

**ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AIR PERMITS PROGRAM**

TECHNICAL ANALYSIS REPORT
for
Air Quality Control Minor Permit AQ0353MSS02

North Slope Borough Power and Light
Kaktovik Power Plant

FUEL CONSUMPTION LIMIT REVISION

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Table of Contents

| | | |
|-----|---|----|
| 1.0 | Introduction..... | 4 |
| 1.1 | Stationary Source Description | 4 |
| 1.2 | Application Description | 4 |
| 1.3 | Emissions Summary and Permit Applicability | 4 |
| 1.4 | Department Findings..... | 5 |
| 2.0 | Permit Requirements..... | 6 |
| 2.1 | General Requirements for all Minor Permits..... | 6 |
| 2.2 | Requirements for a Minor Permit for Air Quality Protection..... | 6 |
| 2.3 | Requirements for a Minor Permit that Revises or Rescinds a Previous Title I Permit..... | 9 |
| 2.4 | General Recordkeeping Requirements | 9 |
| 2.5 | Standard Conditions..... | 10 |
| 3.0 | Permit Administration..... | 10 |

ABBREVIATIONS/ACRONYMS

| | |
|--------------|--|
| AAC..... | Alaska Administrative Code |
| ACMP..... | Alaska Coastal Management Program |
| ADEC..... | Alaska Department of Environmental Conservation |
| AS..... | Alaska Statutes |
| ASTM..... | American Society of Testing and Materials |
| BAE..... | Baseline Actual Emissions |
| CEMS..... | Continuous Emission Monitoring System |
| C.F.R..... | Code of Federal Regulations |
| EPA..... | Environmental Protection Agency |
| MACT..... | Maximum Achievable Control Technology |
| NA..... | Not Applicable |
| NAICS..... | North American Industry Classification System |
| NESHAPS..... | National Emission Standards for Hazardous Air Pollutants |
| NSPS..... | New Source Performance Standards |
| ORL..... | Owner Requested Limit |
| PAE..... | Projected Actual Emissions |
| PS..... | Performance Specification |
| PSD..... | Prevention of Significant Deterioration |
| PTE..... | Potential to Emit |
| RM..... | Reference Method |
| SIC..... | Standard Industrial Classification |
| SN..... | Serial Number |
| TBD..... | To Be Determined |

EUs and Measures

| | |
|---------------|---|
| bhp..... | brake horsepower or boiler horsepower |
| gr./dscf..... | grains per dry standard cubic feet (1 pound = 7,000 grains) |
| dscf..... | dry standard cubic foot |
| gph..... | gallons per hour |
| kW..... | kiloWatts |
| kW-e..... | kiloWatts electric ¹ |
| lbs..... | pounds |
| mmBtu..... | million British thermal EUs |
| ppm..... | parts per million |
| ppmv..... | parts per million by volume |
| tph..... | tons per hour |
| tpy..... | tons per year |
| wt%..... | weight percent |

Pollutants

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

Permit Specific

¹ kW-e refers to rated generator electrical output rather than engine output

1.0 Introduction

This Technical Analysis Report (TAR) provides the Alaska Department of Environmental Conservation's (Department's) basis for issuing Minor Source Specific Air Quality Control Permit AQ0353MSS02 to North Slope Borough Power & Light (NSB) for the Kaktovik Power Plant (Kaktovik) under 18 AAC 50.508(6) and 18 AAC 50.502(c)(3). The minor permit application is dated August 2009. In the minor permit, the Department revises the previous Owner Requested Limit (ORL) established in AQ0353ORL01 to avoid Title V permitting. The revised ORL continues to prevent Kaktovik from being classified under 18 AAC 50.326 by restricting the 12-month fuel consumption.

1.1 Stationary Source Description

Kaktovik is an existing stationary source located in Kaktovik, AK on the North Slope. Kaktovik has four emission units, all of which are diesel electric generators. Emission Units (EUs) 1 and 2 are Caterpillar 3512 generators rated at 955 kW each. EUs 3 and 4 are Caterpillar 3508 generators rated at 425 kW each. Currently, Kaktovik operates under AQ0353ORL01 to restrict the 12-month fuel consumption and has no other minor or operating permits. This ORL is in place to limit oxides of nitrogen (NO_x) emissions to under 100 tons per year (tpy) to avoid a Title V Operating Permit. Prior to the issuance of AQ0353ORL01, Kaktovik operated under Pre-Approved Emission Limit (PAEL) PAL000353.

1.2 Application Description

NSB submitted an application to increase the 12-month rolling fuel consumption from 368,000 gallons to 382,500 gallons. This revision is classified under 18 AAC 50.508(6). This increase in fuel consumption rate keeps the NO_x emissions under 100 tpy to avoid Title V permitting, but the change increases the NO_x emissions by over 10 tpy, therefore this permit is also classified under 18 AAC 50.502(c)(3). NSB also submitted a modeling analysis as required for a permit classified under 18 AAC 50.502(c)(3). NSB also requested the permit contain a condition to raise the Kaktovik's stack heights based on the ambient analysis.

NSB submitted this application to revise the ORL established in AQ0353ORL01 because NSB and the Department both agreed that the NSB could not comply with the limit based on Kaktovik's historical fuel consumption.

NSB also later requested that the minor permit include a condition allowing NSB to operate under a fuel limit equivalent to the fuel limit established in AQ0353ORL01 until the stacks have been raised. NSB requested this condition to remain in compliance with the minor permit before and during construction of the stacks.

1.3 Emissions Summary and Permit Applicability

Table 1 shows the emission summary and shows both the total emissions and net change in emissions based on the revision of the ORL. As shown in the table, this project is not classified under Title V, but triggers 18 AAC 50.502(c)(3) classification for NO_x. NSB based all calculations for net emission changes off of the original PAEL permit. NSB's PAEL permit used protocol under 18 AAC 50.230(c)(D) when calculating NO_x emissions which resulted in 99.7 tpy. For AQ0353MSS02, NSB used AP-42 data and manufacturer data for NO_x. For the requested increased fuel consumption, the result was a decrease in NO_x emissions by 0.2 tpy.

For consistency, NSB recalculated the PAEL NO_x emissions using AP-42 and manufacturer data.

Calculation assumptions in **Table 1** include:

- 1) Emission rates for EUs 1 and 2, the Caterpillar 3512 diesel-electric generators, were based on data provided by the manufacturer.
- 2) Emission rates for EUs 3 and 4, the Caterpillar 3508 diesel-electric generators, were based on AP-42 data.
- 3) EUs 1 – 4 use a sulfur content of 0.2% by weight and mass balance for the SO₂ calculation.
- 4) EUs 1 and 2 have a fuel consumption of 255,000 gallons/year, combined.
- 5) EUs 3 and 4 have a fuel consumption of 127,500 gallons/year, combined.

Table 1 – Emissions Summary and Permit Applicability, tpy

| Parameter | NO _x | CO | SO ₂ | PM-10 | VOC | Totals |
|--------------------------------|-----------------|------|--------------------|--------------------|-----|--------------|
| PAL000353 | 85.8 | 11.5 | 4.7 | 8.3 | 2.3 | 112.6 |
| AQ0353MSS02 | 99.5 | 13.4 | 5.4 | 9.6 | 2.7 | 130.6 |
| Net Emissions Change | 13.7 | 1.9 | 0.7 | 1.3 | 0.4 | 18.0 |
| 18 AAC 50.502(c)(3) Thresholds | 10 | N/A | N/A ^[a] | N/A ^[a] | N/A | - |
| Minor Permit Required? | Yes | No | No | No | No | - |
| Title V Thresholds | 100 | 100 | 100 | 100 | 100 | - |
| Title V Permit Required? | No | No | No | No | No | - |

Table Notes:

[a] - Existing PTE below 502(c)(1) thresholds.

1.4 Department Findings

Based on the review of the application, the Department finds that:

1. NSB is operating Kaktovik under AQ0353ORL01 to avoid Title V permitting, which superseded PAL000353.
2. The Department and NSB both agreed that NSB cannot comply with the fuel limit established in AQ0353ORL01 based on Kaktovik’s historical fuel consumption.
3. To avoid possible permit circumvention, NSB based all calculations for net emission changes off of the PAL000353.
4. This project is classified under 18 AAC 50.508(6) because NSB is requesting to revise the previous ORL to increase the fuel consumption rate to match Kaktovik historical fuel records.
5. This project is also classified under 18 AAC 50.502(c)(3) because the net increase of NO_x emissions is greater than 10 tpy.
6. NSB supplied an ambient analysis as part of their application, as required under 18 AAC 50.540(c)(2)(A) which demonstrates compliance with the ambient air quality standards. In calculating the emissions, NSB limited EUs 1 and 2 fuel consumption to 255,000 gallons/year, combined and EUs 3 and 4 to 127,500 gallons/year, combined.

These limits keep all potential emissions below 100 tpy and avoid Title V permitting. These limits reflect the different emission rates and fuel consumption rates for the different engine models. NSB requested an ORL of 382,500 gallons/year combined for EUs 1 – 4, however this will not keep the NO_x potential emissions below 100 tpy. Therefore, the Department will establish two ORLs based on NSB’s fuel consumption assumptions. NSB must raise the stack heights of EUs 1 – 4 to protect ambient air quality standards before they can operate under the ORLs.

7. NSB requested to operate under a limit of 368,000 gallons/year combined for EUs 1 – 4 until the stack heights are raised. This limit is equivalent to the limit established in AQ0353ORL01. Because it has been established that NSB cannot comply with this fuel limit the Department will allow NSB to operate under a limit based off the limit established in PAL000353 until the stack heights are raised.
8. Kaktovik is located in the North Slope Borough Coastal District. The project is consistent with the Alaska Coastal Management Program (ACMP) through AS 46.40.040(b)(1). The application for a minor permit classified under 18 AAC 50.508(6) and 18 AAC 50.502(c)(3) is not on the ACMP “C list”, therefore the ACMP project modification and Department Single Agency Review procedures do not apply
9. NSB’s application for a minor permit for Kaktovik contains the elements listed in 18 AAC 50.540.

2.0 Permit Requirements

State regulations in 18 AAC 50.544 describe the elements that the Department must include in minor permits. This section of the TAR provides the technical and regulatory basis for the permit requirements in Minor Permit AQ0353MSS02, which is classified under 18 AAC50.508(6) and 18 AAC 50.502(c)(3).

2.1 General Requirements for all Minor Permits

As described in 18 AAC 50.544(a), this minor permit identifies the stationary source, the project, the Permittee, and contact information.

Emission fee requirements are required for each minor permit issued under 18 AAC 50.542, as described in 18 AAC 50.544(a). The Department is establishing the assessable emissions requirement in this permit. **Table 1** shows the assessable emissions are 131 tpy.

2.2 Requirements for a Minor Permit for Air Quality Protection

As required under 18 AAC 50.544(c), each minor permit classified under 18 AAC 50.502(c) must contain

- (1) terms and conditions as necessary to ensure that the source will not cause or contribute to a violation of an ambient standard,
- (2) performance tests for state emission limits, and
- (3) maintenance requirements according to the manufacturer’s or operator’s maintenance procedures.

2.2.1 State Emission Standards

NSB's stationary source inventory includes fuel burning equipment and industrial process subject to standards under 18 AAC 50.055.

2.2.1.1 Visible Emission Standard

Diesel-electric generators (EUs 1 – 4) are fuel-burning equipment subject to the state standards for visible emissions in 18 AAC 50.055(a)(1).

NSB did not provide vendor data showing that the diesel-electric generators will comply with the state standard, therefore the Department is requiring an initial compliance demonstration.

2.2.1.2 Particulate Matter Standard

Diesel-electric generators (EUs 1 – 4) are fuel-burning equipment subject to the state standards for PM emissions of 0.05 grains per dry standard cubic foot of exhaust gas (gr./dscf) in 18 AAC 50.055(b)(1).

NSB did not provide vendor data showing that the diesel-electric generators will comply with the state standard, therefore the Department is requiring an initial compliance demonstration.

2.2.1.3 Sulfur Dioxide Standard

Diesel-electric generators (EUs 1 – 4) are fuel-burning equipment subject to the state standards for SO₂ emissions in 18 AAC 50.055(c).

NSB did not provide an initial compliance demonstration showing that the diesel-electric generators will comply with the state standard. The Department does not expect the EUs to exceed the state standards of 18 AAC 50.055(c) because NSB provided a diesel fuel test showing a maximum sulfur content of 0.2% by weight for Kaktovik diesel. Fuel sulfur content less than 0.5% by weight has been shown to comply with the sulfur dioxide standard. The Department is not requiring any compliance demonstration of EUs 1 – 4.

2.2.2 Ambient Air Quality Analysis

As required under 18 AAC 50.540(c)(2), NSB submitted an ambient air quality analysis for the pollutant triggered under 18 AAC 50.502(c) – i.e., nitrogen dioxide (NO₂). NSB used the U.S. Environmental Protection Agency's (EPA's) SCREEN3 dispersion model for the analysis. The use of SCREEN3 is appropriate.

The NSB conducted the analysis using the "Fast Track" screening procedure described under 18 AAC 50.542(c). While the Department's regulations do not explicitly state that the "Fast Track" procedures may be used for applications requiring a Public Comment period, they do not preclude its use. NSB's approach is acceptable because the Kaktovik Power Plant is located in a sparsely populated area where the presumed background concentrations are commensurate with the assumed background/off-site concentrations associated with the "Fast Track" procedure.

NSB modeled the NO_x emissions from the four Caterpillar generators. The two 3512 generators were modeled at 50, 75 and 100 percent loads using vendor-specified stack parameters and NO_x emission rates. Because no load specific vendor data is available for the two 3508 generators the NSB used an AP-42 NO_x emission factor to estimate the full-load emissions.

NSB assumed a combined annual fuel limit of 255,000 gallons in the two 3512 generators and a combined annual fuel limit of 127,500 gallons in the two 3508 generators. These fuel limits are

based on their requested ORL. NSB also assumed the four generators have stack heights of 45 feet.

SCREEN3 only allows the modeling of one emission unit per run. Therefore, NSB modeled the combined emissions from the two 3512 generators as one emission unit. Similarly, NSB modeled the combined emissions from the two 3508 generators as one emission unit. NSB added the maximum impact from the 3512 generators for each load to the maximum full-load impact from the 3508 generators to estimate the total maximum impact from the four generators. NSB’s approach is acceptable.

SCREEN3 provides 1-hour concentrations. Therefore, applicants must use scaling factors to estimate the ambient concentrations for other averaging periods. EPA provides these scaling factors in, Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised.

NSB used the appropriate 1-hour to annual average scaling factor, 0.10 for converting the 1-hour SCREEN3 estimates into annual average estimates. This scaling factor includes the additional adjustment of +0.02 described in EPA guidance for downwash since the generator plumes are subject to downwash. The NSB also used the national default ambient NO₂-to-NO_x ratio of 0.75, as provided in EPA’s Guideline on Air Quality Models, to refine the estimated ambient NO₂ concentrations. The 0.75 ratio is appropriate for this analysis.

NSB demonstrated that the maximum NO₂ impact did not exceed 80 percent of the AAAQS, as allowed under 18 AAC 50.542(c)(2)(A) for a “Fast Track” procedure. The maximum impacts are summarized below in Table 2.

In order to protect with the AAAQS, NSB must comply with the fuel limit assumptions, maintain a minimum stack height of 45 feet above ground for the four generators, and maintain vertical uncapped stacks for the four generators.

Table 2 – Kaktovik Generators Modeling Results

| Air Pollutant | Avg. Period | Load (Percent) | 3512 Generators Maximum Modeled Conc. (µg/m ³) | 3508 Generators Maximum Modeled Conc. (µg/m ³) | Total Maximum Modeled Conc. (µg/m ³) | Maximum Allowed Impact ^[1] (µg/m ³) |
|-----------------|-------------|----------------|--|--|--|--|
| NO ₂ | Annual | 50 | 29.7 | 19.8 | 49.5 | 80 |
| | | 75 | 24.9 | | 44.7 | 80 |
| | | 100 | 21.8 | | 41.6 | 80 |

Table Notes:

[1]-The maximum allowed NO₂ impact for fast-track screening assessments is 80% of the ambient standard, per 18 AAC 50.542(c)(2)(A). Since the annual average NO₂ standard is 100 µg/m³, the maximum allowed impact is 80 µg/m³.

2.3 Requirements for a Minor Permit that Revises or Rescinds a Previous Title I Permit

As required in 18 AAC 50.544(i), this minor permit contains terms and conditions as necessary to ensure that the Permittee will construct and operate the stationary source in accordance with 18 AAC 50.

2.3.1 Limit to Avoid Title V for Unmodified Stack Heights

NSB requested a condition to allow Kaktovik to operate under this minor permit prior to raising the stack heights. NSB requested to operate under a limit of 368,000 gallons/year combined for EUs 1 – 4. This limit is equivalent to the limit in AQ0353ORL01. Because it has been established that NSB cannot comply with this limit, the Department included a limit based off the PAEL limit of 330,000 gallons/year, combined for EUs 1 –4. NSB affirmed in their application that this limit can avoid Title V by dividing the fuel consumption limit between engine types. Based on the potential emission calculations provided, the Department divided the limit between the two engine types. EUs 1 and 2 have a 220,000 gallon/year limit and EUs 3 and 4 have a 110,000 gallon/year limit. NSB must comply with these limits until the stack heights are raised.

2.3.2 Owner Requested Limit to Avoid Title V

In this minor permit, the Department has revised the 12-month rolling fuel consumption rate from the AQ0353ORL01 limit of 368,000 gallons to the requested limit of 382,500 gallons under 18 AAC 50.508(6). This raise in fuel consumption limit exempts Kaktovik from a Title V operating permit because NO_x potential emissions are less than 100 tpy. Additionally, this increase requires NSB to raise the stack heights at Kaktovik to protect ambient air quality standards.

The Department divided the total fuel consumption limit of 382,500 gallons between the Caterpillar 3512 engines (EUs 1 and 2) and the Caterpillar 3508 (EUs 3 and 4) because NSB's modeling criteria and potential emission calculations differentiated between engine types for emission rates and fuel consumption. EUs 1 and 2 use approximately two-thirds more fuel than EUs 3 and 4 so the limits are 255,000 gallons/year and 127,500 gallons/year, respectively.

The Department has included additional information regarding the affirmation of the stationary source and its ability to avoid Title V under 18 AAC 50.544(d). Should NSB need to revise the limit again a Title V permit or a new avoidance limit may be required.

2.3.3 Ambient Air Quality Protection Requirements

The Department included conditions necessary to protect ambient air quality. NSB must comply with the revised ORL and raise the stacks on EUs 1 – 4 at Kaktovik to 45 feet before operating under the revised ORL.

2.4 General Recordkeeping Requirements

2.4.1 Recordkeeping Requirements

Air quality control permits under 18 AAC 50.502(c) must contain procedures for recordkeeping requirements under 18 AAC 50.544(c)(D).

2.4.2 Certification and Information Requests

All air quality control permits must contain procedures for information requests and certification, including certification requirements described in 18 AAC 50.544(h)(4). Information request requirements are specifically required under 18 AAC 50.200. Certification requirements are specifically required under 18 AAC 50.205.

2.4.3 Submittals

Reports, certification, and other relevant documentation must be submitted to the Compliance Technician at the address specified in the minor permit.

2.4.4 Excess Emission and Permit Deviation Reports, Operating Reports

Excess emission and permit deviation requirements are specifically required under 18 AAC 50.240. Operating reports are required for all permits under 18 AAC 50.502(c) as stipulated under 18 AAC 50.544(c)(1)(E).

2.5 Standard Conditions

The minor permit contains these requirements to ensure that the Permittee will construct and operate the stationary source or modification in accordance with 18 AAC 50, as described in 18 AAC 50.544(c) and 18 AAC 50.544(i).

3.0 Permit Administration

The Permittee may operate under minor permit AQ0353MSS02 upon issuance.