MACTEC

AIR QUALITY STUDY OF GREEN ENERGY PARTNERS/STONEWALL SOLAR AND NATURAL GAS-FIRED POWER PLANT AT LEESBURG, VA

Prepared for

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SECTION 1 – INTRODUCTION

Green Energy Partners is proposing to build a nominal 981 megawatt (rating at International Organization for Standardization (ISO) conditions of 59 degrees F) power plant using natural gas, steam and solar energy on an 80 acre secured parcel of land in Loudoun County, Virginia. The plant is planning to purchase about 5 million gallons per day of treated wastewater from the Leesburg municipal treatment plant that is presently discharging into the Potomac River or reservoir water from the new Loudoun Water treatment system. The water will be used as cooling water and to produce steam for the facility. The capacity of the plant (without solar) will be approximately 980 megawatts total, with approximately 2/3 being produced for intermediate or base load operation and 1/3 being produced for peaking purposes. Electricity would be available to be purchased by Dominion Virginia Power and Northern Virginia Electric Cooperative, the two utilities presently providing power to Loudoun County.

The plant will be located south-southeast of the Town of Leesburg Airport and north of the Dulles Toll Road. The site has access to two natural gas pipelines and to existing Dominion high-voltage transmission lines. The plant will be designed with a low profile, i.e. the exhaust stacks and supporting structures will be lower than the existing high voltage utility lines and towers running through the area. The plant will use highly efficient gas combustion turbine generators and a steam turbine generator to produce the power. This technology is the most efficient for producing energy from fossil fuels in the world today. In addition to the gas turbines, approximately 10 acres of photovoltaic solar panels will be installed to assist in the electricity production. Considering the climate of the area the 10 acres will be able to average a production rate of one (1) megawatt of power.

A concern with the building of any fossil fueled power plant is the effect on the environment, with particular concern for the air pollution resulting from the production of electricity. In this regard the regulatory agencies have adopted stringent air emission limitations for this industry since the inception of the Clean Air Act in 1970. The industry continues to be regulated by the US Environmental Protection Agency (EPA) and other world health agencies because of their significant contribution to community health, long range transport of pollutants and the discharge of greenhouse gases. This plant will be designed with the most advanced air pollution control technology to reduce air discharges as any plant in the US, western Europe and Japan.

MACTEC Engineering and Consulting, Inc. has provided environmental consulting services to government and industry for more than 40 years. The firm has provided consulting services to Loudoun County, Fairfax County, the City of Alexandria, Virginia and the Commonwealth of Virginia as well as Dominion Power, Constellation Energy, UniStar Nuclear Energy and other industrial clients in Virginia, the US and throughout the world. MACTEC has also assisted the US EPA in the development of air dispersion models, better stack testing methods (especially those associated with the formation of secondary pollutants such as sulfates and nitrates from power plants), the permitting procedures used to allow for continued growth in those highly polluted non-attainment areas of the US, and in the evaluation of the impacts associated with hazardous air pollutants or the discharges of odorous matter from industrial sources.

MACTEC was asked to conduct an air quality study of the 981 megawatt power plant located near Leesburg, Virginia using the same analytical tools that are required for securing the environmental permits needed from the regulatory agencies. This report provides a detailed description of potential emissions from the gas turbine units and the small particles lost due to evaporation of water in the cooling tower. Other ancillary sources are also identified and included in the analysis. The emission rates reflect the controls being proposed for the facility and as stated above are the best in the US. The layout, process description and emission rates are described in more detail in Section 2 of this document.

Section 2 contains the summary and conclusions reached in the course of this investigation. Section 3 describes the equipment to be installed and their potential air emissions. In Section 4 we have described the analytical tools that were used to relate air emissions discharged from the plant to the expected ground level concentrations at the property line, in the communities surrounding the plant and at distances of 50 kilometers from the plant. The dispersion models and the meteorology data set used for this analysis are discussed in this section. Additionally, a model was run to determine the dissolved solids deposition from the cooling tower plume because of the possible use of the treated wastewater used in that process. In Section 5 we present a detailed discussion of the modeled results. Using background or existing air quality measurements in the Leesburg area, we then made a comparison of the model predictions to the Virginia and US EPA air quality standards. The analytical tools and the evaluation methodology are identical to those required by the regulatory agencies in determining whether a construction permit can be issued for a facility such as this one.

This report was prepared under the direction of Michael E. Lukey, P.E. William M. Burch, P.E. and Malay Jindal were the two other principle investigators who participated in the analysis. The work was completed at MACTEC's Herndon, Virginia office.

SECTION 2 – SUMMARY OF RESULTS

The results of this investigation are summarized below:

1. Once the plant is built and is operating under the maximum emissions scenario, there will be a negligible effect on the air quality levels at the plant property line, in any of the communities surrounding the plant, the Town of Leesburg, or any other receptors downwind from the source. Assuming a stack height of 120 feet as the basis of the study, the air dispersion of all of the criteria pollutants is well below the levels that the US Environmental Protection Agency has set as a health standard, and, far below the levels that the EPA deems to be significant. For example, the EPA health standard for nitrogen oxides is 100 $\mu g/m^3$ and the significance level is 1.0 $\mu g/m^3$ while the maximum predicted concentration for the entire study area is 0.6 $\mu g/m^3$.

2. The plant will utilize air pollution control equipment that represents the best technology available in the US today. For the two natural gas fired combined cycle units, Green Energy will use an oxidation catalyst to control CO, and a selective catalytic reduction system along with dry low-NOx combustion to provide a 98+% reduction in nitrogen oxides emissions. This is considered to be the best technology by the US EPA and the South Coast Air Quality Management District in Los Angeles, CA (considered by many to be the premier regulatory agency for controlling smog in the US). The peaking units will also utilize SCR, if possible, to control NOx emissions during steady-state operating conditions. The selection of the natural gas power system will mitigate greenhouse emissions.

3. Leesburg, VA is in compliance with all of the EPA and VA ambient air quality standards except for the pollutant ozone. The Washington, DC metropolitan area is designated non-attainment, i.e., exceeds the health standard for this pollutant only. Ozone is associated with the emissions from cars and other sources in and around major metropolitan areas. Green Energy will emit nitrogen oxides which are precursors for the formation of ozone in the presence of sunlight which mainly happen during the hot summer months. Nitrogen oxides emitted in Leesburg will contribute, albeit slightly, to the formation of ozone measured downwind in the eastern DC suburbs. The permitting procedures for allowing new emissions to occur in these non-attainment areas require that companies such as Green Energy *offset* their increase in emissions from discharges emanating from existing operations such that there will be a net reduction in NOx emissions to the DC metropolitan area. Thus, by obtaining offsets, Green Energy will help improve the overall ozone non-attainment issue for the Washington, DC area.

4. The analytical tools used to conduct this investigation represent the state-of-the-art for conducting air quality effects of new sources on surrounding communities. The EPA's AERMOD dispersion model was used along with the hourly meteorological data from Washington Dulles International Airport. Upper air data from Dulles was also used for the ground level predictions from AERMOD

for the criteria pollutants. The SACTI model developed by the Electric Power Research Institute was used to estimate the plume length and particle deposition from the cooling tower. The current or baseline air quality levels were obtained for the year 2008 from nearby monitoring stations for the criteria pollutants. A summary of the air analysis needed for approval by the regulatory agencies was also developed. Technical obstacles are not anticipated for DEQ/EPA approvals.

5. The expected ground level concentrations from the operation of the new 981 megawatt power plant are miniscule. The highest pollutant concentrations predicted from this facility will be about a half of one percent of the Virginia and EPA ambient air quality standards for any pollutant for any averaging period. The highest predictions occurred at the property line, so pollutant concentrations in any surrounding communities will be significantly less than the highest values used in the regulatory approval process. For nitrogen oxides, the maximum concentration at the property line was 0.6 $\mu g/m^3$ and at Leesburg and Ashburn the concentration was 0.02 $\mu g/m^3$.

6. The water vapor plume from the cooling tower will be visible within the plant boundary virtually at all times that the plant is operating but is only expected to extend to the plant boundary to the northwest and southwest of the cooling tower 5 hours per year. At Leesburg Airport the plume could be noticed overhead for 8 minutes per year according to the model. Although the water used for cooling contains more dissolved solids because it comes from a treatment plant, the particulate emissions from the tower are low. The size of the water droplets (60 microns or less) is also small because of the use of highly efficient mist eliminators. As such, there are no water droplets containing particles that are deposited on or off the plant property. The water droplets that remain suspended in the air will travel with the wind and eventually evaporate downwind and leave any entrained particle suspended to travel even further with the wind. These particles, like all other particles that enter the atmosphere, will eventually come to the earth's surface after they combine with other particles or are attached to a water molecule and fall as precipitation.

7. In sum, the Green Energy Partners hybrid power plant will have an insignificant effect on the air quality levels at the property line or in any of the surrounding communities. The current air quality is very good and will remain very good when the new plant is built. Because of the miniscule effects on the air quality levels and the use of the best available control technology for criteria pollutants, regulatory approval is expected. The emission offsets needed to help mitigate the Washington, DC ozone problem should be easily obtainable. Greenhouse gases will be 30% lower than a new coal fired power plant and up to 50% lower than an older equivalent sized coal plant such as Dickerson in Maryland. Finally, other harmful emissions associated with coal plants such as mercury and heavy metals will never be emitted.

SECTION 3 – PROJECT DESCRIPTION

Green Energy Partners/Stonewall L.L.C. intends to construct a new energy facility south of Leesburg, Virginia. The site location is north of the Dulles Greenway (Route 267) at Sycolin Road (Route 643) in Loudoun County. The new facility will generate electric power from the operation of two combustion turbines in combined-cycle, two simple cycle combustion turbines, and a PV solar farm. The turbines will be fired by natural gas. Cooling water is proposed to be treated effluent from the Town of Leesburg's wastewater treatment plant or reservoir water from Loudoun Water's treatment plant. The site was chosen because of its proximity to two natural gas transportation lines, three electric transmission lines, and cooling water supply. The preliminary layout of the new facility is shown on Figure 3.1.

This section provides a description of the major components of the planned facility followed by a summary of the potential air emissions from operation of the site.

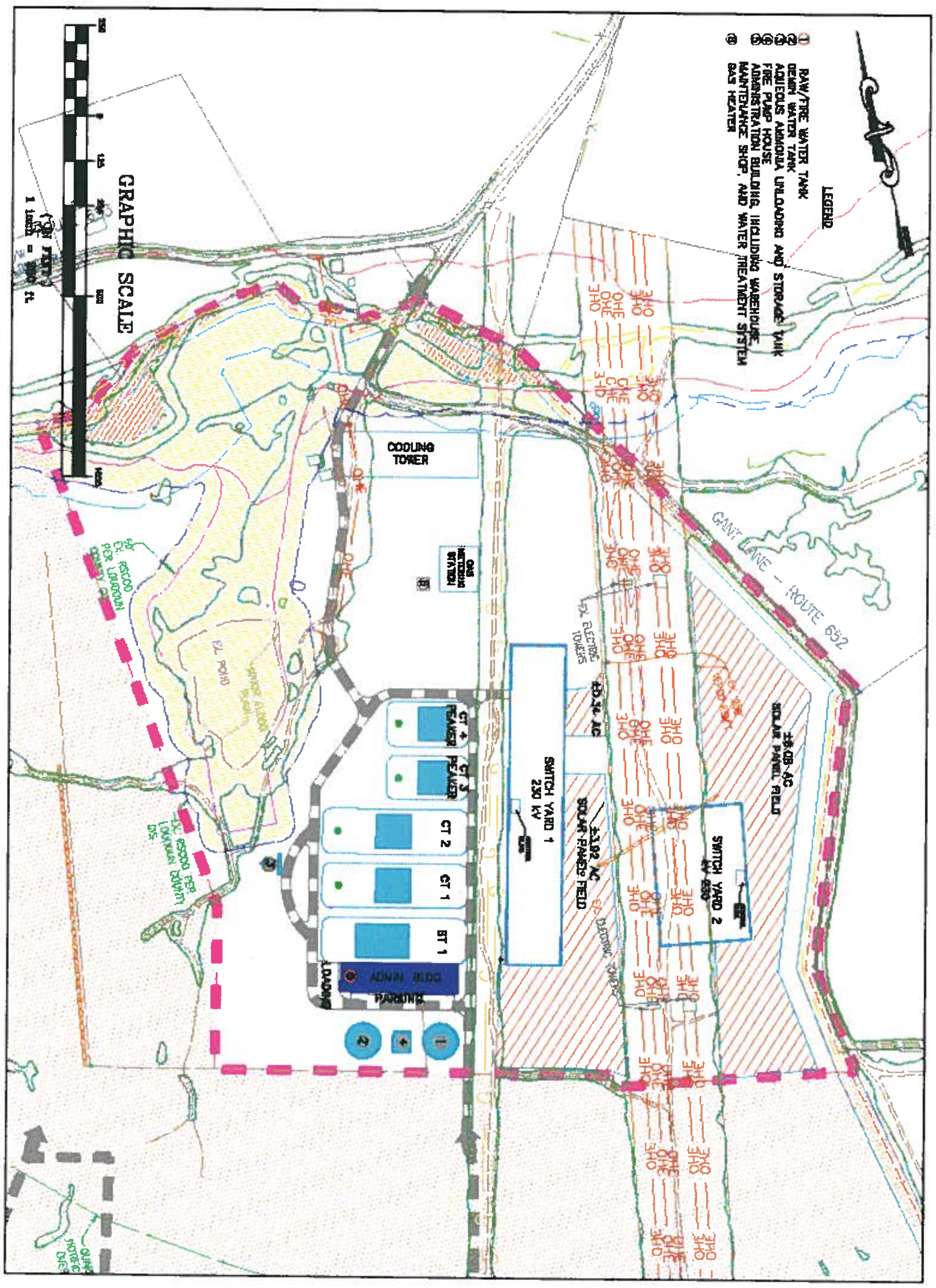
MAJOR EQUIPMENT

The major equipment comprising the new energy facility include four combustion turbines and generators, one steam turbine and generator, two heat recovery steam generators (HRSG) with exhaust stacks, the supporting cooling towers, and the solar farm.

Natural Gas Fired Turbines

The facility will utilize four combustion turbines each rated at 197 MW at 59F to generate power. Two turbines will operate in combined-cycle mode. These combustion turbines will drive electric generators. Hot-exhaust gases from the two combustion turbines will each exhaust through a HRSG, generating steam to drive a single steam turbine and electric generator, thus increasing the total power produced to approximately 586 MW at ISO temperature of 59F. The units will include state-of-the-art combustion technology and control equipment to limit air pollutant emissions. Natural gas is a clean burning fuel that when combusted generates minimal particulate and sulfur oxide emissions. Natural gas has the lowest Greenhouse Gas (GHG) emission rate of all fossil fuels such as coal or fuel oil. The generation of emissions of nitrogen oxides (NOx) will be limited by the use of a dry low NOx combustion system. NOx emissions will be further controlled by the application of a selective catalytic reduction (SCR) control system on the exhaust from the HRSG. The SCR system will rely on aqueous ammonia injection. Aqueous ammonia consists of a solution of water (75%) and ammonia (25%). The rate of ammonia injection will be well-controlled to effectively reduce NOx and limit ammonia "slip" or release to the air during operation of the SCR. The carbon monoxide (CO) emissions will be reduced by use of a CO oxidation catalyst. The use of these controls match the most stringent controls required of any combined cycle combustion turbine in the United States. The combined cycle units are expected to operate intermittently or continuously based on seasonal demand.

Figure 3.1 Plot Plan



Two of the four combustion turbines will operate as simple-cycle peaking units, only operating during periods of high demand for electric power. The peaking units will also be designed to limit their environmental impact including the use of a dry low NOx combustion system and SCR (if determined feasible for application to a peaking unit) to control NOx emissions.

Each of the four combustion turbines will vent through an exhaust stack. The exhaust stack heights will be designed based on good engineering practice to eliminate the potential for downwind air quality effects. The exhaust stacks will be low in profile, visually blending in with and no higher than the existing adjacent power transmission lines and towers that cross the site.

Cooling Towers

Heat generated from the operation of the steam turbine condensers will be collected by cooling water and transferred to the ambient air through the use of a mechanical draft, evaporative cooling tower. A low-profile, 12 cell tower is planned. The source of water for the cooling tower may be treated wastewater from the Leesburg Wastewater Treatment Plant or reservoir water from Loudoun Water water treatment facility. The water will be recirculated through each cell crossing paths with an ambient air stream drawn up by fans through the recirculating water. Heat will be dissipated as a result of evaporation of a portion of the cooling water. Water losses to the air stream or "drift" will be minimized through the use of high-efficiency mist eliminators. The mist eliminators also control any deposition resulting from any dissolved solids in the drift and the release of any chemical additives used to prevent foam formation and algae growth in the tower. A portion of the cooling water will be purged and recycled to the wastewater Treatment Plant. An additional benefit will be a net reduction in the amount of treated wastewater released to the Potomac River and Chesapeake Bay by the Treatment Plant.

Solar Farm

An array of photo-voltaic (PV) panels will be erected on the eastern portion of the site. Approximately 10 acres will be committed as a "Solar Farm" to generate up to an additional 1 MW of power. The PV panels convert solar energy (i.e., sunlight) directly into electrical energy. PV panels have historically been used in the residential and commercial sector, with several newer projects underway or in the planning phase for producing wholesale power by utilities.

SUMMARY OF POTENTIAL EMISSIONS

Air emissions will result from the combustion of natural gas by the natural gas-fired turbines and from the cooling tower drift. These are the only sources of air emissions at the facility (an emergency propane driven fire pump will produce minimal emissions when operated only a few hours per year). The potential emissions from these sources are summarized below. A comparison of the estimated greenhouse gas carbon dioxide produced by the Green Energy facility with that of a similarly sized coal fired power plant is also presented.

Emissions from Operation of Turbines

The combustion of natural gas by the turbines will result in the release of carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NOx), particulate matter (PM/PM10), sulfur oxides (SO_2) and ammonia (NH3). The emission estimates for the turbines are based on data from a potential turbine vendor. For the combined cycle units, as reported by the vendor, the SCR systems were assumed to be capable of maintaining a 2 ppm or lower NOx concentration in the exhaust from the HRSG unit. The 2 ppm level was identified in several recent best available control technology determinations by air pollution control agencies for combined cycle units. The ammonia "slip" or releases rate for estimating emissions was estimated to be 5 ppm or less by the vendor. To estimate worst case emissions, the combined cycle units were assumed to operate around the clock (8,760 hours per year).

Depending on the hourly load demand from the dispatcher, the simple-cycle peaking units may not be able to use the highly efficient SCR control technology. These control units require steady state operating conditions in order to be effective and prevent ammonia slip. Peaking units may be used at a constant load for many hours during the day or they may be changing loads constantly according to the dispatch. Green Energy plans to use the SCR if vendors will guarantee their use for conditions involving swing loads and under predefined continuous load conditions. Because none of these operating conditions can be defined at this time, this analysis assumed that the simple cycle units would use dry low NOx combustion as the control system. The NOx rate was estimated by the vendor to be 9 ppm. The simple cycle units as peaking units were also assumed to operate a maximum of 2,000 hours per year.

The potential emissions from the operation of the turbines are summarized in Table 3.1.

Emissions from Operation of Cooling Towers

The release of pollutants from the operation of cooling towers results from cooling tower drift. The drift is fine water droplets that pass through the cooling tower's drift (mist) eliminators which is necessary to minimize water losses. It also serves to abate visible plumes. The drift contains dissolved solids and chemical amendments added to the cooling tower water. Upon release, the drift (water) evaporates and the dissolved solids in the drift solidify as a particulate containing any non-volatile chemicals that may have been added to the cooling water (such as biocides and anti-foaming agents required for tower performance).

Table 3.1 Potential Air Emissions from New Energy Facility

Pollutant/Unit	One Combined Cycle (CC) Unit	One Simple Cycle (SC) Unit	Four Units (2 CC + 2 SC)
CO			
Lbs/hour	10.0	18.0	56.0
Tons/year	43.8	4.1	95.8
PM/PM10			
Lbs/hour	10.0	10.0	40.0
Tons/year	43.8	2.3	92.2
NOx			
Lbs/hour	16.0	66.0	164.0
Tons/year	70.1	15.1	170.3
SO_2			
Lbs/hour	1.2	1.1	4.6
Tons/year	5.3	0.3	11.1
VOC			
Lbs/hour	2.5	3.0	11.0
Tons/year	11.0	0.7	23.3
Ammonia			
Lbs/hour	14.8	-	29.6
Tons/year	64.7	-	129.5

Emissions from cooling towers are estimated based on an EPA procedure in AP-42 (*Compilation of Air Pollutant Emission Factors,* Section 13.4, January, 1995). The calculation is a mass balance based on the tower's water recirculation rate, the drift eliminator efficiency, and concentration of contaminant in the cooling tower water that becomes drift. The total dissolved solids (TDS) level in the tower water is determined from the TDS level in the influent times the cycles of concentration (operating parameter for recirculation of water within tower).

The new energy plant's cooling tower will be controlled by highly efficient drift eliminators with a design release rate of 0.0005 percent of the water recirculation rate. A review of drift eliminators used by other recently permitted cooling towers found a 0.0005 percent efficient eliminator represents the most stringent control applied at cooling towers for new energy plants. The cooling tower is expected to operate based on 6 cycles of concentration. The influent TDS concentration was estimated to be 600 mg/liter based on the analysis of a sample of the Leesburg Wastewater Treatment Plant. The cooling tower recirculation rate is estimated at 187,400 gallons per minute for all 12 cells combined.

Chemical additives may be used in the operation of the cooling tower. This includes biocides (e.g., sodium hypochlorite) to prevent biological growths, defoaming agents, and dispersing agents. The additives are dispersed in the recirculating cooling tower water and maintained at the part per million levels. They would be released in the cooling tower drift at that same concentration, resulting in a negligible emission rate.

Estimates of emissions from the operation of the cooling tower are presented in Table 3.2.

Table 3.2 Emission Estimates for Cooling Tower Serving New Energy Facility

Particulate Emissions		
Recirculation Rate	Gallons/Minute	187,400
Drift Eliminator Efficiency	% of Recirculation Rate	0.0005
Cycles of Concentration	Number	6
Influent TDS	Mg/liter	600
Drift Loss	Gallons/hour	56
PM/PM10 Emissions	Lbs/hour	1.7
	Tons/year	7.4
Tower Chemical Use		
Biocide Concentration	ppmw	1 – 2
Release in Drift	Lbs/hour	< 0.001
Dispersing Agent Concentration	ppmw	0.1 - 1.0
Release in Drift	Lbs/hour	<0.0005
Antifoaming Agent Concentration	ppmw	0.1 – 0.1
Release in Drift	Lbs/hour	<0.0001

Greenhouse Gas Emissions

The combustion of natural gas will generate Greenhouse Gases (GHG). The most significant GHG is carbon dioxide (CO_2). However, the potential GHG footprint from the new energy facility will be significantly smaller than that of other fossil-fuel fired energy plants of the same comparable size. This will occur as a result of the use of natural gas and the high efficiency (low heat rate) associated with the combustion turbines. Table 3.3 provides a comparison of the potential CO_2 emissions from the new energy facility's combined cycle and simple cycle combustion turbines with the CO_2 generation from a similarly sized coal-fired facility. The CO_2 emission rates are based on emission factors provided by EPA in AP-42. The estimated hourly CO_2 emission from Green Energy is significantly lower that of a similarly-sized coal fired unit. Thus, the use of natural gas-fired combustion turbines provides a significant benefit in reducing GHG generation from future power generation.

Table 3.3 Greenhouse Gas Emissions from the Proposed New Energy Facility in Comparison to a Coal Fired Power Plant

		Comparably Sized Coal-Fired Unit	New Energy Facility		
			Two Combined Cycle (CC) Units	Two Simple Cycle (SC) Units	All Four Units (2 CC + 2 SC)
Generating Capacity	MW	900	600	300	900
Heat Rate	BTU/kW (lower heating value)	10,000	6,200	9,100	
Heat Input	MMBtu/hour	9,000	3,700	2,700	6,400
Fuel Rate	Tons/hour	360			
	MMCF/hour		3.65	2.68	6.32
CO_2 Emissions	Lbs/hour	1,111	219	161	379

SECTION 4 – DEMONSTRATION OF NO EFFECT TO AIR QUALITY IN SURROUNDING COMMUNITIES

For more than 75 years governmental agencies have been using mathematical dispersion models to predict the changes in ground level concentrations resulting from the discharges that occur from elevated sources. Virtually all models require an hour by hour meteorological dataset of the wind direction, wind speed, temperature and cloud cover in order to make the hourly predictions at ground level. Once released into the air the local meteorology determines the fate of a pollutant. A receptor grid is used to assess the effect on air quality in a study area. The receptor is a mathematical point in the x-y plane where the model will provide a prediction. By using several hundred receptors to cover the study area, one can develop isopleths showing the air quality effects on the area. This is the procedure used in this analysis.

DISPERSION MODELING ANALYSIS

Dispersion Models

The current state-of-the-art model jointly developed by US EPA and the American Meteorological Society (AMS) for industrial source applications is called the AMS EPA Regulatory Model, or AERMOD. This model was developed using field measurements and has been extensively evaluated against additional field observations from various locations. MACTEC supported EPA in this model development and evaluation effort. Based on MACTEC's evaluation of the model, EPA found AERMOD to perform far better than other models and therefore adopted it as a guideline model for industrial source applications. AERMOD is a versatile model, i.e., it can simulate emission plumes from various types of sources including stacks, it can model single or multiple sources at once, it can simulate aerodynamic downwash caused by nearby buildings, and it can predict pollutant concentrations at multiple receptor points located all around the compass in a single run of the model. AERMOD was selected for calculating pollutant concentrations because it is the best suited model for this application and is recommended by EPA.

The facility will also consist of one cooling tower with up to 12 cells that will provide cooling water for the steam turbine condenser. By their nature, cooling towers emit water vapor, i.e., wet plumes consisting of tiny water droplets or mist. Any solids that are dissolved in the water are also emitted along with the mist, act as a gas and are mostly transported offsite. If the particles are large they may be deposited in close proximity of the cooling tower. The size of the particle discharged is mainly dependent on the drift eliminator efficiency. With the higher mist eliminator efficiency efficiency, one would expect a fewer number of particles to be deposited. The model used for this analysis is called the Seasonal-Annual Cooling Tower Impact, or SACTI, model. The SACTI model was developed by the Electric Power Research Institute (EPRI) specifically to assess wet cooling tower plumes. It is a probabilistic model in that it predicts the probability of occurrence of certain conditions such as fogging, icing and visible plumes. It can also calculate the expected rate of particle deposition due to the cooling tower emissions.

A significant amount of heat is rejected from fossil fuel fired plants through the cooling tower using the evaporative process, Because of this, a water vapor plume will be visible virtually all of the time. However, the length and the height of the water vapor plume will vary depending on the meteorological conditions with the most visible plumes occurring on the coldest days of the years. Furthermore under certain meteorological conditions, the wet cooling tower plume can be visible beyond the property line and can cause fogging and icing effects on nearby ground surfaces. The cooling towers were modeled using the SACTI model to assess the probability of the plume traveling offsite and also evaluate the potential for any ground-level fogging or icing events to occur. Additional SACTI would define the height of the water vapor plume and any particle deposition effects.

Meteorological Data

All models require input of meteorological data in order to simulate plume transport downwind from the source. Typical meteorological parameters include wind direction, wind speed, temperature, cloud cover and mixing height, i.e., the height of the atmospheric layer closest to the ground where the plume mixing occurs. All of these parameters are routinely measured by the National Weather Service (NWS) at most major airports. Given the proximity of the Washington Dulles International Airport, data from the NWS station at this airport are considered to be representative of local meteorology and were used in this analysis. EPA modeling guidelines recommend the use of five consecutive years of meteorological data in order to capture the range of possible meteorological conditions. Five full years of data were obtained from the EPA website and were used in this analysis.

Figure 4.1 shows a windrose for the five years of modeled meteorological data. A windrose is a chart depicting the frequency of occurrence of various wind directions and wind speeds. The windrose shows that the predominant wind direction is from the south with a frequency of about 13 percent of the time, while significant winds also occur from the northwest and north-northwest directions at approximately 10 percent and 9 percent, respectively. While on a given day the winds can be from any direction, the windrose indicates that there is a larger probability of plumes from the plant to be transported toward either the north (due to winds from the south) or the southeast (due to winds from the northwest).

Source Data

The facility will consist of two combined-cycle combustion turbines which will be used as intermediate or baseload units, and two simple-cycle combustion turbines which will be used as peaking units. The source data required by AERMOD include the source location, pollutant emission rates, and the physical stack parameters such as stack height, stack diameter, exhaust temperature, and the exit velocity of the plume coming out of the stack. Table 4.1 provides a listing of these modeled parameters and emission rates for both types of turbines.

The cooling tower was modeled as 2 rows aligned parallel to each other with six cells in each row. They will employ highly-efficient, state-of-the-art mist eliminators that will allow no more than 0.0005 percent of the circulating water to be emitted. The SACTI model requires the location, orientation and physical parameters of the cooling towers, the amount of heat dissipated by the cooling system, the emission rate of water and the emitted droplet size distribution, and the concentration of dissolved solids in the cooling water. Table 4.2 provides these parameters for the cooling towers.

Table 4.1 Source Parameters for AERMOD Modeling Analysis

Parameter	Combined-Cycle Turbine (Data for each of two units)	Simple-Cycle Turbine (Data for each of two units)
Stack Height (ft)	120	120
Stack Diameter (ft)	12	18
Exhaust Temperature (°F)	172	1,085
Exit Velocity (ft/min)	9,373	10,169
Max. Annual Operation (hrs)	8,760	2,000
Max. Hourly Emissions (lb/hr)		
Nitrogen Oxides	16.0	66.0
Carbon Monoxide	10.0	18.0
Particulate Matter	10.0	10.0
Sulfur Dioxide	1.21	1.10

Table 4.2 Source Parameters for SACTI Modeling Analysis of Cooling Tower

Parameter	Value
No. of Rows / No. of Cells per Row	2 / 6
Cell Height / Diameter (ft)	65 / 33
Tower (row) Dimensions (ft) (L x W x H)	375 x 125 x 50
Total Heat Dissipated (MW)	482
Total Air Flow (lb/min)	1,142,545
Water Recirculation Rate (gal/min)	187,400
Drift Elimination Efficiency	0.0005%
Total Dissolved Solids (ppm)	600
Cycles of Concentration	6
Droplet Size Distribution (diameter)	
10 µm	13.0 %
20 µm	18.5 %
30 µm	24.1 %
40 µm	22.2 %
50 µm	16.7 %
60 µm	6.0 %

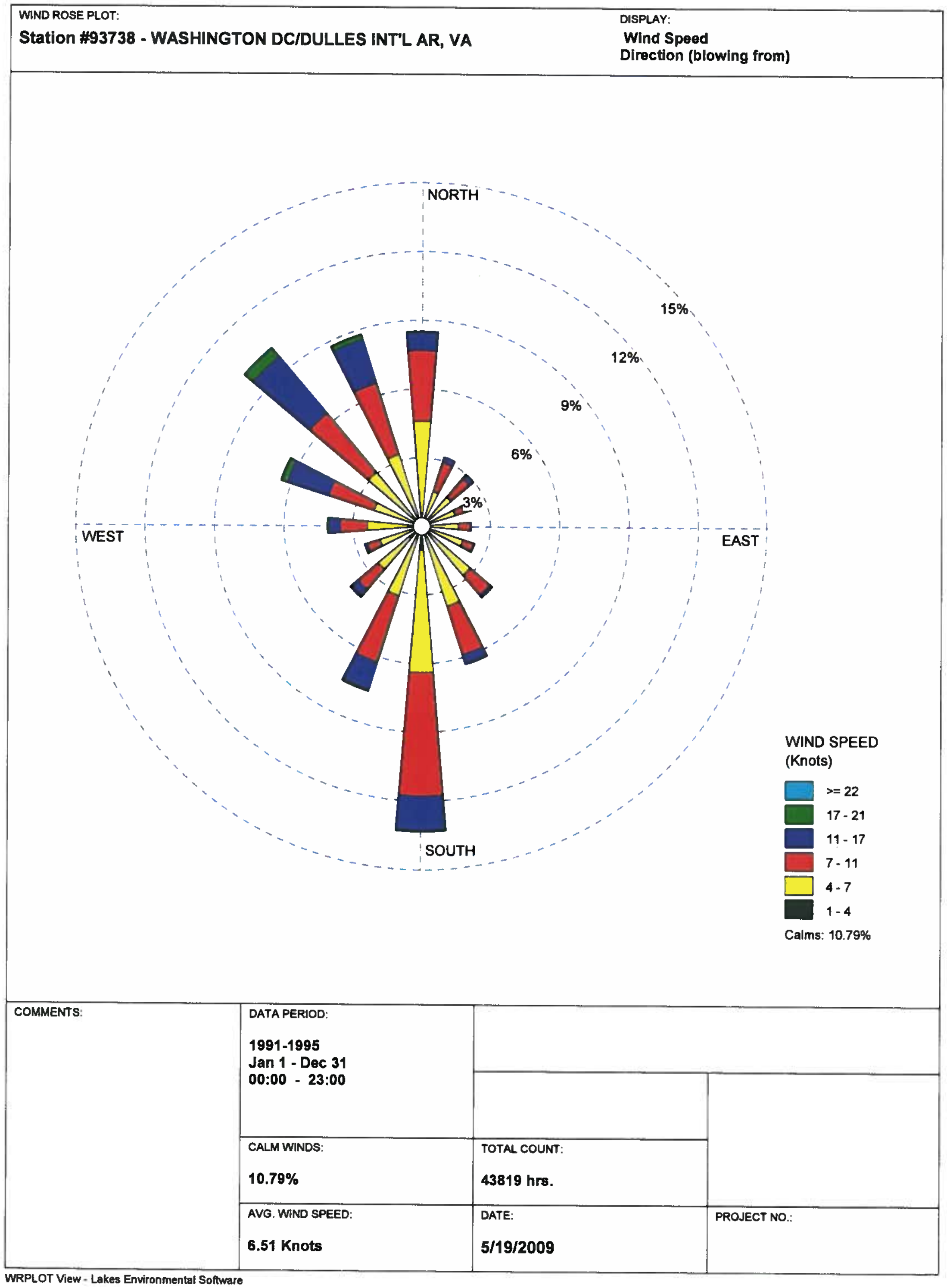


Figure 4.1 Five-Year Composite Windrose for Washington Dulles International Airport

CURRENT AIR QUALITY LEVELS

In evaluating the effect of any new air discharge on the community, it is essential to have a thorough understanding of the baseline or current air quality levels. By EPA definition, this plant will be considered a major source for the pollutant nitrogen oxides and a minor source for all other compounds. Nitrogen oxides emissions are estimated to be less than 170 tons per year (tpy) and the EPA trigger level for the major designation in 100 tpy. Table 4.3 summarizes all of the measured air quality levels in Loudoun and Fairfax Counties.

The reader should note that there are different standards that apply to the same pollutant but for different averaging periods. For example, there is a short term standard for the 24-hour averaging period, i.e., the highest 24-hour value measured for the entire year, and an annual averaging period. The standards were established to recognize the air pollution effects over short term periods and long term periods. For the pollutant PM-10 (particulate matter with a particle diameter of 10 microns or less) the 24-hour standard is 150 micrograms per cubic meter (μg/m^3) and the annual standard is 50 μg/m^3.

Table 4.3 Summary of Current Air Quality Levels Near the Plant Site

Pollutant	Averaging Period	Year	Location	Measured Concentration (μg/m^3)	EPA and VA Ambient Std. (μg/m^3)
Carbon Monoxide	1-hour	2008	Chantilly	1,600	40,000
	8-hour	2008	Chantilly	1,371	10,000
Nitrogen Oxides	annual	2008	Cub Run Treatment Plant	11.3	100
Sulfur Dioxide	3-hour	2008	Chantilly	49.8	1,300
	24-hour	2008	Chantilly	31.4	365
	annual	2008	Chantilly	5.2	80
Particulate Matter 10 microns	24-hour	2008	Chantilly	42	150
	annual	2008	Chantilly	18	50
Particulate Matter 2.5 microns	24-hour	2008	Ashburn	27.5	35
	annual	2008	Ashburn	11.2	15
Ozone New Std.	8-hour	2008	Chantilly	215	160
Old Std.	1-hour	2008	Chantilly	307	220

The data in the table show that the air quality in and around the Leesburg area is very good and well below the standards except for pollutant ozone which is mainly associated with traffic emissions from the metropolitan area.

The predicted concentrations from the dispersion model that provide the estimates for the pollutant concentration from the new plant can be added to the background or current air quality levels and subsequently compared to the air quality standards to determine the effect on the community. (Table 5.1)

REGULATORY APPROVALS NEEDED FOR NEW PLANT

The Virginia Department of Environmental Quality (DEQ) has responsibility for issuing air pollution permits for the Green Energy Partners/Stonewall power plant. DEQ has been granted the permitting authority from the US EPA. EPA still has an oversight role and is often called on to assist with complicated issues for a particular evaluation. A construction permit must be issued before the commencement of any construction activities at the site related to the air emissions sources. There are several different types of air analysis that must be completed in order to obtain the air permit for this facility:

- A prevention of significant deterioration (PSD) analysis is only needed for nitrogen oxides since the emissions from this pollutant for the site are greater than 100 tpy
- A new source review (NSR) analysis is needed to mitigate the metro ozone non-attainment issue for the precursor ozone pollutant nitrogen oxides
- A minor source permit will be needed for the pollutants particulate matter – 10 microns, sulfur dioxide, carbon monoxide and volatile organic compounds

The PSD, NSR and minor source analysis can all be included in one document that would be presented to the Virginia DEQ for approval to construct this facility. Because of the control measures presented in this analysis and the effects on the air quality beyond the property line, it is expected that the DEQ will be able to issue a permit for this plant.

Emission offsets for the pollutant NOx will have to be obtained from other existing sources in the metropolitan Washington, DC area. The offsets can be obtained with assistance from the DEQ on any "banked" emissions that are know for the Washington, DC area or from other facilities in the metro area that may choose to close their operations and sell their emissions credits to Green Energy Partners/Stonewall. The EPA has developed their Appendix S policy for obtaining offsets which has been used on many occasions to facilitate growth in non-attainment areas.

There are as yet no DEQ or EPA regulations that have been established to deal with the greenhouse gas emissions from any industrial sources. The current practice of "controlling" greenhouse gases is to select the process which minimizes emissions. A natural gas fired power plant produces about 35-50% fewer greenhouse emissions than a coal fired power plant. We believe the regulatory agencies will accept the natural gas power system as being the best fossil fuel fired power system to mitigate the greenhouse gas emissions.

SECTION 5 – RESULTS OF ANALYSIS

AMBIENT AIR QUALITY

An ambient air quality analysis was conducted using the EPA-recommended AERMOD model. Table 5.1 presents the predicted pollutant concentrations for the appropriate averaging periods.

Table 5.1 Predicted Pollutant Concentrations

Pollutant	Averaging Period	AERMOD-Predicted Concentration (μg/m^3) from GEPS	Monitored Background Concentration (μg/m^3) Existing	Total Predicted Concentration (μg/m^3)	EPA and VA Ambient Std. (μg/m^3)
CO	1-hour	14.0	1,600	1,614.0	40,000
	8-hour	7.1	1,371	1,378.1	10,000
NOx	Annual	0.6	11.3	11.9	100
SO_2	3-hour	1.2	49.8	51.0	1,300
	24-hour	0.7	31.4	32.1	365
	Annual	0.05	5.2	5.25	80
PM-10	24-hour	6.2	42	48.2	150
	Annual	0.4	18	18.4	50

Note: For short-term averaging periods (24-hour or less), compliance is based on the second highest concentration predicted by AERMOD. For long-term averaging periods (annual), compliance is based on the highest concentration predicted by AERMOD.

The receptor grid used in this modeling analysis consisted of several receptors along the property boundary and a polar grid with receptor points placed on each 10° radial up to a distance of 2,500 meters. About 500 receptors were used in this analysis to assure that the maximum concentrations had been identified in the study area. The above modeling results reflect the maximum predicted concentrations anywhere within the modeled receptor grid. The maximum predicted concentrations were found to occur at or near the property boundary toward the southeast. The only exception was the 1-hour average concentration for CO, which was found to occur at a short distance from the property boundary to the northeast. As shown above, all of these concentrations are well within the EPA and Virginia ambient standards.

The expected concentrations from this new plant are indeed minimal. At the point of maximum concentration the new plant with the background added in will all be well below the air quality standards and any PSD increments. These predicted values from the plant are considered insignificant by the EPA definition which should allow for a timely approval of the project. A visual comparison is presented in Figure 5.1 for the pollutant NOx. Figure 5.2 illustrates the effects of the PM-10 at the point of maximum concentration which is close to the southeast property line.

EPA and the VA DEQ have not defined the permitting or modeling process for the evaluation of the pollutant PM-2.5 for this newly adopted 24-hour air quality standard. Even if all of the particles emitted from the stacks were assumed to be smaller than 2.5 microns, this plant would be in compliance with the new standard, i.e., 6.3 $\mu g/m^3$ plus a background of 27.5 $\mu g/m^3$ would yield a maximum concentration of 33.8 $\mu g/m^3$, which is still below the standard of 35 $\mu g/m^3$. This we believe would be the worst case assumption in evaluating PM-2.5.

No mathematical modeling is needed for single point sources like this facility when evaluating ozone levels in metropolitan areas. Regulatory agencies simply require that the lowest achievable control technology be used along with the emission offsets to secure approval.

In addition to the above receptor grid, two receptors were also placed at the Leesburg and Old Ashburn town centers. The purpose of these receptors was to assess the plant's effect on air quality in these surrounding communities. The concentrations of all modeled pollutants at these two locations were a small fraction of the maximum concentrations listed in Table 5.1. For example, the highest annual average NOx concentration at these receptors is approximately 0.02 $\mu g/m^3$ compared to the maximum concentration of 0.6 $\mu g/m^3$ near the plant. Similarly, the second highest 24-hour average PM-10 concentration at these two receptors is approximately 0.1 $\mu g/m^3$ compared to 6.2 $\mu g/m^3$ near the plant. These concentrations are considered to be insignificant, i.e., is not required to be included in any detailed analysis for air permitting purposes because of the miniscule effect on air quality according to EPA. Therefore, the plant will have an imperceptible effect on air quality in the surrounding communities.

Figure 5.1 Predicted Nitrogen Oxides Concentration at Property Lines (Maximum for Study Area)

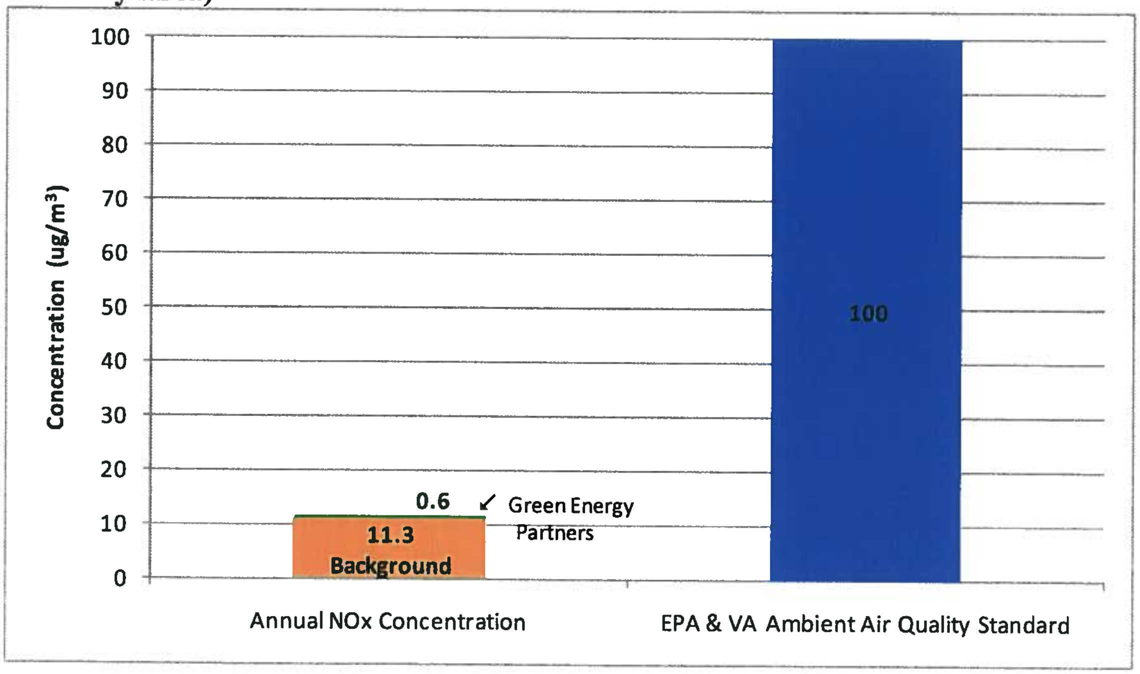
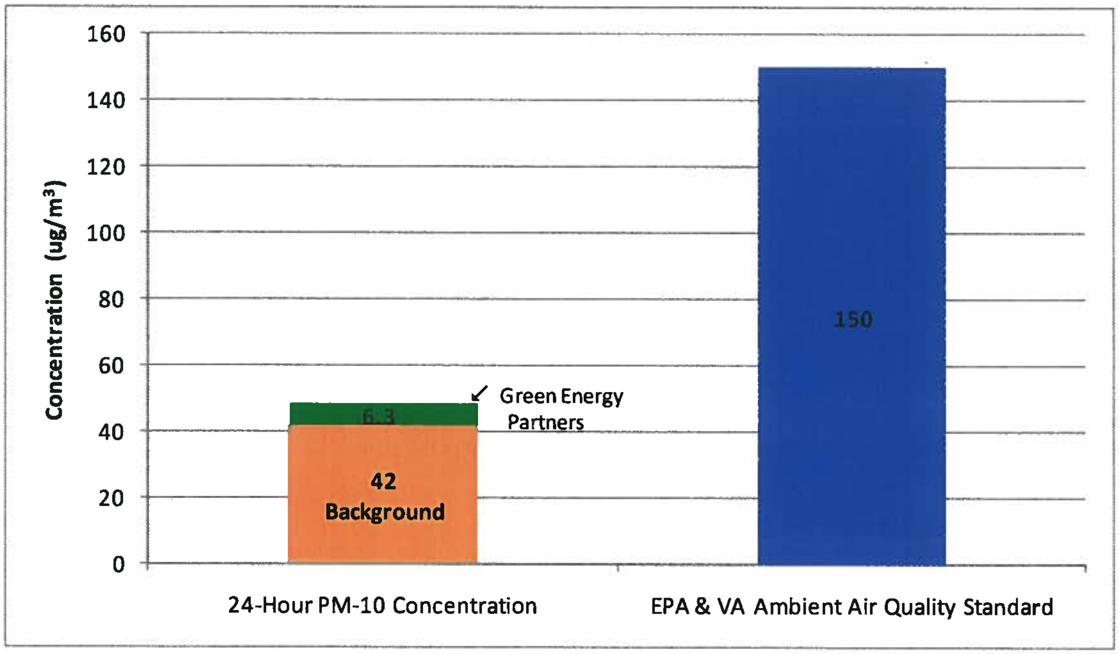


Figure 5.2 Predicted PM-10 Concentration at Property Lines (Maximum for Study Area)



The presentation above is for the two pollutants and averaging periods that come closest to the air quality standards. For all other criteria and hazardous air pollutants the concentrations and proximity to the air quality standards are much lower.

COOLING TOWER ANALYSIS

The SACTI model was applied to assess the potential for occurrence of ground-level fogging and icing, visible plumes, and particle deposition in the area surrounding the power plant. The SACTI plume model uses probability theory to predict the length of the plume. As would be expected, the likelihood of each of these occurrences decreases with increasing distance from the source. Therefore, the greatest probability of occurrence of any of these events would be close to the cooling tower at the power plant.

Ground-Level Fog

For ground-level fogging, the SACTI model estimated that within a distance of 100 meters (328 feet) in any direction from the cooling towers, there could be a total of 150 hours of fogging during the modeled five-year period, or 30 hours per year. However, since the distance from the cooling towers to the property boundary is greater than 100 meters in most directions, a majority of these fogging events would be limited to plant property. The maximum number of fogging occurrences beyond the property boundary is predicted to be less than 7 hours per year at locations near the northeastern boundary of the plant. Similarly, the maximum number of ground-level icing occurrences beyond the property boundary is predicted to be less than 1 hour per year at locations near the northeastern boundary of the plant. Beyond a short distance from the property boundary, the number of fogging and icing events decreases rapidly with distance.

Visible Plumes

A visible water vapor plume will occur virtually at all times that the plant is operating. Of paramount importance with the visible plume are the occurrences that would linger beyond the property line and, therefore, cause a shadowing effect on the surrounding area. There are no environmental regulations which limit shadowing or plume length. However, it is fair to assess whether such impacts could occur for any new installation.

As with ground-level fogging, the majority of the occurrences of elevated visible plumes is limited to the plant property. For example, the SACTI model predicts that elevated plumes may be visible at a distance of 100 meters in any direction from the cooling towers for a total of 100 hours over five years, or 20 hours per year. However, beyond the property boundary, the probability of occurrence of elevated visible plumes decreases rapidly with increasing distance. Within a distance of 300 meters (about 1,000 feet) from the cooling towers, the SACTI model predicts that the occurrence of elevated visible plumes drops to less than one hour per year at any given location. Finally, the model predicts that there could be a visible plume that would occur at the end of the Leesburg airport for 8 minutes per year.

Under certain meteorological conditions, the plume could rise to an elevation of 500 feet. This condition is expected to occur 4 hours per year according to the SACTI model. Typical elevation at the top of the visible plume is expected to be about 150 feet.

Particle Deposition

The SACTI model predicts that there is no probability of solids deposition occurring due to the cooling tower emissions that are well controlled with a highly efficient drift eliminator. Because of the mist eliminator, there were no water droplets that were of such a size that those water droplets would fall in the plant or anywhere in the communities. Water droplets contain particles that if deposited could have an effect on vegetation and other property. The cooling tower planned for Green Energy will not result in water droplets falling on the communities.

The tiny water droplets that pass through the mist eliminator will contain the same fraction of solid or dissolved particles that are found in the recalculated cooling tower water. Once these water droplets are emitted they will act like a gas (fully suspended) and travel with the wind. Eventually, the droplets evaporate and the suspended particles are transported further downwind. All particles emitted into the atmosphere eventually return to the earth; most are "washed out" or combine with other particles and gravitate to the earth. This process takes many days to complete. The volcanic ash (dust particles) that was emitted from Mt. St. Helens reportedly circled the globe for ten years.

Findings

As described above, the probability of occurrence of any adverse effects from the cooling tower plumes on the surrounding community is negligible.