ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Air Permits Program

TECHNICAL ANALYSIS REPORT
For
Air Quality Control Minor Permit AQ1189MSS02

Alaska Electric & Energy Cooperative
Soldotna Combustion Turbine Plant

Establishing PSD Avoidance Limit for NOx

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ABBREVIATIONS / ACRONYMS

AAC.....Alaska Administrative Code
AEEC..... Alaska Electric and Energy Cooperative
CTG.....Combustion Turbine Generator
Department.....Alaska Department of Environmental Conservation
EU .....Emission Units
LPG.....Liquefied Petroleum Gas
N/A.....Not Applicable
ORL.....Owner Requested Limits
PSD .....Prevention of Significant Deterioration
PTE .....Potential to Emit
SCT .....Soldotna Combustion Turbine
TAR.....Technical Analysis Report

Units and Measures

bhp.....brake horsepower
g/hphr .....grams per horsepower-hours
hr/yr.....hours per year
lb/hr.....pounds per hour
lb/MMBtu .....pounds per million British thermal unit input
lb/MMscf.....pounds per million cubic feet
MMBtu/hr .....million British Thermal Units per hour
MW .....megawatts
tpy .....tons per year
^{o}F .....degrees Fahrenheit

Pollutants

CO.....Carbon Monoxide
NOx..... Nitrogen Oxides
PM.....Particulate Matter
PM-2.5 .....Particulate Matter with an aerodynamic diameter $\leq$ 2.5 microns
PM-10 .....Particulate Matter with an aerodynamic diameter $\leq$ 10 microns
SO_2 .....Sulfur Dioxide
VOC .....Volatile Organic Compound

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1. Introduction

This Technical Analysis Report (TAR) provides the Alaska Department of Environmental Conservation's (Department's) basis for issuing Permit AQ1189MSS02 to Alaska Energy & Electric Cooperative, Inc. (AEEC) for the Soldotna Combustion Turbine Plant (SCT). Minor Permit AQ1189MSS02 establishes an owner requested limit (ORL) for nitrogen oxides (NOx) emissions under 18 AAC 50.508(5) to avoid classification as a Prevention of Significant Deterioration (PSD) major source. The permit also revises terms and conditions of Minor Permit AQ1189MSS01 under 18 AAC 50.508(6).

1.1 Stationary Source Description

SCT is a new power plant located 2.2 miles east-northeast of Soldotna, Alaska within the boundaries of existing AEEC properties. It provides a peaking and emergency back-up for the electricity AEEC purchases from Chugach Electric Association. SCT contains two new 49 megawatts (MW) GE LM6000 combustion turbine generators (CTG) with dry-low NOx emissions, a 50 million British thermal units per hour (MMBtu/hr) natural gas-fired inlet air heater, two 2-MMBtu/hr natural gas-fired heaters, a 605 brake horsepower (bhp) Kohler 400REZX emergency LPG generator, a 144 bhp diesel firewater pump, and several small emission units. The Standard Industrial Classification code of the stationary source is 4911 – Electrical Services. The North American Industrial Classification System code of the stationary source is 221112 – Fossil Fuel Electric Power Generation.

AEEC will use the inlet air heater to preheat the CTG inlet air when ambient temperature falls below 20 degrees Fahrenheit (ºF). The inlet air heating equipment will provide a hot water/glycol solution that will transfer heat to the inlet air and provide sufficient heating to meet the minimum inlet temperature for the CTGs. AEEC will use the two natural gas fuel heaters to heat the fuel gas. As of July 1, 2014, AEEC had only installed one CTG (EU 1) and the emergency diesel firewater pump (EU 7) out of the seven emission units authorized by AQ1189MSS01[1]. AEEC installed EU 1 and EU 7 on June 7, 2011[2].

1.2 Application Description

Source tests performed on July 3, 2014 showed that the turbine NOx emission rate was higher than the vendor guaranteed emission rate of 24.32 lb/hr, when the turbine is operated at loads below 25 MW, but at loads above 25 MW the NOx emissions do not exceed 17.38 lb/hr. The NOx emissions for Permit AQ1189MSS01 was based on the vendor-provided NOx emission rates of 24.32 lb/hr. Therefore, the stationary source NOx potential-to-emit (PTE) was under estimated using the vendor-provided data. With only EU 1 operating, the potential NOx emissions of the stationary source will not exceed the PSD threshold. However, when the second turbine (EU 2) comes on line, the potential NOx emissions of the stationary source will exceed the PSD threshold.

[1] Full onsite compliance evaluation the Department conducted on July 1, 2014.
[2] Form B in application for operating permit AQ1189TVP01.

In their operating permit application, AEEC requested the Department to restrict the stationary source NOx emissions to less than 250 tons per year (tpy). Because the NOx emissions are much lower when EUs 1 and 2 operate at 25 MW and above, AEEC requested the use of an equivalency factor of 0.374 for hours of operation at or above 25 MW in estimating NOx emissions from EUs 1 and 2, upon installation of EU 2. Table 1 summarizes the source test results for EUs 1 and 2.

Table 1: NOx Emission Rates for EUs 1 and 2

Power Level	15 MW	20 MW	25 MW	30 MW	35 MW	38 MW
lb NOx/hr	30.77	48.93	15.58	7.22	8.01	8.63

Table Notes:
Obtained from an August 28, 2014 source test report for the source test performed on July 3, 2014

Upon installation of EU 2, AEEC will program a Distributed Control System to automatically calculate the NOx emissions of EUs 1 and 2 hourly and for a rolling 12-month period. The Department is treating AEEC's request as a minor permit application to establish an ORL for NOx emissions under 18 AAC 50.508(5) and to revise AQ1189MSS01, as applicable.

2. Emissions Summary and Permit Applicability

2.1 Potential to Emit

A PSD avoidance limit is not necessary when only one turbine (EU 1) is operating. However, when AEEC installs and operates the second turbine (EU 2), a NOx emission limit is necessary to keep the stationary source NOx emissions below the 250 tpy PSD threshold. See detailed emission calculations in Appendix A of this TAR. The emission calculations in Appendix A are based on the following assumptions:

- The CTGs (EUs 1 and 2) NOx emissions will be limited such that the stationary source NOx emissions remain under 250 tpy.
- The LPG-fired generator (EU 6) will operate no more than 500 hours per year (hr/yr).
- The natural gas-fired heaters (EUs 3, 4, and 5), the diesel-fired firewater pump (EU 7) have unlimited operating hours, and
- The small emission units at the stationary source have unlimited operating hours.

Based on these assumptions, the Department has determined the turbine NOx emissions must be less than 231 tpy for the stationary source to stay below PSD thresholds.

Table 2 presents the criteria pollutant emissions for the stationary source.

Table 2: Stationary Source PTE (tpy)

EU	Description	NOx	CO	PM-2.5	PM-10	PM	SO_2	VOC
1 -2	Nat Gas-fired CTGs	231.0	197.2	35.0	35.0	35.0	11.9	14.4
3 - 5	Nat Gas-fired Heaters	11.6	19.5	1.8	1.8	1.8	0.1	1.3
6	LPG Generator	0.7	1.3	0.0	0.0	0.0	0.0	0.3
7	Diesel Fire Pump	4.2	3.6	0.2	0.2	0.2	1.3	4.2
Several Small Emission Units		1.8	1.8	0.1	0.1	0.1	0.0	0.1
All Emission Units		249.2	223.4	37.1	37.1	37.1	13.4	20.3

2.2 Assessable Emissions

Table 3 shows the assessable emissions are 543 tpy.

Table 3: Assessable Emissions (TPY)

Description of Emissions	NOx	CO	PM	SO_2	VOC	Total
PTE	249.2	223.4	37.1	13.4	20.3	
Assessable Emissions	249	223	37	13	20	542

2.3 Department Findings

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

1. The project is classified under 18 AAC 50.508(5) to limit NOx emissions from the CTGs below 231 tpy to enable the stationary source to avoid classification as a major source under PSD.
2. Manufacturer's specifications indicate that guaranteed emissions from GE LM6000 PF turbines are valid at an ambient temperature between 20ºF and 120ºF. Inlet air heating will be used when ambient temperature is below 20ºF to maintain reliable turbine operation.
3. The source test performed on July 3, 2014 determined worst case emission rates for the CTGs as shown in Table 4.

Table 4: Worst-Case Emission Factors for EUs 1 and 2 (lb/hr)

Pollutant	Power < 25 MW	Power ≥ 25 MW
NOx	48.93	15.58
CO	22.51	20.34

4. The source has not installed the second turbine at this time but expects to install the second turbine in the future. After the second turbine is installed and operated, the source will have emissions above the PSD thresholds. Therefore, an ORL is needed to keep the source below PSD.

5. As a result of the higher NOx emission rates for the turbines, the NOx PTE for the stationary source is 18 tpy more than originally estimated. This is a nominal increase compared to the margin of compliance with the annual nitrogen dioxide (NO_2) AAAQS as reported in the modeling review memo for Permit AQ1189MSS01. As shown in Table 2 of the modeling memo for AQ1189MSS01, the total annual NO_2 impact was 16 micrograms per cubic meter compared to the annual NO_2 standard of 100 micrograms per cubic meter. Therefore, the Department did not require the applicant to submit a modeling analysis for NOx emissions.

3. Permit Requirements

3.1 Requirements for All Minor Permits

As required by 18 AAC 50.544(a), this minor permit issued under 18 AAC 50.542 has included the following:

1. the name and description of the stationary source, the project, the Permittee, contact information in the cover page of the permit;
2. the requirement to pay fees in Section 2 of the permit;
3. no specific conditions established under 18 AAC 50.201;
4. ORLs that apply to the source are in Section 4 of the permit; and
5. the applicable standard permit conditions required in 18 AAC 50.544 contained in 18 AAC 50.345 are listed in Sections 5 and 6 of the permit.

3.2 Requirements for a Minor Permit issued under 18 AAC 50.508(5)

As required by 18 AAC 50.544(h) this minor permit classified under 18 AAC 50.508(5) has included conditions that describe the ORL, including monitoring, recordkeeping, and reporting requirements. This permit limits EU 6 to no more than 500 hr/yr to enable the stationary source CO emissions stay below 250 tpy. The permit contains a requirement to maintain the inlet air temperature of EUs 1 and 2 at a minimum hourly average temperature of 20ºF to satisfy the vendor specification and ensure the NOx emission rates do not exceed the rates the Department assumed in establishing the 231 tpy NOx ORLs for the CTGs.

Section 4 of the permit lists EUs 6, 1, and 2 as the emission units covered by the ORL, and describes the classification that the limit allows the applicant to avoid. These limits allow the stationary source to avoid PSD Major Classification under 18 AAC 50.306.

3.2.1 Owner Requested Limits

The Department is carrying forward the 500 hours per rolling 12-month period operating hours limit for the emergency LPG-fired generator (EU 6) established in AQ1189MSS01. The Department is establishing an ORL for the CTGs NOx emissions to be less than 231 tons per rolling 12-month period. With these two ORLs in place, the NOx emissions of the stationary source would be less than 250 tpy. When only one CTG (EU 1) is operating, the unlimited NOx emissions from EU 1 will not exceed 214 tpy, based on the worst-case NOx emission rate.

Upon startup of the second CTG, the Department is requiring AEEC to track NOx emissions of the CTGs hourly based on worst-case emission rate of 48.93 lb/hr. The CTGs use dry low emissions NOx control system. Based on manufacturer's specification, the CTGs should operate with inlet temperatures equal to or higher than 20ºF. Therefore, the Department included a condition to maintain thermocouples to measure the inlet air temperature to ensure that that the inlet air temperature is equal to or above 20ºF.

3.3 Requirements for a Minor Permit issued under 18 AAC 50.508(6)

AQ1189MSS02 revises AQ1189MSS01 which enables the stationary source to continue to avoid classification as a major stationary source under PSD. Therefore, the Department included conditions in AQ1189MSS02 that continues to enable the stationary source avoid classification as a major stationary source under PSD. AQ1189MSS02 made the following revisions to the terms and conditions of AQ1189MSS01:

- Deleted the First Method Observation for EU 7. Per an August 8, 2014 full compliance evaluation report for a July 1, 2014 site visit, AEEC first started up EU 7 on April 1, 2014 and performed a Method 9 observation on July 9, 2014. This condition is now obsolete.
- Deleted the initial monitoring and reporting for particulate matter emissions for EU 7. This condition is now obsolete.
- Included requirements to report as excess emissions when the hydrogen sulfide (H_2S) content of the fuel gas exceeded 4,000 parts per million by volume (ppmv). Stoichiometric calculations show that SO_2 in the exhaust of emission units burning fuel gas containing 4,000 ppmv of H_2S cannot exceed 500 ppm.
- Included requirements to report as excess emissions when the H_2S content of the LPG fuel exceeded 10,000 ppmv. Stoichiometric calculations show that SO_2 in the exhaust of emission units burning LPG containing 10,000 ppmv of H_2S cannot exceed 500 ppm.
- Deleted the requirements for PSD avoidance for CO for EUs 1 and 2. The limit is no longer necessary because of the new NOx emission rates of EUs 1 and 2.
- Deleted the requirements for CO and NOx source tests for EUs 1 and 2. The Permittee performed the source tests on July 3, 2014.
- Deleted requirements to submit a PSD applicability analysis if the source tests reveals the CO emission factor exceeds 24.65 lb/hr or the NOx emission rate exceeds 24.32 lb/hr.
- Deleted the requirements to a PSD applicability analysis for greenhouse gases emissions if the Permittee did not begin construction by July 1, 2011.

4. Permit Administration

In their application for an initial operating permit, the Permittee requested the Department to revise Minor Permit AQ1189MSS01 to enable them avoid classification under PSD as a major source. The Department is issuing AQ1189MSS02 as a separate action prior to processing the operating permit application. AQ1189MSS02 establishes an ORL under 18 AAC 50.508(5) for NOx emissions to avoid classification under 18 AAC 50.306. The Permittee may operate under AQ1189MSS02 upon issuance.

Appendix A: Emissions Calculations

EU	Description	Rating	Limits	NOx		CO		PM-2.5/PM-10/PM		SO_2		VOCs	
				EF	tpy	EF	tpy	EF	tpy	EF	tpy	EF	tpy
1	Gas-fired CTG	49 MW	231 tpy	48.93 lb/hr	231	22.51 lb/hr	98.59	4 lb/hr	17.52	1.36 lb/hr	5.96	1.64 lb/hr	7.18
2	Gas-fired CTG	49 MW	NOx	48.93 lb/hr		22.51 lb/hr	98.59	4 lb/hr	17.52	1.36 lb/hr	5.96	1.64 lb/hr	7.18
3	Gas-fired boiler	50 mmbtu/hr	8,760 hr/yr	50 lb/mmscf	10.74	84 lb/mmscf	18.04	7.6 lb/mmscf	1.63	0.6 lb/mmscf	0.13	5.5 lb/mmscf	1.18
4	Gas-fired heater	2 mmbtu/hr	8,760 hr/yr	50 lb/mmscf	0.43	84 lb/mmscf	0.72	7.6 lb/mmscf	0.07	0.6 lb/mmscf	0.01	5.5 lb/mmscf	0.05
5	Gas-fired heater	2 mmbtu/hr	8,760 hr/yr	50 lb/mmscf	0.43	84 lb/mmscf	0.72	7.6 lb/mmscf	0.07	0.6 lb/mmscf	0.01	5.5 lb/mmscf	0.05
6	LPG Generator	605 hp	500 hr/yr	2.0 g/hphr	0.67	4.0 g/hphr	1.33	0.07 lb/hr	0.02	0.002 lb/hr	0.00	1.0 g/hphr	0.33
7	Diesel Pump	144 hp	8,760hr/yr	3.0 g/hphr	4.17	2.6 g/hphr	3.62	0.15 g/hphr	0.21	0.00205 lb/hphr	1.29	3.0 g/hphr	4.17
Several small emission units operating unlimited					1.80		1.80		0.10		0.00		0.10
All Emission Units					249.24		223.41		37.14		13.36		20.24

Table Notes: Sources of Emission Factors
NOx emissions for EUs 1 and 2 shown in the table are the limits to enable the stationary source avoid requirements.
CO, PM, SO_2, and VOC emissions for EUs 1 and 2 are based on 8,760 hr/yr to arrive at the worst-case emissions based on the worst-case emission factors.
EUs 1 and 2: Emission factors for NOx and CO come from source tests, PM and VOC are vendor data. EF for SO_2 come from the application and AQ1189MSS01.
EUs 3, 4, and 5: Emission factors obtained from AP-42, Table 1.4-1 and Table 1.4-2.
EU 6: Table 1, 40 CFR 60, Subpart JJJJ for NOx, CO, VOC. AP-42 Natural Gas Rich-Burn Engine, Table 3.2-3 for PM and SO_2 as in application and AQ1189MSS01
EU 7: Emission factors come from Table 4, 40 CFR 60, Subpart IIII. SO_2 emission factor comes from AP-42 Diesel Fuel Table 3.3-1.