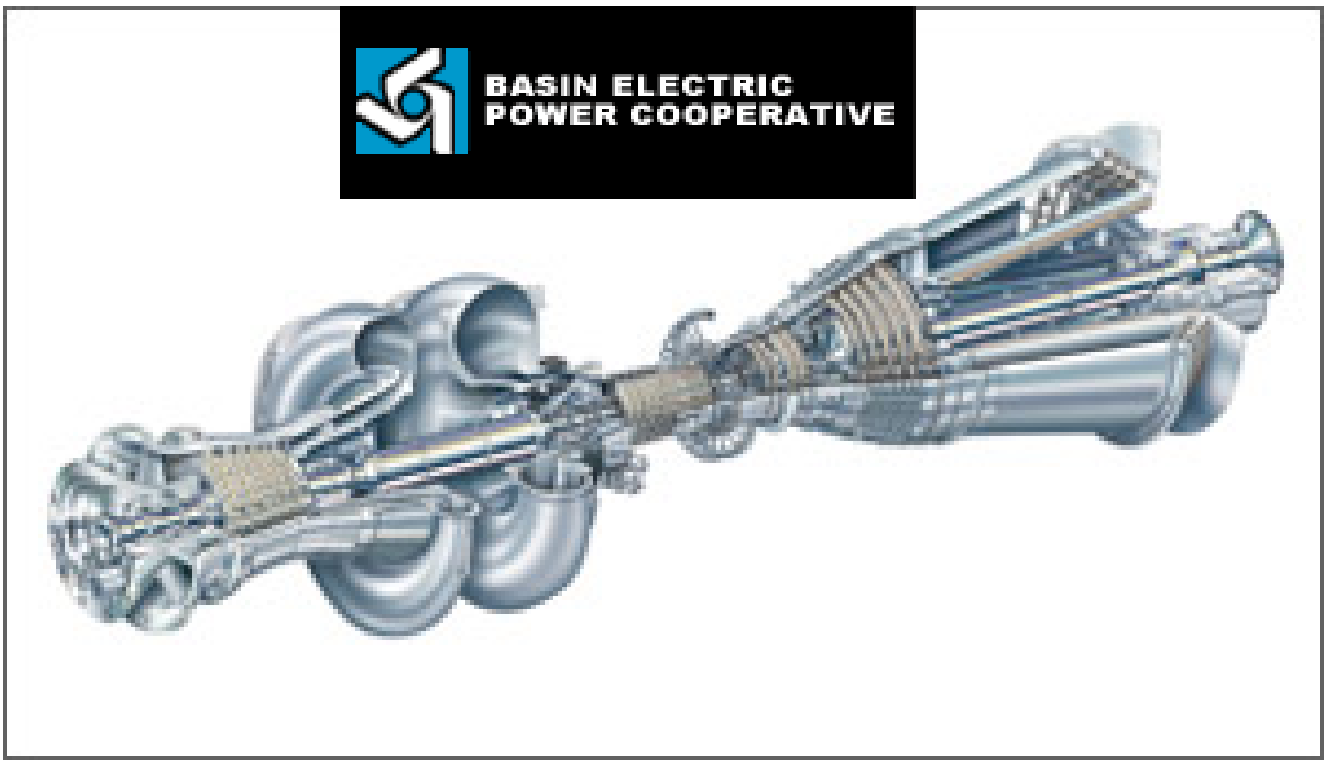
APPENDIX D

AIR QUALITY OPERATING PERMIT APPLICATION

GROTON GENERATING STATION UNIT 2
OPERATING PERMIT APPLICATION



Prepared for:
Basin Electric Power Cooperative
1717 East Interstate Avenue
Bismarck, North Dakota 58503-0564

November 2006

Prepared by:
Tetra Tech Inc.
Suite 300W
4900 Pearl East Circle
Boulder, Colorado 80301

TABLE OF CONTENTS

APPENDIX

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
Basin Electric	Basin Electric Power Cooperative
BPIP	Building Profile Input Program
CAM	Compliance Assurance Monitoring
CFR	Code of Federal Regulations
CO	Carbon monoxide
DEQ	Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
HAP	hazardous air pollutant
Km	Kilometer
kW	kilowatts
lb/MMBtu	pounds per million British thermal units
MMBtu/hr	million British thermal units per hour
MMSCF/yr	million standard cubic feet per year
msl	mean sea level
NAAQS	National Ambient Air Quality Standards
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NSPS	New Source Performance Standards
NSR	New Source Review
O_2	Oxygen
PM_{10}	Particulate matter with a diameter of 10 micrometers or less
ppmv	parts per million by volume
PSD	Prevention of Significant Deterioration
SIC	Standard Industrial Classification
SO_2	Sulfur dioxide
tpy	tons per year
TSP	Total suspended particulates
VOC	Volatile organic compound

1.0 INTRODUCTION

This document presents a technical and regulatory compliance information in support of an application for a modification to a South Dakota Department of Environment and Natural Resources (DENR) Air Pollution Control Program Article 74:36 Title V (Part 70) Operating Permit. The existing Groton Generating Station permitted under Title V Air Quality Operating Permit 28.0802-03 consists of one General Electric (GE) LMS100 natural gas fired turbine, and includes a secondary dry cooling system and other ancillary operations. Because total facility emissions for carbon monoxide (CO) and nitrogen oxides (NO_x) exceed 100 tons per year (tpy), the facility is a "major source" under SD DENR Air Pollution Control Program Article 74:36:01:08. This application is for the modification of permit #: 28.0802-03 involving the addition of a second General Electric (GE) LMS100 natural gas fired turbine at the Groton Generating Station. The proposed modification requires submittal of a Title V permit application. Fuel use limits will be maintained for the unit that keep potential emissions for each criteria pollutant below the 250 tpy threshold for Prevention of Significant Deterioration (PSD) required for preconstruction permits.

The required information outlined in SD DENR Air Pollution Control Program Article 74:36:05:09, is fully contained in this document. The applicant is Basin Electric Power Cooperative (Basin Electric) at the following mailing address:

Basin Electric Power Cooperative
1717 East Interstate Avenue
Bismarck, North Dakota 58501-0564

It is the understanding of Basin Electric that compliance with the conditions and terms of the Operating Permit shall be deemed in compliance with all applicable requirements for the facility. This operating permit application demonstrates the following compliance items for the proposed modification to the Groton Generating Station:

- The facility complies with all applicable rules and regulations of the SD DENR Air Pollution Control Program.
- The proposal does not involve a "major modification" for federal and state New Source Review (NSR) permitting purposes.
- The proposed facility will not prevent the attainment or maintenance of any ambient air quality standard.

- The proposed facility will not cause significant deterioration of existing ambient air quality in the region.
- The proposed facility will not emit any air pollutant in amounts which will:

    (i) prevent attainment or maintenance by any other state of any such national primary or secondary Ambient Air Quality Standard or

    (ii) interfere with measures required by the Federal Clean Air Act to be included in the applicable Implementation Plan for any other state to prevent significant deterioration of air quality or to protect visibility.

This document contains the following sections that will serve to meet the operating permit application requirements of the SD DENR Air Pollution Control Program Article 74:36:05:09. Section 2.0 describes the proposed additional turbine. Section 3.0 discusses air emissions associated with the proposed turbine. Section 4.0 describes applicable requirements for the proposed turbine. Section 5.0 presents an air quality impact analysis for the proposed source configuration. Section 6.0 summarizes the results of the analysis, and Section 7.0 presents references. Appendix A contains the SD DENR permit application forms. Appendix B and Appendix C contain emission estimation documentation. Appendix D contains a compact disc of the electronic modeling files.

2.0 PROJECT DESCRIPTION

The existing Groton Generating Station is an electricity generating station powered by a single GE LMS100 natural gas-fired turbine, located approximately 5 miles south of the town of Groton, in Brown County, South Dakota. Ferney, is located 3 miles south of the site. Aberdeen, SD is located 18 miles northwest of the site. The Spink County line is 9 miles south, The Day County line is 6 miles east, and the Edmunds County line is 30 miles west of the site. The North Dakota state line is 39 miles north of the site. Figure 2-1 shows a site location map, and Figure 2-2 is a plot plan of the Groton Generating Station layout.

The elevation of the site is approximately 1,300 feet above mean sea level (msl). The terrain in the region is relatively flat with some rolling hills. The area surrounding the Groton site is fairly flat and well drained by topographic relief throughout the site. There are isolated wetlands associated with intermittent streams, creeks, and rivers in the general area of the site. The only river in the region is the James River that flows generally north and south located approximately 10 miles west of the site at the closest point. Mud Creek, a tributary to the James River, is located 1 mile north of the site.

Basin Electric is proposing to construct a second natural gas-fired turbine with a secondary dry cooling system identical to the turbine currently installed at the Groton Generating Station. The proposed new source at the Groton Generating Station is an identical GE LMS100 gas turbine, fired by natural gas. The turbine is site rated at 93,464 kilowatts (kW) of output at 78 degrees Fahrenheit (°F). The associated secondary dry cooling system operates with an air flow rate of 25,750,000 pounds per hour (lb/hr).

As indicated in Figure 2-2, the site is enclosed in a secure fenced area. The second turbine will be situated on a concrete pad immediately south of the existing unit and enclosed in a structure, identical to the current turbine at the site.

The Standard Industrial Classification (SIC) number for the facility-wide process is 4911.

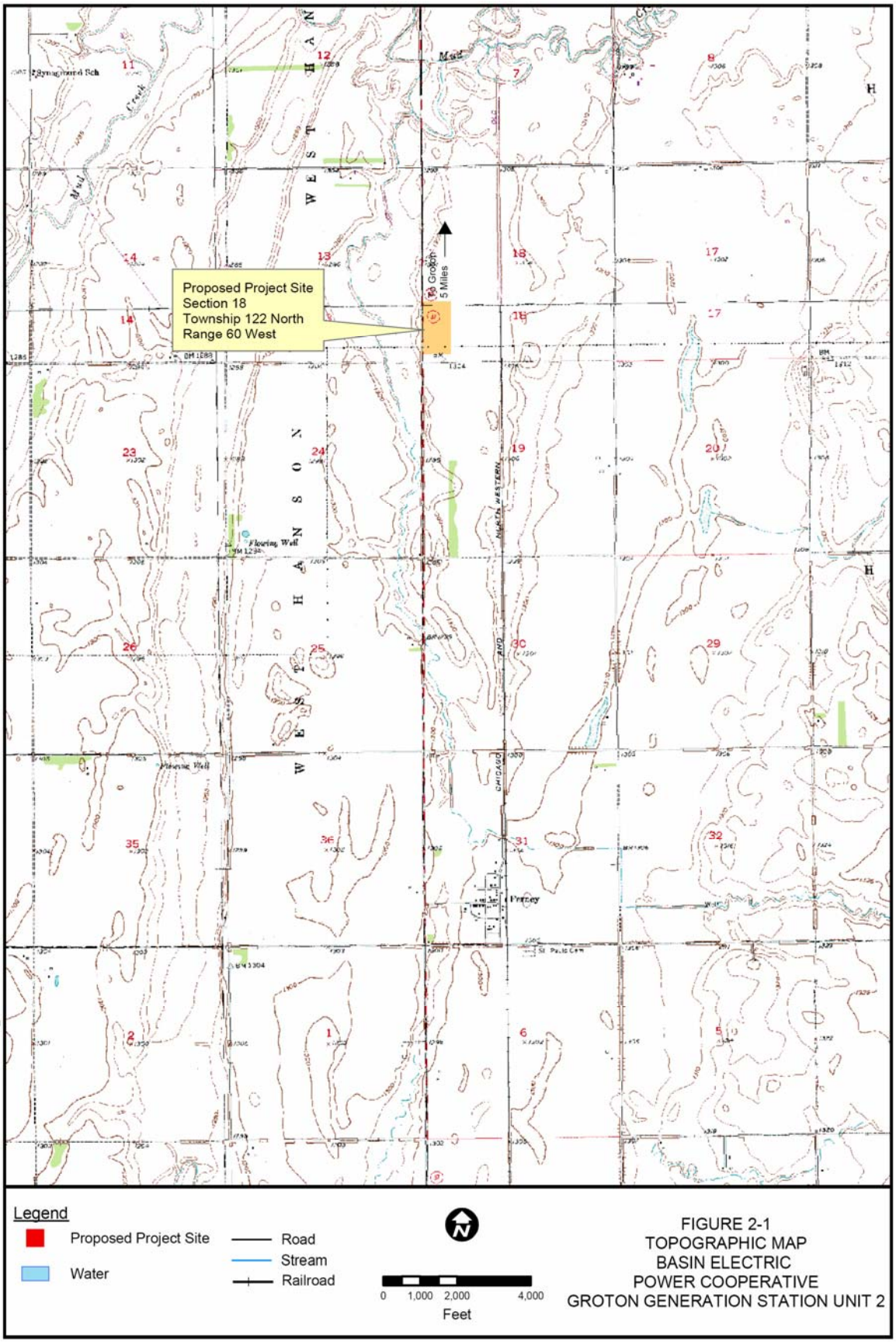


FIGURE 2-1
TOPOGRAPHIC MAP
BASIN ELECTRIC
POWER COOPERATIVE
GROTON GENERATION STATION UNIT 2

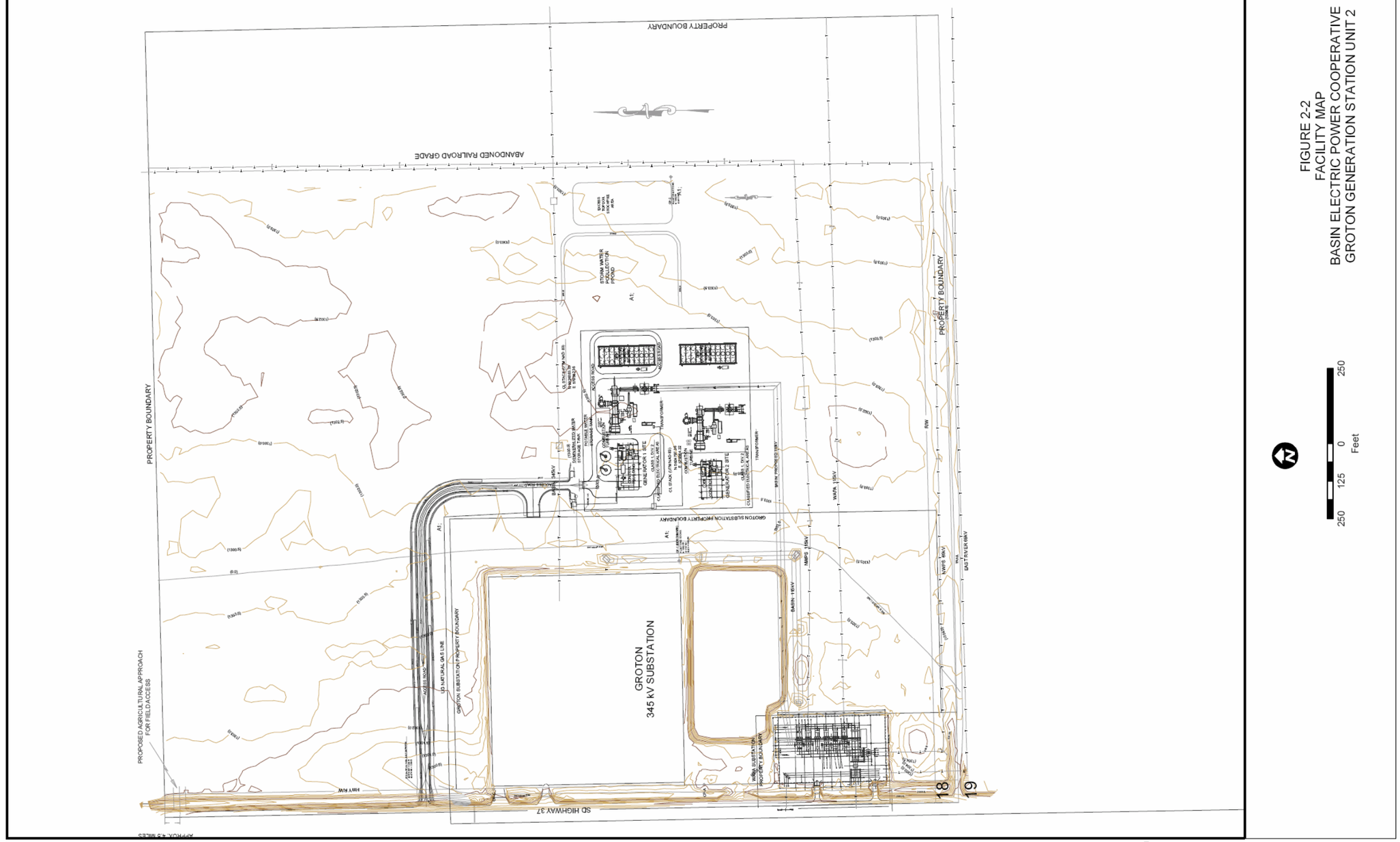


FIGURE 2-2
FACILITY MAP
BASIN ELECTRIC POWER COOPERATIVE
GROTON GENERATION STATION UNIT 2

16-NOV-2006 N:\ARCPRJ\010321\PROJECT\AIRPERMIT\FIG2-2_SITE LAYOUT.MXD

3.0 PROJECTED EMISSIONS

This section presents emissions data for criteria pollutants and hazardous air pollutants (HAPs). Criteria pollutants include:

- Nitrogen dioxide (NO2) – measured as nitrogen oxides (NO_x)
- Carbon monoxide (CO)
- Volatile Organic Compounds (VOCs)
- Total suspended particulates (TSP)
- Particulate matter with a diameter of 10 micrometers or less (PM10)
- Sulfur dioxide (SO_2)
- Lead

General Electric has guaranteed a maximum turbine exhaust concentration of 25 parts per million by volume (ppmv) for NO_x, 28 ppmv for CO, and 5 ppmv for VOCs at 15% oxygen (O_2) and 78°F with the use of a CO reactor, as shown in Appendix C. Emissions from the secondary dry cooling system are assumed to be negligible.

This application reflects fuel use limits for both of the turbines that will keep facility-wide potential emissions at current annual levels below the 250 ton per year threshold for preconstruction permits, required for PSD. This is done by adhering to a fuel use limit of 5,977,397 million British thermal units per year (MMBtu/yr), assuming a lower heating value of 21,530 Btu/lb for the fuel and limiting the combined hours of operation for both turbines to 7,438 hours per year, assuming worst case operating conditions.

3.1 Emission Calculations

The emission data for both criteria pollutants and HAPs includes a summation of facility-wide emission rates for the two turbines. Facility-wide emissions are primarily generated from the two natural gas-fired turbines. Appendix B provides the calculations used to derive the emissions from the facility. Appendix C contains manufacturer's data for the natural gas-fired turbines.

NO_x, CO and VOC emission estimates for the natural gas-fired turbines are based on manufacturer provided information. Emission factors for TSP, PM_{10}, and SO_2 were obtained from AP-42, Table 3.1-2a

(dated 4/00). An emission factor for lead was not available from AP-42, 3.1-2a, and was obtained from AP-42, Table 1.4-2 (dated 7/98). The emission factor for lead was calculated by dividing 0.0005 lb/10^6scf by 1,020 MMBtu/10^6scf. The secondary air cooling system is a dry air system, emissions are assumed to be negligible.

3.2 Load Analysis

Manufacturer's specifications were used to derive emissions for various load conditions. The turbine manufacturer provided estimated operating conditions for sixteen emission scenarios. These emission scenarios covered the combination of ambient temperatures of -30 degrees Fahrenheit (°F), 0° F, 40° F, 59° F, 78° F, and 92° F and equipment loads of 50 percent (%), 75%, and 100%. The manufacturer-specified guarantee emission rates, under variable operating conditions were used for the following pollutants:

- NO_x
- CO
- VOCs

Appendix C contains manufacturer's data for sixteen sets of operating conditions, as well as the "Guarantee" condition at 100% load and 78ºF. Manufacturer information was used to calculate stack emissions rates, as shown in Appendix B. Table 3-1 presents a summary of NO_x, CO and VOC emissions for the sixteen different load scenarios for the natural gas-fired turbines.

Table 3-2 summarizes criteria pollutant emissions for the entire facility. NO_x, CO and VOC emissions for the two natural gas-fired turbines are based on annual average conditions (approximately 40°F, at 100% load) with manufacturer "Guarantee" information. Table 3-3 summarizes facility HAP emissions.

TABLE 3-1

GROTON GENERATING STATION
GE LMS100 TURBINE LOAD SCREENING SCENARIO EMISSIONS

Percent Base Load	%	100	75	50	100	75	50	100	75	50	100	75	50	100	75	50	100	75	50
Ambient Temperature	Deg F	-30	-30	-30	0	0	0	40	40	40	59	59	59	78	78	78	92	92	92
Exhaust Temperature	Deg F	729.0	727.9	744.5	735.9	737.6	754.9	769.2	750.9	768.7	780.3	758.2	776.1	791.4	770.8	788.5	808.9	792.3	817.2
Exit Velocity	m/s	45.2	38.0	30.4	45.3	38.2	30.6	46.1	38.6	30.9	45.8	38.4	30.7	44.5	37.4	30.0	42.6	35.9	28.9
Exhaust Emissions																			
NO_x	ppmvd	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	lb/hr	66	56	45	65	55	44	64	55	44	63	54	43	60	52	41	56	49	39
CO	ppmvd	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
	lb/hr	45	38	30	44	38	30	44	38	30	43	37	29	41	35	28	38	33	26
HC[(1)]	ppmvd	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	lb/hr	13	11	9	13	11	8	12	11	8	12	10	8	12	10	8	11	9	7

[(1)] HC = Hydrocarbons which are assumed to equate to VOC's.

TABLE 3-2
GROTON GENERATION STATION
(2) GE LMS100 TURBINE EMISSIONS SUMMARY FOR CRITERIA POLLUTANTS

Emission Unit:	**(2) GE LMS100 Natural Gas Combustion Turbine Generators**
Fuel Flow:	**786.5 MMBtu/hr**
Control Equipment:	**Dry Low NO_x**

Criteria Pollutants	Emission Factor[A] (lb/MMBtu)[C]	Emission Rate[B] (lb/hr)[D]	Emission Rate (tons/yr)[E]
TSP	6.60E-03	5.19	19.3
PM_{10}	6.60E-03	5.19	19.3
SO_2	3.40E-03	2.67	9.94
NO_x	NA	64.0	238
CO	NA	43.6	238[(F)]
VOC	NA	12.3	45.6
Lead	4.90E-07	3.85E-04	1.43E-02

Notes:

NA Not applicable

[A] The emission factors for TSP, PM_{10}, and SO_2 were obtained from AP-42, Table 3.1-2a (dated 4/00). An emission factor for lead was not available from AP-42, 3.1-2a, and was obtained from AP-42, Table 1.4-2 (dated 7/98). (The emission factor for lead was calculated by dividing 0.0005 lb/10^6scf by 1,020 MMBtu/10^6scf).
NO_x, CO and VOC emissions are based on annual average conditions (approximately 40^{o}F, at 100% load) with manufacturer "Guarantee" information.

[B] The NO_x, CO and VOC emission rates were provided by the manufacturer in units of lb/MMBtu and converted to pounds per hour or tons per year based on fuel flow data at 78^{o}F under 100 percent load conditions. A safety factor was applied to the NO_x and CO emission rates to account for variable temperature conditions, creating maximum emissions. NO_x, CO and VOC emission rates in this table are based on annual average conditions (approximately 40^{o}F, at 100% load) with manufacturer "Guarantee" information. Calculations are provided in Appendix B.

[C] lb/MMBtu => pounds per million British thermal units

[D] lb/hr => pounds per hour

[E] tons/yr => tons per year; assuming operation of 7,438 combined hours per year for two turbines

[F] 238 tons/yr is the permitted CO emission rate in Permit Number 28.0802-03. Basin Electric does not wish to change this value. However, it should be noted that an emission rate of 43.6 lb/hr CO for 7,438 hours/yr will not emit 238 tons/yr.

TABLE 3-3
GROTON GENERATION STATION
GE LMS100 TURBINE EMISSIONS SUMMARY FOR HAZARDOUS AIR POLLUTANTS

Emission Unit:	**(2) GE LMS100 Natural Gas Combustion Turbine Generators**
Fuel Flow:	**786.5 MMBtu/hr**
Control Equipment:	**Dry Low NO_x**

Hazardous Air Pollutants	Emission Factor[A] (lb/MMBtu)[B]	Emission Rate (lb/hr)[C]	Emission Rate (tons/yr)[D]
1,3-Butadiene	4.3E-07	3.38E-04	1.26E-03
Acetaldehyde	4.0E-05	3.15E-02	1.17E-01
Acrolein	6.4E-06	5.03E-03	1.87E-02
Benzene	1.2E-05	9.44E-03	3.51E-02
Ethylbenzene	3.2E-05	2.52E-02	9.36E-02
Formaldehyde	7.1E-04	5.58E-01	2.08E+00
Naphthalene	1.3E-06	1.02E-03	3.80E-03
PAH[E]	2.2E-06	1.73E-03	6.43E-03
Propylene[F]	NA	NA	NA
Propylene Oxide	2.9E-05	2.28E-02	8.48E-02
Toluene	1.3E-04	1.02E-01	3.80E-01
Xylenes	6.4E-05	5.03E-02	1.87E-01
Total Hazardous Air Pollutants		**8.08E-01**	**3.00E+00**

Notes:

NA Not Applicable

A The emission factors were obtained from AP-42, Table 3.1-3 (dated 4/00).

B A fuel flow value of 793.5 MMBtu/hr was used to simulate condition at 78°F under 100 percent load.
lb/MMBtu => pounds per million British thermal units. The emission factor was derived by dividing lb/10^6 scf by 1,020 btu/scf.

C lb/hr => pounds per hour.

D tons/yr => tons per year; assuming operation of 7438 combined hours per year for two turbines

E PAH => Polycyclic aromatic hydrocarbons

F Propylene was not listed in AP-42, Table 3.1-3 as a pollutant for turbines. AP-42, Table 3.3-2 does list it as a pollutant for startup generators (see Table 3-4 in this document). It was added to this table as a placeholder.

4.0 APPLICABLE REQUIREMENTS

This section presents state and federal applicable requirements specific to the proposed new Groton Generating Station natural gas-fired turbine.

The Groton Generating Station is subject to South Dakota's Air Pollution Control Program, Article 74:36, which contain 18 separate chapters relating to air quality. The facility is subject to the general provisions contained in Chapter 1, Definitions; Chapter 2, Ambient Air Quality; Chapter 5, Operating Permits for Part 70 Sources; Chapter 6, Regulated Air Pollutant Emissions; Chapter 7, New Source Performance Standards (NSPS); Chapter 8, National Emission Standards for Hazardous Air Pollutants; Chapter 9, PSD; Chapter 10, NSR; Chapter 11, Performance Testing; Chapter 12, Control of Visible Emissions; Chapter 13, Continuous Emission Monitoring Systems (CEMs); and Chapter 16, Acid Rain Program.

The facility does not contain sources or have emissions that make it subject to the provisions of Chapter 3, Air Quality Episodes, Chapter 4, Operating Permits for Minor Sources; Chapter 17, Rapid City Sanding and Deicing, and Chapter 18, Regulations for the State Facilities in the Rapid City Area.

The remainder of this section addresses the applicability of specific sections of Chapter 2, Ambient Air Quality, Chapter 5, Operating Permits for Part 70 Sources, Chapter 7, NSPS, Chapter 8, National Emission Standards for Hazardous Air Pollutants, Chapter 9, PSD, Chapter 10, NSR, Chapter 13, CEMs, and Chapter 16, Acid Rain Program.

Chapter 2 establishes air quality goals for the state of South Dakota, including protection of public health; prevention of damage to buildings, property, animals, plants, forests, and agricultural crops; optimization of visibility; and minimization of the corrosion of or damage to metals or other materials. This section identifies ambient air quality standards for the state of South Dakota as equivalent to the Federal National Ambient Air Quality Standards (NAAQS). Methods of sampling and analysis for criteria pollutants and ambient air monitoring requirements are defined.

Chapter 5 establishes the permitting requirements to be followed in the preparation of an application. Since the proposed facility-wide emissions, as described in Section 2.0, are below 250 tpy, but above 100 tpy for two criteria pollutants; below 10 tpy for all individual HAPs, and below 25 tpy for all HAPs combined, the proposed facility is a major source as defined in Chapter 1 of this rule. The proposed

facility-wide emission limits are based on facility-wide fuel use limits of 5,035 MMSCF/yr, assuming a fuel heating value of 21,530 Btu/lb and 7,438 hours of operation per year.

Chapter 7, incorporates, by reference, the federal NSPS from Title 40 of the Code of Federal Regulations Part 60 (40 CFR 60) Subpart GG – Standards of Performance for Stationary Gas Turbines. The NSPS Subpart GG establishes NO_x emissions limits for gas turbines with a heat input at peak load equal to or greater than 10 MMBtu/hr. The proposed GE LMS100 turbine has a maximum fuel input of 786.5 MMBtu/hr. The NO_x emission limits from NSPS Subpart GG are presented in Table 4-1 and are dependent on the size and application of the turbine. Based on the size of the proposed GE LMS100 turbine, 786.5 MMBtu/hr, the NSPS emission limit will be 75 ppmv. The proposed emission limit for the GE LMS100 turbine, as presented in Section 3.0, is 25 ppmv, which is below the NSPS Subpart GG limit.

TABLE 4-1

NEW SOURCE PERFORMANCE STANDARDS FOR GAS TURBINES – NO_x EMISSION LIMITS

Fuel Input (MMBtu/hr)	Gas Turbine Size (MW)	NO_x Emission Limit (ppmv at 15% O_2, dry[AB])
< 10	1[C]	None
10 – 100	1 – 10[C]	150
> 100	10+[C]	75

Notes:

A Based on thermal efficiency of 25 percent. This limit may be increased for higher efficiencies by multiplying the limit in Table 4-1 by 14.4/actual heat rate, in kJ/watt-hr.
B A fuel-bound nitrogen allowance may be added to the limits listed in Table 4-1 based on 40 CFR §60.332(a)(3)
C Based on gas turbine heat rate of 10,000 Btu/kW-hr
MMBtu/hr Million British thermal units per hour
MW Megawatt
ppmv Parts per million by volume

Chapter 8 identifies the applicable requirements for the proposed source in relation to the National Emission Standards for Hazardous Air Pollutants (NESHAPs). Predicted HAP emissions are below 10 tpy for any one HAP, and below 25 tpy for all HAPs combined. Therefore, this source will not qualify as a major source for HAPs as defined in Chapter 8, and will not be subject to the requirements of this section.

Chapter 9 incorporates, by reference, the federal PSD regulations. This regulation can affect sources that are within attainment or unclassified areas, such as the area surrounding the Groton site. Chapter 6, Section 4 of the PSD requirements are not triggered since the facility-wide emissions will be below the major source threshold of 250 tpy for PSD as defined in 40 CFR 52.21.

Chapter 10 establishes the requirements of the federal NSR program as applicable to the state of South Dakota. NSR permitting requirements are not triggered because the facility is located within attainment or unclassified areas and will not cause or contribute to a violation of any national ambient air quality standards, as shown in Section 6 of this report.

CEM requirements are established in Chapter 13. Chapter 13, Section 8 establishes that owners and operators of any unit subject to 40CFR64.2, must comply with 40CFR64.1 and 40CFR64.3 through 40CFR64.10. 40CFR64.2 states that "the requirements of this part shall apply to a pollutant-specific emissions unit at a major source that is required to obtain a part 70 or 71 permit if the unit satisfies all of the following criteria:

- The unit is subject to an emission limitation or standard for the applicable regulated air pollutant (or surrogate thereof), other than an emission limitation or standard that is exempt under paragraph (b)(1) of this section;
- The unit uses a control device to achieve compliance with such emission limitation or standard; and
- The unit has potential pre-control device emissions of the applicable regulated air pollutant that are equal to or greater than 100 percent of the amount, in tons per year, required for a source to be classified as a major source."

The proposed natural gas turbine does fall under the definition of sources requiring CEM, and will be subject to the requirements of 40CFR64.1 and 40CFR64.3 through 40CFR64.10. These regulations include descriptions of definitions; monitoring design criteria; submittal requirements; deadlines for submittals; approval of monitoring; operation of approved monitoring; quality improvement plan requirements; reporting and record keeping requirements; and savings provisions.

Chapter 16 references the requirements of 40CFR Part 75 for Acid Rain Provisions. This section identifies CEM requirements for NO_x, SO_2, CO_2 (or O_2), and stack flow, with calculation of emission rates. The proposed natural gas turbine does fall under the definition of sources subject to 40CFR Part 75 for Acid Rain Provisions.

5.0 AIR QUALITY IMPACT ANALYSIS

The Groton Generating Station was permitted for one GE LMS100 natural gas combustion turbine in May 2005 (South Dakota DENR Permit No. 28.0802-03). The attached operating permit application proposes the construction and operation of a second combustion turbine, identical to the one currently permitted and installed at the Groton Generating Facility. Dispersion modeling was used to estimate the air quality impact of potential emissions of NO_x and CO from both combustion turbine generators at the Groton Generating Station. The dispersion modeling followed the guidance outlined in the EPA's *Guideline on Air Quality Models (Revised)* (EPA 2005). Modeling was conducted to demonstrate that potential air pollution emission impacts from two generators are below National Ambient Air Quality Standards (NAAQS) and South Dakota Ambient Air Quality Standards, in accordance with South Dakota Air Regulation §74:36:05:06, *Standard for Issuance of Operating Permit*. Basin Electric is proposing that the operation of two combustion turbines at the Groton Generating Facility will not produce higher annual emissions than those currently permitted for one turbine in Permit Number 28.0802-03. Therefore, Basin Electric Power Cooperative is proposing emission limits on the two combustion turbines of 238 tons per year of nitrogen oxides and 238 tons per year of carbon monoxide, keeping the facility below the major source threshold of 250 tpy with respect to PSD, but above the South Dakota Title V Operating Permit major source threshold of 100 tpy, for CO and for NO_x. The turbine site is located in an area that is designated as attainment for all criteria pollutants. The remainder of this section describes the procedures used to conduct the dispersion modeling analysis, and discusses the modeling results.

5.1 Model Selection

Dispersion modeling was conducted using the AERMOD modeling system, consisting of AERMET, AERMAP and AERMOD. The AERMOD modeling system was developed to incorporate air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. The Federal Register Notice (Vol. 70, No. 216) of November 9, 2005 states that beginning November 9, 2006 AERMOD should be used for appropriate applications as replacement for ISCST3. The recommended applications of AERMOD are consistent with the needs of the Groton Generating Station impact analysis; therefore, AERMOD was selected. PRIME was used to evaluate building downwash

AERMOD was run using all regulatory default options. The model was run using rural dispersion parameters, incorporating the local, flat terrain into the calculations.

5.2 Land Use Classifications

The elevation of the site is approximately 1,300 feet above msl. The terrain in the region is relatively flat with some rolling hills. The area surrounding the Groton site is well-drained although there is little topographic relief throughout the site. There are no significant urban centers within a 50-km radius of the proposed site; therefore, rural dispersion parameters were used in the modeling.

Land use classification of a 3 km radius surrounding the Huron Regional Airport (WBAN 14936) was used to establish the albedo, bowen ratio and surface roughness variables used as input to AERMET. Seasonal characteristic values were used in AERMET based on the values found in the *User's Guide for the AERMOD Meteorological Preprocessor (AERMET)*, Tables 4-1, 4-2b and 4-3.

5.3 Meteorological Data

Dispersion modeling was conducted using five years of surface meteorological data (2000-2004) from the Huron Regional Airport (WBAN 14936) and upper air data from the Aberdeen Regional Airport (WBAN 14929). The surface data is HUSWO format and the upper air data is fsl format. This data set is representative of meteorological conditions that will affect dispersion of stack effluent plumes from the Groton site.

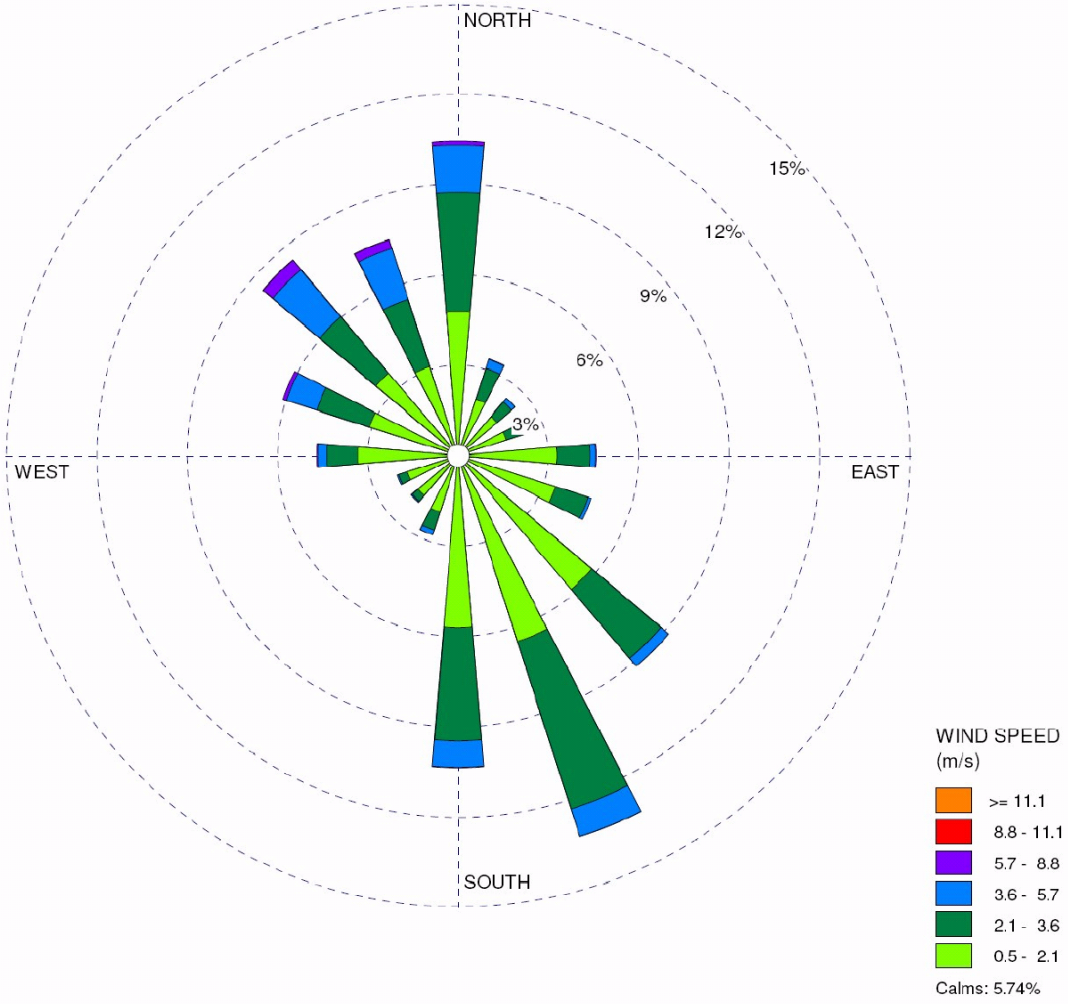
A windrose representing the five years of meteorological data from the Huron site is presented in Figure 5-1. The meteorological data is included with this permit application on compact disc in Appendix D.

5.4 Modeled Emission Sources

The proposed source is a simple cycle, natural gas-fired turbine with no backup fuel, identical to the turbine already existing on the site (South Dakota DENR Permit No. 28.0802-03). The generating capacity of the unit is 100 megawatts (MW). Water injection is used for control of nitrogen oxides (NO_x) and a catalyst reactor is used for the control of CO and VOCs. Annual average emissions of NO_x and short term (hourly) average emissions of CO were modeled for these sources to obtain annual and short term average pollutant concentrations, respectively. Basin Electric is proposing combined emission limits on the two combustion turbines of 238 tons per year of NO_x and 238 tons per year of CO, which are the same permitted emission limits of the original turbine. For this modeling analysis, worst case scenarios

WIND ROSE PLOT:
Station #14936 - HURON/REGIONAL ARPT, SD

DISPLAY:
Wind Speed
Direction (blowing from)



DATA PERIOD:
2000 2001 2002 2003 2004
Jan 1 - Dec 31
00:00 - 23:00

CALM WINDS:
5.74%

TOTAL COUNT:
43848 hrs.

AVG. WIND SPEED:
2.09 m/s

Figure 5-1
Huron Meteorology Data Windrose
(WBAN 14936)

were assumed by modeling each turbine at maximum emission rates for each scenario. Modeled NO_x emissions from the turbines are dependent on ambient temperature and specified load. GE, the turbine manufacturer, provided emission information based on these variables (see Appendix C). Thirty-six NO_x and CO model runs were conducted to account for the variability in ambient temperature and specified load (i.e. 18 different load analyses for each turbine). Table 5-1 presents stack parameters and emission rates used to model NO_x and CO under the various scenarios.

For NAAQS modeling, only current/proposed emission sources will be considered. Compliance with the NAAQS will be demonstrated by taking the highest modeled concentration for each pollutant, adding the appropriate background concentration, and comparing the sum to the applicable NAAQS. To ensure that PSD requirements do not apply to the proposed source, resultant concentrations will also be compared to applicable PSD significance thresholds.

5.5 Building Downwash

The AERMOD model inputs include building dimensions to assess the potential for downwash effects on emissions from associated nearby structures. AERMOD uses BPIPPRM, which is the same method of calculating downwash that was used in ISCPRIME. It includes several advances over ISCST3 in building downwash effects including enhanced dispersion in the wake, reduced plume rise due to streamline deflection and increased turbulence, and a continuous treatment of near and far wakes (Schulman and others 1998). The direction-specific downwash parameters were calculated using facility plot-plan maps, and BPIPPRM software. Output from BPIPPRM was incorporated into the AERMOD modeling input files. All output files from BPIPPRM are provided with this permit application on a compact disk provided in Appendix D.

5.6 Model Receptors

The modeling for the proposed facility was completed using an extensive receptor grid to ensure that the maximum estimated impacts are identified. Following EPA guidelines, receptor locations were identified with sufficient density and spatial coverage to isolate the area where the highest impacts are anticipated. The following receptor spacing was used:

- 50-meter (m) spacing along the proposed perimeter fenceline;
- 100-m spacing from the fenceline to 1.0 kilometer (km) from the fenceline;

TABLE 5-1

BASIN ELECTRIC COMBUSTION TURBINE GENERATORS
MODELED SOURCE PARAMETERS

Scenario #[(A)]	Load (%)	Ambient Temp (°F)	NO_x Emission Rate (g/s)	CO Emission Rate (g/s)	Stack Height (m)	Exit Temperature (K)	Stack Diameter (m)	Exit Velocity (m/s)
Scenario 1	100	-30	8.26	5.63	26.2	660.37	3.51	45.20
Scenario 2	75	-30	7.03	4.80	26.2	659.76	3.51	38.03
Scenario 3	50	-30	5.61	3.83	26.2	668.98	3.51	30.44
Scenario 4	100	0	8.22	5.61	26.2	664.21	3.51	45.35
Scenario 5	75	0	6.99	4.76	26.2	665.15	3.51	38.18
Scenario 6	50	0	5.58	3.80	26.2	674.76	3.51	30.55
Scenario 7	100	40	8.06	5.50	26.2	682.71	3.51	46.09
Scenario 8	75	40	6.59	4.74	26.2	672.54	3.51	38.62
Scenario 9	50	40	5.54	3.78	26.2	682.43	3.51	30.88
Scenario 10	100	59	7.90	5.38	26.2	688.87	3.51	45.85
Scenario 11	75	59	6.84	4.66	26.2	676.59	3.51	38.41
Scenario 12	50	59	5.45	3.72	26.2	686.54	3.51	30.73
Scenario 13	100	78	7.57	5.16	26.2	695.04	3.51	44.50
Scenario 14	75	78	6.55	4.46	26.2	683.59	3.51	37.39
Scenario 15	50	78	5.23	3.56	26.2	693.43	3.51	29.97
Scenario 16	100	92	7.11	4.85	26.2	704.76	3.51	42.58
Scenario 17	75	92	6.14	4.19	26.2	695.54	3.51	35.90
Scenario 18	50	92	4.88	3.33	26.2	709.37	3.51	28.91

Notes:

A Each scenario was modeled twice, once for each turbine, to represent worst case emissions.
NA Not applicable

- 500-m spacing from 1.0 km to 5.0 km from the fenceline; and
- 1000-m spacing from 5.0 km to 12.0 km from the fenceline.

All coordinates were input as Universal Transverse Mercator (UTM) eastings and northings, in horizontal datum NAD83. Terrain elevations for all the receptors were determined using digital elevation model data files. A total of 1,613 model receptors were included in the modeling analysis. Figure 5-2 shows a plot of the receptors.

5.7 Background Concentrations

Ambient background concentrations represent the contribution of pollutant sources not included in the modeling analysis, including naturally occurring sources. The background concentration for each criteria pollutant is added to the maximum modeled concentration to calculate the total estimated pollutant concentration for comparison with the NAAQS. Published concentrations for NO_2 and CO near the study area are not available because there are no nearby monitoring stations for these criteria pollutants. Therefore, no background concentrations will be added to the modeled concentrations for the proposed source. As shown in the following sections of this report, background concentrations will not be of concern given the low level of predicted impacts.

5.8 Modeling Results

The predicted maximum impacts from the proposed Basin Electric combustion turbine demonstrate that operation of the generator will not cause or contribute to violations of applicable air quality standards.

Predicted maximum modeled concentrations of NO_x and CO are well below the applicable PSD Significance Levels, as well as South Dakota Ambient Air Quality Standards and NAAQS. Maximum impacts were predicted largely northwest and southeast of the site. Table 5-2 compares the PSD Significance Levels and NAAQS with maximum modeled concentrations.

All modeling input and output files are provided with this permit application on compact disc in Appendix D.

FIGURE 5-2

MAP OF MODELED RECEPTORS

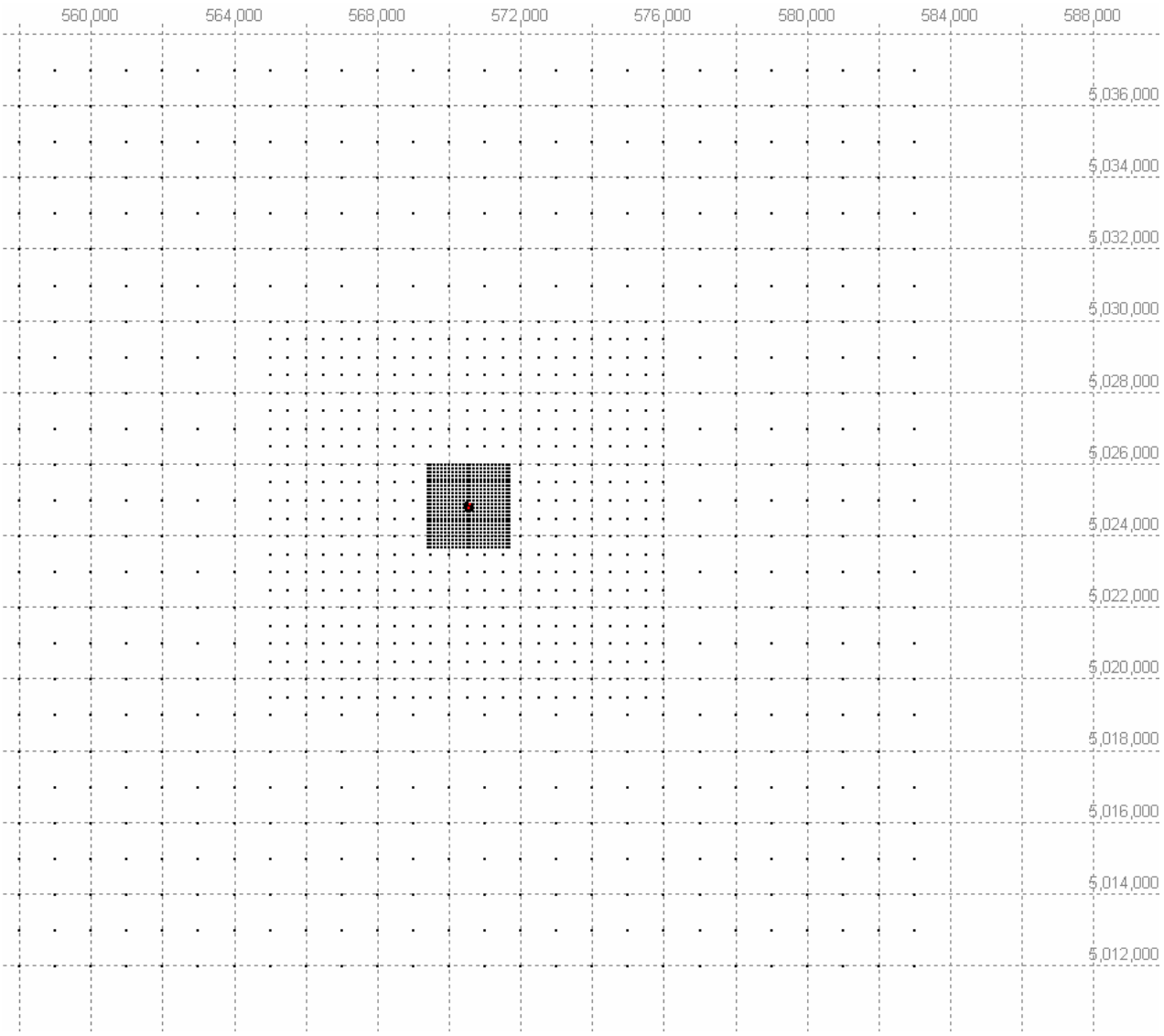


TABLE 5-2

BASIN ELECTRIC COMBUSTION TURBINE GENERATORS
DISPERSION MODELING RESULTS

Scenario #	Maximum Modeled Concentration ($\mu g/m^3$)		
	Annual NO_x	1-Hour CO	8-Hour CO
Scenario 1	0.21	16.50	5.56
Scenario 2	0.22	16.25	5.57
Scenario 3	0.22	14.87	5.39
Scenario 4	0.21	16.36	5.54
Scenario 5	0.21	16.04	5.47
Scenario 6	0.22	14.70	5.30
Scenario 7	0.20	15.70	5.25
Scenario 8	0.21	15.81	5.34
Scenario 9	0.21	14.52	5.18
Scenario 10	0.19	15.41	5.14
Scenario 11	0.21	15.59	5.26
Scenario 12	0.21	14.32	5.11
Scenario 13	0.19	15.18	5.04
Scenario 14	0.20	15.19	5.14
Scenario 15	0.20	13.87	5.00
Scenario 16	0.19	14.81	4.89
Scenario 17	0.20	14.65	4.96
Scenario 18	0.19	13.18	4.81
Prevention of Significant Deterioration Significance Level	1	2,000	500
National Ambient Air Quality Standard	100	40,000	10,000

Notes:

($\mu g/m^3$) Micrograms per cubic meter

6.0 SUMMARY AND CONCLUSIONS

Basin Electric Power Cooperative is proposing to install and operate a natural gas-fired, turbine identical to the existing turbine (South Dakota DENR Permit No. 28.0802-03) at the Groton Generating Station in Brown County, South Dakota. Emissions were calculated for criteria pollutants and HAPs. This analysis demonstrates that the applicable requirements identified in Section 4.0 would be met by the proposed facility. An air quality impact analysis has shown that this proposed turbine will have no significant impact on ambient air quality. Based on information provided, all applicable requirements of South Dakota's Air Pollution Control Program, Article 74:36 will be met.

7.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 1990. "New Source Review Workshop Manual - Prevention of Significant Deterioration and Nonattainment Area Permitting (Draft)." Office of Air Quality Planning and Standards. Research Triangle Park, NC. October.

EPA. 2005. "Guideline on Air Quality Models (Revised)." 40 Code of Federal Regulations, Part 51, Appendix W. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

Schulman, L.L., D.G. Strimaitis, and J.S. Scire. 1998. "Development and Evaluation of the PRIME Plume Rise and Building Downwash Model." Submitted to Journal of the Air & Waste Management Association.

APPENDIX A

PERMIT APPLICATION FORM

Air Quality Permit Application Form

Title V (Part 70) Operating Permit

General Information Form

And

Certification of Applicant Form

SEND ALL MATERIALS TO:

SD Department of Environment and Natural Resources
Air Quality Program
523 East Capitol
Pierre, South Dakota 57501-3181

(Please complete shaded areas - if you have questions call (605) 773-3151)

GENERAL INFORMATION

If permit is being renewed or amended, give existing permit number:	
1. Facility name:	Groton Generating Station
2. Mailing address:	
Street and/or box number	1717 East Interstate Avenue
City, state, zip code	Bismarck, North Dakota 58503-0564
3. Facility location (if plant is portable, enter location at time of submittal):	
Street and city	5 miles south of the town of Groton, in Brown County, South Dakota
Legal description and county	SW ¼ of Section 18, Township 122 North, Range 60 West

(Quarter, Section, Township, Range)

4. Permit contact:	
Name/title	Jerry Menge
Telephone number	(701) 223-0441
5. Facility contact, if different than permit contact (Person to contact for arranging inspections):	
Name/title	
Telephone number	
6. Responsible official:	
Name/title	Vernon Laning (Designated Representative) Vice President of Operations Jim K. Miller (Designated Alternate Representative) Manager of Environmental Affairs
Telephone number	(701) 233-0441

A responsible official is defined as a president, vice president, secretary, or treasurer for a corporation; general partner or the proprietor for a partnership; and principal executive officer or ranking elected official for municipal, state, federal or public agency.

B. PLANT DESCRIPTION

1. Standard Industrial Classification Code (SIC code):

Primary SIC code: 4911-Electricity Generation Secondary SIC code (if applicable):

Please contact the Department if unable to determine your SIC code.

2. Briefly describe the operations at the facility, including raw materials and finished products:

Natural gas-fired turbines for electricity generation

Please attach one copy, if available, of any prepared plans and the manufacturer's specifications of any equipment, including pollution control devices. If additional space is needed to describe operations, please attach the additional paper to this application.

3. A **new source or modification to an existing source** is required to demonstrate that the operation of the new source or modification will not prevent or interfere with the attainment or maintenance of an applicable ambient air quality standard. Please attach air dispersion modeling or other documents that will demonstrate the new source or modification will not prevent or interfere with the attainment or maintenance of an applicable ambient air quality standard.

Has air dispersion modeling been conducted (please check one)? [X] Yes [ ] No

If air dispersion modeling has been conducted, please attach a copy of the report to this application unless the Department has a copy already.

C. COMPLIANCE PLAN

If it is anticipated that a permitted unit will not be operating in compliance at the time of permit issuance, a proposed compliance plan shall be included with the application. The proposed compliance plan shall include a narrative description of the following:

1. The requirements (i.e., statutes, air quality rules, permit conditions, etc.) the source is not in compliance with at the time of submittal of this application or permit issuance;
2. How the facility intends to bring the unit(s) into compliance; and
3. A compliance schedule for when the source will achieve compliance with such requirements;

The compliance schedule must include a statement that progress reports will be submitted at least once every six months and must be at least as stringent as that contained in any judicial consent decree or administrative order to which the applicant is subject.

D. MAPS

For stationary sources only, please enclose a map or a drawing showing roadways, location of plant and the nearest residents in each direction from the source. Include other structures, which may be affected.

E. AIR QUALITY EMISSIONS SUMMARY

If air quality emissions are available, please complete the following table:

	Actual	Potential Controlled	Potential Uncontrolled
Pollutant	(tons per year)	(tons per year)	(tons per year)
Particulate		See Table 3-2	
Sulfur Dioxide		See Table 3-2	
Nitrogen Oxide		See Table 3-2	
Carbon Monoxide		See Table 3-2	
Volatile Organic Compounds		See Table 3-2	
Hazardous Air Pollutants (if applicable)			
		See Table 3-3	

Remember that potential emissions are calculated assuming that the permitted unit is operated 24 hours per day, 7 days per week, 52 weeks per year at maximum design capacity. Attach all calculations, MSDS sheets for all products containing volatile organic compounds and/or hazardous air pollutants, and other supporting documentation.

Please contact the Department if assistance is needed for calculating emissions for the permitted units such as emission factors, clarifying what potential emissions are, efficiency for control equipment, etc.

F. ADDITIONAL FORMS

The following forms must be completed for each piece of specific equipment at the facility and submitted with this form:

Boiler	Incinerator	Kiln Dryer
Miscellaneous Process	Paint Booth	Storage Tank

The following forms must be completed for each piece of specific air control equipment at the facility and submitted with this form:

Baghouse	Cyclone	Electrostatic Precipitator
Miscellaneous Control	Thermo Oxidizer	Wet Scrubber

G. CERTIFICATION OF COMPLIANCE

I certify the following:

1. The methods such as monitoring, record keeping, reporting, and stack test performance results described within this application shall be used to determine continuous or intermittent compliance;
2. A compliance certification document will be submitted to the Department at least annually or at other times designated by the Department for the duration of the permit;
3. The source is in compliance and will continue to demonstrate compliance with all applicable requirements, except for those designated in the attached compliance plan (if applicable); and
4. This application is submitted in accordance with the provisions of the South Dakota Codified Laws 34A-1 and Administrative Rules of South Dakota 74:36. To the best of my knowledge, after reasonable inquiry, the statements and information contained in the application and supporting documents are true, accurate, and complete. In accordance with South Dakota Codified Laws 1-40-27, I have also enclosed a completed Certification of Applicant form.

Signature:		
Print Name:	Vernon Laning	Date:
	Responsible Official	

CERTIFICATION OF APPLICANT

(please complete shaded areas - if you have questions call (605) 773-3151)

In the Matter of the Application of	Groton Generating Station
	(Facility Name)
State of	South Dakota
County of	Brown

I, [ ] , the applicant in the above matter after being duly sworn upon oath hereby certify the following information in regard to this application:

South Dakota Codified Laws Section 1-40-27 provides:

"The secretary may reject an application for any permit filed pursuant to Titles 34A or 45, including any application by any concentrated swine feeding operation for authorization to operate under a general permit, upon making a specific finding that:

(1) The applicant is unsuited or unqualified to perform the obligations of a permit holder based upon a finding that the applicant, any officer, director, partner or resident general manager of the facility for which application has been made:

(a) Has intentionally misrepresented a material fact in applying for a permit;

(b) Has been convicted of a felony or other crime involving moral turpitude;

(c) Has habitually and intentionally violated environmental laws of any state or the United States which have caused significant and material environmental damage;

(d) Has had any permit revoked under the environmental laws of any state or the United States; or

(e) Has otherwise demonstrated through clear and convincing evidence of previous actions that the applicant lacks the necessary good character and competency to reliably carry out the obligations imposed by law upon the permit holder; or

(2) The application substantially duplicates an application by the same applicant denied within the past five years which denial has not been reversed by a court of competent jurisdiction. Nothing in this subdivision may be construed to prohibit an applicant from submitting a new application for a permit previously denied, if the new application represents a good faith attempt by the applicant to correct the deficiencies that served as the basis for the denial in the original application.

All applications filed pursuant to Titles 34A and 45 shall include a certification, sworn to under oath and signed by the applicant, that he is not disqualified by reason of this section from obtaining a permit. In the absence of evidence to the contrary, that certification shall constitute a prima facie showing of the suitability and qualification of the applicant. If at any point in the application review, recommendation or hearing process, the secretary finds the applicant has intentionally made any material misrepresentation of fact in regard to this certification, consideration of the application may be suspended and the application may be rejected as provided for under this section.

Applications rejected pursuant to this section constitute final agency action upon that application and may be appealed to circuit court as provided for under chapter 1-26."

Pursuant to SDCL 1-40-27, I certify that I have read the forgoing provision of state law, and that I am not disqualified by reason of that provision from obtaining the permit for which application has been made.

Dated this _____ , day of _____ , 20 _____

_____

Applicant (signature)

Subscribed and sworn before me this:

Dated this _____ , day of _____ , 20 _____

_____

Notary Public (signature)

My commission expires: _____

(SEAL)

PLEASE ATTACH SHEET DISCLOSING ALL FACTS PERTAINING TO SDCL 1-40-27 (1) (a) THROUGH (e).
ALL VIOLATIONS MUST BE DISCLOSED, BUT WILL NOT AUTOMATICALLY RESULT IN THE REJECTION OF AN APPLICATION.

Air Quality Permit Application Form

Boiler Turbine or Furnace

This form is to be submitted, if necessary, along with the Title V (Part 70) Operating Permit or Minor Operating Permit.

(please complete shaded areas)

1. Facility identification (i.e., Boiler #1, Unit #1, etc): Turbine #1

2. Manufacturer: GE | Manufacture date: NA

3. Model number: LMS100

4. Type (i.e., steam boiler, simple cycle combustion turbine, generator, etc.)

Natural Gas Turbine

5. Maximum designed operating rate (name plate):

	786.5	million Btus per hour heat input	
or		horsepower with boiler efficiency:	
or		kilowatts with boiler efficiency:	

6. Check the appropriate box(es) for primary and secondary fuels:

X	Natural gas			Propane	
	Distillate oil	Sulfur content		Weight percent	
	Residual oil	Sulfur content		Weight percent	
	Bituminous Coal		Subbituminous Coal		Lignite Coal
Coal sulfur content		Weight percent	Coal ash content		Weight percent
	Other (please specify)				

7. Has a stack test been conducted (check appropriate box)? | | Yes | X | No

If a stack test has been conducted, please attach a copy of the most recent stack test report to this application. If the Department already has a copy of the most recent stack test, please specify the date of most recent stack test.

Date of most recent stack test:

Control Equipment: If applicable, types of air pollution control equipment (Examples: baghouse, cyclone, wet scrubber, electrostatic precipitator, thermal oxidizer, miscellaneous control device, etc.).

CO catalyst

Please complete the appropriate air quality permit application form for each type of control equipment that controls air emissions from this operation.

Stack Information: If this application is a renewal, contact the air program. We may have this information.

X- Coordinate or Easting:	1,871,989	feet	570,582	meters
Y- Coordinate or Northing:	16,485,838	feet	5,024,883	meters
Base Elevation of Stack:	1303	feet	396.2	meters
Stack Height:	85.92	feet	26.2	meters
Exit Stack Diameter	11.5	feet	3.51	meters
Exit Stack Temperature	850	degrees Fahrenheit		

Exit Stack Velocity and/or Flow Rate:

Velocity:	146	feet per second	44.5	meters per second
		and/or		
Flow Rate:	946,472	actual cubic feet per minute	446.7	actual cubic meters per second

Air Quality Permit Application Form

Boiler Turbine or Furnace

This form is to be submitted, if necessary, along with the Title V (Part 70) Operating Permit or Minor Operating Permit.

(please complete shaded areas)

1. Facility identification (i.e., Boiler #1, Unit #1, etc): Turbine #2

2. Manufacturer: GE Manufacture date: NA

3. Model number: LMS100

4. Type (i.e., steam boiler, simple cycle combustion turbine, generator, etc.)

Natural Gas Turbine

5. Maximum designed operating rate (name plate):

	786.5	million Btus per hour heat input	
or		horsepower with boiler efficiency:	
or		kilowatts with boiler efficiency:	

6. Check the appropriate box(es) for primary and secondary fuels:

X	Natural gas			Propane	
	Distillate oil	Sulfur content		Weight percent	
	Residual oil	Sulfur content		Weight percent	
	Bituminous Coal		Subbituminous Coal		Lignite Coal
Coal sulfur content		Weight percent	Coal ash content		Weight percent
	Other (please specify)				

7. Has a stack test been conducted (check appropriate box)? Yes X No

If a stack test has been conducted, please attach a copy of the most recent stack test report to this application. If the Department already has a copy of the most recent stack test, please specify the date of most recent stack test.

Date of most recent stack test:

Control Equipment: If applicable, types of air pollution control equipment (Examples: baghouse, cyclone, wet scrubber, electrostatic precipitator, thermal oxidizer, miscellaneous control device, etc.).

CO catalyst

Please complete the appropriate air quality permit application form for each type of control equipment that controls air emissions from this operation.

Stack Information: If this application is a renewal, contact the air program. We may have this information.

X- Coordinate or Easting:	1,871,930	feet	570,564	meters
Y- Coordinate or Northing:	16,485,556	feet	5,024,797	meters
Base Elevation of Stack:	1302	feet	396.7	meters
Stack Height:	85.92	feet	26.2	meters
Exit Stack Diameter	11.5	feet	3.51	meters
Exit Stack Temperature	850	degrees Fahrenheit		

Exit Stack Velocity and/or Flow Rate:

Velocity:	146	feet per second	44.5	meters per second
		and/or		
Flow Rate:	946,472	actual cubic feet per minute	446.7	actual cubic meters per second

APPENDIX B

EMISSION CALCULATIONS

Average Molecular Weight of Exhaust:

$MW_{exh} = (\%AR \times MW_{AR}) + (\%N_2 \times MW_{N2}) + (\%O_2 \times MW_{O2}) + (\%CO_2 \times MW_{CO2}) + (\%H_2O \times MW_{H2O}) + (\%CO \times MW_{CO}) + (\%HC \times MW_{HC}) + (\%NO_X \times MW_{NOX})$

Volume of 1 mole of exhaust gas (V): $Va = \frac{TaVsPs}{TsPa}$ m^3/g-mole

where:

Ta = actual temperature	K		
Vs = 0.022415	m^3		standard volume of air
Ts = 273	K		standard temperature
Pa = actual pressure	psia		
Ps = 14.7	psia		standard pressure

Density of Exhaust: $\rho_{exh} = \frac{MW_{exh}\ (g/g\text{-}mole)}{Va\ (m^3/g\text{-}mole)}$ (g/m^3)

Exhaust Flow Rate: $Qa = \frac{Q\ (lb/hr) \times \frac{hr}{60\ min}}{\rho_{exh}\ (lb/ft^3)}$ acfm

$Qd,s = \frac{Qa \times (Ts + 20)}{Ta} \times (1 - \%H_20/100)$ dscfm

Exhaust Velocity: $v = \frac{Qa}{A}$

To calculate the mass emission rate from the 15% O2 corrected dry emission standard, the actual concentration must first be determined based on the actual (or measured) O2 content.
Pollutant ppmvd = (Pollutant ppmvd @ 15% O2) x (20.9 - O2%act)/(20.9 - 15)

Hourly Mass Emission Rates:

CO (lb/hr) = (CO ppmvd) x (28 lb/lbmole CO) x (Q dscfm) x (60 min/hr) x (10^6-lbmoles/ 10^6 1-lbmole)/(385.5 ft^3/lbmole Air)

NOx (lb/hr) = (NOx ppmvd) x (46 lb/lbmole NO2) x (Q dscfm) x (60 min/hr) x (10^6-lbmoles/ 10^6 1-lbmole)/(385.5 ft^3/lbmole Air)

VOC (lb/hr) = (VOC ppmvd) x (44.1 lb/lbmole VOC) x (Q dscfm) x (60 min/hr) x (10^6-lbmoles/ 10^6 1-lbmole)/(385.5 ft^3/lbmole Air)

Example Hourly Mass Emission Rate Calculations:[(1)]

CO: 43.6 lb/hr = (28 ppmvd) x (28 lb/lbmole NO2) x (357,428 dscfm) x (60 min/hr) / (1000000) / (385.5 ft^3/lbmole Air)

NO_x: 64.0 lb/hr = (25 ppmvd) x (46 lb/lbmole NO2) x (357,428 dscfm) x (60 min/hr) / (1000000) / (385.5 ft^3/lbmole Air)

CO: 12.3 lb/hr = (5 ppmvd) x (44.1 lb/lbmole NO2) x (357,428 dscfm) x (60 min/hr) / (1000000) / (385.5 ft^3/lbmole Air)

[(1)] Example calculations are based on a 100% load, an ambient temperature of 40^o F, exhaust temperature of 682.71 Deg K, and an exit velocity of 46.09 m/s (Modeling Scenario 7). CO, NO_x and VOC annual emission rates in Table 3.2 are based on these calculations which represent annual average conditions with manufacturer "Guarantee" information.

APPENDIX C

TURBINE DATA

TURBINE GEN SET PERFORMANCE
FOR
Basin Electric Capacity Addition

GUARANTEED PARAMETERS		JOBSITE LOCATION: ND, USA	
Btu/kW·hr, LHV 8,415 kJ/kW·hr, LHV 8,878	AT	NET PLANT KW 93,464	NOx EMISSIONS 25 PPMVD AT 15 % O2
		GUARANTEE John Matsey Date: 3/17/04	**GE SUPPLIED CO CATYLYST** CO EMISSIONS 28 PPMVD AT 15 % O2
			VOC EMISSIONS 5 PPMVD AT 15 % O2

NOT VALID WITHOUT STAMP

BASIS OF GUARANTEE:	BASE LOAD, GAS FUEL NOZZLE SYSTEM NO BLEED OR EXTRACTED POWER
ENGINE:	(1) GE LMS100 GAS TURBINE
FUEL:	21530 Btu/lb / (50076 kJ/kg) LHV, GAS FUEL
FUEL TEMP:	50°F(28°C) above dew p @ GEAEP BASEPLATE Fuel Temperature 365°F(185°C)
GENERATOR OUTPUT:	13.8 kV, 60 Hz
POWER FACTOR:	≥ .9
AMBIENT TEMP:	78.3°F / (25.7°C)
AMBIENT RH:	53.0%
INLET CONDITIONING:	NONE
ALTITUDE:	1302 ft/ (396.8 m)
AMBIENT PRESSURE:	14.018 PSIA
INLET FILTER LOSS:	≤ 4.0 inH_2O/ (101.6 mmH_2O)
EXHAUST LOSS:	≤ 12.0 inH_2O/ (304.8 mmH_2O)
NOX CONTROL:	Water
INJECTION RATE:	33778 PPH/ (15322 KG/hr) ±20% FLOW
ENGINE CONDITION:	NEW AND CLEAN ≤ 200 SITE FIRED HOURS
FIELD TEST METHOD:	
PERFORMANCE:	GE AERO ENERGY PRODUCTS SGTGPTM
NOX:	EPA Method 20
CO:	EPA Method 10
VOC:	EPA Method 25/18

** SI values are for reference purposes only

THIS GUARANTEE SUPERSEDES ANY
PREVIOUS GUARANTEES PRESENTED

Estimated Average Engine Performance NOT FOR GUARANTEE

GE Aero Energy
A GE Power Systems Business

Performance By: **Johnny Metcalf**
Project Info:

Engine: **LMS100 PA**
Deck Info: **G0179C - 87o.scp**
Generator: **BDAX 82-445ER 60Hz, 13.8kV, 0.9PF (35404)**
Fuel: **Site Gas Fuel#900-772, 19000 Btu/lb,LHV**

Date: **03/11/2004**
Time: **6:02:34 PM**
Version: **3.0.32**

Case #	**100**	
Ambient Conditions		
Dry Bulb, °F	78.3	
Wet Bulb, °F	65.8	
RH, %	53.0	
Altitude, ft	1302.0	
Ambient Pressure, psia	14.018	
Engine Inlet		
Comp Inlet Temp, °F	78.3	
RH, %	53.0	
Conditioning	NONE	
Tons or kBtu	0	
Pressure Losses		
Inlet Loss, inH20	4.00	
Exhaust Loss, inH20	12.00	
kW, Gen Terms	**96799**	93464
Est. Btu/kW-hr, LHV	**7882**	8415
Guar. Btu/kW-hr, LHV	**8210**	
AUX LOADS	3335	
Fuel Flow		
MMBtu/hr, LHV	762.9	
lb/hr	40154	
NOx Control	**Water**	
Water Injection		
lb/hr	33778	
Temperature, °F	100.0	
Intercooler	**Air-Air**	
Spray Mist Cooler	OFF	
IC Heat Extraction, btu/s	26300	
KOD Water Extraction, lb/s	0.0	
Control Parameters		
HP Speed, RPM	9370	
LP Speed, RPM	5316	
PT Speed, RPM	3600	
PS3 - CDP, psia	535.4	
T23 - Intcrl Inlet Temp, °F	355.7	
T25 - HPC Inlet Temp, °F	100.0	
T3 - CDT, °F	725.0	
T48, °R	2031	
Exhaust Parameters		
Temperature, °F	793.5	
lb/sec	439.6	
lb/hr	1582568	
Energy, Btu/s- ref 0 °R	143248	
Cp, Btu/lb-R	0.2775	
Emissions (NOT FOR USE IN ENVIRONMENTAL PERMITS)		
REF @ 15% O2	15	
NOx ppmvd Ref 15% O2	25	
NOx as NO2, lb/hr	77	
CO ppmvd Ref 15% O2	157	
CO, lb/hr	293.94	
HC ppmvd Ref 15% O2	8	
HC, lb/hr	8.00	

Estimated Average Engine Performance NOT FOR GUARANTEE

GE Aero Energy
A GE Power Systems Business

Performance By: **Johnny Metcalf**
Project Info:

Engine: **LMS100 PA**
Deck Info: **G0179C - 87o.scp**
Generator: **BDAX 82-445ER 60Hz, 13.8kV, 0.9PF (35404)**
Fuel: **Site Gas Fuel#900-772, 19000 Btu/lb,LHV**

Date: **03/11/2004**
Time: **6:02:34 PM**
Version: **3.0.32**

Exh Wght % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)

AR	1.2139
N2	71.4003
O2	12.9248
CO2	6.3771
H20	8.0615
SO2	0.0000
CO	0.0186
HC	0.0005
NOX	0.0033

Exh Mole % Dry (NOT FOR USE IN ENVIRONMENTAL PERMITS)

AR	0.9712
N2	81.4617
O2	12.9101
CO2	4.6314
H20	0.0000
SO2	0.0000
CO	0.0212
HC	0.0010
NOX	0.0034

Exh Mole % Wet (NOT FOR USE IN ENVIRONMENTAL PERMITS)

AR	0.8497
N2	71.2686
O2	11.2947
CO2	4.0519
H20	12.5128
SO2	0.0000
CO	0.0185
HC	0.0009
NOX	0.0030

Aero Energy Fuel Number	**900-772 (DEFAULT GAS 365)**	
	Volume %	**Weight %**
Hydrogen	0.0000	0.0000
Methane	84.5000	71.8447
Ethane	5.5800	8.8924
Ethylene	0.0000	0.0000
Propane	2.0500	4.7909
Propylene	0.0000	0.0000
Butane	0.7800	2.4027
Butylene	0.0000	0.0000
Butadiene	0.0000	0.0000
Pentane	0.1800	0.6883
Cyclopentane	0.0000	0.0000
Hexane	0.1700	0.7764
Heptane	0.0000	0.0000
Carbon Monoxide	0.0000	0.0000
Carbon Dioxide	0.6700	1.5628
Nitrogen	5.9300	8.8044
Water Vapor	0.0000	0.0000
Oxygen	0.1400	0.2374
Hydrogen Sulfide	0.0000	0.0000
Ammonia	0.0000	0.0000

Btu/lb, LHV	19000
Btu/scf, LHV	947
Btu/scf, HHV	1047
Btu/lb, HHV	21007
Fuel Temp, °F	365.0
NOx Scalar	1.121
Specific Gravity	0.65