ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Air Permits Program

TECHNICAL ANALYSIS REPORT
FOR
AIR QUALITY CONTROL MINOR PERMIT AQ0486MSS02

PROVIDENCE HEALTH SYSTEM - WASHINGTON
PROVIDENCE ALASKA MEDICAL CENTER

Emergency Power Supply System

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Abbreviations and Acronyms

Acronyms

AAC .....Alaska Administrative Code
AAAQS .....Alaska Ambient Air Quality Standards
ACMP.....Alaska Coastal Management Plan
Department .....Alaska Department of Environmental Conservation
AP-42 .....EPA's Compilation of Air Pollutant Emission Factors, Vol. 1
CAT.....Caterpillar
EF .....Emission Factors
EPA .....United States Environmental Protection Agency
EPSS.....Emergency Power Supply System
EU.....Emission Units
MR&R.....Monitoring, Recording, and Reporting
NSPS .....New Source Performance Standard
NTE .....Not-to-exceed
O&M .....Operation and Maintenance
ORL.....Owner Requested Limit
PAMC.....Providence Alaska Medical Center
PSD.....Prevention of Significant Deterioration
PTE.....Potential to Emit
TAR.....Technical Analysis Report
TV.....Title V
ULSD .....Ultra Low Sulfur Diesel (Diesel fuel that contains 15 ppmw of Sulfur)
VE.....Visible Emissions

Units and Measures

cfm.....cubic feet per minute
dscf .....dry standard cubic foot
gal .....gallon, gallons
gal/hr.....gallons per hour
gr/dscf.....grains per dry standard cubic feet
g/kW-hr .....grams per kilowatt-hr
hr.....hour, hours
kW .....kilowatts
lbs .....pounds
lb/MMscf .....pounds per million cubic feet
MMBtu .....million British Thermal Units
MMBTU/hr .....million British Thermal Units per hour
MMscf .....million standard cubic feet
MMscf/yr.....million standard cubic feet per year
ppm.....parts per million
ppmw .....parts per million by weight
tpy.....tons per year

Pollutants

CO .....Carbon Monoxide
NO_x.....Oxides of Nitrogen
NO_2.....Nitrogen Dioxide
PM .....Particulate Matter
PM-10.....Particulate Matter with an aerodynamic diameter less than 10 microns
SO_2 .....Sulfur Dioxide
VOC .....Volatile Organic Compound

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1. Introduction

This Technical Analysis Report (TAR) provides Alaska Department of Environmental Conservation's (Department's) basis for issuing Air Quality Control Minor Permit AQ0486MSS02 to Providence Health System-Washington, a non-profit corporation doing business as Providence Alaska Medical Center (PAMC). The permit is for the installation and operation of five new diesel-fired emergency power generators and a natural gas-fired space heater for PAMC's Emergency Power Supply System (EPSS). This permit is classified under 18 AAC 50.508(5) and 18 AAC 50.502(c)(3)(A)(iii).

1.1 Stationary Source Description

PAMC is a medical center located at 3200 Providence Drive, Anchorage. PAMC is currently operating under Minor Permit AQ0486MSS01. Permit AQ0486MSS02 establishes Owner Requested Limits (ORLs) to avoid an operating permit, as well as a Prevention of Significant Deterioration (PSD) permit, by restricting oxides of nitrogen (NO_x) emissions to 84.6 tons per year (tpy).

Table 1 of Minor Permit AQ0486MSS02 lists EU 37 through 41which were installed after the issuance of Minor Permit AQ0486MSS01. The installation of these units, by themselves, do not require an air quality permit due to their small engine ratings. In the application for Minor Permit AQ0486MSS02, the applicant included the emissions from these sources in the analysis for the requested emission limits.

1.2 Application Description

PAMC plans to install five 2,000 kilowatt (kW) diesel-fired generators and a 1.9 MMBtu/hr gas-fired heater as part of their EPSS project. In the wake of Hurricane Katrina, the national commission that accredits healthcare organizations urged hospitals to develop disaster response plans that enable hospitals to maintain services for at least four days in the event of a major disaster or extended power outage. PAMC's application to install and operate five new generators and a natural gas space heater is part of their disaster response plan. In addition to using these generators in emergencies, PAMC may use the new units to help meet peak power needs.

PAMC will house the new emission units in a new 24,000 square foot building located west of the existing Services Building J. PAMC provided drawings and plot plans of the buildings in Attachment 1 of the application. PAMC intends to purchase and install generators certified by the manufacturer as compliant with New Source Performance Standards (NSPS) Subpart IIII – Performance Standards for Stationary Compression Ignition Internal Combustion Engines. Attachment 2 of the application contains specifications of the emission units and statements by Caterpillar (CAT) that the units comply with NSPS and International Standards Organization specifications.

To avoid classification as a PSD major stationary source, PAMC requested an ORL under 18 AAC 50.508(5) to restrict the combined operation of the five new EPSS generators to 2,400 hours per year. PAMC made no requests for the 1.9 MMBtu/hr space heater. PAMC also submitted their minor permit application under 18 AAC 50.502(c)(3)(A)(iii) since NO_x

emissions from the EPSS project exceeds 10 tpy. Table 1: Description of New EPSS Units Authorized under Permit AQ0486MSS02
summarizes the new emission units PAMC will install and operate under Minor Permit AQ0486MSS02.

Table 1: Description of New EPSS Units Authorized under Permit AQ0486MSS02

ID No.	EPSS Equipment	Engine Model	Rating	Fuel Burned	Annual Limit
EPSS 1 - 5	Generators 1 through 5	CAT D3516C	2,000 kW each	0.05 wt % S Diesel	2,400 hrs total
EPSS GP-1	Space Heater	---	1.9 MMBtu/hr	Natural Gas	Unrestricted

PAMC conducted a dispersion modeling analysis for NO_x as required by 18 AAC 50.540(c)(2)(A) because NO_x emissions from the proposed units exceeded 10 tpy. PAMC demonstrated that the EPSS project will not cause or contribute to a violation of the annual average nitrogen dioxide (NO_2) Alaska Ambient Air Quality Standard (AAAQS) found in 18 AAC 50.010(5). Appendix C presents the Department's review of the modeling analysis.

2. Emissions Summary and Permit Applicability

2.1 Emissions Summary

The Department reviewed PAMC's emission estimates. The Department based the analysis in this section on emissions from EU1 through EU36 as found in the TAR of Minor Permit AQ0486MSS01, emissions from EU37 through EU41, and emissions from the proposed EPSS units estimated with not-to-exceed (NTE) emission factors (EF) provided in the application.

PAMC stated the EPSS generators are subject to New Source Performance Standards (NSPS) that restricts the sulfur content of the diesel fuel. The restriction is phased over time. The initial restriction is 150 parts per million by weight (ppmw), followed by 15 ppmw. PAMC therefore used the 150 ppmw assumption to estimate their project SO_2 emissions.

Table 2 summarizes the emissions as estimated by the Department. The emissions from the proposed EPSS generators are based on the 2,400 hours per year requested by the applicant and burning diesel fuel with a sulfur content of 0.05 percent by weight.

Table 2: Summary of Potential-to-Emit (PTE) Emissions (tpy)

Description of Emission Units	Pollutant Emissions (tpy)					Source of Emission Estimates
	NO_x	**CO**	**PM-10**	**SO_2**	**VOC**	
EU1 through EU36 (TAR AQ0486MSS01)	84.6	61.9	6.7	42.1	5.0	Table A-1, Table A-2 of Appendix A and TAR of AQ0486MSS01
EU37 through EU41 (Tables A-1, A-2)	3.5	1.0	0.4	1.3	0.6	
EU1 through EU41	*88.1*	*62.9*	*7.1*	*43.4*	*5.6*	
Proposed Generators (EU42 – EU46)	50.2	4.1	0.3	1.2	1.1	Table A-7 of Appendix A to this TAR
Proposed Natural Gas Heater (EU47)	0.8	0.7	0.1	0.3	0.1	
EU42 through EU47	*51.1*	*4.8*	*0.3*	*1.5*	*1.1*	
EU1 through EU47	***139.2***	***67.7***	***7.5***	***44.9***	***6.7***	***Tables in Appendix***

2.2 Permit Applicability

Because PAMC is an existing stationary source, emissions from the proposed EPSS units are emission increases. Table 3 compares the project emissions to the minor permit thresholds in 18 AAC 50.502(c)(3). The project emissions trigger the minor permit thresholds for NO_x, but not for any other pollutant.

Table 3: Permit Applicability Determination

Description of Scenario	Pollutant Emissions (tpy)				
	NO_x	CO	PM-10	SO_2	VOC
Existing Emissions	*88.1*	*62.9*	*7.1*	*43.4*	*5.6*
Project Emissions	51.1	4.8	0.4	1.5	6.7
Minor Permit Thresholds	10	N/A	10	10	N/A
Minor Permit Required under 18 AAC 50.502(c)(3)?	**Yes**	N/A	No	No	N/A

Table Notes
In order for the project emissions to be subject to the 10 tpy minor permit applicability thresholds in 18 AAC 50.502(c)(3), the existing emissions must exceed the following thresholds in 18 AAC 50.502(c)(1) for the given pollutant: 40 tpy for NO_x; 40 tpy for SO_2 and 15 tpy for PM-10.

The Department does not typically impose NSPS requirements through the Title I Minor Permit program. The Department therefore determined whether a fuel sulfur restriction is needed to avoid classification under 18 AAC 50.502(c)(3) for SO_2. The Department also verified what permit classifications PAMC is avoiding through the 2,400 hour per year ORL. Table 4 presents the resulting unrestricted emissions.

Table 4: Permit Applicability Determination for Unrestricted Operations

Description of Scenario	Pollutant Emissions (tpy)				
	NO_x	CO	PM-10	SO_2	VOC
Existing Emissions	*88.1*	*62.9*	*7.1*	*43.4*	*5.6*
Unrestricted Project Emissions	917.8	75.8	5.1	213.4 [a]	20.0

Minor Permit Thresholds	10	N/A	10	10	N/A
Minor Permit Required under 18 AAC 50.502(c)(3)?	[b]	N/A	No	**Yes**	N/A

Table Notes
[a] Assumes all diesel-fired emission units are burning diesel fuel with sulfur content of 5,000 ppmw (0.5 percent).
[b] While the project NO_x emissions exceed the 10 tpy minor permit threshold, they also exceed the 250 tpy PSD threshold. Therefore, PSD review rather than minor permit review would have been required for NO_x per 18 AAC 50.502(a)(1).

Using diesel fuel with a sulfur content of 0.5 percent by weight would trigger the SO_2 minor permit requirements under 18 AAC 50.502(c)(3). The Department then determined that 0.42 percent limit was sufficient to avoid this classification.. Through ex-parte communications with PAMC's Consultant, it was agreed that a fuel sulfur limit of 0.05 percent was more than adequate.

Without the 2,400 hour per year ORL the NO_x emissions from the EPSS project would be 918 tpy. Since this exceeds the 250 tpy PSD threshold, the project *would have* required PSD review for NO_x per 40 CFR 52.21(b)(1)(i)(c).

2.3 Assessable Emissions

From Table 2: Summary of Potential-to-Emit (PTE) Emissions (tpy), PM-10 and VOC emissions for PAMC do not exceed 10 tpy and do not count toward assessable emissions. The 139 tpy NO_x, 68 tpy CO, and 45 tpy SO_2 PTE emissions total 252 tpy. Therefore the assessable emissions for PAMC are 252 tpy.

2.4 Department Findings

The Department made the following findings regarding PAMC's application.

(a) Without any restriction on operation hours, NO_x emissions from the proposed units make the project a PSD major. The ORL of 2,400 hr/yr allows PAMC to avoid classification as a major stationary source subject to PSD review.

(b) The EPSS project will increase the potential NO_x emissions by 51 tpy. Since the emissions increase exceeds 10 tpy of NO_x, the project requires a minor permit under 18 AAC 502(c)(3)(A)(iii).

(c) PAMC will no longer be able to avoid Title V permitting through the operational restrictions imposed in Minor Permit AQ0486MSS01. The revised PTE for PAMC will be 139 tpy of NO_x which exceeds the 100 tpy Title V permitting threshold. PAMC will therefore need to submit a *complete* Title V permit application within 12 months of starting the emission units authorized in Minor Permit AQ0486MSS02.

(d) While PAMC will no longer be able to avoid Title V permitting once the new units become operational, the operating restrictions imposed in Minor Permit AQ0486MSS01 are still needed to avoid PSD and to protect the annual average NO_2 AAAQS.

(e) PAMC's permit application satisfies the requirements in 18 AAC 50.540.

(f) 18 AAC 50.540(c)(2)(A) requires PAMC to include an ambient analysis that demonstrates compliance with annual average NO_2 AAAQS. The Department's modeling review report is included with this TAR as Appendix C.

(g) The emergency power generators (Emission Units EPSS1 through EPSS5) are subject to the following Air Quality Control regulations: 18 AAC 50.055(a)(1) for visible emissions (VE); 18 AAC 50.055(b)(1) for particulate matter (PM); and 18 AAC 50.055(c) for sulfur compound emissions. The Department has previously determined that units burning diesel fuel containing less than 7,500 ppmw of sulfur will comply with the state standard. The state standard requires SO_2 concentration in the exhaust not to exceed 500 ppmv. The Department expects the exhaust from the generators to contain about 33 ppmv SO_2 because the generators will burn LSD with sulfur content not exceeding 500 ppmw. Tracking of sulfur content of the LSD is sufficient to demonstrate compliance with the sulfur compound standard. Calculations presented in Appendix B show that the generators will comply with the PM exhaust standard.

(h) The Natural Gas Heater GP-1 is subject to 18 AAC 50.055(a)(1) for VE; 18 AAC 50.055(b)(1) for PM; and 18 AAC 50.055(c) for sulfur compound emissions. GP-1 will burn pipeline quality natural gas. In the Department's compliance experience, units burning natural gas comply with VE, PM, and sulfur compounds standards. Certifying that Heater GP-1 burned only natural gas is sufficient demonstration that the heater will comply with the standards.

(i) PAMC is not located in an area that requires an Alaska Coastal Management Program (ACMP) review. Only projects in low-lying areas of Anchorage require ACMP review. The Department has previously processed several permit applications for projects located at PAMC without ACMP reviews.

3. Permit Requirements

3.1 Requirements for All Minor Permits

As described in 18 AAC 50.544(a), each minor permit issued under 18 AAC 50.542 must identify the stationary source, the project, the Permittee, contact information, the requirement to pay fees, and applicable standard permit conditions in 18 AAC 50.345. The permit cover page identifies the stationary source, project, Permittee, and contact information. The permit also contains the fee requirements, assessable emissions, and standard conditions needed to make the permit enforceable**.**

3.2 Requirements for Minor Permits Issued under 18 AAC 50.508(5)

Per 18 AAC 50.544(h), Minor Permit AQ0486MSS02:

(a) describes the ORLs, including specific testing and monitoring, recording and reporting (MR&R) requirements;
(b) lists all equipment covered by the ORLs; and
(c) states that the ORLs allows PAMC to avoid classification as a major stationary source.

3.3 Requirements for a Minor Permit issued under 18 AAC 50.502(c)

As required under 18 AAC 50.544(c), the permit includes terms and conditions that:

(a) assure PAMC's project will not cause or contribute to a violation of the annual average NO_2 AAAQS;
(b) assure emission limits satisfy applicable emission standards under 18 AAC 50.055; and
(c) require recordkeeping and periodic reporting on emission and operations.

3.4 Assessable Fees for Potential Emissions

In accordance with the Department's billing regulations of 18 AAC 50.410, the permit requires PAMC to pay assessable fees for each air pollutant in excess of 10 tpy. The Department bases assessable fees on emissions from all emission units. The Department calculated 252 tpy of assessable emissions based on the PTE for NO_x. CO, and SO_2 presented in Table 2: Summary of Potential-to-Emit (PTE) Emissions (tpy).

4. Permit Administration

PAMC may operate the five emergency generators (EPSS-1 through EPSS-5) and Natural Gas Heater GP-1 in accordance with Minor Permit AQ0486MSS02 upon issuance.

Minor Permit AQ0486MSS02 allows PAMC to emit more than 100 tpy of NO_x. Therefore, within 12 months of starting to operate the emission units authorized by Minor Permit AQ0486MSS02, PAMC must submit a complete Title V application.

Appendix A: Emissions from Proposed PAMC Emission Units

Appendix A presents characteristics and emissions of existing and proposed fuel burning equipment at PAMC. Table A-1 presents equipment and emissions authorized by Minor Permit AQ0486MSS01. Table 1 of Minor Permit AQ0486MSS01 lists the equipment in detail as Equipment IDs 1 through 26 and 28 through 36. Equipment ID 27 is a storage tank and not included in Table A-1.

Table A-1: Potential Emissions Authorized under Minor Permit AQ0486MSS01

Description of Unit	Rating	Annual Limits	Pollutant Emissions (tpy)				
			NO_x	CO	PM-10	SO_2	VOC
SB-03 E. Keller Boiler	38.5 MMBTU/hr	500,000 gals and 1,000 MMscf	5.0 50.0	1.3, 42.0	1.0, 3.8	17.5, 17.1	0.1, 2.8
SB-04 E. Keller Boiler	38.5 MMBTU/hr						
SB-05 Nebraska Boiler	49 MMBTU/hr						
SB-06 Cleaver Brooks	42.2 MMBTU/hr						
B1 MOB Hub Boiler 1	12.6 MMBTU/hr						
B2 MOB Hub Boiler 2	12.6 MMBTU/hr						
Small Boilers and Heaters	10.405 MMBTU/hr	None	4.6	3.8	0.4	1.6	0.3
G-01 Cummins Generator	1,000 kW	250 hrs	4.0	0.9	0.1	0.6	0.1
G-02 Cummins Generator	1,000 kW	250 hrs	4.0	0.9	0.1	0.6	0.1
G-03 Solar Turbine	900 kW	250 hrs	0.1	0.0	0.1	1.0	0.0
G-04 Detroit Generator	400 kW	250 hrs	2.1	0.5	0.2	0.2	0.2
G-201 Cummins Generator	300 kW	250 hrs	1.6	0.3	0.1	0.2	0.1
G-301 Komatsu Generator	450 kW	250 hrs	2.3	0.5	0.2	0.3	0.2
G-1 MOB Generator	846 kW	250 hrs	2.2	2.7	0.1	0.5	0.3
API Boilers and Generators	10 MMBTU/hr	None	4.4	3.7	0.3	1.5	0.2
API Generator	846 kW	500 hrs	4.3	5.3	0.3	1.0	0.6
Total	**----**		**84.6**	**61.9**	**6.7**	**42.1**	**5.0**

Table Notes:
Exhibit A of Minor Permit AQ0486MSS01 provides details of the emission from the 35 fuel burning equipment.

Table A-2 presents characteristics and emissions of EU37 through EU41.

Table A-2: Potential Emissions Emission Units 37 through 41

Description of Unit	Rating	Maximum Use	Potential Pollutant Emissions (tpy)				
			NO_x	CO	PM-10	SO_2	VOC
Natural Gas House Boiler, EU37	2 MMBtu/hr	18 MMscf	0.88	0.18	0.11	0.30	0.05
Natural Gas Hub Boiler, EU38	2 MMBtu/hr	18. MMscf	0.88	0.18	0.11	0.30	0.05
Diesel Tower S Generator, EU39	250 hp	500 hours	0.40	0.36	0.02	0.22	0.41
Natural Gas Tower S Boiler, EU40	2 MMBtu/hr	18 MMscf	0.88	0.18	0.11	0.30	0.05
Natural Gas Building Boiler, EU41	1 MMBtu/hr	9 MMscf	0.44	0.09	0.05	0.15	0.03
EU37 through EU41			**3.48**	**0.99**	**0.40**	**1.27**	**0.59**

Table Notes:
Table obtained from Attachment 4 of PAMC application for Minor Permit AQ0486MSS02. PAMC did not obtain permits for these because PAMC said the PTE of the equipment did not reach thresholds that require permits.
Fuel consumption represents amount of natural gas units can burn if the units operate for 8,760 hours a year.
For EU39, PAMC assumed the EPA default 500 operating hours for an emergency generator.

Table A-3 through A-7 presents characteristics, fuel characteristics, NTE EF and emissions of proposed diesel EU42 through EU46 (EPSS-1 through EPSS-5) and natural gas heater EU47 (EPSS GP-1) as estimated by the Department.

Table A-3: Emission Factors and Emissions for Generators (EU42 through EU46) Operating for 2,400 hrs/yr

Pollutant	NTE EF (lb/hr)	TPY
NO_x	41.87	50.24
CO	3.43	4.12
PM-10	0.23	0.28
VOC	0.91	1.09

Table Notes:
Source of EFs: Gen Set Package Performance Data, Caterpillar Model 3516C (in Attachment 2 of application)

Table A-4: Fuel Consumption and SO_2 Emissions by Diesel Generators (EU42 through EU46)

Description	Quantity	Units	Reference of Data
Maximum Operation in a year	2,400	hours	Owner Requested Limit
Fuel Consumption Rate	138	gal/hr	Caterpillar manufacturer's data
Annual Consumption	331	1,000 gal/yr	By calculation
Density of Fuel Burned	7.05	lb/gal	AP-42, Appendix A – Distillate Oil
Annual Fuel Consumption	1,168	tpy	By calculation
Sulfur Content of Fuel	500	ppmw	Department assumption
Total Sulfur in Fuel Burned	0.584	tpy	Mass balance
SO_2 Emitted	1.168	tpy	Twice amount of sulfur burned

Table A-5: Natural Gas Consumption and SO_2 Emissions Emitted by the Natural Gas EPSS Heater (EU47)

Description	Quantity	Units	Reference of Data
Natural Gas Burned	16.64	MMscf/yr	Attachment 4 of application
Sulfur Content in Natural Gas	0.12	Grains/scf	Attachment 4, Pg 6 of 7
Sulfur in Fuel	285	lb/yr	Assuming 7,000 grains/lb
SO_2 Emitted	0.29	tpy	Twice amount of sulfur burned

Table A-6: Emission Factors and Emissions from Natural Gas Heater (EU47)

Pollutant	AP-42 (lb/MMscf)	TPY
NO_x	100.0	0.83
CO	84.0	0.70
PM	7.6	0.06
VOC	5.5	0.05
SO_2 (see Table A-5)	Mass balance	0.29

Table Notes:
tpy = ((16.64 MMscf) × (Emission Factor, lb per MMscf)) ÷ 2,000
The EFs come from AP-42, Table 1.4.1, and Table 1.4-2.

Table A-7: Summary Emissions for 5 Diesel EPSS EUs (EU42 through EU46) and EU47

Proposed Units	Rating	Annual Limits	Pollutant Emissions (tpy)				
			NO_x	CO	PM-10	SO_2	VOC
5Diesel EUs (ID 42 – 46)	2,937 hp each	2,400 hrs total	50.24	4.12	0.28	1.17	1.09
1 Natural Gas Heater (ID 47)	1.9 MMBtu/hr	16.64 MMscf	0.83	0.70	0.06	0.29	0.05
Applicant's Estimates			**51.07**	**4.82**	**0.34**	**1.46**	**1.14**

Table Notes:
Table obtained from Table A-3 through A-6 and are based on NTE emission factors provided by Caterpillar

Appendix B: Compliance with Emission Standards for Emission Units

PM Standards for the Proposed Diesel Generators

Table B-1 presents calculations that show that the diesel units will comply with the state PM standards of 0.05 grains per standard cubic foot under 18 AAC 50.055. The PM concentration in the exhaust of the diesel units is less than 10% of the PM standard.

Table B-1: Estimation of PM Concentration in Exhaust of Diesel EPSS Generators (ID 42 through 46)

Description of Quantity	Value	Reference
NTE EF	0.23 lb/hr	Caterpillar data for Model 3516C
NTE EF	1,610 grains per hour	7,000 grains per pound
NTE EF	26.83 grains per minute	60 minutes per hour
Wet Stack Gas Exhaust Flow Rate	6,071 scfm	Caterpillar data for Model 3516C
Dry Stack Gas Exhaust Flow Rate	5,562 scfm	Caterpillar data for Model 3516C
PM Concentration in Wet Exhaust Gas	0.00442 grains per wet cubic foot	By calculation
PM Concentration in Dry Exhaust Gas	0.00482 grains per dry cubic foot	By calculation

Table Notes:
Using similar calculations, applicant obtained 0.017 gr/scf assuming EF of 0.2g/kW-hr and 2,000 kW rating.

SO_2 Standard for Diesel Generators

The Department has previously demonstrated by calculation that equipment burning liquid fuel with sulfur content below 7,500 ppmw will comply with the state S standard of 500 ppmv SO_2 in the exhaust gas. The proposed diesel equipment will burn LSD fuel with sulfur content not exceeding 500 ppmw. Therefore, the Department does not expect concentration of SO_2 in the exhaust of the diesel generators to exceed 33 ppmv and will therefore comply with the sulfur emission standard.

Sulfur Compounds, PM, and VE Standards for Natural Gas-fired Equipment

From the compliance experience of the Department, equipment burning pipeline-quality natural gas consistently operate with no opacity and negligible VE and comply with the PM standard of 0.05 grains per cubic foot. The Department has previously determined that burning natural gas fuel that contains less than 5,700 ppmv S will produce an exhaust that contains less than 500 ppmv SO_2.

Appendix C: Department Review of PAMC Modeling

MEMORANDUM

State of Alaska
Department of Environmental Conservation
Division of Air Quality

TO: File

DATE: June 22, 2010

THRU: Alan Schuler, P.E.
Environmental Engineer I
Air Permits Program

FILE NO:

PHONE: 269-7574
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FROM: Krystin K. Bablinskas
Environmental Eng. Assoc. I
Air Permits Program

SUBJECT: Review of PAMC's Ambient Assessment

This memorandum summarizes the Department's findings regarding the ambient analysis submitted by Providence Alaska Medical Center (PAMC) for the Emergency Power Supply System (EPSS) Project at the Providence Alaska Medical Center. PAMC submitted this analysis in support of their December 16, 2009 minor permit application (AQ0486MSS02). As described in this memorandum, PAMC's analysis adequately shows that operating their emission units within the requested constraints will not cause or contribute to a violation of the Alaska Ambient Air Quality Standards (AAAQS) provided in 18 AAC 50.010.

BACKGROUND

PAMC is located off Providence Drive in the northeast quadrant of the Municipality of Anchorage. PAMC currently operates the medical center under minor permit AQ0486MSS01. PAMC has initiated the EPSS Project to upgrade power generation capability in the wake of natural disasters, such as Hurricane Katrina. The EPSS Project includes the installation of five new 2,000 kilowatt (kW) diesel-fired emergency generators, and a 1.9 MMBtu/hr natural gas-fired boiler, and the removal of four of the eight existing generators. Additionally, the project includes modification of an existing boiler stack to remove a rain cap. Without rain cap removal, PAMC will not comply with the annual average nitrogen dioxide (NO_2) AAAQS when adding the new generators.

The EPSS Project requires a minor permit under 18 AAC 50.502(c)(3)(A)(iii) because the increase in oxides of nitrogen (NO_X) emissions exceeds the 10 ton per year minor permit threshold. Additionally, PAMC requested an Owner Requested Limit (ORL) under 18 AAC 50.508(5) to avoid a Prevention of Significant Deterioration (PSD) permit under 18 AAC 50.306. The ORL sets a maximum operational limit for the five 2,000 kW generators at 2,400 hours per year, combined.

Applicants subject to 18 AAC 50.502(c)(3) must provide an ambient AAAQS analysis for the triggered pollutants per 18 AAC 50.540(c)(2). Therefore, PAMC was required to demonstrate compliance with the annual average NO_2 AAAQS.

The Department forwarded a number of modeling deficiencies and concerns to PAMC on May 6, 2010. PAMC's consultant, Hoefler Consulting Group (HCG), provided a revised ambient demonstration on behalf of PAMC on May 21, 2010. This memorandum references the May 21st revision, unless noted otherwise.

APPROACH

PAMC used computer analysis (modeling) to predict the ambient air quality impacts. HGC conducted the modeling analysis on behalf of PAMC.

Model Selection

There are a number of air dispersion models available to applicants and regulators. The U.S. Environmental Protection Agency (EPA) lists these models in their *Guideline on Air Quality Models* (Guideline). PAMC used EPA's AERMOD Modeling System (AERMOD) for the ambient analysis. AERMOD is an appropriate modeling system for this application.

The AERMOD Modeling System consists of three components: AERMAP (which is used to process terrain data and develop elevations for the receptor grid/emission units), AERMET (which is used to process the meteorological data), and the AERMOD dispersion model (which is used to estimate the ambient concentrations). PAMC used the current version of each component (version 09292 for AERMOD, version 09040 for AERMAP and version 06341 for AERMET).

Meteorological Data

AERMOD requires hourly meteorological data to estimate plume dispersion. According to the Guideline, a *minimum* of one-year of site-specific data, or five years of representative National Weather Service (NWS) data should be used. When modeling with site-specific data, the Guideline states that additional years (up to five) should be used when available to account for year-to-year variation in meteorological conditions.

PAMC used five years (2004 – 2008) of surface and upper air NWS data from Ted Stevens Anchorage International Airport (ANC). The airport is located within the Anchorage Bowl about 5 miles west of the medical center and adequately represents the meteorological conditions at the center.

AERMET requires the area surrounding the meteorological tower to be characterized in regards to the following three surface parameters: noon-time albedo, bowen ratio, and surface roughness length. PAMC adequately followed EPA and Department guidance for selecting and processing the surface parameters.

Emission Unit Inventory

PAMC has a large, complex facility with several buildings and a large emission unit inventory consisting of a few large units and many small emission units. The small emission units are scattered throughout the facility and for modeling purposes can be considered insignificant. PAMC excluded emission units based on the location and size, since small units far from the large generators and boilers will have little impact on the concentrations near these large units.

Thus, PAMC did not model heaters and boilers rated at less than 2 MMBtu/hr, including the proposed gas-fired boiler. PAMC only modeled the more substantive units, which are listed below in Table 1. The modeled inventory also includes the existing emergency generators (EUs 5 through 8), though PAMC plans to remove these generators once the new generators (EUs 42 through 46) are installed. The un-modeled units can be derived from Attachment 4 of their permit application.

Table 1: Modeled Emission Unit Inventory

EUs	Equip. No.	Description	Fuel Type	Capacity	Operation Restrictions	Stack Parameters	
						Capped?	Horizontal?
1	SB-03	Steam Boiler	Natural Gas/Diesel	38.5 MMBtu/hr	1,000 MMscf/yr (includes EUs 28 & 29) 500,000 gal/yr		
2	SB-04	Steam Boiler	Natural Gas/Diesel	38.5 MMBtu/hr		Yes	
3	SB-05	Steam Boiler	Natural Gas/Diesel	49.0 MMBtu/hr		Yes	
4	SB-06	Steam Boiler	Natural Gas/Diesel	42.2 MMBtu/hr		Yes	
5	G-01	Emergency Power Generator	Diesel	1,000 kW	250 hr/yr		
6	G-02	Emergency Power Generator	Diesel	1,000 kW	250 hr/yr		
7	G-03	Emergency Power Generator	Diesel	900 kW	250 hr/yr	Yes	
8	G-04	Emergency Power Generator	Diesel	400 kW	250 hr/yr	Yes	
17	G-201	Emergency Power Generator G-201	Diesel	300 kW	250 hr/yr		
18	G-301	Emergency Power Generator G-301	Diesel	450 kW	250 hr/yr		Yes
28	B-1	MOB Hub Boiler 1	Natural Gas	12.6 MMBtu/hr	1,000 MMscf/yr (includes EUs 1 – 4)		
29	B-2	MOB Hub Boiler 2	Natural Gas	12.6 MMBtu/hr			
30	G-1	East MOB Emergency Gen	Diesel	846 kW	250 hr/yr		Yes
35	API-3	API Emergency Generator	Diesel	846 kW	500 hr/yr		Yes
39	G-2	Tower S Emergency Gen	Diesel	250 hp	500 hr/yr		
42	EPSS-1	EPSS Generator 1 (Cat D3516C)	Diesel	2,000 kW	2,400 hr/yr		
43	EPSS-2	EPSS Generator 2 (Cat D3516C)	Diesel	2,000 kW			
44	EPSS-3	EPSS Generator 3 (Cat D3516C)	Diesel	2,000 kW			
45	EPSS-4	EPSS Generator 4 (Cat D3516C)	Diesel	2,000 kW			
46	EPSS-5	EPSS Generator 5 (Cat D3516C)	Diesel	2,000 kW			

Emission Rates and Stack Parameters
The assumed emission rates and stack parameters have significant roles in an ambient demonstration. Therefore, the Department checks these parameters very carefully.

PAMC provided vendor data that listed exhaust parameters for the new emergency generators (EUs 42 through 46). Additional information was also provided for the existing modeled units (EUs 1 through 8, 28 through 30, 35, and 39). The Department verified that the exhaust parameters and emissions provided in the application were used in the modeling files.

Stack Heights
PAMC used the following parameters to characterize the stack heights for the proposed generators:

A release height that equals or exceeds:
- 53 feet above the grade;
- 7 feet above the roof the generator building; and
- 2 feet above highest portion (penthouse) of generator building.

PAMC provided elevation drawings showing the same proposed stack heights. The Department included these stack heights as a condition in the minor permit.

Operational Restrictions
Table 1 also lists the assumed operational restrictions for each emission unit. The restrictions assumed for the existing units EU1 through EU36 match the limits currently imposed in Minor Permit AQ0486MSS01 to avoid Title V and PSD permitting.

PAMC requested a 2,400 hour per year combined operating limit on the new emergency generators (EUs 42 through 46) to avoid PSD review. Since the limit is combined, PAMC arbitrarily distributed the hourly limit over the five new emergency generators for the ambient assessment. PAMC allocated the hourly restriction as 600 hours per year for EUs 42 through 45 and zero hours per year for EU46. This is a reasonable allocation given the identical nature of these emission units.

Though the original intention for these operational restrictions is to avoid additional permitting requirements, PAMC's modeling analysis shows that the restrictions are also needed to protect the annual average NO_2 AAAQS. As shown in the Results section of this memorandum, the maximum NO_2 impact is 98.3 micrograms per cubic meter ($\mu g/m^3$). This is so close to the 100 $\mu g/m^3$ air quality standard that minor increases in operation could lead to modeled violations of the AAAQS. Therefore, the Department is imposing these operational limits as ambient air conditions in Minor Permit AQ0486MSS02.

Horizontal/Capped Stacks
The presence of non-vertical stacks or stacks with rain caps requires special handling in an AERMOD analysis. The proper approach for characterizing a horizontal/capped stack is described in EPA's *AERMOD Implementation Guide*. For capped and horizontal stacks subject to building downwash, the user should input the actual stack diameter and exit temperature, but

set the exit velocity to a nominally low value (0.001 m/s). If the capped/horizontal stack is *not* subject to downwash, then the 0.001 m/s exit velocity should be used along with an artificially large diameter (set to maintain the actual exhaust flow rate).

EPA has developed a non-default option in AERMOD that will revise the stack characteristics as warranted, for stacks that are identified as capped or horizontal. EPA Region 10 granted the Department permission to use this option in general in October 2007.[1]

For EUs 2 through 4 and 7 through 8, PAMC used EPA's guidance for capped stacks subject to downwash. EU 1 currently has a rain cap, but this was removed for the modeling analysis to increase the vertical momentum of exhaust released from the stack and further improve air quality. The Department included this change as a permit condition.

The Department also considered whether additional stack orientation/cap restrictions were warranted due to the extremely small margin of compliance in PAMC's ambient demonstration. The Department focused this assessment on the two 12.6 MMBtu/hr boilers (EUs 28 and 29) which PAMC modeled as uncapped, vertical releases. The Department was concerned that subsequent capping of these units would lead to a modeled violation. Therefore, the Department ran a sensitivity analysis to determine the effects of capping these two units. The Department capped the stacks using the non-default capping option in AERMOD and using the actual stack parameters. The Department kept the other units unchanged. The Department ran the model for year 2008 since it results in the largest concentration. The resulting concentration remained unchanged. Therefore, the Department did not include additional conditions for emission units' stack configurations.

Horizontal stacks on EUs 18, 35, and 39 were modeled using non-default "POINTHOR" BETA option in AERMOD using actual stack parameters. The Department concludes that all these approaches are sufficient for describing the stack parameters.

PAMC plans to have the new emergency generator's (EUs 42 through 46) stacks inclined at least 60 degrees above the horizontal. AERMOD does not have an optional setting for this orientation. PAMC therefore calculated and used the vertical component of the exit velocity. However, they did *not* adjust the stack diameter since the stacks are subject to downwash. PAMC's approach is consistent with EPA's AERMOD Implementation Guide. The Department is including PAMC's 60-degree assumption as a permit requirement since shallower orientations would likely lead to a modeled violation of the annual average NO_2 AAAQS.

Ambient NO_2 Modeling

The modeling of ambient NO_2 concentrations can sometimes be refined through the use of ambient air data assumptions. PAMC used the national default ambient NO_2-to-NOx ratio of 0.75, as provided in the Guideline, to refine the estimated ambient NO_2 concentrations. The 0.75 ratio is appropriate for this analysis.

[1] E-mail from Herman Wong (EPA R10) to Alan Schuler (Department); *RE: Capped/Horizontal Stack Issue*; October 2, 2007.

Ambient Air Boundary
For purposes of air quality modeling, "ambient air" means outside air to which the public has access. Ambient air typically excludes that portion of the atmosphere within a stationary source's boundary. PAMC allows the public to have access to all areas surrounding the facility. Therefore, all outdoor areas within the PAMC campus (and beyond) is considered ambient air.

Receptor Grid
PAMC used a receptor grid that starts at the PAMC main building footprint and extends outward. The receptor grid follows the PAMC main building footprint with a spacing of 5 m. The same spacing is repeated along the API and MOB building foot prints. The receptors increase to a spacing of 10 m from the building footprint to 100 m outward and then increase to 50 m spacing out to 500 m. Additionally, PAMC placed flagpole receptors along the periphery of the employee parking garage located just north of the generator building.

Downwash
Downwash refers to conditions where nearby structures influence plume dispersion. Downwash can occur when a stack height is less than a height derived by a procedure called "Good Engineering Practice," as defined in 18 AAC 50.990(42). The modeling of downwash-related impacts requires the inclusion of dimensions from nearby buildings.

The PAMC campus is a large collection of buildings. For the purposes of this ambient demonstration, PAMC included only applicable buildings. These are the main PAMC building, a complex, multi-tiered structure and two smaller API and MOB buildings. Each building has several existing emission units. For the new emergency generators, PAMC included the proposed building slightly offset from the main campus. Based on the information provided to the Department in PAMC's December 16, 2009 application, the Department concludes this is adequate information.

Off-Site Impacts
In a cumulative impact analysis, the applicant must include impacts from large sources located within 50 km of the applicant's SIA. These impacts from "off-site" sources are typically assessed through modeling. However, the off-site impacts in an AAAQS analysis can also be accounted for with ambient monitoring data, if representative data is available.

PAMC included in their May 21, 2010 submittal an assessment of the offsite existing impacts. Three power plants are located within the SIA of PAMC: Chugach Electric International Station Power Plant, and two Municipal Light and Power (ML&P) generating stations. PAMC conducted an SIA analysis on each power plant to assess whether or not each power plant has an impact greater than the SIL at the PAMC campus. The results of SIA analysis are shown in Table 2.

Table 2: Off-site SIA Analysis

Source Group	Maximum Annual Average NO_2 Impact ($\mu g/m^3$)	NO_2 SIL ($\mu g/m^3$)
ML&P 1	0.4	1.0
ML&P 2	0.3	
Chugach	0.1	
All	0.8	

The results from PAMC's SIA analysis show that neither power plant significantly impacts air quality near the PAMC campus. Therefore, PAMC did not need to include the offsite inventories as part of their ambient analysis. The Department reviewed PAMC's submittal and concluded that PAMC's analysis was sufficient.

Background Concentrations

The background concentration represents impacts from sources not included in the modeling analysis. Typical examples include natural, area-wide, and long-range transport sources. The background concentration must be evaluated on a case-by-case basis for each ambient analysis. Once the background concentration is determined, it is added to the modeled concentration to estimate the total ambient concentration.

Adequate background NO_2 data for Anchorage is currently unavailable. In previous permit actions, the Department has allowed applicants to substitute data from similar areas with justification. PAMC used substitute data from Inver Grove Heights, Minnesota which has an annual average NO_2 concentration of 14.2 $\mu g/m^3$. The Department previously allowed use of this annual average concentration as substitute background NO_2 in air quality permits for Elmendorf Air Force Base (EAFB). EAFB is located just north of downtown Anchorage, but is somewhat offset by open land, similar to Inver Grove Heights. PAMC notes that the PAMC campus has similar surroundings to EAFB and Inver Grove Heights. It is located near a major urban area, but is also surrounded by parks and open land. PAMC notes that these similarities and previous actions by the Department are justification for using this data as a substitute. The Department concurs that this data is sufficient as representative background data.

RESULTS AND DISCUSSION

The maximum NO_2 AAAQS impacts, along with the background concentrations, total impacts, and AAAQS are shown in Table 3. All of the total impacts are less than the AAAQS. Therefore, PAMC has demonstrated compliance with the AAAQS.

Table 3: Maximum AAAQS Impacts

Air Pollutant	Avg. Period	Maximum Modeled Conc ($\mu g/m^3$)	Bkgd Conc ($\mu g/m^3$)	TOTAL IMPACT: Max conc plus bkgd ($\mu g/m^3$)	Ambient Standard ($\mu g/m^3$)
NO_2	Annual	84.1	14.2	**98.3**	100

It is important to note that since ambient concentrations vary with distance and direction from each emission unit, the maximum values shown represent the highest annual and high second high short term values value that may occur within the area. Except for maximum short term concentrations which are allowed to exceed the respective standards once per year, the concentrations at other locations within the modeling domain should be less than the values reported above.

CONCLUSION

The Department reviewed PAMC's modeling analysis for the EPSS Project and concluded the following:

1. The NO_2 emissions associated with operating the proposed emission units will not cause or contribute to a violation of the AAAQS listed in 18 AAC 50.010.
2. PAMC conducted their modeling analysis in a manner consistent with EPA's *Guideline on Air Quality Models*, as required under 18 AAC 50.215(b)(1).

The Department developed conditions in the minor permit to ensure PAMC complies with the annual average NO_2 AAAQS. These conditions are summarized below.

1. Remove boiler stack raincap on emission unit 3;
2. The release height of each new emergency generator stack must equal or exceed
    a. 53 feet above grade;
    b. 7 feet above the roof; and
    c. 2 feet above the highest portion (penthouse) of the generator building; and
    d. oriented at least 60 degrees above the horizontal;
3. Comply with the existing owner requested limits currently described in Section 3 of Minor Permit AQ0486MSS01; and
4. Limit the combined operation of the new emergency generators to 2,400 hours per year.