I6 5.4 x 6.5 INDUSTRIAL
3408 DIT V8 5.4 x 6.0 INDUSTRIAL
3408 DITA V8 5.4 x 6.0 INDUSTRIAL
3408 DITA V8 5.4 x 6.0 GEN SET
3412 DIT V12 5.4 x 6.0 GEN SET
3412 DIT V12 5.4 x 6.0 IND AND 50 HZ GEN SET
3412 DITT V12 5.4 x 6.0 IND AND 50 HZ GEN SET
3412 DITTA V12 5.4 x 6.0 50 HZ GEN SET
3412 DITTA V12 5.4 x 6.0 60 HZ GEN SET
3412 DITTA V12 5.4 x 6.0 INDUSTRIAL

Table 1

It is difficult to supply all the information that could be requested. The emission data is presented in g/hr. In some cases the emissions may be requested in ppm. The ppm can be approximately calculated using the equations given in Table 2.

Emissions Calculations
SO_2 g/hr = .01998 X (fuel rate g/hr) X (% fuel sulfur by weight)
NO_x concentration (ppm) = 629 X $\frac{(NO_x \text{ mass emissions g/hr})}{(\text{Exhaust mass flow kg/hr})}$
CO concentration (ppm) = 1034 X $\frac{(\text{CO mass emissions g/hr})}{(\text{Exhaust mass flow kg/hr})}$
HC concentration (ppm) = 2067 X $\frac{(\text{HC mass emission g/hr})}{(\text{Exhaust mass flow kg/hr})}$
SO_2 concentration (ppm) = 452 X $\frac{(SO_2 \text{ mass emissions g/hr})}{(\text{Exhaust mass flow kg/hr})}$

Table 2

The SO_2 produced by an engine is a function of the sulfur in the fuel. Table 2 gives an equation for calculating SO_2 in the exhaust. Fuel sulfur varies greatly. An average value to be used in the above equation is .2 for many industrial fuels.

The engine tests were run with inlet air temperature and pressure to the engine of 85°F and 28.4 in.hg ABS respectively.

The Caterpillar smoke density number is given for each point. To determine smoke opacity, use the smoke chart in Table 3 and the appropriate stack diameter.

The particulate matter is based on a correlation between smoke density and particulates. Particulates consist of soot, soluble organic fractions, sulfates, and miscellaneous compounds from the oil additive package. Soluble organic fraction is approximately 60 to 80% lubricating oil that finds its way into the combustion chamber by passing the piston rings, flowing down the valve guides, or flowing past the turbocharger seals. If a field measurement is made on a very old, worn out engine, the particulates could be higher than the value listed in the table. The current Caterpillar accepted particulate measuring procedure, ISO 8178-1, was not available at the time these engines were tested. The values of particulates estimated from smoke are a good approximation of the values obtained with the ISO procedure.

The EPA approved particulate measurement procedure, Method 5, will give equivalent results if the contractor is skilled.

The gaseous emission measurements were made using SAE test procedures recommended at the time the emissions were run. These procedures have changed very little and are consistent with EPA CFR 40 part 86 subpart D. Subpart D is similar to the following procedures:

EPA	SAE
Method 25A for HC	J215
Method 10 for CO	J177a
Method 7E for NO_x	J177a

For further emission information, consult TMI performance parameter DM1176-01.

The exhaust stack temperatures can vary depending on how far downstream from the turbocharger the measurement was made. In most of the cases shown in the tables, the thermocouple would have been less than 6 feet from the turbocharger outlet. Exhaust temperatures at this location would have a ± 5% °C range from the table values.

Brake specific fuel consumption (BSFC) was measured using #2 diesel fuel with 35 API and LHV of 18,390 Btu/lb.

If field measurements are to be made, refer to EDS 81.0, 11-91, LEKQ1341, for field test guidelines.

A note is at the bottom of each performance sheet explaining that the emission values have been increased by the factors given. This increase is to cover measurement errors and engine to engine differences. The emission data given is for engines with relatively low hours, and thus applies only to well maintained engines. The emissions from old, or poorly maintained engines could differ from the emissions given in the table.

If a letter needs to accompany the data, the following format may be used.

Example Text:

Emissions Data

Attached is the exhaust emission data requested. The data was obtained through actual engine test on an engine of similar configuration to yours. Emissions data was measured using procedures consistent with EPA CFR 40, part 86, subpart D. The particulate matter is estimated from a smoke density to particulate correlation. The fuel used was #2 diesel with 35 API and LHV of 18,390 Btu/lb. The data is based on steady state engine operating conditions with inlet air conditions of 85°F and 28.4 in. hg ABS temperature and pressure respectively.

The NO_x shown is not actually in the exhaust. It's based on the assumption that all NO and NO_2 in the exhaust is converted to NO_2 in the atmosphere. The NO_x is reported with a molecular weight equal to NO_2 and is corrected for 75 grains/lb engine inlet air humidity.

This is Caterpillar's best estimate of the emissions of your engine. If exact emissions information is required, an emissions test will be needed on your engine.

(If SO_x is provided in the emission data, include the following sentence.) The SO_x value is based on fuel sulfur content of .2% by weight.

If the inquiry is for NO_x data only, don't include HC, particulate, CO, etc. data. If an air board has the extra data, they are likely to want a measurement of these species during an audit. The extra testing adds expense.

If you have questions regarding use of this information, please call:

John Dystrup
Caterpillar Engine Division
309-578-2616

Smoke Conversion Chart

Opacity	Stack Diameter									
%	2"	3"	4"	5"	6"	8"	10"	12"	14"	18"
1	0.06	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01
2	0.13	0.08	0.07	0.05	0.05	0.03	0.02	0.02	0.02	0.01
3	0.21	0.12	0.11	0.08	0.08	0.05	0.04	0.04	0.03	0.02
4	0.29	0.17	0.15	0.11	0.11	0.07	0.06	0.05	0.04	0.03
5	0.36	0.22	0.18	0.14	0.13	0.09	0.07	0.06	0.05	0.04
6	0.43	0.27	0.22	0.17	0.16	0.11	0.09	0.07	0.06	0.05
7	0.52	0.32	0.26	0.20	0.19	0.13	0.11	0.09	0.07	0.06
8	0.61	0.38	0.30	0.24	0.21	0.15	0.12	0.10	0.08	0.07
9	0.69	0.43	0.35	0.27	0.24	0.17	0.14	0.12	0.09	0.08
10	0.77	0.49	0.39	0.31	0.26	0.19	0.16	0.13	0.10	0.09
11	0.87	0.54	0.43	0.34	0.29	0.21	0.17	0.14	0.11	0.10
12	0.97	0.60	0.47	0.38	0.32	0.23	0.19	0.16	0.13	0.11
13	1.08	0.66	0.52	0.42	0.34	0.25	0.20	0.17	0.14	0.12
14		0.73	0.56	0.45	0.37	0.27	0.22	0.18	0.15	0.13
15		0.79	0.61	0.49	0.40	0.29	0.24	0.20	0.16	0.14
16		0.87	0.66	0.53	0.42	0.31	0.25	0.21	0.17	0.15
17		0.94	0.70	0.56	0.45	0.33	0.27	0.23	0.18	0.16
18		1.00	0.75	0.60	0.48	0.36	0.29	0.24	0.20	0.17
19			0.80	0.64	0.51	0.38	0.30	0.25	0.21	0.18
20			0.85	0.68	0.54	0.40	0.32	0.27	0.22	0.19
21			0.90	0.72	0.57	0.42	0.34	0.28	0.23	0.20
22			0.95	0.76	0.60	0.44	0.36	0.30	0.25	0.21
23			1.00	0.81	0.64	0.46	0.38	0.31	0.26	0.22
24				0.85	0.67	0.48	0.39	0.32	0.28	0.24
25				0.90	0.71	0.51	0.41	0.34	0.29	0.25
26				0.94	0.74	0.53	0.43	0.36	0.30	0.26
27				0.98	0.79	0.56	0.45	0.37	0.32	0.27
28				1.03	0.81	0.59	0.48	0.39	0.33	0.28
29					0.85	0.61	0.50	0.40	0.35	0.29
30					0.88	0.64	0.52	0.42	0.36	0.30
31					0.93	0.67	0.54	0.43	0.37	0.32
32					0.99	0.70	0.56	0.45	0.40	0.33
33					1.05	0.73	0.59	0.47	0.41	0.34
34						0.76	0.61	0.49	0.43	0.35
35						0.79	0.63	0.51	0.44	0.36
36						0.83	0.66	0.52	0.46	0.37
37						0.86	0.69	0.54	0.48	0.39
38						0.90	0.71	0.56	0.49	0.40
39						0.94	0.74	0.58	0.51	0.41
40						0.98	0.76	0.61	0.52	0.42
45							0.90	0.72	0.62	0.48
50								0.85	0.72	0.55
55								1.00	0.84	0.64
60									0.99	0.74
65										0.86
70										1.01

EMISSIONS DATA FOR D399 JWAC PCTA PRECHAMBER ENGINES

POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTICULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
					1300 RPM						
960.4	100.0	1376.9	240.4	12209.4	833.8	40.5	0.05	228.3	493.3	6100.5	25.1
716.4	75.0	1036.3	238.4	8996.4	902.7	63.0	0.02	73.5	415.6	4905.9	27.3
482.8	50.0	691.5	242.8	6242.4	718.6	63.0	0.02	56.1	365.6	3748.2	30.7
242.5	25.0	347.5	288.5	3396.6	947.0	340.5	0.04	84.6	287.8	2824.5	40.8
19.4	2.0	27.6	1562.3	413.1	1902.1	513.0	0.09	164.7	115.6	2444.1	92.6
					1200 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTICULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
976.1	100.0	1515.5	237.5	11016.0	1800.0	75.5	0.02	87.7	510.0	5855.0	24.4
732.1	75.0	1136.9	231.3	8445.6	1350.0	83.7	0.02	68.0	438.9	4538.2	25.5
490.3	50.0	761.2	235.3	5875.2	900.0	133.5	0.02	52.1	392.2	3477.7	29.8
246.3	25.0	382.7	268.6	3121.2	900.0	291.8	0.03	62.1	293.3	2764.5	41.5
17.9	2.0	27.6	1285.7	1101.6	1800.0	978.6	0.07	115.7	154.4	2208.2	104.2
					1000 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTICULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
813.4	100.0	1515.5	234.1	9180.0	1296.0	67.5	0.02	65.3	537.8	4362.7	21.5
611.9	75.0	1140.4	231.8	6572.9	990.0	54.5	0.02	49.5	493.3	3304.5	22.4
408.2	50.0	761.2	229.3	4957.2	918.0	44.1	0.02	37.9	426.7	2531.4	25.6
205.2	25.0	382.7	258.1	2754.0	918.0	115.2	0.03	47.6	287.8	2117.7	40.2
14.9	2.0	27.6	1393.0	918.0	1152.0	892.4	0.05	67.7	115.6	1809.1	117.6

The nominal values of NOx, CO, HC, and particulates have been multiplied by the factors 1.2 1.8 2.0 1.5 respectively to take into account measurement and engine variability. If the nominal values are desired, the table values may be divided by the respective factors.
This is Caterpillar's best estimate of the emissions of your engine.
If exact emissions data is required, an emissions test will be needed on your engine.

EMISSIONS DATA FOR D399 SCAC (85) PRECHAMBER ENGINES											
			WATER COOLED EXHAUST MANIFOLDS								
					1300 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTIC-ULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
960.4	100.0	1376.9	240.4	8148.2	833.8	40.5	0.08	350.8	422.8	5858.2	25.3
716.4	75.0	1036.3	238.4	6005.6	902.7	63.0	0.04	141.5	372.2	4727.3	27.6
482.8	50.0	691.5	242.8	3672.0	718.6	63.0	0.05	139.5	320.0	3725.9	31.7
242.5	25.0	347.5	288.5	2034.3	947.0	340.5	0.06	130.4	239.4	2903.6	41.4
19.4	2.0	27.6	1562.3	413.1	1902.1	513.0	0.09	170.3	145.0	2527.7	83.3
					1200 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTIC-ULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
976.1	100.0	1515.5	237.5	7993.9	882.7	75.5	0.06	251.2	437.2	5592.3	23.1
732.1	75.0	1136.9	231.3	6159.8	710.1	83.7	0.04	133.8	390.0	4467.3	25.3
490.3	50.0	761.2	235.3	4360.5	622.6	133.5	0.03	79.1	332.8	3521.8	29.5
246.3	25.0	382.7	268.6	2407.0	816.5	291.8	0.05	103.7	239.4	2771.4	40.8
17.9	2.0	27.6	1285.7	405.8	2553.7	978.6	0.09	162.5	135.6	2411.4	89.3
					1000 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTIC-ULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
813.4	100.0	1515.5	234.1	6510.5	1102.3	137.0	0.12	373.1	483.9	4154.1	20.8
611.9	75.0	1140.4	231.8	4828.7	501.7	108.9	0.05	119.9	430.6	3204.5	21.6
408.2	50.0	761.2	229.3	3787.7	277.7	88.2	0.03	56.1	353.3	2495.5	25.6
205.2	25.0	382.7	258.1	2607.1	416.3	115.2	0.06	95.4	227.8	2125.0	39.1
14.9	2.0	27.6	1393.0	284.6	3761.1	892.4	0.06	85.9	116.1	1912.3	90.9
					800 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTIC-ULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
355.2	100.0	827.4	231.3	2597.9	318.2	52.5	0.10	138.9	406.1	1855.0	21.5
267.2	75.0	622.6	227.7	2653.0	266.6	46.4	0.07	88.0	317.8	1679.1	26.5
177.6	50.0	413.7	242.8	1909.4	257.9	69.5	0.07	83.5	237.2	1593.2	35.9
89.6	25.0	208.9	294.0	840.9	458.1	89.4	0.05	57.6	163.3	1540.0	57.4
10.4	3.0	24.1	1390.3	110.2	2694.8	863.3	0.04	45.4	103.3	1514.5	102.9
					475 RPM						
POWER KW	% LOAD	BMEP KPA	S FUEL CONSUM GM/KW-H	NOx AS NO2 GM/HR	CO GM/HR	TOTAL HC's GM/HR	CAT SMOKE	PARTIC-ULATES GM/HR	EXHAUST STACK TEMP C	EXHAUST MASS KG/HR	A/F
5.3	IDLE	20.7	1439.3	88.1	2202.5	507.0	0.08	53.8	84.4	898.6	116.3

The nominal values of NOx, CO, HC, and particulates have been multiplied by the factors 1.2 1.8 2.0 1.5 respectively to take into account measurement and engine variability. If the nominal values are desired, the table values may be divided by the respective factors.
This is Caterpillar's best estimate of the emissions of your engine.
If exact emissions data is required, an emissions test will be needed on your engine.

Frontier Discoverer Boilers Emission Factors

Clayton Industries

TYPICAL GENERATOR EMISSIONS : LIGHT OIL - #2 DIESEL

August 1, 2001

	BOILER HORSE POWER		150	150 SE	200	200 SE	250	250 SE	300	300 SE
	ASSUMED EFFICIENCY, %		85	87	84	87	84	87	84	87
	RATED INPUT	(MMBTU/HR)	5.907	5.772	7.970	7.695	9.963	9.619	11.955	11.543
	FLUE GAS RATE	(SCFM)	1152	1126	1555	1501	1943	1876	2332	2252
	FLUE GAS RATE	(ACFM) 400 F	1891	1848	2552	2464	3190	3080	3828	3696
	FLUE GAS RATE	(LBS/HR)	5272	5151	7114	6868	8892	8585	10671	10303
	EXH STACK DIA.	(IN)	18	18	18	18	24	24	24	24
	FLUE VELOCITY	(FT/S) 400 F	17.8	17.4	24.1	23.2	16.9	16.3	20.3	19.6
	NOx	PPMV	150	150	150	150	170	170	226	226
		LBS/DAY	28.5	27.9	38.5	37.1	54.5	52.6	86.9	83.9
	CO	PPMV	100	100	100	100	100	100	100	100
		LBS/DAY	11.0	10.7	14.8	14.3	18.5	17.9	22.3	21.5
note 2	SO2 (est)	PPMV	153	153	153	153	153	153	153	153
		LBS/DAY	40	39	54	53	68	66	82	79
notes 4 & 7	PARTICULATES (est)	LBS/DAY	3.3	3.3	4.5	4.4	5.6	5.4	6.8	6.5
notes 4	VOC (est)	LBS/DAY	0.20	0.20	0.27	0.26	0.34	0.33	0.41	0.40
notes 4 & 8	TOC (est)	LBS/DAY	0.26	0.25	0.34	0.33	0.43	0.42	0.52	0.50

	BOILER HORSE POWER		350	350 SE	400	400 SE	500	500 SE	600	600 SE
	ASSUMED EFFICIENCY, %		84	87	83	87	83	86	85	87
	RATED INPUT	(MMBTU/HR)	13.948	13.467	16.133	15.391	20.166	19.462	23.629	23.086
	FLUE GAS RATE	(SCFM)	2721	2627	3147	3002	3933	3796	4609	4503
	FLUE GAS RATE	(ACFM) 400 F	4466	4312	5165	4928	6457	6232	7566	7392
	FLUE GAS RATE	(LBS/HR)	12449	12020	14399	13737	17998	17371	21090	20605
	EXH STACK DIA.	(IN)	24	24	32	32	32	32	32	32
	FLUE VELOCITY	(FT/S) 400 F	23.7	22.9	15.4	14.7	19.3	18.6	22.6	22.1
	NOx	PPMV	230	230	170	170	190	190	250	250
		LBS/DAY	103.2	99.6	88.2	84.2	123.3	119.0	190.0	185.7
	CO	PPMV	100	100	100	100	100	100	100	100
		LBS/DAY	26.0	25.1	30.0	28.7	37.5	36.2	44.0	43.0
note 2	SO2 (est)	PPMV	153	153	153	153	153	153	153	153
		LBS/DAY	95	92	110	105	138	133	161	158
notes 4 & 7	PARTICULATES (est)	LBS/DAY	7.9	7.6	9.1	8.7	11.4	11.0	13.4	13.1
notes 4	VOC (est)	LBS/DAY	0.48	0.46	0.55	0.53	0.69	0.67	0.81	0.79
notes 4 & 8	TOC (est)	LBS/DAY	0.60	0.58	0.70	0.66	0.87	0.84	1.02	1.00

NOTES:
1) EMISSION DATA GIVEN FOR MAXIMUM CONTINUOUS FIRING RATE. (15% EXCESS AIR). PPMV VALUES CORRECTED TO 3% O2.
2) VALUES FOR SULFUR DIOXIDE ASSUME: 92.5% CONVERSION FROM SULFUR CONTENT IN FUEL, 0.3% BY WEIGHT .
3) DATA BASED ON 19500 BTU/# LIGHT OIL.
4) ESTIMATED VALUES BASED ON TYPICAL INDUSTRY DATA.
5) INDICATED VALUES ARE TYPICAL ONLY. ACTUAL VALUES WILL VARY WITH ACTUAL OPERATING CONDITIONS.
6) CONSULT FACTORY FOR GUARANTEED VALUES.
7) APPROXIMATELY 61% FILTERABLE OF WHICH APPROXIMATELY HALF IS PM10. REMAINING 39% IS CONDENSABLE AND LESS THAN ONE MICRON OF WHICH 65% IS INORGANIC.
8) APPROXIMATELY 21% BY WEIGHT IS METHANE.

EMISSION.WQ1 BG

TABLE 4

Fennica/Nordica Main Engines Emission Factors

-----Original Message-----
From: Niemelä Helena [mailto:Helena.Niemela@finstaship.fi]
Sent: Wednesday, October 25, 2006 10:33 AM
To: Craik, Keith KM SIEP-EPW
Cc: Power, Alan T SEPCO; Kondratjeff Peter
Subject: Emissions

Keith,

I trust you have already received this report of Viking's and the information about Fennica´s emissions, but I'm still sending them just in case.

Emissions

Engine loads	100 %	75 %	50 %
No_x [g/kWh]	11,5	12	11,5
CO [g/kWh]	0,4	0,45	0,6
THC as CH_4 [g/kWh]	0,4	0,6	0,8
CO_2 [g/kWh]	620	620	645
SO_2 [g/kWh]*	2	2	2

* Sulphur content of fuel is 0,5%

Could you please tell me if you have some sort of a plan concerning the emission minimizing in any way? Could you in any way prioritise the emissions? This would help us in order to plan and inquire more information about any possible modifications or installations etc to Fennica.

Regards,
Helena

Helena Niemelä
FINSTASHIP / Offshore
e-mail: helena.niemela@finstaship.fi
tel. +358 306 20 7108
mob. +358 46 876 7108

Pt. Barrow Tug Main Engines Emission Factors

EMISSIONS DATA

EPA TIER-2 2006 - ** B5

Gaseous emissions data measurements are consistent with those described in EPA 40 CFR PART 89 SUBPART D and ISO 8178 for measuring HC, CO, PM, and NOx.

Gaseous emissions values are WEIGHTED CYCLE AVERAGES and are in compliance with the following non-road regulations:

LOCALITY	AGENCY/LEVEL	MAX LIMITS - g/kw-hr		
U.S. (incl Calif)	EPA/TIER-2	CO:3.5	NOx + HC:6.4	PM:0.20

EXHAUST STACK DIAMETER	10 IN
WET EXHAUST MASS	18,679.7 LB/HR
WET EXHAUST FLOW (638.60 F STACK TEMP)	8,754.51 CFM
WET EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	3,967.00 STD CFM
DRY EXHAUST FLOW RATE (32 DEG F AND 29.98 IN HG)	3,633.88 STD CFM
FUEL FLOW RATE	74 GAL/HR

RATED SPEED "Not to exceed data"

ENGINE SPEED RPM	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT	DRY SMOKE OPACITY PERCENT	BOSCH SMOKE NUMBER
1800	100	1502	20.54	1.84	0.70	.180	12.60	1.1	1.28
1800	75	1127	11.14	1.78	0.76	.230	13.20	1.8	1.28
1800	50	751	5.78	2.11	0.73	.270	13.90	2.2	1.28
1800	25	376	4.88	2.76	0.60	.280	15.10	3.5	1.28
1800	10	150	4.00	3.12	0.72	.180	16.60	2.7	1.28

RATED SPEED "Nominal Data"

ENGINE SPEED RPM	PERCENT LOAD	ENGINE POWER BHP	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	TOTAL CO2 LB/HR	PART MATTER LB/HR	OXYGEN IN EXHAUST PERCENT	DRY SMOKE OPACITY PERCENT	BOSCH SMOKE NUMBER
1800	100	1502	17.12	1.02	0.53	1,605.2	0.130	12.60	1.1	1.28
1800	75	1127	9.29	0.99	0.57	1,285.4	0.170	13.20	1.8	1.28
1800	50	751	4.81	1.17	0.55	955.9	0.200	13.90	2.2	1.28
1800	25	376	4.07	1.54	0.45	546.9	0.200	15.10	3.5	1.28
1800	10	150	3.33	1.73	0.54	326.2	0.130	16.60	2.7	1.28

INTERMEDIATE SPEED "Not to exceed data"

ENGINE SPEED RPM	PERCENT LOAD	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	PART MATTER LB/HR	O2 IN EXHAUST PERCENT	O2(DRY) SMOKE OPAC PERCENT	O2(DRY) BOSCH SMKE NO.
1350	100	11.13	2.89	0.35	0.230	10.82	2.4	1.28
1350	75	7.42	3.01	0.38	0.230	11.29	3.1	1.28
1350	50	5.31	2.14	0.40	0.130	12.28	2.7	1.28
1350	25	3.82	2.94	0.87	0.110	14.63	1.1	1.28
1350	10	1.96	6.03	2.60	0.350	16.91	0.3	1.28

INTERMEDIATE SPEED "Nominal Data"

ENGINE SPEED RPM	PERCENT LOAD	TOTAL NOX (AS NO2) LB/HR	TOTAL CO LB/HR	TOTAL HC LB/HR	TOTAL CO2 LB/HR	PART MATTER LB/HR	O2 IN EXHAUST PERCENT	O2(DRY) SMOKE OPAC PERCENT	O2 (DRY) BOSCH SMKE NO.
1350	100	9.27	1.61	0.27	1,340.5	0.160	10.82	2.4	1.28
1350	75	6.18	1.67	0.29	1,058.2	0.160	11.29	3.1	1.28
1350	50	4.42	1.19	0.30	727.4	0.090	12.28	2.7	1.28
1350	25	3.19	1.64	0.65	403.2	0.080	14.63	1.1	1.28
1350	10	1.64	3.35	1.96	226.4	0.250	16.91	0.3	1.28

Altitude Capability Data(Corrected Power Altitude Capability)

Ambient Operating Temp. / Altitude	50 F	68 F	86 F	104 F	122 F	NORMAL
0 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp
984 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp
1,640 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp
3,281 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp
4,921 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp
6,562 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,502 hp
8,202 F	1,502 hp	1,502 hp	1,502 hp	1,502 hp	1,482 hp	1,502 hp
9,843 F	1,502 hp	1,502 hp	1,483 hp	1,436 hp	1,392 hp	1,502 hp
10,499 F	1,502 hp	1,495 hp	1,446 hp	1,400 hp	1,356 hp	1,502 hp

The powers listed above and all the Powers displayed are Corrected Powers

Pt. Barrow Tug Generators Emission Factors

From: Blazevich, Chris [mailto:CBlazevich@NCPowerSystems.com]
Sent: Tuesday, October 17, 2006 8:50 AM
To: Stich, Brian
Cc: Phillips, Mark
Subject: FW: 3304b emissions

Brian,

Here is what I received from Cat on the 3304 generator. Notice that this is a dry manifold and you have a water cooled manifold but I hope this will work for you. Please let me know if you have any other questions.

Best regards,

Chris Blazevich

NC Power Systems CO.

Office 425-251-6438

Cell 425-241-0817

From: McClanahan, Brandon
Sent: Tuesday, October 17, 2006 8:07 AM
To: Blazevich, Chris
Subject: 3304b emissions

*** Vijay Tamma : TU 10/17/2006 08:24 CST ***

Emissions data for wet manifold engine is not available. Below are theestimates based on the dry manifold engine data. Thease are only estimates. If exact values are needed, then an emissions test maybe needed for your engine. Numbers below are at 100% load and are in grams/hour units.

HC - 29

CO - 274

NOx - 1458

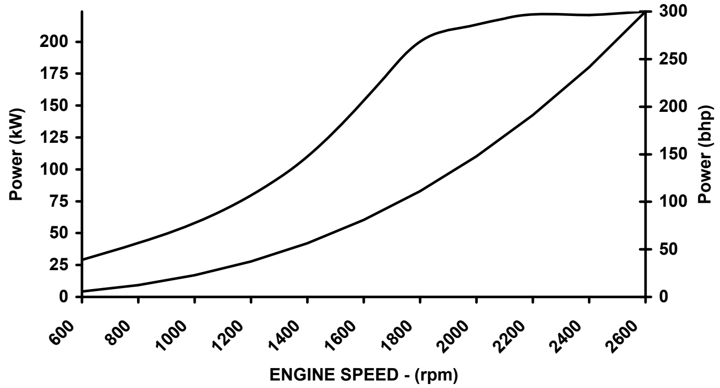
PM - 31

Kvichak Work Boats Main Engines Emission Factors

CUMMINS MERCRUISER DIESEL Charleston, SC 29405 Marine Performance Curves	Basic Engine Model: **QSB5.9-305 MCD** Engine Configuration: **D403075MX03**	Curve Number: **M-91365** CPL Code: **8464** Date: **1-Jan-06**

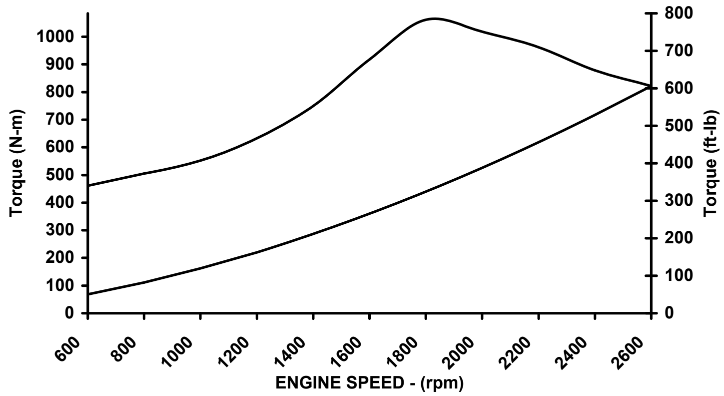
Displacement:	**5.9 liter**	**[359 in^3]**	
Bore:	**102 mm**	**[4.02 in]**	Advertised Power: kW [bhp, mhp] @ rpm **224 [300, 305] @ 2600**
Stroke:	**120 mm**	**[4.72 in]**	
Fuel System:	**HPCR**		Aspiration: **Turbocharged / Sea Water Aftercooled**
Cylinders:	**6**		Rating Type: **Medium Continuous Duty**

CERTIFIED: This marine diesel engine is certified to the model year requirements of EPA Marine Tier 2 per 40 CFR 94 and conforms with the NOx requirements of the International Maritime Organization (IMO), MARPOL 73/78 Annex VI, Regulation 13 as applicable.



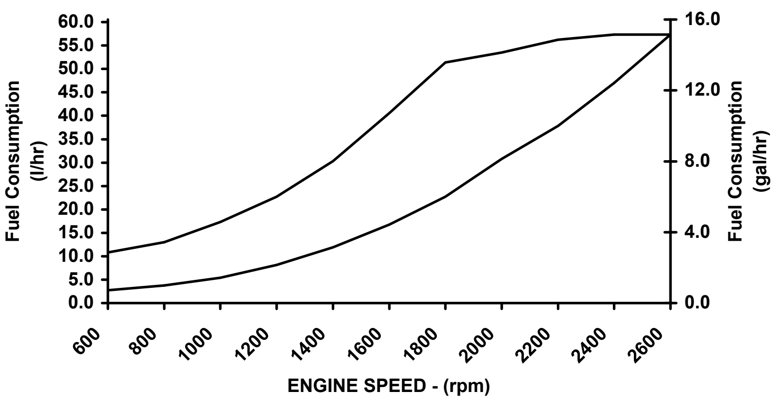
RATED POWER OUTPUT CURVE

rpm	kW	bhp
2600	224	300
2400	221	296
2200	222	297
2000	213	286
1800	200	268
1600	154	206
1400	110	147
1200	80	107
1000	58	77
800	42	57
600	29	39



FULL LOAD TORQUE CURVE

rpm	N-m	ft-lb
2600	822	606
2400	879	648
2200	961	709
2000	1018	751
1800	1062	783
1600	918	677
1400	750	553
1200	633	467
1000	552	407
800	506	373
600	461	340



FUEL CONSUMPTION - PROP CURVE

rpm	l/hr	gal/hr
2600	57.3	15.1
2400	47.0	12.4
2200	37.9	10.0
2000	30.8	8.1
1800	22.7	6.0
1600	16.8	4.4
1400	11.9	3.1
1200	8.1	2.1
1000	5.4	1.4
800	3.8	1.0
600	2.7	0.7

Rated Conditions: Ratings are based upon ISO 8665 and SAE J1228 reference conditions; air pressure of 100 kPa [29.612 in Hg], air temperature 25 deg. C [77 deg. F] and 30% relative humidity. Power is in accordance with IMCI procedure. Member NMMA.

Rated Curves (upper) represents rated power at the crankshaft for mature gross engine performance capabilities obtained and corrected in accordance with ISO 3046. Propeller Curve (lower) is based on a typical fixed propeller demand curve using a 2.7 exponent. Propeller Shaft Power is approximately 3% less than rated crankshaft power after typical reverse/reduction gear losses and may vary depending on the type of gear or propulsion system used.

Fuel Consumption is based on fuel of 35 deg. API gravity at 16 deg. C [60 deg. F0 having LHV of 42,780 kj/kg [18390 Btu/lb] and weighing 838.9 g/liter [7.001 lb/U.S. gal].

Medium Continuous Rating: This power rating is intended for continuous use in variable load applications where full power is limited to six (6) hours out of every twelve (12) hours of operation. Also, reduced power operations must be at or below 200 RPM of the maximum rated RPM. This is an ISO 3046 Fuel Stop Power Rating and is for applications that operate 3,000 hours per year or less.

James D Kahlenbeck

CHIEF ENGINEER

Marine Engine Performance Data

Curve No.: M-91365
DS-3075
DATE: 01Jan06

General Engine Data

Engine Model		QSB5.9-305 MCD
Rating Type		Med. Cont. Duty
Rated Engine Power	kW [bhp]	224 [300]
Rated Engine Speed	rpm	2600
Rated HP Production Tolerance	±%	5
Rated Engine Torque	N•m [ft•lb]	822 [606]
Peak Engine Torque @ 1800 rpm	N•m [ft•lb]	1062 [783]
Brake Mean Effective Pressure	kPa [psi]	1755 [255]
Indicated Mean Effective Pressure	kPa [psi]	N/A
Minimum Idle Speed Setting	rpm	600
Normal Idle Speed Variation	±rpm	10
High Idle Speed Range — Minimum	rpm	2665
High Idle Speed Range — Maximum	rpm	2685
Maximum Allowable Engine Speed	rpm	2685
Maximum Torque Capacity from Front of Crank[2]	N•m [ft•lb]	468 [345]
Compression Ratio		17.2:1
Piston Speed	m/sec [ft/min]	10.4 [2045]
Firing Order		1-5-3-6-2-4
Weight (Dry) Engine only - Average	kg [lb]	N.A.
Weight (Dry) Engine With Heat Exchanger System - Average	kg [lb]	612 [1350]
Weight Tolerance (Dry) Engine only - Average	kg [lb]	N.A.

Noise and Vibration

Average Noise Level – Top	(Idle)	dBA @ 1m	76
	(Rated)	dBA @ 1m	97
Average Noise Level – Right Side	(Idle)	dBA @ 1m	76
	(Rated)	dBA @ 1m	98
Average Noise Level – Left Side	(Idle)	dBA @ 1m	77
	(Rated)	dBA @ 1m	107
Average Noise Level – Front	(Idle)	dBA @ 1m	76
	(Rated)	dBA @ 1m	98

Fuel System[1]

Average Fuel Consumption – ISO 8178 E3Standard Test Cycle	l/hr [gal/hr]	38.7 [10.2]
Fuel Consumption @ Rated Speed	l/hr [gal/hr]	57 [15]
Approximate Fuel Flow to Pump	l/hr [gal/hr]	189 [50]
Maximum Allowable Fuel Supply to Pump Temperature	°C [°F]	60 [140]
Approximate Fuel Flow Return to Tank	l/hr [gal/hr]	132 [35]
Approximate Fuel Return to Tank Temperature	°C [°F]	66 [150]
Maximum Heat Rejection to Drain Fuel[5]	kW [Btu/min]	2 [99]
Fuel Transfer Pump Pressure Range	kPa [psi]	76 [11]
Fuel Rail Pressure — Gauge	kPa [psi]	N.A.
Fuel Rail Pressure — INSITE	kPa [psi]	135,999 [19,725]

Air System[1]

Intake Manifold Pressure	kPa [in Hg]	172 [51]
Intake Air Flow	l/sec [cfm]	278 [58]
Heat Rejection to Ambient	kW [Btu/min]	32 [1810]
Maximum Air Cleaner Inlet Temperature Rise Over Ambient	°C [°F]	17 [30]

Exhaust System[1]

Exhaust Gas Flow	l/sec [cfm]	600 [1272]
Exhaust Gas Temperature — Turbine Out	°C [°F]	421 [789]
Exhaust Gas Temperature — Manifold	°C [°F]	559 [1038]

TBD = To Be Decided **N/A = Not Applicable** **N.A. = Not Available**

[1]All Data at Rated Conditions
[2]Consult Installation Direction Booklet for Limitations
[3]Heat rejection values are based on 50% water/ 50% ethylene glycol mix and do NOT include fouling factors. If sourcing your own cooler, a service fouling factor should be applied according to the cooler manufacturer's recommendation.
[4]Consult option notes for flow specifications of optional Cummins seawater pumps, if applicable.
[5]May not be at rated load and speed. Maximum heat rejection may occur at other than rated conditions.

CUMMINS ENGINE COMPANY, INC.
COLUMBUS, INDIANA

All Data is Subject to Change Without Notice - Consult the following Cummins intranet site for most recent data: http://www.cummins.com

Marine Engine Performance Data

Curve No.: M-91365
DS-3075
DATE: 01Jan06

Emissions (in accordance with ISO 8178 Cycle E3)

NOx (Oxides of Nitrogen)	g/kw·hr [g/hp·hr]	6.227 [4.644]
HC (Hydrocarbons)	g/kw·hr [g/hp·hr]	0.104 [0.078]
CO (Carbon Monoxide)	g/kw·hr [g/hp·hr]	0.208 [0.155]
PM (Particulate Matter)	g/kw·hr [g/hp·hr]	0.103 [0.077]

Cooling System[1]

Sea Water Pump Specifications	MAB 0.08.17-07/16/2001	
Pressure Cap Rating (With Heat Exchanger Option)	kPa [psi]	103 [15]

Sea Water Aftercooled Engine (SWAC)

Coolant Flow to Engine Heat Exchanger	l/min [gal/min]	238 [63]
Standard Thermostat Operating Range Start to Open	°C [°F]	74 [165]
Full Open	°C [°F]	85 [185]
Heat Rejection to Engine Coolant[3]	kW [Btu/min]	166 [9470]

Engines with Low Temperature Aftercooling (LTA)
Single Loop LTA

Coolant Flow to Cooler (with blocked open thermostat)	l/min [gal/min]	238 [63]
LTA Thermostat Operating Range Start to Open	°C [°F]	66 [150]
Full Open	°C [°F]	80 [175]
Heat Rejection to LTA Coolant[3]	kW [Btu/min]	183 [10420]
Maximum LTA Coolant Return Temperature	°C [°F]	54 [130]

TBD = To Be Decided **N/A = Not Applicable** **N.A. = Not Available**

1All Data at Rated Conditions
2Consult Installation Direction Booklet for Limitations
3Heat rejection values are based on 50% water/ 50% ethylene glycol mix and do NOT include fouling factors. If sourcing your own cooler, a service fouling factor should be applied according to the cooler manufacturer's recommendation.
4Consult option notes for flow specifications of optional Cummins seawater pumps, if applicable.
5May not be at rated load and speed. Maximum heat rejection may occur at other than rated conditions.

CUMMINS ENGINE COMPANY, INC.
COLUMBUS, INDIANA

Kvichak Skimming Vessel Main Engines Emission Factors

Alaska Diesel Electric

ENGINE EXHAUST EMISSIONS TEST
FOR MARPOL 73/78 ANNEX VI NOx LIMITS

Purpose of Test:	Verify compliance with MARPOL/IMO NOx Limit			
Test Date: 3/13/00	Test Number: 1		Engine Tech:	GW
Fuel Type: D2	Test Cycle: E-3 Marine		Emissions Tech:	GW
Engine Type:	L6140AL2KC		Project Leader:	DG
Aspiration: Turbo	Serial #: 1401-1920			
Engine Rating:	H.P.	700 @ RPM	2,100	
Comments:	21deg timing			
File Name	E-331300-1			

A. ENGINE PERFORMANCE DATA	Mode 1	Mode 2	Mode 3	Mode 4
MANIFOLD PRESSURE, PSIG	38.1	29.5	15.9	5.2
Engine Torque (ft-lb)	1751	1444	1094	696
Engine Power (bhp)	700	525	350	175
Engine power (kw)	522	392	261	131
Fuel Flow (kg/hr)	125.74	78.72	58.92	29.03
Intake Air (dry kg/hr)	2898	2153	1560	803
Exhaust flow (dry kg/hr)	3023	2231	1619	832
Engine RPM	2100	1910	1680	1320
Engine RPM % of Rated	1.00	0.91	0.80	0.63
Engine Load % of Rated	1.00	0.75	0.50	0.25
BSFC (lbs fuel/bhp-hr)	0.396	0.331	0.371	0.366
Exhaust Gas Temp. (deg F)	754	642	655	603
KC RETURN TEMP, DEG F.	130	130	130	130
B. GASEOUS EMISSIONS FUEL WT1	43	25	44	39
FUEL WT2	29.14	15.36	35.34	32.6
NOx (dry ppmv)	930	930	1135	1381
CO (dry ppmv)	226	69	74	115
O2 (%)	9.7	11.4	11.1	11.5
CO2 (%)	8.4	7.1	7.4	7.1
SMOKE	0.4	0.5	0.2	0.5
C. EXHAUST EMISSIONS ANALYSIS				
FUELTIME	3	3.333	4	6
Mode Weighting Factors	0.2	0.5	0.15	0.15
Weighted Specific NOx (gms/kw-hr)	2.40	4.44	1.18	0.74
Weighted Specific CO (gms/kw-hr)	0.38	0.09	0.07	0.05

D. RESULTS

Total Mode Weighted NOx	**8.76 gms/kw-hr**	**6.53 gms/bhp-hr**
Total Mode Weighted CO	**0.59 gms/kw-hr**	**0.44 gms/bhp-hr**

MARPOL NOx Limit **9.8 gms/kw-hr**

PASS/FAIL MARPOL NOx LIMITS PASS

APPENDIX C

ADEC Owner Request Limit Forms

OWNER REQUESTED LIMIT IDENTIFICATION FORM

Alaska Department of Environmental Conservation **Owner Requested Limit Application**	**ADEC USE ONLY** Receiving Date: ADEC Control #: ORL :

STATIONARY SOURCE IDENTIFICATION FORM

Section 1 Stationary Source Information

Stationary Source Name:Frontier Discoverer and associated vessels			
Project Name (if different): Frontier Discoverer Exploration Drilling Program	Stationary Source Contact:Steve Meehen		
Source Physical Address:Beaufort Sea OCS Waters	City:Houston	State:TX	Zip:77002
	Telephone:713-481-7500		
	E-Mail Address:Smeehen@Frontier-drill.com		
UTM Coordinates or Latitude/Longitude:	Northing:	Easting:	Zone:
	Latitude:	Longitude:	

Section 2 Legal Owner

Name:Frontier Drilling USA, Inc		
Mailing Address:1000 Louisiana, Suite 1210		
City:Houston	State:TX	Zip:77002
Telephone #:713-481-7500		
E-Mail Address:Smeehen@Frontier-drill.com		

Section 3 Operator *(if different from owner)*

Name:Shell Offshore, Inc.		
Mailing Address:701 Poydras Street		
City:New Orleans	State:LA	Zip:70139
Telephone #:504-728-7673		
E-Mail Address:Robert.McAlister@Shell.com		

Section 4 Designated Agent *(for service of process)*

Name:ASRC Energy Services, RTS		
Mailing Address:3900 C Street, Suite 601		
City Anchorage	State:AK	Zip:99503
Physical Address:Same		
City:	State:	Zip:
Telephone #:907-339-5486		
E-Mail Address:Greg.Horner@asrecenergy.com		

Section 5 Billing Contact Person *(if different from owner)*

Name:		
Mailing Address:		
City:	State:	Zip:
Telephone #:		
E-Mail Address:		

Section 6 Application Contact

Name:Wayne Wooster, Air Sciences, Inc.			
Mailing Address:421 SW 6th Ave Ste 1400	City:Portland	State:OR	Zip:97204
	Telephone:503-525-9394 ext. 15		
	E-Mail Address:wwooster@airsci.com		

Section 7 Certification

This certification applies to the Air Quality Control Owner Requested Limit Application for the Discoverer (Stationary Source Name)
submitted to the department on: 12/29/06 .

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:	Date:12/29/06
Printed Name: Susan Childs	Title:Regulatory Coordinator, Alaska

Section 13 Attachments

☒ Attachments Included. List attachments: Fuel use limitations
Fuel sulfur content limitation

APPENDIX D

40 CFR Part 55 NOI Letters

40 CFR 55.4 Requirements to Submit a Notice of Intent

Notice of Intent (NOI) to submit an Application for Preconstruction Permit Frontier Discoverer 2007-2009 Beaufort Sea Exploratory Drilling Program

Shell Offshore, Inc. (SOI) hereby submits the information below pursuant to the 40 CFR Part 55 Outer Continental Shelf (OCS) Air Regulations, Section 55.4 Requirements to submit a notice of intent. Paragraph 55.4(b) lists nine specific requirements for exploratory sources to include in the notice of intent (NOI). Each of the requirements is paraphrased below followed by SOI's response.

Requirement No. 1 - 40 CFR 55.4(b)(1): General company information.

The pertinent owner, owner's agent, operator, and facility contact information is presented in Table 1.

Table 1: Company and Operator Information

Owner	
Name	Frontier Drilling USA, Inc.
Address	1000 Louisiana, Suite 1210, Houston, TX 77002
Contact	Steve Meehen
Contact phone number	(713) 481-7500
Contact e-mail address	smeehen@frontier-drill.com
Operator	
Name	Shell Offshore, Inc.
Address	701 Poydras Street, New Orleans, LA 70139
Contact	Keith Craik
Contact phone number	(713) 546-6669
Contact e-mail address	keith.craik@shell.com
Agent	
Name	ASRC Energy Services, RTS
Address	3900 C Street, Suite 601, Anchorage, AK 99503
Contact	Greg Horner
Contact phone number	(907) 339-5486
Contact e-mail address	greg.horner@asrcenergy.com

Requirement No. 2 - 40 CFR 55.4(b)(2): Facility description.

The Frontier Discoverer Exploratory Drilling Program will be an exploration project conducting exploratory oil and gas drilling operations (North American Industry Classification System

[NAICS] code 211111 Crude Petroleum and Natural Gas Extraction) on SOI's oil and gas lease-holdings on federal OCS waters located in the Beaufort Sea. The proposed drilling sites are located on federal OCS waters between longitude 144 degrees W and longitude 151 degrees W. SOI's leases in the Beaufort Sea exist, at their closest point, approximately nine miles north of Point Thomson shoreline and five miles northwest of Barter Island shoreline for the eastern lease-holding locations, and twelve miles north of Anachlik Island shoreline for the western lease-holding locations.

The project is scheduled to last three drilling seasons (2007, 2008, and 2009) lasting up to 120 days per calendar year, weather and ice conditions permitting. SOI anticipates drilling operations per drill site will range from 30 to 60 days. SOI, therefore, anticipates drilling up to three drill site locations per year. The drilling season is projected to run from approximately August 1 through November 30 each year, again weather and ice conditions permitting SOI intends to conduct a three-year exploratory drilling program, 2007 through 2009, although drilling activity may occur in 2010 and 2011 if ice conditions prevent significant exploratory drilling activity in 2007, 2008, or 2009. The project is scheduled to begin in mid-to-late July 2007 and end December 1, 2009, but may extend into 2010 and 2011 if ice and weather conditions limit the extent of drilling in 2007, 2008, or 2009.

The Frontier Discoverer Exploratory Drilling Program will consist of several vessels. The primary exploration drilling activities will be conducted from the Frontier Discoverer, a self-propelled drilling vessel. The Frontier Discoverer will be supported by a number of associated support vessels. The associated support vessels will include two icebreaker vessels, a re-supply ship, and an oil spill response (OSR) fleet. The Kapitan Dranitsyn will perform primary ice management duty (icebreaking). The Fennica or its identical sister vessel, the Nordica, will assist the Kapitan Dranitsyn with ice management duty in 2007 through 2009. The Jim Kilabuk will serve as the re-supply vessel. The OSR fleet will consist of one larger OSR vessel and a number of smaller boats. Photographs and diagrams of the Frontier Discoverer and associated support vessels will be provided in the air permit application.

The exploratory drilling process consists of three phases, rig placement, drilling operations, and rig removal. The Frontier Discoverer will sail to the Beaufort Sea along with its supporting icebreaker vessels to the SOI lease-holding OCS drill site. One of the icebreakers will assist the Frontier Discoverer to maneuver and anchor it to the seabed and will then move away from the Frontier Discoverer to perform ice management duty. The Frontier Discoverer will perform its drilling operations and at operation completion of that drill site one of the icebreaker vessels will assist the Frontier Discoverer to pull anchors, sail with the Frontier Discoverer to the next drill site location, and then assist in the anchoring and ice management duty as described above. Meanwhile, the Jim Kilabuk will re-supply the Frontier Discoverer every two to three weeks. The

Frontier Discoverer OSR fleet will be stationed nearby the Frontier Discoverer in case of a spill and will conduct oil spill drill response exercises. At the end of the drilling season the two icebreaker vessels will assist the Frontier Discoverer to pull anchors and then sail out of the Arctic theater to Southeast Asia or other off-season operating location. A complete facility description will be provided in the air permit application.

Requirement No. 3 - 40 CFR 55.4(b)(3): Estimate of the proposed project's potential emissions (PTE).

Following September 2006, EPA Region 10 (EPA) guidance SOI has defined the Frontier Discoverer drilling vessel, when anchored or otherwise attached to the seabed at each drill site, as a separate "stationary source." EPA's September 2006 guidance further requires that the emissions from the project's associated support vessels be included in the "source" potential-to-emit (PTE) when the support vessels are within 25 miles of the anchored drilling vessel. These guidance interpretations are consistent with the OCS source definition found in 40 CFR 55.2. SOI intends to operate the Frontier Discoverer and its associated support vessels as a synthetic minor source that will not exceed 250 tons per drilling site per year of any new source review regulated air contaminant. The project's primary air contaminant is nitrogen oxides (NO_2) with lesser quantities of carbon monoxide (CO), small-diameter particulate matter (PM_{10}), volatile organic compounds (VOC), and sulfur dioxide (SO_2). The project's potential emissions will vary depending on the length of the drilling operations per drill site, the compliment of ice management vessels employed, and the severity of the ice conditions surrounding the drill site. For example, SOI estimates the Frontier Discoverer drilling vessel for a 43-day drilling operation will result in approximately 52 tons NO_x. The associated support vessels NO_x emissions may approach 193 tons, again depending on the icebreaker vessels combination employed and the severity of the ice conditions surrounding the Frontier Discoverer drilling vessel. The 2007 emissions estimated based on a 43-day drill site are presented in Table 2.

Table 2: Frontier Discoverer 2007 Emissions Estimate (Based on Projected 43-Day Drill Site Operation)

Emissions	NO_x (tpy)	CO (tpy)	PM_{10} (tpy)	VOC (tpy)	SO_2 (tpy)
Frontier Discoverer	51.8	6.7	1.7	0.9	4.7
Kapitan Dranitsyn	107.6	37.1	3.4	7.3	7.1
Nordica Emissions	80.5	2.9	1.7	2.8	5.4
Frontier Discoverer OSR Fleet	3.9	1.0	0.1	0.8	0.4
Jim Kilabuk	1.2	0.3	0.03	0.1	0.1
Total	245.0	47.9	7.0	11.8	17.7

SOI intends to limit drill operations at each drilling site (e.g., a fleet-wide fuel consumption limit) to ensure that no air contaminant exceeds 250 tons per year, i.e., a synthetic minor new source. SOI will accept federally enforceable operational limits to stay below the 250-ton-per-year major new source review threshold value.

Requirement No. 4 – 40 CFR 55.4(b)(4): Description of all emission points including associated vessels.

A complete description of the Frontier Discoverer Exploratory Drilling Program vessels, combustion sources identification, size rating, emission factor, hourly emissions, and project site yearly emissions will be provided in the air permit application. However, the dominant emission source for the project is the associated support vessel main propulsion engines. The support vessel main propulsion engines / electrical generators and auxiliary engines account for 98 percent to more than 99 percent of the support vessel emissions. As for the drilling vessel itself, the Frontier Discoverer propulsion engine, main drilling engines and deck cranes account for 95 percent to more than 98 percent of the drilling vessel emissions._All of the Frontier Discoverer and the associated marine support vessels combustion sources will consist of marine / non-road compression-ignition internal combustion engines, boilers, and heaters. All of these combustion sources will be diesel fuel fired. The engines will have the purpose of generating electricity, pumping, compressing, providing direct drive mechanical power, and for powering mobile machinery. SOI intends to collect generated on-site trash for off-site disposal / management and / or for incineration on one of the icebreaker incinerators. SOI does not intend to burn trash in the Frontier Discoverer's on-site trash incinerator. Nor does SOI intend to flare drilling well off-gases during the project.

Requirement No. 5 – 40 CFR 55.4(b)(5): Estimate of quantity and type of fuels and raw materials to be used.

The estimated diesel fuel consumption for the 43-day drilling operation described above is presented in Table 3.

Table 3: Frontier Discoverer Exploratory Drilling Program Diesel Fuel Consumption Estimate (Based on Projected 43-Day Drill Site Operation)

Material	Quantity	Units
Frontier Discoverer drilling vessel diesel fuel	0.36	Million gallons
Associated support vessels diesel fuel	1.07	Million gallons
Total Frontier Discoverer Exploratory Drilling Program diesel fuel	1.43	Million gallons

Requirement No. 6 – 40 CFR 55.4(b)(6): Description of proposed air pollution control equipment.

No add-on air pollution control equipment is being proposed for any of the Frontier Discoverer Exploratory Drilling Program emission sources.

Requirement No. 7 – 40 CFR 55.4(b)(7): Proposed limitations on source operations or any work practice standards affecting emissions.

SOI, since all combustion sources are diesel fuel fired, proposes to limit the project drill site emissions to less than 250 tons by monitoring diesel fuel consumption on each project vessel: the Frontier Discoverer drilling vessel, each of the icebreaker vessels, the re-supply vessel, and the combined OSR fleet. SOI proposes to calculate emissions from each vessel's fuel consumption by using an assigned vessel-wide emission factor (e.g., the icebreaker vessel main propulsion engine emission factor – lb / hp-hr), multiplied by fuel consumption and EPA AP42 average brake specific fuel consumption and diesel fuel heating values. SOI will then sum each vessel's emissions to determine the project fleet-wide emissions running total. SOI proposes to implement fuel consumption monitoring on each project vessel on a monthly and as necessary, a weekly basis, to ensure that the project-wide fuel consumption limits emissions to less than 250 tons per drill site per year. SOI believes the fleet-wide diesel fuel consumption can easily be monitored and documented. Fuel consumption can be measured weekly or daily, as necessary, by dipstick in the fuel tanks and documented as part of the operations procedures. SOI may need to install fuel meters on some of the emission sources.

Requirement No. 8 – 40 CFR 55.4(b)(8): Other information affecting emissions.

In March 2006, SOI and its contractors, ASRC Energy Services, RTS, and Air Sciences Inc., discussed with the EPA Region 10 staff the choice of an approved air quality model. EPA directed SOI and Air Sciences to model the project emissions with a conservative screening model, SCREEN3. The SCREEN3 model (which incorporates worst-case assumptions) frequently overestimates real-world impacts from the project. SOI will model the project emissions to demonstrate compliance with applicable air quality standards. SOI will include the modeled source characterization (i.e., short-term emission rate, stack heights, stack diameter, stack height, exit velocity, and temperature, etc.), model selection, meteorological data, background concentrations, evaluation methodology, and modeling results in the air permit application. In addition, SOI intends to obtain at least a 500-meter Safety Exclusion Zone from the United States Coast Guard to help keep non-project related people and vessels a safe distance away from the drilling vessel. SOI will model the project emissions to the 500-meter Safety Exclusion Zone as the point of ambient air. SOI will provide a copy of the United States Coast Guard Safety Exclusion Zone application to EPA under a separate cover letter from the air permit application.

Requirement No. 9 – 40 CFR 55.4(b)(9): Such other information as may be necessary to determine the applicability of onshore requirements.

The Corresponding Onshore Area (COA) for the Frontier Discoverer project is the Northern Alaska Intrastate Air Quality Control Region that has been classified by the Alaska Department of Environmental Conservation (ADEC) as Air Quality Class II area. ADEC suggested using the background ambient air quality concentrations measured at the Arctic North Slope Eastern Region (ANSER) for ambient air quality modeling purposes. SOI concurs with ADEC's recommendation that the ANSER background ambient air quality concentration is appropriate since no significant growth activity has occurred in the nearby areas of the western or eastern SOI lease-holding OCS blocks.

APPENDIX E

Modeling Calculations and SCREEN3 Model Output

Shell Discoverer - Beuafort Sea, Alaska
Modeling Calculations
12/13/2006

Averaging Period >	Distance (m)	Max. Modeled X/Q (μg*s/m^3*g) 1-hour	3-hour	8-hour	24-hour	Annual
Drill Rig: Discoverer						
Stack #1: 6 Main Drilling Engines	500 [A]	19.75	17.78	13.83	7.90	1.58
Stack #2: 2 Air Compressors	500 [A]	216.10	194.49	151.27	86.44	17.29
Stack #3: 2 HPP Engines	500 [A]	274.40	246.96	192.08	109.76	21.95
Stack #4: 2 Diesel Crane Engines	500 [A]	216.30	194.67	151.41	86.52	17.30
Stack #5: 2 Heat Boilers	500 [A]	109.50	98.55	76.65	43.80	8.76
Stack #6: 1 Logging Winch	500 [A]	452.80	407.52	316.96	181.12	36.22
Support Vessels: Discoverer Fleet						
Kapitan Dranitsyn	13,500 [B]	0.4102	0.37	0.29	0.16	0.03
Fennica/Nordica	6,000 [C]	1.041	0.94	0.73	0.42	0.08
Oil Response Ships - Discoverer	500 [A]	56.84	51.16	39.79	22.74	4.55
Jim Kilabuk - Discoverer	500 [A]	56.84	51.16	39.79	22.74	4.55

[A] Distance to exclusion zone (i.e. ambient air boundary).
[B] Center of primary icebreaker ice management activity to point of maximum impact.
[C] Center of secondary icebreaker ice management activity to point of maximum impact.

Source ID	# Stacks	Emissions (g/sec) 1-hour	3-hour	8-hour	24-hour	Annual	Max. Modeled X/Q (μg*s/m^3*g) 1-hour	3-hour	8-hour	24-hour	Annual	Max. Modeled Impact (μg/m^3) 1-hour	3-hour	8-hour	24-hour	Annual
NOx																
Drill Rig: Discoverer																
Stack #1: 6 Main Drilling Engines	1	---	---	---	---	1.93E+00	---	---	---	---	1.58	---	---	---	---	3.1
Stack #2: 2 Air Compressors	1	---	---	---	---	1.02E-01	---	---	---	---	17.29	---	---	---	---	1.8
Stack #3: 2 HPP Engines	1	---	---	---	---	5.54E-01	---	---	---	---	21.95	---	---	---	---	12.2
Stack #4: 2 Diesel Crane Engines	1	---	---	---	---	3.52E-01	---	---	---	---	17.30	---	---	---	---	6.1
Stack #5: 2 Heat Boilers	1	---	---	---	---	4.98E-02	---	---	---	---	8.76	---	---	---	---	0.4
Stack #6: 1 Logging Winch	1	---	---	---	---	6.74E-02	---	---	---	---	36.22	---	---	---	---	2.4
Support Vessels: Discoverer Fleet																
Kapitan Dranitsyn	1	---	---	---	---	1.09E+01	---	---	---	---	0.03	---	---	---	---	0.4
Fennica/Nordica	1	---	---	---	---	8.13E+00	---	---	---	---	0.08	---	---	---	---	0.7
Oil Response Ships - Discoverer	1	---	---	---	---	2.35E+00	---	---	---	---	4.55	---	---	---	---	10.7
Jim Kilabuk - Discoverer	1	---	---	---	---	2.82E+00	---	---	---	---	4.55	---	---	---	---	12.8
											NOx Total Impact >	---	---	---	---	50.5
PM_{10}																
Drill Rig: Discoverer																
Stack #1: 6 Main Drilling Engines	1	---	---	---	4.92E-01	6.07E-02	---	---	---	7.90	1.58	---	---	---	3.9	0.1
Stack #2: 2 Air Compressors	1	---	---	---	4.15E-02	5.11E-03	---	---	---	86.44	17.29	---	---	---	3.6	0.1
Stack #3: 2 HPP Engines	1	---	---	---	3.19E-01	3.93E-02	---	---	---	109.76	21.95	---	---	---	35.0	0.9
Stack #4: 2 Diesel Crane Engines	1	---	---	---	2.02E-01	2.49E-02	---	---	---	86.52	17.30	---	---	---	17.5	0.4
Stack #5: 2 Heat Boilers	1	---	---	---	4.72E-02	5.82E-03	---	---	---	43.80	8.76	---	---	---	2.1	0.1
Stack #6: 1 Logging Winch	1	---	---	---	3.88E-02	4.78E-03	---	---	---	181.12	36.22	---	---	---	7.0	0.2
Support Vessels: Discoverer Fleet																
Kapitan Dranitsyn	1	---	---	---	1.86E+00	2.29E-01	---	---	---	0.16	0.03	---	---	---	0.3	0.01
Fennica/Nordica	1	---	---	---	1.42E+00	1.75E-01	---	---	---	0.42	0.08	---	---	---	0.6	0.01
Oil Response Ships - Discoverer	1	---	---	---	4.06E-01	5.00E-02	---	---	---	22.74	4.55	---	---	---	9.2	0.2
Jim Kilabuk - Discoverer	1	---	---	---	4.45E-01	5.48E-02	---	---	---	22.74	4.55	---	---	---	10.1	0.2
											PM_{10} Total Impact >	---	---	---	89.3	2.2
SO_2																
Drill Rig: Discoverer																
Stack #1: 6 Main Drilling Engines	1	---	1.49E+00	---	1.49E+00	1.84E-01	---	17.78	---	7.90	1.58	---	26.5	---	11.8	0.3
Stack #2: 2 Air Compressors	1	---	1.94E-01	---	1.94E-01	2.39E-02	---	194.49	---	86.44	17.29	---	37.7	---	16.7	0.4
Stack #3: 2 HPP Engines	1	---	2.23E-01	---	2.23E-01	2.75E-02	---	246.96	---	109.76	21.95	---	55.0	---	24.4	0.6
Stack #4: 2 Diesel Crane Engines	1	---	1.41E-01	---	1.41E-01	1.74E-02	---	194.67	---	86.52	17.30	---	27.5	---	12.2	0.3
Stack #5: 2 Heat Boilers	1	---	5.49E-02	---	5.49E-02	6.77E-03	---	98.55	---	43.80	8.76	---	5.4	---	2.4	0.1
Stack #6: 1 Logging Winch	1	---	2.71E-02	---	2.71E-02	3.34E-03	---	407.52	---	181.12	36.22	---	11.0	---	4.9	0.1
Support Vessels: Discoverer Fleet																
Kapitan Dranitsyn	1	---	5.71E+00	---	5.71E+00	7.04E-01	---	0.37	---	0.16	0.03	---	2.1	---	0.9	0.02
Fennica/Nordica	1	---	4.38E+00	---	4.38E+00	5.40E-01	---	0.94	---	0.42	0.08	---	4.1	---	1.8	0.04
Oil Response Ships - Discoverer	1	---	1.93E+00	---	1.93E+00	2.38E-01	---	51.16	---	22.74	4.55	---	98.6	---	43.8	1.1
Jim Kilabuk - Discoverer	1	---	1.45E+00	---	1.45E+00	1.79E-01	---	51.16	---	22.74	4.55	---	74.2	---	33.0	0.8
											SO_2 Total Impact >	---	342.2	---	152.1	3.8

Stack #1: 6 Main Engines – MAINENGS

```
                                                                        12/11/06
                                                                        12:14:24
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***



 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      17.4000
    STK INSIDE DIAM (M)    =        .3500
    STK EXIT VELOCITY (M/S)=      63.3000
    STK GAS EXIT TEMP (K)  =     498.0000
    AMBIENT AIR TEMP (K)   =     273.0000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      10.6700
    MIN HORIZ BLDG DIM (M) =      21.3400
    MAX HORIZ BLDG DIM (M) =     156.6700

 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


 BUOY. FLUX =    8.589 M**4/S**3;  MOM. FLUX =   67.269 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** 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
500.	19.75	4	8.0	8.7	2560.0	29.77	36.32	24.71	HS
600.	17.28	4	8.0	8.7	2560.0	29.77	42.86	27.42	HS
700.	15.58	3	2.5	2.6	800.0	58.08	75.39	45.63	NO
800.	15.23	4	5.0	5.4	1600.0	37.18	55.86	27.37	NO
900.	14.78	4	4.5	4.9	1440.0	39.38	62.20	30.13	NO
1000.	14.30	4	4.0	4.3	1280.0	42.13	68.49	32.86	NO
1100.	13.68	4	3.5	3.8	1120.0	45.66	74.75	35.07	NO
1200.	13.06	4	3.5	3.8	1120.0	45.66	80.84	36.98	NO
1300.	12.52	4	3.0	3.3	960.0	50.37	87.03	39.15	NO
1400.	12.03	4	3.0	3.3	960.0	50.37	93.03	40.96	NO
1500.	11.52	4	3.0	3.3	960.0	50.37	98.99	42.72	NO
1600.	11.10	4	2.5	2.7	800.0	56.97	105.10	44.89	NO
1700.	10.73	4	2.5	2.7	800.0	56.97	110.98	46.56	NO
1800.	10.35	4	2.5	2.7	800.0	56.97	116.83	48.21	NO
1900.	10.08	5	1.0	1.2	10000.0	73.13	92.73	36.12	NO
2000.	10.43	5	1.0	1.2	10000.0	73.13	97.01	37.08	NO
2100.	10.65	5	1.0	1.2	10000.0	73.13	101.29	37.94	NO
2200.	10.83	5	1.0	1.2	10000.0	73.13	105.54	38.78	NO
2300.	10.97	5	1.0	1.2	10000.0	73.13	109.78	39.61	NO
2400.	11.08	5	1.0	1.2	10000.0	73.13	114.01	40.43	NO
2500.	11.16	5	1.0	1.2	10000.0	73.13	118.22	41.24	NO
2600.	11.22	5	1.0	1.2	10000.0	73.13	122.41	42.04	NO
2700.	11.25	5	1.0	1.2	10000.0	73.13	126.59	42.82	NO
2800.	11.27	5	1.0	1.2	10000.0	73.13	130.76	43.60	NO
2900.	11.26	5	1.0	1.2	10000.0	73.13	134.91	44.37	NO
3000.	11.24	5	1.0	1.2	10000.0	73.13	139.05	45.12	NO
3500.	10.95	5	1.0	1.2	10000.0	73.13	159.55	48.78	NO
4000.	10.48	5	1.0	1.2	10000.0	73.13	179.76	52.25	NO
4500.	10.49	6	1.0	1.4	10000.0	61.97	133.11	34.97	NO
5000.	10.41	6	1.0	1.4	10000.0	61.97	146.23	36.50	NO
5500.	10.24	6	1.0	1.4	10000.0	61.97	159.20	37.96	NO

```
  6000.   10.03        6     1.0     1.4 10000.0   61.97  172.05    39.35     NO
  6500.   9.788        6     1.0     1.4 10000.0   61.97  184.78    40.69     NO
  7000.   9.527        6     1.0     1.4 10000.0   61.97  197.40    41.98     NO
  7500.   9.225        6     1.0     1.4 10000.0   61.97  209.92    43.09     NO
  8000.   8.929        6     1.0     1.4 10000.0   61.97  222.35    44.16     NO
  8500.   8.643        6     1.0     1.4 10000.0   61.97  234.69    45.19     NO
  9000.   8.367        6     1.0     1.4 10000.0   61.97  246.94    46.19     NO
  9500.   8.101        6     1.0     1.4 10000.0   61.97  259.11    47.16     NO
 10000.   7.846        6     1.0     1.4 10000.0   61.97  271.20    48.10     NO
 15000.   5.854        6     1.0     1.4 10000.0   61.97  388.64    56.34     NO
 20000.   4.584        6     1.0     1.4 10000.0   61.97  501.11    61.62     NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   500. M:
   500.   19.75        4     8.0     8.7  2560.0   29.77   36.32    24.71     HS

 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)     =    .0000        CONC (UG/M**3)     =    .0000
  CRIT WS @10M (M/S) =    99.99        CRIT WS @10M (M/S) =    99.99
  CRIT WS @ HS (M/S) =    99.99        CRIT WS @ HS (M/S) =    99.99
  DILUTION WS (M/S)  =    99.99        DILUTION WS (M/S)  =    99.99
  CAVITY HT (M)      =    11.94        CAVITY HT (M)      =    10.67
  CAVITY LENGTH (M)  =    58.70        CAVITY LENGTH (M)  =    24.90
  ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =   156.67

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         19.75         500.         0.


 ***************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ***************************************************
```

Stack #2: 2 Air Compressors – COMPENGS

```
                                                                        12/11/06
                                                                        12:14:25
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***
```

```
SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        POINT
   EMISSION RATE (G/S)    =      1.00000
   STACK HEIGHT (M)       =       7.0100
   STK INSIDE DIAM (M)    =        .2100
   STK EXIT VELOCITY (M/S)=      40.0000
   STK GAS EXIT TEMP (K)  =     699.8000
   AMBIENT AIR TEMP (K)   =     273.0000
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   BUILDING HEIGHT (M)    =      10.6700
   MIN HORIZ BLDG DIM (M) =      21.3400
   MAX HORIZ BLDG DIM (M) =     156.6700

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


BUOY. FLUX =    2.637 M**4/S**3;  MOM. FLUX =    6.882 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** 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
500.	216.1	6	2.5	2.5	10000.0	18.35	17.97	14.16	SS
600.	189.2	6	2.5	2.5	10000.0	18.35	21.24	15.02	SS
700.	168.0	6	2.5	2.5	10000.0	18.35	24.46	15.86	SS
800.	154.1	6	2.0	2.0	10000.0	20.86	27.63	16.04	SS
900.	142.5	6	2.0	2.0	10000.0	20.86	30.78	16.84	SS
1000.	132.2	6	2.0	2.0	10000.0	20.86	33.88	17.62	SS
1100.	123.0	6	2.0	2.0	10000.0	20.86	36.96	18.38	SS
1200.	116.5	6	1.5	1.5	10000.0	24.71	40.01	18.31	SS
1300.	111.6	6	1.5	1.5	10000.0	24.71	43.04	19.05	SS
1400.	106.8	6	1.5	1.5	10000.0	24.71	46.05	19.78	SS
1500.	102.1	6	1.5	1.5	10000.0	24.71	49.03	20.49	SS
1600.	97.62	6	1.5	1.5	10000.0	24.71	51.99	21.19	SS
1700.	92.44	6	1.5	1.5	10000.0	24.71	54.94	21.23	SS
1800.	88.59	6	1.5	1.5	10000.0	24.71	57.87	21.87	SS
1900.	84.88	6	1.5	1.5	10000.0	24.71	60.78	22.45	SS
2000.	83.19	6	1.0	1.0	10000.0	31.33	63.68	22.20	SS
2100.	81.52	6	1.0	1.0	10000.0	31.33	66.56	22.77	SS
2200.	79.77	6	1.0	1.0	10000.0	31.33	69.42	23.33	SS
2300.	77.99	6	1.0	1.0	10000.0	31.33	72.28	23.87	SS
2400.	76.19	6	1.0	1.0	10000.0	31.33	75.12	24.41	SS
2500.	74.40	6	1.0	1.0	10000.0	31.33	77.95	24.94	SS
2600.	72.61	6	1.0	1.0	10000.0	31.33	80.76	25.46	SS
2700.	70.85	6	1.0	1.0	10000.0	31.33	83.57	25.97	SS
2800.	69.12	6	1.0	1.0	10000.0	31.33	86.36	26.47	SS
2900.	67.43	6	1.0	1.0	10000.0	31.33	89.15	26.97	SS
3000.	65.48	6	1.0	1.0	10000.0	31.33	91.92	27.07	SS
3500.	57.99	6	1.0	1.0	10000.0	31.33	105.65	29.06	SS
4000.	51.71	6	1.0	1.0	10000.0	31.33	119.17	30.91	SS
4500.	46.44	6	1.0	1.0	10000.0	31.33	132.50	32.65	SS
5000.	41.99	6	1.0	1.0	10000.0	31.33	145.67	34.28	SS
5500.	38.20	6	1.0	1.0	10000.0	31.33	158.69	35.82	SS
6000.	34.96	6	1.0	1.0	10000.0	31.33	171.58	37.30	SS
6500.	32.15	6	1.0	1.0	10000.0	31.33	184.34	38.71	SS
7000.	29.73	6	1.0	1.0	10000.0	31.33	196.99	40.00	SS
7500.	27.63	6	1.0	1.0	10000.0	31.33	209.54	41.16	SS
8000.	25.77	6	1.0	1.0	10000.0	31.33	221.98	42.28	SS
8500.	24.13	6	1.0	1.0	10000.0	31.33	234.34	43.36	SS
9000.	22.67	6	1.0	1.0	10000.0	31.33	246.61	44.40	SS
9500.	21.35	6	1.0	1.0	10000.0	31.33	258.79	45.41	SS
10000.	20.17	6	1.0	1.0	10000.0	31.33	270.90	46.38	SS

```
 15000.   12.69        6     1.0    1.0 10000.0   31.33  388.43   54.88    SS
 20000.   9.208        6     1.0    1.0 10000.0   31.33  500.95   60.29    SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   500. M:
   500.   216.1        6     2.5    2.5 10000.0   18.35   17.97   14.16    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)     =    210.8         CONC (UG/M**3)     =    1161.
  CRIT WS @10M (M/S) =     3.78         CRIT WS @10M (M/S) =     5.04
  CRIT WS @ HS (M/S) =     3.78         CRIT WS @ HS (M/S) =     5.04
  DILUTION WS (M/S)  =     1.89         DILUTION WS (M/S)  =     2.52
  CAVITY HT (M)      =    11.94         CAVITY HT (M)      =    10.67
  CAVITY LENGTH (M)  =    58.70         CAVITY LENGTH (M)  =    24.90
  ALONGWIND DIM (M)  =    21.34         ALONGWIND DIM (M)  =   156.67

****************************************
      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       216.1          500.         0.

BLDG. CAVITY-1       210.8           59.        --  (DIST = CAVITY LENGTH)

BLDG. CAVITY-2       1161.           25.        --  (DIST = CAVITY LENGTH)


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Stack #3: 2 HPP Engines - HPPENGS

```
                                                                           12/11/06
                                                                           12:14:25
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***


SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        POINT
   EMISSION RATE (G/S)    =      1.00000
   STACK HEIGHT (M)       =       7.0100
   STK INSIDE DIAM (M)    =        .1800
   STK EXIT VELOCITY (M/S)=      40.0000
   STK GAS EXIT TEMP (K)  =     700.0000
   AMBIENT AIR TEMP (K)   =     273.0000
```

RECEPTOR HEIGHT (M) = .0000
URBAN/RURAL OPTION = RURAL
BUILDING HEIGHT (M) = 10.6700
MIN HORIZ BLDG DIM (M) = 21.3400
MAX HORIZ BLDG DIM (M) = 156.6700

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 1.938 M**4/S**3; MOM. FLUX = 5.054 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** 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
500.	274.4	6	2.0	2.0	10000.0	18.05	17.97	13.91	SS
600.	240.6	6	2.0	2.0	10000.0	18.05	21.24	14.78	SS
700.	213.7	6	2.0	2.0	10000.0	18.05	24.46	15.62	SS
800.	193.2	6	1.5	1.5	10000.0	21.34	27.63	15.60	SS
900.	180.5	6	1.5	1.5	10000.0	21.34	30.78	16.41	SS
1000.	168.7	6	1.5	1.5	10000.0	21.34	33.88	17.20	SS
1100.	157.9	6	1.5	1.5	10000.0	21.34	36.96	17.98	SS
1200.	148.0	6	1.5	1.5	10000.0	21.34	40.01	18.73	SS
1300.	138.9	6	1.5	1.5	10000.0	21.34	43.04	19.46	SS
1400.	131.8	6	1.0	1.0	10000.0	27.11	46.05	19.05	SS
1500.	128.3	6	1.0	1.0	10000.0	27.11	49.03	19.78	SS
1600.	124.5	6	1.0	1.0	10000.0	27.11	51.99	20.49	SS
1700.	120.6	6	1.0	1.0	10000.0	27.11	54.94	21.19	SS
1800.	114.9	6	1.0	1.0	10000.0	27.11	57.87	21.30	SS
1900.	111.2	6	1.0	1.0	10000.0	27.11	60.78	21.93	SS
2000.	107.5	6	1.0	1.0	10000.0	27.11	63.68	22.51	SS
2100.	103.9	6	1.0	1.0	10000.0	27.11	66.56	23.07	SS
2200.	100.5	6	1.0	1.0	10000.0	27.11	69.42	23.63	SS
2300.	97.12	6	1.0	1.0	10000.0	27.11	72.28	24.17	SS
2400.	93.92	6	1.0	1.0	10000.0	27.11	75.12	24.70	SS
2500.	90.85	6	1.0	1.0	10000.0	27.11	77.95	25.22	SS
2600.	87.92	6	1.0	1.0	10000.0	27.11	80.76	25.74	SS
2700.	85.11	6	1.0	1.0	10000.0	27.11	83.57	26.24	SS
2800.	82.43	6	1.0	1.0	10000.0	27.11	86.36	26.74	SS
2900.	79.86	6	1.0	1.0	10000.0	27.11	89.15	26.79	SS
3000.	77.46	6	1.0	1.0	10000.0	27.11	91.92	27.24	SS
3500.	67.04	6	1.0	1.0	10000.0	27.11	105.65	29.22	SS
4000.	58.75	6	1.0	1.0	10000.0	27.11	119.17	31.06	SS
4500.	52.05	6	1.0	1.0	10000.0	27.11	132.50	32.78	SS
5000.	46.56	6	1.0	1.0	10000.0	27.11	145.67	34.41	SS
5500.	41.99	6	1.0	1.0	10000.0	27.11	158.69	35.95	SS
6000.	38.13	6	1.0	1.0	10000.0	27.11	171.58	37.41	SS
6500.	34.85	6	1.0	1.0	10000.0	27.11	184.34	38.82	SS
7000.	32.10	6	1.0	1.0	10000.0	27.11	196.99	40.01	SS
7500.	29.71	6	1.0	1.0	10000.0	27.11	209.54	41.17	SS
8000.	27.61	6	1.0	1.0	10000.0	27.11	221.98	42.28	SS
8500.	25.76	6	1.0	1.0	10000.0	27.11	234.34	43.36	SS
9000.	24.13	6	1.0	1.0	10000.0	27.11	246.61	44.40	SS
9500.	22.66	6	1.0	1.0	10000.0	27.11	258.79	45.41	SS
10000.	21.35	6	1.0	1.0	10000.0	27.11	270.90	46.39	SS
15000.	13.22	6	1.0	1.0	10000.0	27.11	388.43	54.88	SS
20000.	9.525	6	1.0	1.0	10000.0	27.11	500.95	60.29	SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

500.	274.4	6	2.0	2.0	10000.0	18.05	17.97	13.91	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)     =    250.1        CONC (UG/M**3)     =    1338.
  CRIT WS @10M (M/S) =     3.19        CRIT WS @10M (M/S) =     4.38
  CRIT WS @ HS (M/S) =     3.19        CRIT WS @ HS (M/S) =     4.38
  DILUTION WS (M/S)  =     1.59        DILUTION WS (M/S)  =     2.19
  CAVITY HT (M)      =    11.94        CAVITY HT (M)      =    10.67
  CAVITY LENGTH (M)  =    58.70        CAVITY LENGTH (M)  =    24.90
  ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =   156.67

*****************************************
      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       274.4          500.        0.

BLDG. CAVITY-1       250.1           59.       --  (DIST = CAVITY LENGTH)

BLDG. CAVITY-2       1338.           25.       --  (DIST = CAVITY LENGTH)


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Stack #4: 2 Diesel Crane Engines - DECKCRNS

```
                                                                    12/11/06
                                                                    12:14:26
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***


SIMPLE TERRAIN INPUTS:
   SOURCE TYPE             =        POINT
   EMISSION RATE (G/S)     =      1.00000
   STACK HEIGHT (M)        =      18.2900
   STK INSIDE DIAM (M)     =      35.9500
   STK EXIT VELOCITY (M/S)=         .0010
   STK GAS EXIT TEMP (K)   =     672.0000
   AMBIENT AIR TEMP (K)    =     273.0000
   RECEPTOR HEIGHT (M)     =        .0000
   URBAN/RURAL OPTION      =        RURAL
   BUILDING HEIGHT (M)     =      10.6700
   MIN HORIZ BLDG DIM (M) =       21.3400
   MAX HORIZ BLDG DIM (M) =      156.6700

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
```

THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 1.881 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** 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
500.	216.3	6	1.0	1.4	10000.0	26.62	19.51	17.90	HS
600.	195.7	6	1.0	1.4	10000.0	26.62	22.56	18.62	HS
700.	178.7	6	1.0	1.4	10000.0	26.62	25.61	19.33	HS
800.	164.5	6	1.0	1.4	10000.0	26.62	28.66	20.03	HS
900.	152.3	6	1.0	1.4	10000.0	26.62	31.70	20.72	HS
1000.	141.7	6	1.0	1.4	10000.0	26.62	34.73	21.39	HS
1100.	132.4	6	1.0	1.4	10000.0	26.62	37.74	22.05	HS
1200.	124.2	6	1.0	1.4	10000.0	26.62	40.73	22.71	HS
1300.	115.6	6	1.0	1.4	10000.0	26.62	43.71	22.65	HS
1400.	109.3	6	1.0	1.4	10000.0	26.62	46.67	23.25	HS
1500.	103.4	6	1.0	1.4	10000.0	26.62	49.62	23.79	HS
1600.	98.16	6	1.0	1.4	10000.0	26.62	52.55	24.32	HS
1700.	93.34	6	1.0	1.4	10000.0	26.62	55.46	24.85	HS
1800.	88.93	6	1.0	1.4	10000.0	26.62	58.37	25.37	HS
1900.	84.87	6	1.0	1.4	10000.0	26.62	61.25	25.87	HS
2000.	81.12	6	1.0	1.4	10000.0	26.62	64.13	26.37	HS
2100.	77.66	6	1.0	1.4	10000.0	26.62	66.99	26.87	HS
2200.	74.44	6	1.0	1.4	10000.0	26.62	69.84	27.35	HS
2300.	71.45	6	1.0	1.4	10000.0	26.62	72.68	27.83	HS
2400.	68.83	6	1.0	1.4	10000.0	26.62	75.50	27.54	HS
2500.	66.27	6	1.0	1.4	10000.0	26.62	78.32	28.02	HS
2600.	63.88	6	1.0	1.4	10000.0	26.62	81.12	28.42	HS
2700.	61.64	6	1.0	1.4	10000.0	26.62	83.92	28.81	HS
2800.	59.53	6	1.0	1.4	10000.0	26.62	86.70	29.20	HS
2900.	57.55	6	1.0	1.4	10000.0	26.62	89.47	29.58	HS
3000.	55.69	6	1.0	1.4	10000.0	26.62	92.24	29.95	HS
3500.	47.78	6	1.0	1.4	10000.0	26.62	105.93	31.75	HS
4000.	41.66	6	1.0	1.4	10000.0	26.62	119.41	33.44	HS
4500.	36.80	6	1.0	1.4	10000.0	26.62	132.72	35.03	HS
5000.	32.85	6	1.0	1.4	10000.0	26.62	145.87	36.55	HS
5500.	29.60	6	1.0	1.4	10000.0	26.62	158.87	37.99	HS
6000.	26.87	6	1.0	1.4	10000.0	26.62	171.75	39.38	HS
6500.	24.55	6	1.0	1.4	10000.0	26.62	184.50	40.71	HS
7000.	22.72	6	1.0	1.4	10000.0	26.62	197.14	41.51	HS
7500.	21.03	6	1.0	1.4	10000.0	26.62	209.68	42.62	HS
8000.	19.54	6	1.0	1.4	10000.0	26.62	222.12	43.69	HS
8500.	18.24	6	1.0	1.4	10000.0	26.62	234.46	44.73	HS
9000.	17.09	6	1.0	1.4	10000.0	26.62	246.72	45.73	HS
9500.	16.05	6	1.0	1.4	10000.0	26.62	258.91	46.70	HS
10000.	15.13	6	1.0	1.4	10000.0	26.62	271.01	47.65	HS
15000.	9.442	6	1.0	1.4	10000.0	26.62	388.50	55.49	HS
20000.	6.808	6	1.0	1.4	10000.0	26.62	501.01	60.84	HS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

500.	216.3	6	1.0	1.4	10000.0	26.62	19.51	17.90	HS

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)     =    398.8        CONC (UG/M**3)     =    2928.
   CRIT WS @10M (M/S) =     1.00        CRIT WS @10M (M/S) =     1.00
   CRIT WS @ HS (M/S) =     1.13        CRIT WS @ HS (M/S) =     1.13
   DILUTION WS (M/S)  =     1.00        DILUTION WS (M/S)  =     1.00
   CAVITY HT (M)      =    11.94        CAVITY HT (M)      =    10.67
   CAVITY LENGTH (M)  =    58.70        CAVITY LENGTH (M)  =    24.90
   ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =   156.67

 ****************************************
       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      216.3          500.        0.

 BLDG. CAVITY-1      398.8           59.       --  (DIST = CAVITY LENGTH)

 BLDG. CAVITY-2      2928.           25.       --  (DIST = CAVITY LENGTH)


 ***************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ***************************************************
```

Stack #5: 2 Heat Boilers – HEATBOIL

```
                                                                       12/11/06
                                                                       12:14:26
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***



 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =      17.4000
    STK INSIDE DIAM (M)    =        .4600
    STK EXIT VELOCITY (M/S)=       7.3362
    STK GAS EXIT TEMP (K)  =     366.5000
    AMBIENT AIR TEMP (K)   =     273.0000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      10.6700
    MIN HORIZ BLDG DIM (M) =      21.3400
    MAX HORIZ BLDG DIM (M) =     156.6700

 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


 BUOY. FLUX =     .971 M**4/S**3;  MOM. FLUX =    2.121 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** 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
500.	109.5	4	1.0	1.1	320.0	36.68	36.56	25.07	HS
600.	102.3	4	1.0	1.1	320.0	36.68	43.07	27.75	HS
700.	93.96	4	1.0	1.1	320.0	36.68	49.50	30.37	HS
800.	83.84	4	1.0	1.1	320.0	36.68	55.85	30.84	HS
900.	77.15	4	1.0	1.1	320.0	36.68	62.13	33.24	HS
1000.	70.74	4	1.0	1.1	320.0	36.68	68.35	35.22	HS
1100.	64.99	4	1.0	1.1	320.0	36.68	74.51	37.15	HS
1200.	59.85	4	1.0	1.1	320.0	36.68	80.63	39.02	HS
1300.	55.27	4	1.0	1.1	320.0	36.68	86.69	40.84	HS
1400.	51.55	6	1.0	1.4	10000.0	38.95	46.46	22.81	HS
1500.	50.67	6	1.0	1.4	10000.0	38.95	49.42	23.37	HS
1600.	49.75	6	1.0	1.4	10000.0	38.95	52.36	23.91	HS
1700.	48.80	6	1.0	1.4	10000.0	38.95	55.28	24.44	HS
1800.	47.85	6	1.0	1.4	10000.0	38.95	58.19	24.97	HS
1900.	46.89	6	1.0	1.4	10000.0	38.95	61.09	25.49	HS
2000.	45.93	6	1.0	1.4	10000.0	38.95	63.97	25.99	HS
2100.	44.98	6	1.0	1.4	10000.0	38.95	66.84	26.49	HS
2200.	44.03	6	1.0	1.4	10000.0	38.95	69.70	26.98	HS
2300.	43.10	6	1.0	1.4	10000.0	38.95	72.54	27.47	HS
2400.	41.03	6	1.0	1.4	10000.0	38.95	75.37	27.18	HS
2500.	40.26	6	1.0	1.4	10000.0	38.95	78.19	27.66	HS
2600.	39.41	6	1.0	1.4	10000.0	38.95	81.00	28.06	HS
2700.	38.58	6	1.0	1.4	10000.0	38.95	83.80	28.46	HS
2800.	37.77	6	1.0	1.4	10000.0	38.95	86.58	28.85	HS
2900.	36.99	6	1.0	1.4	10000.0	38.95	89.36	29.24	HS
3000.	36.23	6	1.0	1.4	10000.0	38.95	92.13	29.62	HS
3500.	32.74	6	1.0	1.4	10000.0	38.95	105.83	31.44	HS
4000.	29.75	6	1.0	1.4	10000.0	38.95	119.33	33.14	HS
4500.	27.17	6	1.0	1.4	10000.0	38.95	132.64	34.75	HS
5000.	24.94	6	1.0	1.4	10000.0	38.95	145.80	36.27	HS
5500.	22.99	6	1.0	1.4	10000.0	38.95	158.81	37.73	HS
6000.	21.29	6	1.0	1.4	10000.0	38.95	171.69	39.12	HS
6500.	19.79	6	1.0	1.4	10000.0	38.95	184.45	40.46	HS
7000.	18.49	6	1.0	1.4	10000.0	38.95	197.09	41.27	HS
7500.	17.32	6	1.0	1.4	10000.0	38.95	209.63	42.38	HS
8000.	16.28	6	1.0	1.4	10000.0	38.95	222.07	43.46	HS
8500.	15.34	6	1.0	1.4	10000.0	38.95	234.42	44.50	HS
9000.	14.50	6	1.0	1.4	10000.0	38.95	246.68	45.51	HS
9500.	13.73	6	1.0	1.4	10000.0	38.95	258.87	46.49	HS
10000.	13.03	6	1.0	1.4	10000.0	38.95	270.97	47.44	HS
15000.	8.525	6	1.0	1.4	10000.0	38.95	388.48	55.31	HS
20000.	6.284	6	1.0	1.4	10000.0	38.95	500.99	60.67	HS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

500.	109.5	4	1.0	1.1	320.0	36.68	36.56	25.07	HS

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 ***
CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99

*** CAVITY CALCULATION - 2 ***
CONC (UG/M**3) = .0000
CRIT WS @10M (M/S) = 99.99
CRIT WS @ HS (M/S) = 99.99

```
  DILUTION WS (M/S)  =    99.99        DILUTION WS (M/S)  =    99.99
  CAVITY HT (M)      =    11.94        CAVITY HT (M)      =    10.67
  CAVITY LENGTH (M)  =    58.70        CAVITY LENGTH (M)  =    24.90
  ALONGWIND DIM (M)  =    21.34        ALONGWIND DIM (M)  =   156.67

 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      109.5            500.        0.


 ***************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ***************************************************
```

Stack #6: 1 Logging Winch – LOGWNCH

```
                                                                  12/11/06
                                                                  12:14:26
  ***   SCREEN3 MODEL RUN   ***
  *** VERSION DATED 96043 ***



 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE            =        POINT
    EMISSION RATE (G/S)    =      1.00000
    STACK HEIGHT (M)       =       7.7000
    STK INSIDE DIAM (M)    =        .1000
    STK EXIT VELOCITY (M/S)=      52.9734
    STK GAS EXIT TEMP (K)  =     710.9000
    AMBIENT AIR TEMP (K)   =     273.0000
    RECEPTOR HEIGHT (M)    =        .0000
    URBAN/RURAL OPTION     =        RURAL
    BUILDING HEIGHT (M)    =      10.6700
    MIN HORIZ BLDG DIM (M) =      21.3400
    MAX HORIZ BLDG DIM (M) =     156.6700

 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


 BUOY. FLUX =     .800 M**4/S**3;  MOM. FLUX =    2.694 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** 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
 -------  ----------  ----   -----  -----  ------   ------  ------  ------  -----
    500.    452.8       6     1.5     1.5 10000.0   15.55   17.97   13.72    SS
```

600.	391.2	6	1.0	1.0	10000.0	19.45	21.24	13.43	SS
700.	356.6	6	1.0	1.0	10000.0	19.45	24.46	14.10	SS
800.	330.8	6	1.0	1.0	10000.0	19.45	27.63	14.96	SS
900.	306.9	6	1.0	1.0	10000.0	19.45	30.78	15.79	SS
1000.	285.0	6	1.0	1.0	10000.0	19.45	33.88	16.60	SS
1100.	265.0	6	1.0	1.0	10000.0	19.45	36.96	17.39	SS
1200.	246.9	6	1.0	1.0	10000.0	19.45	40.01	18.16	SS
1300.	230.5	6	1.0	1.0	10000.0	19.45	43.04	18.90	SS
1400.	215.6	6	1.0	1.0	10000.0	19.45	46.05	19.64	SS
1500.	202.1	6	1.0	1.0	10000.0	19.45	49.03	20.35	SS
1600.	189.8	6	1.0	1.0	10000.0	19.45	51.99	21.05	SS
1700.	179.6	6	1.0	1.0	10000.0	19.45	54.94	21.10	SS
1800.	169.6	6	1.0	1.0	10000.0	19.45	57.87	21.77	SS
1900.	160.5	6	1.0	1.0	10000.0	19.45	60.78	22.35	SS
2000.	152.2	6	1.0	1.0	10000.0	19.45	63.68	22.91	SS
2100.	144.6	6	1.0	1.0	10000.0	19.45	66.56	23.47	SS
2200.	137.6	6	1.0	1.0	10000.0	19.45	69.42	24.01	SS
2300.	131.1	6	1.0	1.0	10000.0	19.45	72.28	24.55	SS
2400.	125.1	6	1.0	1.0	10000.0	19.45	75.12	25.07	SS
2500.	119.6	6	1.0	1.0	10000.0	19.45	77.95	25.59	SS
2600.	114.4	6	1.0	1.0	10000.0	19.45	80.76	26.10	SS
2700.	109.6	6	1.0	1.0	10000.0	19.45	83.57	26.60	SS
2800.	106.1	6	1.0	1.0	10000.0	19.45	86.36	26.58	SS
2900.	101.9	6	1.0	1.0	10000.0	19.45	89.15	27.06	SS
3000.	98.12	6	1.0	1.0	10000.0	19.45	91.92	27.47	SS
3500.	82.29	6	1.0	1.0	10000.0	19.45	105.65	29.43	SS
4000.	70.42	6	1.0	1.0	10000.0	19.45	119.17	31.26	SS
4500.	61.23	6	1.0	1.0	10000.0	19.45	132.50	32.97	SS
5000.	53.95	6	1.0	1.0	10000.0	19.45	145.67	34.58	SS
5500.	48.05	6	1.0	1.0	10000.0	19.45	158.69	36.11	SS
6000.	43.19	6	1.0	1.0	10000.0	19.45	171.58	37.57	SS
6500.	39.12	6	1.0	1.0	10000.0	19.45	184.34	38.97	SS
7000.	35.82	6	1.0	1.0	10000.0	19.45	196.99	40.10	SS
7500.	32.95	6	1.0	1.0	10000.0	19.45	209.54	41.26	SS
8000.	30.46	6	1.0	1.0	10000.0	19.45	221.98	42.37	SS
8500.	28.28	6	1.0	1.0	10000.0	19.45	234.34	43.45	SS
9000.	26.37	6	1.0	1.0	10000.0	19.45	246.61	44.49	SS
9500.	24.68	6	1.0	1.0	10000.0	19.45	258.79	45.49	SS
10000.	23.17	6	1.0	1.0	10000.0	19.45	270.90	46.47	SS
15000.	14.02	6	1.0	1.0	10000.0	19.45	388.43	54.88	SS
20000.	10.00	6	1.0	1.0	10000.0	19.45	500.95	60.29	SS

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

500.	452.8	6	1.5	1.5	10000.0	15.55	17.97	13.72	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) =	292.6	CONC (UG/M**3) =	1518.
CRIT WS @10M (M/S) =	2.73	CRIT WS @10M (M/S) =	3.86
CRIT WS @ HS (M/S) =	2.73	CRIT WS @ HS (M/S) =	3.86
DILUTION WS (M/S) =	1.36	DILUTION WS (M/S) =	1.93
CAVITY HT (M) =	11.94	CAVITY HT (M) =	10.67
CAVITY LENGTH (M) =	58.70	CAVITY LENGTH (M) =	24.90
ALONGWIND DIM (M) =	21.34	ALONGWIND DIM (M) =	156.67

****
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        452.8          500.         0.

 BLDG. CAVITY-1        292.6           59.        --   (DIST = CAVITY LENGTH)

 BLDG. CAVITY-2        1518.           25.        --   (DIST = CAVITY LENGTH)


 ***************************************************
 ** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
 ***************************************************
```

Kapitan Dranitsyn, Initial Point Source – KAPITAN

```
                                                                    12/11/06
                                                                    09:02:49
  ***  SCREEN3 MODEL RUN  ***
  *** VERSION DATED 96043 ***


 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE              =        POINT
    EMISSION RATE (G/S)      =      1.00000
    STACK HEIGHT (M)         =      35.0520
    STK INSIDE DIAM (M)      =        .3198
    STK EXIT VELOCITY (M/S)=        41.5025
    STK GAS EXIT TEMP (K)    =     523.1500
    AMBIENT AIR TEMP (K)     =     273.0000
    RECEPTOR HEIGHT (M)      =        .0000
    URBAN/RURAL OPTION       =        RURAL
    BUILDING HEIGHT (M)      =        .0000
    MIN HORIZ BLDG DIM (M) =          .0000
    MAX HORIZ BLDG DIM (M) =          .0000

 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


 BUOY. FLUX =    4.975 M**4/S**3;  MOM. FLUX =   22.980 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** 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
500.	15.32	1	1.0	1.1	320.0	100.42	114.57	106.31	NO
600.	14.48	2	1.5	1.6	480.0	78.63	98.29	63.64	NO
700.	14.15	2	1.0	1.1	320.0	100.42	113.52	76.23	NO
800.	13.90	3	1.5	1.7	480.0	77.02	84.99	51.28	NO
900.	13.91	3	1.5	1.7	480.0	77.02	94.44	56.80	NO
1000.	13.48	3	1.5	1.7	480.0	77.02	103.81	62.31	NO
1100.	13.05	3	1.0	1.1	320.0	98.01	113.89	69.09	NO
1200.	12.89	3	1.0	1.1	320.0	98.01	123.04	74.44	NO
1300.	12.52	3	1.0	1.1	320.0	98.01	132.13	79.78	NO

1400.	12.04	3	1.0	1.1	320.0	98.01	141.16	85.10	NO
1500.	11.49	3	1.0	1.1	320.0	98.01	150.14	90.40	NO
1600.	10.92	3	1.0	1.1	320.0	98.01	159.06	95.69	NO
1700.	10.34	3	1.0	1.1	320.0	98.01	167.94	100.95	NO
1800.	9.770	3	1.0	1.1	320.0	98.01	176.76	106.20	NO
1900.	9.412	4	1.5	1.8	480.0	74.47	122.65	49.81	NO
2000.	9.323	4	1.5	1.8	480.0	74.47	128.44	51.40	NO
2100.	9.204	4	1.5	1.8	480.0	74.47	134.20	52.96	NO
2200.	9.063	4	1.5	1.8	480.0	74.47	139.94	54.50	NO
2300.	8.905	4	1.5	1.8	480.0	74.47	145.65	56.02	NO
2400.	8.735	4	1.5	1.8	480.0	74.47	151.33	57.51	NO
2500.	8.556	4	1.5	1.8	480.0	74.47	157.00	58.99	NO
2600.	8.372	4	1.5	1.8	480.0	74.47	162.63	60.44	NO
2700.	8.185	4	1.5	1.8	480.0	74.47	168.25	61.88	NO
2800.	8.083	4	1.0	1.2	320.0	94.18	174.30	64.54	NO
2900.	8.014	4	1.0	1.2	320.0	94.18	179.87	65.91	NO
3000.	7.935	4	1.0	1.2	320.0	94.18	185.41	67.27	NO
3500.	7.413	4	1.0	1.2	320.0	94.18	212.86	73.45	NO
4000.	7.035	5	1.0	1.6	10000.0	77.86	179.48	51.25	NO
4500.	6.766	5	1.0	1.6	10000.0	77.86	199.46	54.22	NO
5000.	6.464	5	1.0	1.6	10000.0	77.86	219.20	57.04	NO
5500.	6.152	5	1.0	1.6	10000.0	77.86	238.73	59.72	NO
6000.	5.845	5	1.0	1.6	10000.0	77.86	258.06	62.30	NO
6500.	5.549	5	1.0	1.6	10000.0	77.86	277.21	64.77	NO
7000.	5.268	5	1.0	1.6	10000.0	77.86	296.19	67.16	NO
7500.	5.003	5	1.0	1.6	10000.0	77.86	315.01	69.46	NO
8000.	4.884	6	1.0	2.0	10000.0	67.73	222.18	43.30	NO
8500.	4.784	6	1.0	2.0	10000.0	67.73	234.53	44.35	NO
9000.	4.680	6	1.0	2.0	10000.0	67.73	246.78	45.37	NO
9500.	4.575	6	1.0	2.0	10000.0	67.73	258.96	46.36	NO
10000.	4.469	6	1.0	2.0	10000.0	67.73	271.06	47.31	NO
15000.	3.522	6	1.0	2.0	10000.0	67.73	388.54	55.67	NO
20000.	2.821	6	1.0	2.0	10000.0	67.73	501.04	61.01	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

500.	15.32	1	1.0	1.1	320.0	100.42	114.57	106.31	NO

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

****
*** SCREEN DISCRETE 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
13500.	3.779	6	1.0	2.0	10000.0	67.73	353.90	53.36	NO

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

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	15.32	500.	0.

****

** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Kapitan Dranitsyn, Final Area Source – KAP_BIG

12/11/06
09:05:32

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = AREA
EMISSION RATE (G/(S-M**2)) = .666667E-08
SOURCE HEIGHT (M) = 67.7300
LENGTH OF LARGER SIDE (M) = 15000.0000
LENGTH OF SMALLER SIDE (M) = 10000.0000
RECEPTOR HEIGHT (M) = .0000
URBAN/RURAL OPTION = RURAL
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** 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)	MAX DIR (DEG)
500.	.2565	4	1.0	1.3	320.0	67.73	31.
600.	.2591	4	1.0	1.3	320.0	67.73	31.
700.	.2617	4	1.0	1.3	320.0	67.73	31.
800.	.2642	4	1.0	1.3	320.0	67.73	31.
900.	.2668	4	1.0	1.3	320.0	67.73	31.
1000.	.2694	4	1.0	1.3	320.0	67.73	31.
1100.	.2719	4	1.0	1.3	320.0	67.73	31.
1200.	.2744	4	1.0	1.3	320.0	67.73	31.
1300.	.2769	4	1.0	1.3	320.0	67.73	31.
1400.	.2794	4	1.0	1.3	320.0	67.73	31.
1500.	.2819	4	1.0	1.3	320.0	67.73	31.
1600.	.2843	4	1.0	1.3	320.0	67.73	31.
1700.	.2868	4	1.0	1.3	320.0	67.73	31.
1800.	.2892	4	1.0	1.3	320.0	67.73	31.
1900.	.2909	4	1.0	1.3	320.0	67.73	30.
2000.	.2933	4	1.0	1.3	320.0	67.73	30.
2100.	.2957	4	1.0	1.3	320.0	67.73	30.
2200.	.2981	4	1.0	1.3	320.0	67.73	30.
2300.	.3006	4	1.0	1.3	320.0	67.73	30.
2400.	.3029	4	1.0	1.3	320.0	67.73	30.
2500.	.3053	4	1.0	1.3	320.0	67.73	30.

```
  2600.   .3077        4     1.0    1.3   320.0   67.73     30.
  2700.   .3101        4     1.0    1.3   320.0   67.73     30.
  2800.   .3124        4     1.0    1.3   320.0   67.73     30.
  2900.   .3148        4     1.0    1.3   320.0   67.73     30.
  3000.   .3171        4     1.0    1.3   320.0   67.73     30.
  3500.   .3287        4     1.0    1.3   320.0   67.73     30.
  4000.   .3400        4     1.0    1.3   320.0   67.73     30.
  4500.   .3505        4     1.0    1.3   320.0   67.73     29.
  5000.   .3636        4     1.0    1.3   320.0   67.73     28.
  5500.   .3756        4     1.0    1.3   320.0   67.73     29.
  6000.   .3864        4     1.0    1.3   320.0   67.73     29.
  6500.   .3971        4     1.0    1.3   320.0   67.73     29.
  7000.   .4071        4     1.0    1.3   320.0   67.73     28.
  7500.   .4251        4     1.0    1.3   320.0   67.73     27.
  8000.   .4366        4     1.0    1.3   320.0   67.73     28.
  8500.   .4477        4     1.0    1.3   320.0   67.73     30.
  9000.   .4563        4     1.0    1.3   320.0   67.73     33.
  9500.   .4576        4     1.0    1.3   320.0   67.73     32.
 10000.   .4631        4     1.0    1.3   320.0   67.73     33.
 15000.   .3854        4     1.0    1.3   320.0   67.73     31.
 20000.   .3520        5     1.0    2.0 10000.0   67.73     31.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   500. M:
 10123.   .4633        4     1.0    1.3   320.0   67.73     33.

*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC            U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)  (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
 13500.   .4102        4     1.0    1.3   320.0   67.73     32.

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION         MAX CONC    DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)    MAX (M)    HT (M)
--------------    -----------    -------   -------
SIMPLE TERRAIN       .4633        10123.        0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

Fennica/Nordica, Initial Point Source – FENNICA

12/11/06
09:02:49

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.00000
STACK HEIGHT (M)	=	32.0040
STK INSIDE DIAM (M)	=	.2659
STK EXIT VELOCITY (M/S)	=	36.0084
STK GAS EXIT TEMP (K)	=	573.1500
AMBIENT AIR TEMP (K)	=	273.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL
BUILDING HEIGHT (M)	=	.0000
MIN HORIZ BLDG DIM (M)	=	.0000
MAX HORIZ BLDG DIM (M)	=	.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 3.269 M**4/S**3; MOM. FLUX = 10.920 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** 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
500.	21.16	2	1.5	1.6	480.0	64.02	83.26	51.91	NO
600.	21.29	2	1.0	1.1	320.0	80.02	98.46	63.90	NO
700.	21.05	3	1.5	1.7	480.0	62.92	75.01	45.00	NO
800.	20.37	3	1.5	1.7	480.0	62.92	84.61	50.63	NO
900.	20.44	3	1.0	1.1	320.0	78.38	94.61	57.08	NO
1000.	19.88	3	1.0	1.1	320.0	78.38	103.96	62.56	NO
1100.	18.94	3	1.0	1.1	320.0	78.38	113.23	68.01	NO
1200.	17.83	3	1.0	1.1	320.0	78.38	122.43	73.44	NO
1300.	16.67	3	1.0	1.1	320.0	78.38	131.57	78.84	NO
1400.	15.52	3	1.0	1.1	320.0	78.38	140.64	84.22	NO
1500.	15.05	4	1.5	1.8	480.0	61.17	98.89	42.49	NO
1600.	14.77	4	1.5	1.8	480.0	61.17	104.82	44.23	NO
1700.	14.44	4	1.5	1.8	480.0	61.17	110.72	45.93	NO
1800.	14.06	4	1.5	1.8	480.0	61.17	116.58	47.60	NO
1900.	13.86	4	1.0	1.2	320.0	75.76	122.77	50.11	NO
2000.	13.74	4	1.0	1.2	320.0	75.76	128.55	51.69	NO
2100.	13.59	4	1.0	1.2	320.0	75.76	134.31	53.24	NO
2200.	13.39	4	1.0	1.2	320.0	75.76	140.04	54.77	NO
2300.	13.17	4	1.0	1.2	320.0	75.76	145.75	56.28	NO
2400.	12.93	4	1.0	1.2	320.0	75.76	151.43	57.77	NO
2500.	12.68	4	1.0	1.2	320.0	75.76	157.09	59.24	NO
2600.	12.42	4	1.0	1.2	320.0	75.76	162.73	60.68	NO
2700.	12.15	4	1.0	1.2	320.0	75.76	168.34	62.12	NO
2800.	11.88	4	1.0	1.2	320.0	75.76	173.93	63.53	NO
2900.	11.61	4	1.0	1.2	320.0	75.76	179.51	64.92	NO

3000.	11.34	4	1.0	1.2	320.0	75.76	185.06	66.31	NO
3500.	10.05	4	1.0	1.2	320.0	75.76	212.55	72.56	NO
4000.	9.107	5	1.0	1.5	10000.0	69.62	179.38	50.91	NO
4500.	8.560	5	1.0	1.5	10000.0	69.62	199.37	53.90	NO
5000.	8.026	5	1.0	1.5	10000.0	69.62	219.12	56.74	NO
5500.	7.520	5	1.0	1.5	10000.0	69.62	238.66	59.44	NO
6000.	7.163	6	1.0	1.9	10000.0	60.89	171.78	38.14	NO
6500.	7.023	6	1.0	1.9	10000.0	60.89	184.53	39.52	NO
7000.	6.861	6	1.0	1.9	10000.0	60.89	197.17	40.84	NO
7500.	6.661	6	1.0	1.9	10000.0	60.89	209.70	41.98	NO
8000.	6.460	6	1.0	1.9	10000.0	60.89	222.14	43.08	NO
8500.	6.263	6	1.0	1.9	10000.0	60.89	234.48	44.14	NO
9000.	6.070	6	1.0	1.9	10000.0	60.89	246.75	45.16	NO
9500.	5.883	6	1.0	1.9	10000.0	60.89	258.93	46.15	NO
10000.	5.703	6	1.0	1.9	10000.0	60.89	271.03	47.11	NO
15000.	4.265	6	1.0	1.9	10000.0	60.89	388.52	55.50	NO
20000.	3.338	6	1.0	1.9	10000.0	60.89	501.02	60.86	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

555.	21.54	2	1.0	1.1	320.0	80.02	92.07	59.02	NO

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

****
*** SCREEN DISCRETE 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
6000.	7.163	6	1.0	1.9	10000.0	60.89	171.78	38.14	NO

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

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	21.54	555.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

12/11/06
09:05:33

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	AREA
EMISSION RATE (G/(S-M**2))	=	.200000E-07
SOURCE HEIGHT (M)	=	60.8900
LENGTH OF LARGER SIDE (M)	=	10000.0000
LENGTH OF SMALLER SIDE (M)	=	5000.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** 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)	MAX DIR (DEG)
500.	.5526	4	1.0	1.3	320.0	60.89	22.
600.	.5626	4	1.0	1.3	320.0	60.89	22.
700.	.5726	4	1.0	1.3	320.0	60.89	22.
800.	.5810	4	1.0	1.3	320.0	60.89	21.
900.	.5910	4	1.0	1.3	320.0	60.89	21.
1000.	.6009	4	1.0	1.3	320.0	60.89	21.
1100.	.6107	4	1.0	1.3	320.0	60.89	21.
1200.	.6205	4	1.0	1.3	320.0	60.89	21.
1300.	.6302	4	1.0	1.3	320.0	60.89	21.
1400.	.6399	4	1.0	1.3	320.0	60.89	21.
1500.	.6495	4	1.0	1.3	320.0	60.89	21.
1600.	.6590	4	1.0	1.3	320.0	60.89	21.
1700.	.6683	4	1.0	1.3	320.0	60.89	21.
1800.	.6758	4	1.0	1.3	320.0	60.89	20.
1900.	.6851	4	1.0	1.3	320.0	60.89	20.
2000.	.6943	4	1.0	1.3	320.0	60.89	20.
2100.	.7034	4	1.0	1.3	320.0	60.89	20.
2200.	.7125	4	1.0	1.3	320.0	60.89	20.
2300.	.7215	4	1.0	1.3	320.0	60.89	20.
2400.	.7304	4	1.0	1.3	320.0	60.89	20.
2500.	.7393	4	1.0	1.3	320.0	60.89	20.
2600.	.7482	4	1.0	1.3	320.0	60.89	20.
2700.	.7570	4	1.0	1.3	320.0	60.89	20.
2800.	.7641	4	1.0	1.3	320.0	60.89	19.
2900.	.7728	4	1.0	1.3	320.0	60.89	19.
3000.	.7815	4	1.0	1.3	320.0	60.89	19.
3500.	.8224	4	1.0	1.3	320.0	60.89	18.
4000.	.8640	4	1.0	1.3	320.0	60.89	18.
4500.	.9030	4	1.0	1.3	320.0	60.89	17.
5000.	.9456	4	1.0	1.3	320.0	60.89	21.
5500.	.9830	4	1.0	1.3	320.0	60.89	21.
6000.	1.024	4	1.0	1.3	320.0	60.89	21.
6500.	1.040	4	1.0	1.3	320.0	60.89	24.
7000.	1.034	4	1.0	1.3	320.0	60.89	25.
7500.	1.013	4	1.0	1.3	320.0	60.89	24.
8000.	.9871	4	1.0	1.3	320.0	60.89	24.

8500.	.9586	4	1.0	1.3	320.0	60.89	23.
9000.	.9316	4	1.0	1.3	320.0	60.89	23.
9500.	.9044	4	1.0	1.3	320.0	60.89	22.
10000.	.8763	4	1.0	1.3	320.0	60.89	20.
15000.	.7511	5	1.0	1.9	10000.0	60.89	17.
20000.	.6704	5	1.0	1.9	10000.0	60.89	6.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 500. M:

6609.	1.041	4	1.0	1.3	320.0	60.89	25.

****
*** SCREEN DISCRETE 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)	MAX DIR (DEG)
6000.	1.024	4	1.0	1.3	320.0	60.89	21.

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	1.041	6609.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

Jim Kilabuk - KILABUK

12/11/06
09:02:49

*** 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)     =        .1836
   STK EXIT VELOCITY (M/S)=       39.9990
   STK GAS EXIT TEMP (K)   =     699.8167
   AMBIENT AIR TEMP (K)    =     273.0000
   RECEPTOR HEIGHT (M)     =        .0000
   URBAN/RURAL OPTION      =        RURAL
   BUILDING HEIGHT (M)     =        .0000
   MIN HORIZ BLDG DIM (M) =         .0000
   MAX HORIZ BLDG DIM (M) =         .0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


BUOY. FLUX =    2.015 M**4/S**3;  MOM. FLUX =    5.258 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** 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
500.	56.84	3	1.5	1.6	480.0	38.40	55.17	33.10	NO
600.	53.26	4	2.0	2.1	640.0	32.25	42.99	21.76	NO
700.	51.91	4	2.0	2.1	640.0	32.25	49.43	24.52	NO
800.	50.13	4	1.5	1.6	480.0	37.92	55.95	27.56	NO
900.	48.17	4	1.5	1.6	480.0	37.92	62.22	30.17	NO
1000.	45.47	4	1.5	1.6	480.0	37.92	68.43	32.74	NO
1100.	42.87	4	1.0	1.1	320.0	49.26	74.94	35.48	NO
1200.	41.40	4	1.0	1.1	320.0	49.26	81.02	37.38	NO
1300.	39.77	4	1.0	1.1	320.0	49.26	87.06	39.22	NO
1400.	38.07	4	1.0	1.1	320.0	49.26	93.06	41.03	NO
1500.	36.35	4	1.0	1.1	320.0	49.26	99.02	42.79	NO
1600.	34.68	4	1.0	1.1	320.0	49.26	104.94	44.51	NO
1700.	33.06	4	1.0	1.1	320.0	49.26	110.83	46.20	NO
1800.	31.50	4	1.0	1.1	320.0	49.26	116.69	47.86	NO
1900.	30.03	4	1.0	1.1	320.0	49.26	122.52	49.49	NO
2000.	29.17	5	1.0	1.2	10000.0	50.15	96.22	34.94	NO
2100.	29.47	6	1.0	1.3	10000.0	43.41	67.04	23.62	NO
2200.	29.77	6	1.0	1.3	10000.0	43.41	69.89	24.16	NO
2300.	29.98	6	1.0	1.3	10000.0	43.41	72.72	24.69	NO
2400.	30.10	6	1.0	1.3	10000.0	43.41	75.55	25.21	NO
2500.	30.15	6	1.0	1.3	10000.0	43.41	78.36	25.72	NO
2600.	30.13	6	1.0	1.3	10000.0	43.41	81.16	26.22	NO
2700.	30.06	6	1.0	1.3	10000.0	43.41	83.96	26.71	NO
2800.	29.95	6	1.0	1.3	10000.0	43.41	86.74	27.20	NO
2900.	29.79	6	1.0	1.3	10000.0	43.41	89.51	27.68	NO
3000.	29.60	6	1.0	1.3	10000.0	43.41	92.27	28.15	NO
3500.	27.96	6	1.0	1.3	10000.0	43.41	105.96	30.08	NO
4000.	26.23	6	1.0	1.3	10000.0	43.41	119.44	31.87	NO
4500.	24.55	6	1.0	1.3	10000.0	43.41	132.75	33.55	NO
5000.	22.96	6	1.0	1.3	10000.0	43.41	145.89	35.14	NO
5500.	21.50	6	1.0	1.3	10000.0	43.41	158.90	36.65	NO
6000.	20.16	6	1.0	1.3	10000.0	43.41	171.77	38.09	NO
6500.	18.94	6	1.0	1.3	10000.0	43.41	184.52	39.47	NO
7000.	17.82	6	1.0	1.3	10000.0	43.41	197.16	40.80	NO
7500.	16.80	6	1.0	1.3	10000.0	43.41	209.69	41.94	NO
8000.	15.88	6	1.0	1.3	10000.0	43.41	222.13	43.04	NO
8500.	15.04	6	1.0	1.3	10000.0	43.41	234.48	44.10	NO
9000.	14.28	6	1.0	1.3	10000.0	43.41	246.74	45.12	NO
9500.	13.58	6	1.0	1.3	10000.0	43.41	258.92	46.11	NO
10000.	12.94	6	1.0	1.3	10000.0	43.41	271.02	47.08	NO
15000.	8.625	6	1.0	1.3	10000.0	43.41	388.51	55.47	NO

```
 20000.   6.422       6     1.0    1.3 10000.0   43.41  501.01   60.83    NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   500. M:
   500.   56.84       3     1.5    1.6   480.0   38.40   55.17   33.10    NO

 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

*********************************
*** SCREEN DISCRETE 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
-------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
   500.   56.84       3     1.5    1.6   480.0   38.40   55.17   33.10    NO

 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

     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      56.84          500.        0.


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```