

Petitioner's Exhibit 2a



CALCULATIONS

PROJECT TITLE:	Frontier Discoverer	BY:	R. Steen
PROJECT NO:	180-15	PAGE 1	OF 1
SUBJECT:	Owner Requested Limit (ORL)	SHEET 1	
		DATE:	2/6/2007

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

General ORL NOx Compliance Equation: $E_A + E_B + E_C + E_D + E_E + K \leq 245 \text{ ton NOx} * 2000 \text{ lb NOx}$

Where:

- E_A = Emissions from Frontier Discoverer (FD) Vessel A
- E_B = Emissions from Kapitan Dranitsyn (KD) Vessel B
- E_C = Emissions from Fennica/Nordica (F/N) Vessel C
- E_D = Emissions from Jim Kilabuk Vessel D
- E_E = Emissions from Frontier Discoverer OSR Fleet Vessel E
- K = Emission from sources that are fixed as a constant

Specific ORL NOx Compliance Equation:

$(F_{A1} * EF_{A1}) + (F_{A2} * EF_{A2}) + (F_{A3} * EF_{A3}) + (F_{A4} * EF_{A4}) + (F_{B1} * EF_{B1}) + (F_{B2} * EF_{B2}) + (F_{C1} * EF_{C1}) + (F_{C2} * EF_{C2}) + (F_D * EF_D) + (F_E * EF_E) + K \leq 245 * 2000 \text{ lb NOx}$

Where:

- F_i = Fuel consumption (gallons) by source group i
- EF_i = Emission factor (lb NOx/gal fuel) by source group i
- K = Constant emissions (tons) from sources with emissions not based on fuel use (incinerators)
- 245 = NOx emission limit (tpy)

Calculation of NOx Emission Factors and Example Comparison with ORL

Average Capacity Factor (CF) emissions factor (EF) Adjustment for operation below capacity

FD Cat 399, FD propulsion, KD propulsion & aux engines:	104%
F/N Propulsion:	101%
All other Engines (the small ones):	108%
Boilers max EF is at capacity:	100%

ORL Equation Variables:

	Vessel Source Group (i)	Adj. Avg. CF [^] NOx Emission Factor (lb/gal) (EFi)	Example (measured) Fuel Use (gal) (Fi)	Per Source Group Emissions (tons)	Emission Units to be tested Yes or No	Emissions from Tested Units (tons)
FD six Caterpillar 399 main drilling engines	A1	0.254	283,632	36.1	Yes	36.1
FD Mit. 6UEC65 main propulsion engine	A2	0.455	15,879	3.6	No	
FD boilers	A3	0.028	48,170	0.7	No	
FD remaining sources	A4	0.139	10,062	0.7	No	
KD propulsion & auxiliary engines	B1	0.455	451,882	102.7	Yes	102.7
KD boilers	B2	0.020	135,985	1.4	No	
F/N four main propulsion engines	C1	0.375	433,649	81.4	Yes	81.4
F/N two boilers	C2	0.020	24,696	0.2	No	
Jim Kilabuk sources	D	0.654	5,046	1.6	No	
OSR Fleet sources	E	0.472	23,800	5.6	No	
Constant emissions	K	-	-	0.8	No	
			1,432,801	234.8		220.1
						94% of total

If total emission of 234.8 tons NOx is less than 245 ton limit it represents compliance.

[^]Adj. Avg. CF EF is the adjusted average capacity-factor emission-factor, which is the emission factor at 100% load multiplied by the % adjustment that accounts for changes in emission at operating loads.



CALCULATIONS

PROJECT TITLE: Frontier Discoverer	BY: D. Young
PROJECT NO: 180-15	PAGE 1 OF 1 SHEET 2
SUBJECT: Emission Factors (EF)	DATE: 2/6/2007

Emission Factors (EF)

<u>Vessel</u> Engine or boiler	Vessel Source and Group (i)	Unit's capacity (hourly)	EF Reference	NOx Emission Factor	Engine Heat rate (Btu/Hp-hr)	NOx EF* (lb/gal)	Number in group
Discoverer Rig							
Drilling Engine Cat. 399	A1	1,282 Hp	Caterpillar data for D399	0.245 lb/gal	-	0.245	6
Prop. Engine Mit. 6UEC65	A2	7,063 Hp	AP42 Sec 3.4 10/96	3.2 lb/mmBtu	-	0.438	1
Heat Boiler	A3	7.97 mmBtu	Clayton Industries (manufacturer)	0.201 lb/mmBtu	-	0.028	2
Air Compressor	A4	500 Hp	Tier 3 (CFR § 89.112 (a))	0.00658 lb/hp-hr	7,000	0.129	2
HPP Engine	A4	250 Hp	AP42 Sec 3.3 10/96	0.031 lb/hp-hr	7,000	0.607	2
Port Fwd Deck Crane Cat. D343	A4	365 Hp	AP42 Sec 3.3 10/96	0.031 lb/hp-hr	7,000	0.607	1
Stbd Fwd Deck Crane Cat. D343	A4	365 Hp	AP42 Sec 3.3 10/96	0.031 lb/hp-hr	7,000	0.607	1
Cementing Unit Engine	A4	325 Hp	AP42 Sec 3.3 10/96	0.031 lb/hp-hr	7,000	0.607	2
Kapitan Dranitsyn							
Main Engine	B1	4,140 Hp	AP42 Sec 3.4 10/96	3.2 lb/mmBtu	-	0.438	6
Auxiliary Engine	B1	1,050 Hp	AP42 Sec 3.4 10/96	3.2 lb/mmBtu	-	0.438	5
Heat Boiler	B2	18 mmBtu	AP42 Tbl 1.3-1 9/98	0.143 lb/mmBtu	-	0.020	2
Fennica/Nordica							
Main Engine	C1	7,884 Hp	Finstaship (owner)	0.0189 lb/hp-hr	7,000	0.370	2
Main Engine	C1	5,913 Hp	Finstaship (owner)	0.0189 lb/hp-hr	7,000	0.370	2
Heat Boiler	C2	4.44 mmBtu	AP42 Tbl 1.3-1 9/98	0.143 lb/mmBtu	-	0.020	2
Jim Kilabuk (resupply vessel)							
Main Engine EMD V20 645	D	3,600 Hp	AP42 Sec 3.4 10/96	3.2 lb/mmBtu	-	0.438	2
Generator, Cat. D3406	D	292 Hp	AP42 Sec 3.3 10/96	0.031 lb/hp-hr	7,000	0.607	2
Bow Thruster Cat. D343	D	300 Hp	AP42 Sec 3.3 10/96	0.031 lb/hp-hr	7,000	0.607	1
Discoverer's OSR Fleet							
Engines on Pt. Barrow tug	E	1,502 Hp	Tier 2 (Caterpillar data)	0.0105 lb/hp-hr	7,000	0.206	2
Generator on Pt. Barrow	E	150 Hp	Caterpillar data for 3304B	0.0195 lb/hp-hr	7,000	0.382	1
Kvichak 47' skimming vessel	E	700 Hp	Vendor MARPOL73/78 VI test	0.0144 lb/hp-hr	7,000	0.282	2
Kvichak 34' work boat #3	E	300 Hp	Cummins data for 6BTA	0.01024 lb/hp-hr	7,000	0.200	2
Kvichak 34' work boat #4	E	300 Hp	Cummins data for 6BTA	0.01024 lb/hp-hr	7,000	0.200	2
Kvichak 34' work boat #5	E	300 Hp	Cummins data for 6BTA	0.01024 lb/hp-hr	7,000	0.200	2
Kvichak 34' work boat #6	E	300 Hp	Cummins data for 6BTA	0.01024 lb/hp-hr	7,000	0.200	2
Engine on tug for supply barge	E	1,500 Hp	AP42 Sec 3.4 10/96	3.2 lb/mmBtu	-	0.438	2

* Bold values are transferred to compliance equation

Fuel heat content (AP42) 137,000 btu/gal

Constant emissions

						Emissions*	
Atlas 600 incinerator on Discoverer	K	100 kg	AP42 Tbl 2.1-12 Ind. multi-chamber 10/96	3 lb/ton		0.5	
Incinerator on the Kapitan Dranitsyn	K	70 kg	AP42 Tbl 2.1-12 Ind. multi-chamber 10/96	3 lb/ton		0.3	
						0.8	Total NOx
*Example of emission s calc		100 kg	2.205 lb	ton	3 lb NOx	24 hr	120
		hour	kg	2000 lb	ton of waste	day	location
						ton	= 0.5 ton NOx
						2000 lb	



CALCULATIONS

PROJECT TITLE: Frontier Discoverer	BY: D Young
PROJECT NO: 180-15	PAGE 1 OF 1 SHEET 3
SUBJECT: Emission at multiple loads	DATE: 2/6/2007

Caterpillar D399 genset on the Discoverer
Manufacturer Data for D399 SCAC (85) at 1200 RPM

Given			Calculations*							
Power kw	% load	Spec. Fuel Consum. gm/kw-hr	NOx [^] EF gm/hr	NOx EF g/kw-hr	EF Load/Max load %	EF Cumulative Average %	Fuel gal/hr	NOx lb/gal	NOx lb/hr	Heat rate btu/hp-hr
976.1	100	237.5	7993.9	8.19	100%	100%	71.98	0.245	17.6	7534
732.1	75	233.3	6159.8	8.41	103%	101%	53.03	0.256	13.6	7401
490.3	50	235.3	4360.5	8.89	109%	104%	35.82	0.268	9.6	7464
246.3	25	268.6	2407.0	9.77	119%	108%	20.54	0.258	5.3	8521

Mass conversion factor 453.6 g/lb
 Density of diesel fuel (AP42) 7.1 lb/gallon
 Power conversion factor 1.341 hp/kw
 Heat content of diesel fuel (AP42) 137,000 btu/gal

*Calculation Examples

NOx emission factor of lb NOx/gal obtained by:

$$\frac{7993.9 \text{ g NOx}}{\text{hr}} \times \frac{1 \text{ lb}}{453.6 \text{ g}} \times \frac{1 \text{ hr}}{71.98 \text{ gal}} = 0.245 \text{ lb NOx /gal}$$

Fuel input in terms of gal/hr obtained by:

$$976.1 \text{ kw} \times \frac{237.5 \text{ g fuel}}{\text{kw hr}} \times \frac{1 \text{ lb}}{453.6 \text{ g}} \times \frac{1 \text{ gal}}{7.1 \text{ lb fuel}} = 71.98 \text{ gal/hr}$$

^This NOx value is manufacturer value (i.e., their nominal value for NOx multiplied by their factor of 1.2).

Fennica/Nordica

Data from Finstaship

Given		Calculations	
Load %	NOx g/kw-hr	EF Load/Max load %	EF Cumulative Average %
100	11.5	100%	100%
75	12	104%	102%
50	11.5	100%	101%