

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Air Permits Program

TECHNICAL ANALYSIS REPORT
for
Air Quality Control Minor Permit AQ0352MSS01

North Slope Borough
Nuiqsut Power & Light

Authorization to Install and Operate Two Gas-fired Generators

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ABBREVIATIONS/ACRONYMS

Acronyms

AAC	Alaska Administrative Code
Department	Alaska Department of Environmental Conservation
CFR	Code of Federal Regulations
EF	Emission Factor
HAP	Hazardous Air Pollutant
NSB	North Slope Borough
N/A.....	Not Applicable
ORL.....	Owner Requested Limits
PSD.....	Prevention of Significant Deterioration
PTE.....	Potential to Emit
TAR.....	Technical Analysis Report

Units and Measures

Btu	British Thermal Units
bhp.....	brake horsepower
bhp-hr	brake horsepower-hours
cf.....	cubic feet
g	grams
gal	gallons
g/hphr	grams per horsepower-hour
hr.....	hours
hr/yr	hours per year
lb.....	pound, pounds
lb/gal.....	pounds per gallon
lb/bhp-hr	pounds per brake horsepower-hr
lb/MMBtu.....	pounds per million Btu
MMBtu	million Btu
MMscf	million standard cubic feet
ppmv.....	parts per million by volume
tpy.....	tons per year

Pollutants

CO	Carbon Monoxide
H ₂ S	Hydrogen Sulfide
HAP.....	Hazardous Air Pollutant
NO _x	Oxides of Nitrogen
NO ₂	Nitrogen Dioxide
PM-10.....	Particulate Matter with an aerodynamic diameter less than 10 microns
SO ₂	Sulfur Dioxide
VOC	Volatile Organic Compound

1. Introduction

This Technical Analysis Report (TAR) provides the Alaska Department of Environmental Conservation's (Department's) basis for issuing Air Quality Control Minor Permit AQ0352MSS01 to the North Slope Borough (NSB) for the Nuiqsut Power & Light stationary source. This minor permit authorizes the installation and operation of two natural gas-fired generators that the NSB installed in September 2008 without authorization, and establishes an Owner Requested Limit (ORL) for the existing diesel-fired generators to reclassify the stationary source from a Title V source to a non-Title V source. The ORL will also avoid project classification under 18 AAC 50.502(c)(3). The Department intends to rescind the NSB's existing air permit for this stationary source, General Permit AQ0352GPA02, upon issuance of Minor Permit AQ0352MSS01.

1.1 Stationary Source Description

Nuiqsut Power & Light is an existing public utility that generates electricity for Nuiqsut, a community located in northern Alaska at approximately 70°N latitude and 151°W longitude. The NSB is currently operating the utility under General Permit AQ0352GPA02, which authorizes the operation of four existing diesel-fired generators under a source-wide PSD-avoidance limit of 825,000 gallons of diesel oil a year.

Recent availability of North Slope natural gas presented an opportunity to reduce costs and emissions. To meet growing demand, the NSB installed two natural gas-fired generators in September 2008. The natural gas generators will allow the NSB to reduce the fuel consumed by the diesel-fired generators to 185,200 gallons per year, which will lead to an overall reduction in source-wide emissions. However, the NSB installed the gas-fired generators without first obtaining the requisite authorization under Title I of the Clean Air Act.

1.2 Description of Application

The NSB is now seeking a Title I permit to fulfill their Clean Air Act obligation. They are also requesting an ORL under 18 AAC 50.508(5) to limit the source-wide nitrogen oxides (NO_x) emissions to less than 100 tpy in order to avoid classification as a Title V major source. The NSB also stated the ORL is needed to avoid classification as a PSD major source.

The NSB specifically requested a minor permit under 18 AAC 50.502(c)(3) to authorize the continued operation of the previously installed gas-fired generators. They further asked that the minor permit replace their existing general permit (AQ0352GPA02).

Minor permit applications classified under 18 AAC 50.502(c)(3) must include an ambient air demonstration for the triggered pollutants, per 18 AAC 50.540(c)(2)(A). However, the NSB asked that the Department waive the ambient demonstration requirement since there will be a decrease in source-wide emissions. The NSB asked that the Department provide this waiver in writing, as allowed under 18 AAC 50.540(c)(2).

In regards to the ORL, the NSB specifically requested that the Department limit the total fuel consumption of the two gas-fired generators to 151 million standard cubic feet (MMscf) of

natural gas per year, and the four diesel generators to 185,200 gallons of fuel oil per year.¹ The NSB stated that without the ORLs, the natural gas-fired generators and diesel-powered generators could emit 443 tons of NO_x and 125 tons of carbon monoxide (CO) per year. According to the NSB, such emission levels would have required both a Title V permit and a PSD permit. The ORLs restrict the NO_x emissions to 86 tpy and CO emissions to 44 tpy, which enables the NSB to avoid Title V classification. The NSB did not specify how they would track fuel consumption.

While not required under the minor permit program, the NSB included a discussion as to whether the gas-fired generators would be subject to the New Source Performance Standards and the National Emission Standards for Hazardous Air Pollutants. These requirements are beyond the scope of the Title I minor permit program, and therefore, will not be addressed further in this TAR.

2. Emissions Summary and Permit Applicability

The Department checked the applicant's emission estimates. The applicant used the existing (baseline) actual emissions to future potential emissions approach for estimating the change in emissions for this project. They also included the gas-generator emissions in calculating the source-wide actual emissions.

The Department disagrees with the NSB's actual-to-potential emissions approach for the following reasons:

- 1) the gas-generators were installed without authorization, and therefore, NSB cannot include their emissions (i.e., cannot be subtracted from the proposed emissions) in a permit applicability determination; and
- 2) the use of baseline actual emissions can only be used when determining whether a proposed change at an *existing* PSD-major source triggers a new PSD review, or determining the net change in actual emissions in a minor permit applicability determination conducted under 18 AAC 50.502(c)(3)(B). Since the Nuiqsut Power & Light stationary source is currently operating under a PSD-avoidance strategy, this approach is inappropriate for making a PSD applicability determination. The NSB also appears to have used the future potential emissions in making their minor permit applicability determination under the 18 AAC 50.502(c)(3)(A) provision – rather than the use of actual emissions under 18 AAC 50.502(c)(3)(B), which means the existing emissions must also be presented as potential emissions as well.

The Department therefore used potential emissions in all permit applicability determinations associated with this project. The Department's findings are summarized in Section 2.4.

2.1 Emissions under AQ0352MSS01 and Existing Permit AQ0352GPA02

To make appropriate comparisons, the Department used the existing limit of 825,000 gallons per year (gals/yr) fuel consumption allowed under General Permit AQ0352GPA02 for determining

¹ While not stated in the application, the 151 MMscf/year value represents continuous, full-load operation of both generators.

the existing potential to emit (PTE). For estimating the future PTE, the Department assumed unlimited operation for the two gas-generators (which is what the NSB’s requested 151 MMscf/yr limit represents) and the NSB’s requested limit of 185,200 gals/yr for the diesel-fired generators.

The Department used the NSB’s assumed sulfur content of 0.5 percent, by weight, in estimating the SO₂ emissions from the diesel-fired generators. The Department assumed the fuel gas contains 200 parts per million by volume (ppmv) of hydrogen sulfide (H₂S), the maximum H₂S content allowed at the stationary source that supplies gas to Nuiqsut, in estimating the SO₂ emissions from the gas-fired generators. Alpine Central Processing Facility operated by ConocoPhillips Alaska, Inc. (CPAI) supplies gas to Nuiqsut. If the H₂S content of the gas CPAI supplies to Nuiqsut ever exceeds 200 ppmv because of a future CPAI permit revision, NSB must request a permit revision to reflect the new H₂S content.

The Department also estimated the formaldehyde emissions that may occur from the gas-fired generators to determine whether the project would trigger the permitting requirements under 18 AAC 50.316 for major sources of hazardous air pollutants (HAPs).

Table 1 presents a summary of the Department’s PTE calculations and compares them to the minor and HAPs major permitting thresholds. The conclusions are discussed in Section 2.2.

Table 1: Potential Emissions under General Permit AQ0352GPA02 and Minor Permit AQ0352MSS01 (tpy)

Description of Emissions	NO _x	CO	PM-10	SO ₂	VOC	Formaldehyde
Existing PTE	183.5	48.7	3.3	29.1	4.7	0.1
<i>Proposed PTE</i>						
Two Gas Generators	44.3	33.3	0.8	2.5	9.3	4.0
Four Diesel Generators (with ORL)	41.2	10.9	0.7	6.5	1.1	0.0
Total Source-wide PTE	85.5	44.2	1.5	9.0	10.4	4.0
Change in PTE (Proposed – Existing)	-98.0	-4.5	-1.8	-20.1	5.7	3.9
Minor Permit Applicability Threshold under 18 AAC 50.502(c)(3)	10	N/A	N/A ^[a]	N/A ^[a]	N/A	N/A
Minor Permit Required under 18 AAC 50.502(c)(3)?	No	N/A	No	No	N/A	N/A
HAP Major Threshold	N/A	N/A	N/A	N/A	N/A	10
HAP Permit Required?	N/A	N/A	N/A	N/A	N/A	No

Table Notes:

^[a] The 10 tpy applicability thresholds for PM-10 and SO₂ in 18 AAC 50.502(c)(3) do not apply since the existing emissions do not exceed the PTE thresholds listed for those pollutants in 18 AAC 50.502(c)(1).

2.2 Permit Applicability Tests for Emissions under Proposed Permit.

Under the existing permit, the stationary source is a Title V source because it emits more than 100 tpy of a criteria pollutant. In this case, the triggered pollutant is NO_x. It is *not* a PSD major source though, since it does not emit more than 250 tpy of a regulated NSR pollutant. In regards to minor permit classification, NO_x is the only pollutant where the PTE from the existing source exceeds the thresholds listed in 18 AAC 50.502(c)(1). Therefore, NO_x is the only pollutant of

concern when determining whether the new gas-fired generators triggers a minor permit classification under 18 AAC 50.502(c)(3).

The combined PTE from the two gas-fired generators is 44 tpy of NO_x. This emission rate exceeds the 10 tpy minor permit threshold in 18 AAC 502(c)(3) and *would have* triggered the minor permit requirements under this classification if it were not for the NSB's request to reduce the diesel-fired generator emissions. With the off-setting emissions from the diesel-fired generators, the total source-wide PTE decreases by 98 tpy of NO_x. Therefore, 18 AAC 50.502(c)(3) is not triggered. With or without the off-setting emissions, the 44 tpy of NO_x emissions from the gas-fired generators do *not* trigger the 250 tpy PSD threshold. The same finding is true for the other potential PSD-pollutants: No pollutant is emitted in a quantity that triggers PSD review.

The change in formaldehyde emissions is 4 tpy. This is below the 10 tpy threshold that would make Nuiqsut Power & Light a HAP major source. Therefore, the project does not trigger major source review under 18 AAC 50.316.

2.3 Assessable Emissions

The total assessable emissions are determined source-wide, but do not include pollutants that are emitted at less than 10 tpy, per 18 AAC 50.410. The existing assessable emissions are 369 tons². The new assessable emissions under Minor Permit AQ0352MSS01 are 140 tpy, which is the sum of the following potential emissions: 85.5 tons of NO_x, 44.2 tons of CO, and 10.4 tons of VOC.

2.4 Department Findings

The Department has made the following findings regarding NSB's application:

1. Installation of the two gas-fired generators should have required a minor permit under 18 AAC 50.502(c)(3) since the existing NO_x emissions from the stationary source exceeds 40 tpy and the unrestricted NO_x emissions from these new units exceeds 10 tpy.
2. Contrary to the NSB's assessment, installation of the two gas-fired generators would *not* have triggered the PSD permitting requirements since the source was already under a PSD-avoidance strategy (i.e., the source-wide emissions were less than 250 tpy) and the unrestricted emissions increase from these new units did *not* exceed the 250 tpy PSD threshold.
3. The project does *not* require a HAP major construction permit under 18 AAC 50.316. The project's 4 tpy increase in formaldehyde emissions is less than 10 tpy HAP major threshold.
4. The project is classified under 18 AAC 50.508(5) since the owner is requesting limits to reclassify the stationary source as not needing a Title V permit. The requested limits will continue to maintain the existing PSD-avoidance strategy.
5. The ORL will lead to a source-wide decrease in potential emissions. The requested limits will therefore also avoid project classification under 18 AAC 50.502(c)(3).

² As specified on Page 4 of General Permit AQ0352GPA02, the existing assessable emissions for Nuiqsut Power & Light is 369 tons.

6. The use of an annual fuel limit for the diesel-fired generators necessitates a method for the operator to demonstrate compliance with the limit. The Department is therefore requiring the NSB to install a fuel meter(s) on the diesel-fired generators. The NSB may either use one fuel meter to measure the fuel burned by all four diesel-fired generator, or use dedicated fuel meters for each unit. Since the source-wide PTE for each pollutant is more than 10 percent below the Title V thresholds, meters accurate to within five percent could be used without jeopardizing the Title V avoidance strategy.
7. The gas-fired generators are subject to the following Air Quality Control regulations: 18 AAC 50.055(a)(1) for visible emissions; 18 AAC 50.055(b)(1) for particulate matter; and 18 AAC 50.055(c) for sulfur compound emissions. However, there is no requirement in 18 AAC 50.544 to include these provisions in minor permits establishing an ORL under 18 AAC 50.508(5). Therefore, Minor Permit AQ0352MSS01 does *not* reiterate the Permittee's obligation to comply with the 18 AAC 50.055 provisions.
8. The provisions under the Alaska Coastal Management Program do not apply for minor permits classified under 18 AAC 50.508(5).

3. Permit Requirements

3.1 Requirements for All Minor Permits

As required by 18 AAC 50.544(a), Minor Permit AQ0352MSS01

- (a) identifies the stationary source, the project, Permittee, and contact information;
- (b) includes the requirement to pay fees in accordance with 18 AAC 50.400 through 499;
- (c) includes the applicable standard permit conditions from 18 AAC 50.345.

3.2 Periodic Affirmation for Non Title V Sources

Upon issuance of Minor Permit AQ0352MSS01, the Nuiqsut Power & Light stationary source will no longer be classified as a Title V source. As required by 18 AAC 50.544(d), this permit therefore includes an annual affirmation of whether the stationary source is still accurately described by the application and minor permit, and whether the owner has made changes that would trigger the requirement of a new permit. The NSB must provide their annual affirmations by February 1st of each year.

The application indicates the diesel units will burn diesel fuel that does not contain more than 0.5 percent by weight of sulfur. The permit therefore includes a condition on fuel sulfur content to ensure the NSB complies with the fuel sulfur assumption.

As discussed in Section 2.1, the Department used 200 ppmv H₂S as the upper-bound of the fuel gas sulfur content. The Department has therefore included the 200 ppmv H₂S assumption as a condition under 18 AAC 50.544(d) that the NSB must annually confirm.

3.3 Owner Requested Limits under 18 AAC 50.508(5)

The NSB requested ORLs for fuel consumption under 18 AAC 50.508(5). The Department found that the requested 151 MMscf/yr limit for the gas-fired generators is superfluous since it

does not restrict the operation of these units. Therefore, the Department is not including a fuel consumption limit for the gas generators in Minor Permit AQ0352MSS01.

The requested 185,200 gallon per year limit for the diesel-fired generators will restrict operation and is needed to avoid classification as a Title V source. The Department is therefore including this ORL in Minor Permit AQ0352MSS01. As required by 18 AAC 50.544(h), the permit includes conditions that:

- (a) describe the ORL, including specific testing and monitoring, recording, and reporting (MR&R) requirements;
- (b) list all equipment covered by the ORL; and
- (c) describe the permit classification that the ORL allows the NSB to avoid.

Under Minor Permit AQ0352MSS01, the diesel-fired generators will be allowed to burn roughly a quarter of the amount authorized under General Permit AQ0352GPA02. The Department was therefore concerned that coarser methods for monitoring fuel consumption under AQ0352GPA02 could lead to a violation of the Title V avoidance strategy. The Department is therefore requiring the NSB to install fuel meters to measure the annual fuel consumption of the diesel-fired generators. The NSB may limit the installation to just one meter, if it is installed at a point that measures the total fuel consumption for all four diesel-fired units. If this approach is impractical, then they will need to install unit-specific fuel meters. As discussed in the Findings Section of this TAR, the fuel meters must be accurate to within five percent. A greater accuracy may be used, but is unnecessary for the given emissions cap.

4. Permit Administration

The Department followed the provisions of 18 AAC 50.542(d) and 18 AAC 50.542(f)(8) in issuing minor permit AQ0352MSS01. The NSB may operate under Minor Permit AQ0352MSS01 upon issuance.

Appendix A – Detailed Emission Calculations

Detailed Calculations Used or Referenced in the TAR.

This appendix presents estimates provided by the applicant and emissions as estimated by the Department. The applicant provided latest available data that show that between June 2008 and May 2009, the applicant operated the unpermitted gas-fired generators more than the permitted diesel generators. To simplify the situation, the Department assumed emissions allowed in the general permit that authorized the diesel generators as existing emissions.

Characteristics of Diesel Generators

Table A-1 presents fuel consumption for diesel units under existing permit and proposed permit

Table A-1: Fuel Consumption of Four Diesel Units

Description	Gallons per year	MMBtu/yr	Reference
Under Existing GPA-01	825,000	114,675	Existing Permit Condition
Under Proposed Permit	185,193	25,742	Proposed Owner Requested Limit

Table Notes:

One gallon diesel is equivalent to 139,000 Btu (AP-42, Appendix A)

Table A-2 presents emission factors for combustion of diesel fuel in generators.

Table A-2: Emission Factors for Combustion of Diesel Fuel in Generators (lb/MMBtu)

NO _x	CO	PM-10	VOC	Formaldehyde	SO ₂
3.2	0.85	0.057	0.082	0.00118	70.5 lb/1,000 gal

Table Notes:

Emission Factors come from AP-42, Table 3.4-1 and Table 3.4-2.

SO₂ emission factor is by mass balance assuming density for diesel is 7.05 lb/gallon as given in AP-42, Appendix A

Table A-3 presents emissions from the four diesel generators operating under the existing permit and the proposed permit.

Table A-3: Emissions from Diesel Generators (tpy)

Description	NO _x	CO	PM-10	SO ₂	VOC	Formaldehyde
Under Existing Permit (PTE)	183.5	48.7	3.3	29.1	3.3	0.1
Under Proposed Permit (ORL)	41.2	10.9	0.7	6.5	1.1	0.0

Characteristics of Natural Gas Generators

Table A-4 presents characteristics of the Nuiqsut Power & Light natural gas generators

Table A-4: Characteristics of Natural Gas Generators

Emission Unit	Model	Rated bhp	Bhp-hr/yr	Btu/bhp-hr	MMBtu/yr	MMscf/yr
Gas Generator 1	CAT G3516	1,148	10,056,480	7,471	75,132	
Gas Generator 2	CAT G3516	1,148	10,056,480	7,471	75,132	
Both Generators					150,264	150.3

Table Notes:

Permittee may operate each generator 8,760 hours a year

Heat content of the natural gas is 1,000 Btu/scf (as provided by application)

Caterpillar, the vendor, provided the Btu/bhp-hr conversion factor

Table A-5 presents emission factors for the gas generators

Table A-5: Emission Factors for Natural Gas Generators

NO_x	CO	PM-10	VOC	Formaldehyde
2.00 g/bhp-hr	1.50 g/bhp-hr	0.010 lb/MMBtu	0.42 g/bhp-hr	0.0528 lb/MMBtu

Table Notes:

Equipment manufacturer provided the missions factors for NO_x, CO, and VOC
 Emission factors for PM-10 and formaldehyde come from AP-42, Table 3.2-2

Table A-6 presents emissions from the two natural gas generators

Table A-6: Emissions from the Two Natural Gas Generators (tpy)

NO_x	CO	PM-10	VOC	Formaldehyde	SO₂
44.34	33.26	0.75	9.31	3.97	2.47

Table Notes:

The Department estimated SO₂ emissions by mass balance assuming the natural gas contains 200 ppmv H₂S

Table A-7 summarizes emissions from the units.

Table A-7: Summary of Emissions from Generators under Existing and Proposed Permits

Description	NO_x	CO	PM-10	SO₂	VOC	Formaldehyde	Comments
Existing Permit	183.5	48.7	3.3	29.1	4.7	0.1	Title V source
Gas Generators	44.3	33.3	0.8	2.5	9.3	4.0	Triggers 502(c)(3)
Diesel Gen (ORL)	41.2	10.9	0.7	6.5	1.1	0.0	
Proposed Permit	85.5	44.2	1.5	9.0	10.4	2.0	
Emission Increase	(98)	(4.5)	(1.8)	(20.1)	5.7	3.9	502(c) not triggered