ADDENDUM TO PERMIT ENGINEERING EVALUATION
Dated September 30, 2010 for
Dominion – Warren County Power Station
Registration 81391

During the public comment period for Dominion-WCPS, several reductions in emission limits were proposed by Dominion and significant changes were made to the mitigation plan included in the draft PSD permit.

Accordingly, the following attachments to the Permit Engineering Evaluation were revised and have been included with this addendum:

- Attachment A – Maximum Annual Turbine Emissions with Startups and Shutdowns
- Attachment C – DEQ Air Quality Modeling Analysis Memorandum

Attachment A

Table B-4 Maximum Annual Emissions with Startups and Shutdowns - Mitsubishi M501 GAC

Operating Parameters - Each Unit

			Potential Emission Rates (Per Turbine)				3x3x1 Configuration
Parameter	Combustion Turbine w/ Duct Firing	Combustion Turbine w/out Duct Firing	Annual Emissions based on DB Firing & CT Only Operating Hour Limits	Annual Emissions Based on CT Only Year-Round	Annual Emissions with Startup and Shutdown	Worst-Case Annual Emissions	Worst-Case Annual Emissions (Total)
Operating Hours	6000 hr/yr	2760 hr/yr					
NOx:	25.3 lb/hr	21.7 lb/hr	105.9 ton/yr	95.0 ton/yr	89.2 ton/yr	105.9 ton/yr	317.7 ton/yr
CO:	17.4 lb/hr	9.9 lb/hr	65.9 ton/yr	43.4 ton/yr	116.2 ton/yr	116.2 ton/yr	348.5 ton/yr
VOC:	6.1 lb/hr	2.6 lb/hr	22.1 ton/yr	11.6 ton/yr	60.3 ton/yr	60.3 ton/yr	181.0 ton/yr
PM10/PM2.5:	14.00 lb/hr	8.00 lb/hr	53.0 ton/yr	35.0 ton/yr	45.7 ton/yr	53.0 ton/yr	159.1 ton/yr
SO2:	0.98 lb/hr	0.84 lb/hr	4.1 ton/yr	3.7 ton/yr	3.3 ton/yr	4.1 ton/yr	12.3 ton/yr
H2SO4:	0.88 lb/hr	0.40 lb/hr	3.2 ton/yr	1.7 ton/yr	<3.2 ton/yr	3.2 ton/yr	9.5 ton/yr
NH3:	23.4 lb/hr	20.0 lb/hr	97.8 ton/yr	87.8 ton/yr	<97.8 ton/yr	97.8 ton/yr	293.5 ton/yr
Lead:	0.0017 lb/hr	0.0015 lb/hr	0.007 ton/yr	0.006 ton/yr	<0.007 ton/yr	0.007 ton/yr	0.022 ton/yr

Notes:

Duct burner capacity estimated at 500 MMBtu/hr (at 100% load).

Hourly emission estimates are based on worst-case ambient conditions (i.e., temperature, % relative humidity) at normal operations.

For lead, emission rates for natural gas firing are based on the worst-case firing rate, a heat content value of 1020 Btu/scf and the AP-42 emission factor of 0.0005 lb/MMcf.

For "Annual emissions with DB Firing at Operating Hour Limit", emission estimates were calculated as follows:

Annual Emissions (ton/yr) = [Pollutant Emission Rate, CT w/DB (lb/hr) x Operating Hours, CT w/DB (hr/yr) + Pollutant Emission Rate, CT only (lb/hr) x Operating Hours, CT only (hr/yr)] / (2000 lb / ton)

For "annual emissions with no DB firing", emission estimates for the natural gas firing (CT only) were based on 8760 operating hours per year.

ATTACHMENT C

MEMORANDUM

DEPARTMENT OF ENVIRONMENTAL QUALITY
Office of Air Data Analysis and Planning

629 East Main Street, Richmond, VA 23219
8th Floor **804/698-4000**

To: Janardan Pandey, Air Permit Manager (VRO)

From: Mike Kiss, Coordinator - Air Quality Assessments Group (AQAG)

Date: October 4, 2010 (Revised December 6, 2010)

Subject: Virginia Department of Environmental Quality (DEQ) Technical Review of the Air Quality Analyses in Support of the PSD Permit Application for the Proposed Dominion Natural Gas-Fired Power Plant in Warren County, Virginia (Warren County Power Station)

Copies: Tamera Thompson, Bobby Lute

I. Project Background

Virginia Electric and Power Company, a subsidiary of Dominion Resources, Inc. (Dominion), has proposed to construct and operate a 1280 megawatt (MW) natural gas-fired combined-cycle electric generating facility in the Warren Industrial Park, approximately one mile north of Interstate Route 66, in Warren County, Virginia. The proposed new facility, called the Warren County Power Station, will consist of three identical natural gas-fired only turbines, each with its own duct-fired heat recovery steam generator (HRSG), one reheat condensing steam turbine generator, three inlet turbine chillers, a natural gas-fired only auxiliary boiler, a diesel-fired emergency generator and fire water pump engine, and a natural gas-fired only fuel heater. Dominion has proposed to install Mitsubishi (M501 GAC) turbines.

The proposed facility meets the definition of major source under 9 VAC 5 Chapter 80, Article 8 (Prevention of Significant Deterioration (PSD)) of the Commonwealth of Virginia Regulations for the Control and Abatement of Air Pollution because it is a fossil-fuel-fired steam electric plant of more than 250 MMBtu/hr heat input capacity and has the potential to emit 100 tons per year or more of a regulated pollutant. The pollutants subject to PSD review are nitrogen oxides (NO_X), particulate matter having an aerodynamic diameter equal to or less than 10 microns (PM_{10}), particulate matter having an aerodynamic diameter equal to or less than 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), volatile organic compounds (VOC), and sulfuric acid mist. As a result, PSD regulations require an air quality analysis be performed that demonstrates that the projected air emissions from the proposed facility will neither cause or significantly contribute to a violation of any applicable National Ambient Air Quality Standard (NAAQS) or PSD increment. In addition, PSD regulations require that an additional impact analysis consisting of a soil and vegetation analysis, a growth analysis and a visibility impairment analysis be conducted. An analysis of the project's impact on air quality and air quality related values (AQRVs) in any affected Class I area is also required. The AQRV analysis is subject to review by the AQAG and the appropriate Federal Land Manager (FLM).

The following is a summary of the AQAG's review of the required air quality analyses for the Warren County Power Station for both Class I and Class II PSD areas. The worst-case impacts from all operating loads, including startup and shutdown operations, are presented in this memorandum.

The Class I and Class II air quality analyses received by the AQAG were dated July 2 and 14, 2010. Supplemental analyses received by the AQAG were dated August 27, 2010 and September 2, 2010.

II. Modeling Methodology

The Class I and Class II air quality modeling analyses conform to 40 CFR Part 51, Appendix W - Guideline on Air Quality Models and were performed in accordance with their respective approved modeling methodology that were included in a protocol that was submitted in advance by the proposed facility. DEQ approved the protocol on March 23, 2010. The FLMs were provided an opportunity to comment on the Class I area modeling methodology. The United States Forest Service (USFS) provided comments in an e-mail dated February 4. 2010. The USFS concluded, based on the emission rates in the protocol and distances to the Class I areas, that *"modeling would not show any significant additional impacts to air quality related values (AQRV) at the Class I areas administered by the US Forest Service."* Therefore, the USFS did not request that a Class I AQRV analysis be included in the PSD permit application. The National Park Service (NPS) FLM provided comments and approved the modeling protocol in an e-mail dated April 1, 2010. The NPS issues were also discussed and agreed upon during a conference call on April 19, 2010.

The air quality model used for both Class I and Class II area analyses was the most recent version of the AERMOD modeling system (Version 09292). The AERMOD modeling system is the preferred EPA-approved regulatory model for near-field applications and is contained in Appendix W of 40 CFR Part 51. The PLUVUE II model (Version 96170) was also used to assess plume impairment in Shenandoah National Park. This model is approved by the FLMs for evaluating plume impairment (i.e., near-field visibility impacts) in Class I areas.

III. Modeling Results

A. Class II Area - Preliminary Modeling Analysis

A preliminary modeling analysis for criteria pollutants was conducted in accordance with PSD regulations to predict the maximum ambient air impacts. The preliminary analysis modeled emissions from the proposed facility only to determine whether or not the impacts were above the applicable significant impact levels (SILs). For those pollutants for which maximum predicted impacts were less than the SIL, no further analyses was required (i.e., predicted maximum impacts less than SILs are considered insignificant and of no further concern). For impacts predicted to be equal to or greater than the SIL, a more refined air quality modeling analysis (i.e., full impact or cumulative impact analysis) is required to assess compliance with the NAAQS and PSD increment.

The emissions associated with four (4) representative operating loads were modeled, as well as startup/shutdown emissions. Attachment A contains the specific emission rates and corresponding stack parameters that were modeled. Table 1 below shows the maximum predicted ambient air concentrations.

Table 1
Class II Preliminary Modeling Analysis Results vs. Significant Impact Levels

Pollutant	Averaging Period	Maximum Predicted Concentration From Proposed Facility (μg/m³)	Class II Significant Impact Level (μg/m³)
NO_2	1-Hour	N/A[1]	7.5
	Annual	0.60	1
PM_{10}	24-hour	6.74	5
	Annual	0.43	1
$PM_{2.5}$	24-hour	6.74	1.2
	Annual	0.41	0.3
CO	1-hour	869.70	2,000
	8-hour	139.21	500

(1) SIL modeling not conducted for 1-hour NO_2. Worst-case assumption was used (i.e., project emissions are significant out to the valid range of the model (i.e., 50 km)).

The modeling results for NO_2 (annual averaging period), PM_{10} (annual averaging period), and CO (1-hour and 8-hour averaging periods) were less than the applicable SILs. Therefore, a full impact analysis for these pollutants and averaging periods was not required. However, a full impact analysis for NO_2 (1-hour averaging period), PM_{10} (24-hour averaging period), and $PM_{2.5}$ (24-hour and annual averaging periods) was conducted because the preliminary modeling analysis results exceeded the applicable SILs.

The AQAG has adopted the NO_2 (1-hour) SIL in Table 1 based on a review of the following documentation:

Guidance Concerning the Implementation of the 1-hour NO2 NAAQS for the Prevention of Significant Deterioration Program, Stephen D. Page, EPA, June 29, 2010.

The staff concurs with the EPA recommendations in this memorandum that it is appropriate to derive an interim 1-hour NO_2 SIL by using an impact equal to 4% of the 1-hour NO_2 NAAQS (4 ppb is equivalent to 7.5 $\mu g/m^3$). The AQAG believes that it is reasonable to adopt this value based on consideration of the impact level relative to the NAAQS and past EPA rationale for existing short-term averaging period SILs. The use of 4% of the NAAQS as a threshold is also consistent with previous EPA rulemaking and supporting documentation as described in the June 29, 2010 EPA memorandum.

The AQAG has adopted the $PM_{2.5}$ (24-hour and annual) SILs in Table 1 based on a review of the following documentation:

Prevention of Significant Deterioration (PSD) for Particulate Matter Less Than 2.5 Micrometers (PM2.5)-Increments, Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC); Proposed Rule, 40 CFR Parts 51 and 52, September 21, 2007.

The AQAG determined that EPA's Option 3 on Page 54115 of the Federal Register was appropriate as an interim value based on (1) the fact that these values are the most stringent option proposed by EPA, (2) it uses the existing PM_{10} SIL to PM_{10} NAAQS ratio as a basis for its derivation, and (3) staff has verbal confirmation from EPA that the final SIL will be selected from one of the proposed options. It should be noted that air quality impacts resulting from direct (primary) PM_{10} and $PM_{2.5}$ emissions can often be correlated. In fact, direct PM_{10} and $PM_{2.5}$ emissions from a natural gas-fired combined-cycle electric generating facility are usually identical for all practical purposes.

B. Class II Area – Cumulative Impact Modeling Analysis

The cumulative impact analysis described below consisted of separate analyses to assess compliance with the NAAQS for NO_2, PM_{10}, and $PM_{2.5}$ and the PSD increment for PM_{10} for the indicated averaging periods. No PSD increment analyses were required for NO_2 (1-hour averaging period) and $PM_{2.5}$ (24-hour and annual averaging periods) because EPA has not yet promulgated Class II PSD increments for these pollutants and averaging periods.

It is important to note that the cumulative impact modeling results (both NAAQS and PSD increment) can sometimes be less than the "source only" modeling results in Table 1 of this memorandum. This is due to the fact that source only modeling uses the maximum concentration to determine significance, whereas the cumulative modeling results reflect the form of the air quality standard. For example, the following criteria must be met to attain the NAAQS:

- CO (1-hour and 8-hour) - Not to be exceeded more than once per year
- NO_2 (1-hour) - To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed the standard
- NO_2 (annual) - Never to exceed the standard
- PM_{10} (24-hour) - Not to be exceeded more than once per year on average over 3 years
- $PM_{2.5}$ (24-hour) - To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed the standard
- $PM_{2.5}$ (annual) - To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed the standard

NAAQS Analysis

The NAAQS analysis included emissions from the proposed source, emissions from existing sources from Virginia, West Virginia, and Maryland and representative ambient background concentrations of NO_2, PM_{10}, and $PM_{2.5}$. The results of the analysis are presented in Table 2 and demonstrate compliance with the applicable NAAQS.

Table 2
NAAQS Modeling - Cumulative Impact Results

Pollutant	Averaging Period	Modeled Concentration From All Sources ($\mu g/m^3$)	Project Contribution to Modeled Concentration ($\mu g/m^3$)	Ambient Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	1-hour	109.07	7.97[(1)]	75.2	184.27	188
PM_{10}	24-hour	4.98	4.92	34.7	39.68	150
$PM_{2.5}$	24-hour	4.38	4.23	28.0	32.38	35
	Annual	0.48	0.38	11.7	12.18	15

[(1)] The project contribution provided represents the highest single year's concentration that significantly contributes to the Total Concentration.

PSD Increment Analysis

The 24-hour PM_{10} PSD increment analysis included emissions from the proposed source and emissions from increment-consuming sources from Virginia, West Virginia, and Maryland. Table 3 below presents the results of the analysis and shows that the 24-hour PM_{10} concentration was below the PSD increment.

Table 3
PSD Increment Modeling - Cumulative Impact Results

Pollutant	Averaging Period	Modeled Concentration From All Sources (µg/m³)	Project Contribution to Modeled Concentration (µg/m³)	Class II PSD Increment (µg/m³)
PM_{10}	24-hour	4.98	4.92	30

See Section D of this memorandum (Other Modeling Considerations) for a discussion on the recently promulgated $PM_{2.5}$ increments.

NAAQS and PSD Increment Analyses Conclusions

Based on DEQ's review of the NAAQS and PSD increment analyses, the proposed Warren County Power Station does not cause or significantly contribute to a predicted violation of any applicable NAAQS or Class II area PSD increment.

Toxics Analysis

The source is subject to the state toxics regulations at 9 VAC 5-60-300 et al. An analysis was conducted in accordance with the regulations and the predicted concentrations for each toxic pollutant were below their respective Significant Ambient Air Concentrations (SAAC). Table 4 summarizes the toxic pollutant modeling analysis results.

Table 4
Toxics Analysis Maximum Predicted Concentrations

Toxic Pollutant	Averaging Period	Maximum Modeled Concentration From Project (µg/m³)	SAAC (µg/m³)
Acrolein	1-hour	4.36E-02	17.25
	Annual	2.30E-04	0.46
Formaldehyde	1-hour	1.58E+00	62.5
	Annual	9.24E-03	2.4

Toxic Pollutant	Averaging Period	Maximum Modeled Concentration From Project ($\mu g/m^3$)	SAAC ($\mu g/m^3$)
Cadmium	1-hour	1.23E-02	2.5
Chromium	1-hour	1.56E-02	2.5
Nickel	1-hour	2.34E-02	5

Additional Impact Analysis

In accordance with the PSD regulations, additional impact analyses were performed to assess the impacts from the proposed facility on visibility, vegetation and soils, and the potential for and impact of secondary growth. These analyses are discussed below.

Visibility

A screening modeling analysis was conducted to assess the potential for visual plume impacts in Class II areas within 50 kilometers (km) of the project site. A review of National Parks in Virginia indicated that the Appalachian Trail is the closest identified potentially sensitive area outside Shenandoah National Park. The project site is about 11 km northwest of the nearest approach of the Appalachian Trail.

The visibility screening modeling approach followed guidance provided in EPA's *Workbook for Plume Visual Impact Screening and Analysis (Revised) (October 1992; EPA-454/R-92-023)*. The two visibility metrics that were evaluated in the VISCREEN modeling analysis are:

- **Plume contrast (|C|)**: Contrast can be defined at any wavelength as the relative difference in the intensity (called spectral radiance) between the viewed object (e.g., plume) and its background (e.g., sky). Plume contrast results from an increase or decrease in light transmitted from the viewing background through the plume to the observer.

- **Plume perceptibility (ΔE)**: A parameter used to characterize the perceptibility of a plume on the basis of the color difference between the plume and a viewing background such as the sky, a cloud, or a terrain feature.

The VISCREEN results were developed for startup/shutdown and normal operating scenarios. All results were below the significance criteria in the nearest Class II National Park. Therefore, the plume is expected to be imperceptible against the background sky and the terrain. A Class I area visibility analysis was performed for Shenandoah National Park and is discussed in Section C of this memorandum (Class I Area Modeling Analysis).

The visibility in the area near the proposed facility will be protected by operational requirements, such as air pollution controls and clean burning fuels, and stringent limits on visible emissions that are incorporated into the draft permit.

Vegetation and Soils

An analysis on sensitive vegetation types with significant commercial or recreational value was conducted. The analysis compared maximum predicted concentrations from the proposed facility against a range of injury thresholds found in various peer-reviewed research articles as well as criteria contained in the EPA document *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals (EPA, 1981).* Table 5 shows the maximum predicted concentrations for NO_2, PM_{10}, and CO were all below the respective thresholds (i.e., the minimum reported levels at which damage or growth effects to vegetation may occur). As a result, no adverse impacts on vegetation are expected.

Table 5
Comparison of Vegetation Sensitivity Thresholds to Maximum Modeled Concentrations from the Warren County Power Station

Pollutant	Averaging Period	Maximum Modeled Concentration From Proposed Facility ($\mu g/m^3$)	Sensitive Vegetation Threshold ($\mu g/m^3$)
NO_2	1-hour	342.97(1)	940
	4-hour	73.56	3,760
	1-month	1.12	564
	Annual	0.60	94
PM_{10}	24-hour	6.74	150
	Annual	0.43	50
CO	1-week	7.65	1,800,000

(1) Please note the 1-hour NO_2 concentration is the highest modeled concentration over the 5 modeled years. This is not consistent with how the new 1-hour NO_2 NAAQS is defined.

The impact of the emissions on soils in the vicinity of the proposed project was evaluated. The soil type was determined from data collected from the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSGUGO) database and the NRCS Web Soil Survey tool. The soil types within the nearby counties of Warren, Clarke, Frederick, and Shenandoah are similar in composition.

The predominant soil types in Warren County are silt and stony loams. In Clarke County, the predominate soil types are silt and sandy loams with rocky outcrops. Frederick County contains a mixture of silt and gravely/cobbly loams with some areas of fine sandy loams. In Shenandoah County, the soil types are also a mixture of silt, clay, and cobbly and sandy loams.

The soil types in the adjacent counties are generally considered to have a moderate to high buffering capacity and have a higher capacity to absorb acidic deposition without changing the soil pH. Based on the soil types and quantity of emissions from the proposed project, no adverse impact on local soils is anticipated.

A discussion of the impacts of acidic deposition in Shenandoah National Park is provided in Section C of this memorandum (Class I Area Modeling Analysis).

Growth

The work force for the proposed facility is expected to range from 400 to 600 jobs during various phases of the construction. It is expected that a significant regional construction force is already available to build the proposed facility. Therefore, it is anticipated that no new housing, commercial or industrial construction is necessary to support the Warren County Power Station during the two-year construction schedule. The proposed facility will also require approximately 20 to 25 permanent positions. It is assumed that individuals that already live in the region will perform a number of these jobs. No new housing requirements are expected for any new personnel moving to the area. In addition, due to the small number of new individuals expected to move into the area to support the Warren County Power Station and the existence of some commercial activity in the area, new commercial construction would not be necessary to support the permanent work force. Additionally, no significant level of industrial related support will be necessary for the Warren County Power Station. Therefore, industrial growth is not expected.

Based on the growth expectations discussed above, no new significant emissions from secondary growth during the construction and operation phases of the Warren County Power Station are anticipated.

C. Class I Area Modeling Analysis

The FLMs are provided reviewing authority of Class I areas that may be affected by emissions from a proposed source by the PSD regulations and are specifically charged with protecting the Air Quality Related Values (AQRV) within the Class I areas. The closest Class I area to the proposed facility is the Shenandoah National Park (SNP). Its nearest point is approximately 7.1 km from the project site. The next closest Class I area, Dolly Sods Wilderness Area in West Virginia, is approximately 100 km upwind (based on the prevailing wind direction) from the proposed facility.

Modeling guidance provided in 2008 by the Federal Land Managers' Air Quality Related Values Work Group (FLAG), provides screening criteria for determining whether a source may be excluded from performing a Class I area AQRV modeling analysis. The FLMs may consider excluding a source from modeling if its total SO_2, NO_X, PM_{10}, and H_2SO_4 annual emissions (in tons per year, based on 24-hour maximum allowable emissions) divided by the distance (in km) from the Class I area is less than or equal to 10. The sum of the emissions for the proposed project is not expected to exceed approximately 600 tons per year (tpy). Therefore, the FLAG 2008 screening distance for the SNP is 84.5 (600 tpy/7.1 km). The screening distance for all other Class I areas is less than 6 (600 tpy/100 km or greater). Based on the FLM screening criteria, an AQRV analysis was conducted for the SNP. The USFS did not require an analysis of the more distant Class I areas (Dolly Sods Wilderness Area, Otter Creek Wilderness Area, and James River Face Wilderness Area).

A preliminary modeling analysis for NO_2, PM_{10}, and $PM_{2.5}$ was conducted to determine whether or not the predicted maximum ambient air impacts in the SNP were above the Class I SILs. CO emissions were not modeled because the maximum ambient air impacts for the Class II area were well below the applicable Class II SILs (see Table 1 for details) and there is no Class I area SIL for this pollutant. The emissions used in the Class I area modeling were the same as those used for the Class II area modeling. A more refined air quality modeling analysis (i.e., cumulative impact analysis) was required to assess compliance with the NAAQS and Class I PSD increments for impacts predicted to be equal to or above the Class I SIL. No additional air quality analysis was required for pollutants when the proposed project's impacts were less than the SIL.

The proposed facility's maximum predicted ambient air concentrations for NO_2, PM_{10}, and $PM_{2.5}$ in the SNP are presented in Table 6. The predicted concentrations for all pollutants were above all of the applicable Class I SILs in the SNP. Therefore, a cumulative impact analysis was required for these pollutants. It is important to note that no analysis was required for demonstrating compliance with the annual PM_{10} NAAQS because the standard was revoked by EPA in 2006. Additionally, no Class I PSD increment analysis for $PM_{2.5}$ and 1-hour NO_2 was required because EPA has not yet promulgated these Class I PSD increments. See Section D of this memorandum (Other Modeling Considerations) for a discussion on the recently promulgated $PM_{2.5}$ increments.

Table 6
Summary of Maximum Predicted Concentrations from the Proposed Facility for Shenandoah National Park

Pollutant	Averaging Period	Maximum Predicted Concentration From Proposed Facility (µg/m³)	Class I Significant Impact Level (µg/m³)
NO_2	1-hour	N/A[1]	7.5
	Annual	0.27	0.1
PM_{10}	24-hour	5.55	0.3
	Annual	0.21	0.2
$PM_{2.5}$	24-hour	5.55	0.07
	Annual	0.21	0.06

(1) SIL modeling not conducted for 1-hour NO_2. Worst-case assumption was used (i.e., project emissions are significant out to the valid range of the model (i.e., 50 km)).

NAAQS Analysis

The NAAQS analysis for SNP included emissions from the proposed source, emissions from existing sources from Virginia and West Virginia, and representative ambient background concentrations of NO_2, PM_{10}, and $PM_{2.5}$. The results of the analysis are presented in Table 7 and demonstrate compliance with the NO_2, PM_{10}, and $PM_{2.5}$ NAAQS. Please note that the 1-hour NO_2 receptor grid did not differentiate between Class I and Class II receptors. Therefore, the NO_2 concentration presented in the table below is the highest design value for both Class I and Class II areas (i.e., the same value as presented in Table 2).

Table 7
NAAQS Modeling - Cumulative Impact Results for Shenandoah National Park

Pollutant	Averaging Period	Modeled Concentration From All Sources (µg/m³)	Project Contribution to Modeled Concentration (µg/m³)	Ambient Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)
NO_2	1-hour	109.07	7.97[1]	75.2	184.27	188
	Annual	0.45	0.27	12.5	12.95	100
PM_{10}	24-hour	5.15	5.10	34.7	39.85	150
$PM_{2.5}$	24-hour	3.74	3.72	28.0	31.74	35
	Annual	0.13	0.11	11.7	11.83	15

(1) The project contribution provided represents the highest single year's concentration that significantly contributes to the Total Concentration.

PSD Increment Analysis

The PSD increment analysis included emissions from the proposed source and emissions from increment-consuming sources from Virginia and West Virginia. Table 8 presents the results of the PSD increment analysis. All predicted impacts are less than the applicable PSD increments.

Table 8
PSD Increment Modeling - Cumulative Impact Results for Shenandoah National Park

Pollutant	Averaging Period	Modeled Concentration From All Sources ($\mu g/m^3$)	Project Contribution to Modeled Concentration ($\mu g/m^3$)	Class I PSD Increment ($\mu g/m^3$)
NO_2	Annual	0.45	0.27	2.5
PM_{10}	24-hour	5.15	5.10	8
	Annual	0.27	0.21	4

See Section D of this memorandum (Other Modeling Considerations) for a discussion on the recently promulgated $PM_{2.5}$ increments.

Air Quality Related Values

An AQRV analysis (acidic deposition and visibility) was performed for the Class I area (i.e., SNP) and is discussed in the sections below.

Acidic Deposition

An analysis of the potential sulfur (S) and nitrogen (N) deposition at the SNP was conducted in accordance with guidance from the FLM. The FLM approved the protocol on April 19, 2010. The results of the analysis were compared to the sulfur and nitrogen deposition analysis threshold (DAT) of 0.010 kilograms per hectare per year (kg/ha/yr) for eastern Class I areas. The DAT is defined as the additional amount of sulfur or nitrogen deposition within a Class I area, below which estimated impacts from a proposed new or modified source are considered insignificant. The DAT is a deposition threshold, not necessarily an adverse impact threshold. If the additional amount of deposition is greater than or equal to the DAT, further analysis is usually required by DEQ and the FLM.

Table 9 presents a summary of the maximum predicted sulfur and nitrogen deposition rates for the SNP. The maximum predicted sulfur deposition rate was below the DAT and the maximum predicted nitrogen deposition rate was above the DAT. Two models were run to obtain these results. AERMOD was run in accordance with the approved modeling protocol. CALPUFF was run by the DEQ, FLM, and the applicant to provide supplemental information on nitrogen deposition.

Table 9
Maximum Predicted Annual Sulfur and Nitrogen Deposition Rates from the Proposed Facility for Shenandoah National Park

AERMOD Sulfur Deposition (kg N/ha/yr)	Deposition Analysis Threshold for S (kg N/ha/yr)	AERMOD Nitrogen Deposition (kg S/ha/yr)	CALPUFF Nitrogen Deposition (kg S/ha/yr)	Deposition Analysis Threshold for N (kg S/ha/yr)
0.008	0.010	0.04	0.022	0.010

Both the NPS and DEQ have stated concerns about acidic deposition in the SNP. DEQ continues to evaluate and respond to these issues as part of its agency obligations under the U.S. Clean Water Act. For example, DEQ issues its 305(b)/303(d) Water Quality Assessment Integrated Report (Integrated Report) every 2 years. This report provides a summary of the water quality conditions in Virginia, including SNP. DEQ develops and submits this report to the EPA every even-numbered year. The report satisfies the requirements of the U.S. Clean Water Act sections 305(b) and 303(d) and the Virginia Water Quality Monitoring, Information and Restoration Act. The goals of Virginia's water quality assessment program are to determine whether waters meet water quality standards and to establish a schedule to restore waters with impaired water quality. Additional information can be found at the following link:

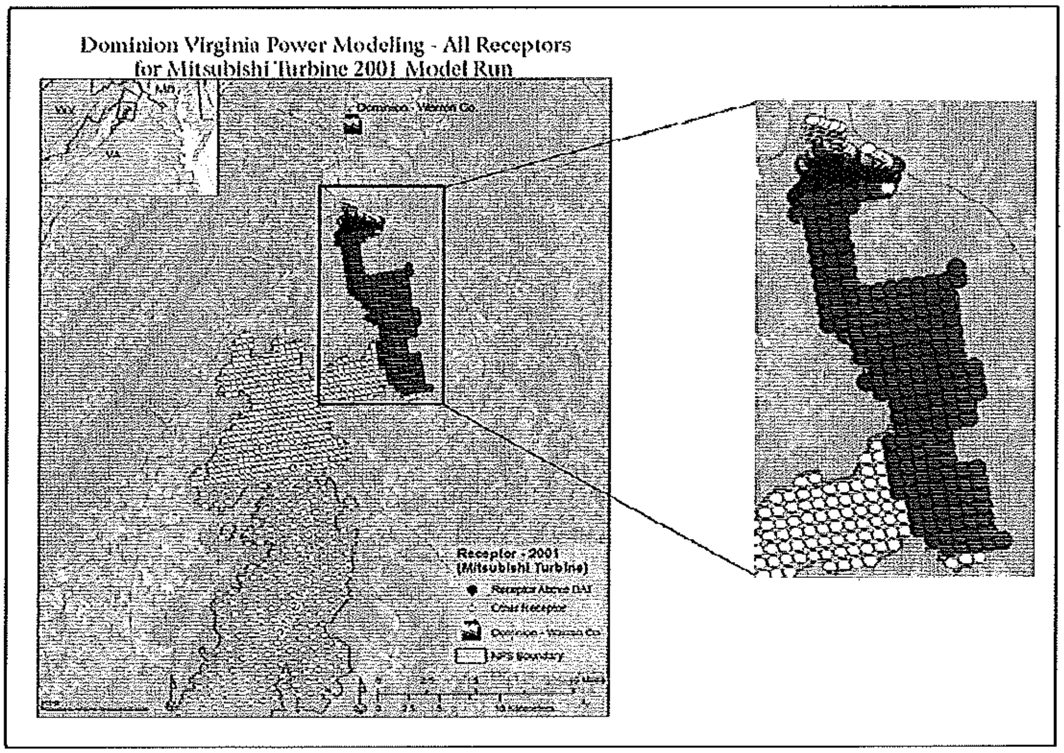
http://www.deq.virginia.gov/wqa/

Recently collected stream samples, although not certified by DEQ, indicate that stream acidification in the SNP continues to impact water quality. For example, the Shenandoah Watershed Study (SWAS) program conducts watershed research and monitoring in the Shenandoah National Park as well as other areas. The SWAS program studies acidic deposition in sensitive streams, most of which support reproducing populations of the native brook trout. The SWAS program concluded that stream water acidification is a continuing problem in Virginia's forested mountain watersheds. A link to the SWAS program is provided below:

http://swas.evsc.virginia.edu/

As previously stated, DEQ recognizes the importance of protecting the SNP from the impacts of acidic deposition. The proposed Dominion facility is subject to Acid Rain permitting requirements established under Title IV of the 1990 Clean Air Act Amendments - The Acid Rain Program. The overall goal of the Acid Rain Program is to achieve significant environmental and public health benefits through reductions in emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_X), the primary causes of acid rain. The proposed facility is fueled by natural gas, the least polluting of the possible fuel sources. As a result, the Acid Rain requirements associated with this power plant will be minimal. The Acid Rain Program requirements being implemented regionally will likely result in significant long-term environmental improvements in agricultural lands, lakes, streams, and forests in Virginia and the SNP.

The NPS has expressed concern that locations within the northern end of the SNP had predicted nitrogen deposition greater than 0.020 kg/ha/yr, a value more than twice the DAT. The following figure illustrates the receptors with modeled impacts greater than the DAT. The maximum modeled nitrogen deposition at any receptor was 0.022 kg/ha/yr.



DEQ agrees additional nitrogen deposition resulting from emissions from the proposed project may adversely impact streams and aquatic biota already impaired because of acidification. The NPS comments do not specifically quantify what impact a loading of 0.022 kg/h/yr (maximum receptor) would have on a stream's pH. DEQ also supports a modeling approach which averages impacts across an individual watershed as opposed to the standard NPS practice of using the maximum impact at any one receptor to determine significance.

The NPS correctly states that DEQ has classified Jeremy's Run as a watershed in the northern portion of the SNP that is impaired for pH. It is important to note, however, that the proposed facility's impact within Jeremy's Run is below the DAT; therefore, it is not expected to significantly contribute to acidic deposition in this particular watershed using the NPS criteria.

Lastly, the pH special standard that currently applies to Jeremy's Run and other streams in the SNP is 6.5-9.5. This standard range is based on the assumption of limestone substrate in the western portion of Virginia, namely in the lower elevations of the Shenandoah Valley. Many of the streams in the SNP, such as Jeremy's Run, are defined as headwaters where the substrate is not limestone. Therefore, streams located at the higher elevations (i.e., both the western and eastern slopes of the SNP) do not fit this description. In fact, the USFS had a number of their streams with a similar substrate to those in the SNP reclassified in the last triennial review of water quality standards. These USFS streams are now subject to the statewide pH standard of 6-9.

Visibility

Plume visibility impacts inside the SNP within 50 km were evaluated using the PLUVUE II model. This approach is preferred by the FLMs and is consistent with past modeling exercises (i.e., previous permitting of the Competitive Power Ventures (CPV) project at the same site).

Several viewpoints within the Class I area were selected by the NPS for the plume visibility analysis. These are as follows:

- **Shenandoah Valley Overlook**: located about 9 km from the proposed project site, it offers views to the north toward Front Royal.

- **Dickey Ridge**: located about 11 km from the proposed project site, it offers views to the northeast within the Park and views to the southeast and southwest toward terrain within the Park.

- **Signal Knob Overlook**: located about 12.5 km from the proposed project site, it offers fairly long views to the south, southwest, and southeast within Park boundaries. In addition, there is a view toward the west to areas beyond Park boundaries.

- **Compton Gap Road**: selected as a supplemental viewpoint by the NPS due to its location at the highest point along Compton Gap Road, about 14.6 km from the project site. It offers long views of Park terrain toward the southwest and shorter views toward the west and northwest.

- **Lands Run Road Gate**: selected as a supplemental viewpoint by the NPS for its location where Lands Run Road crosses the western boundary of the Park. It is approximately 16.5 km from the proposed project site and it offers long views to the south and southwest, although viewing distances to the east are limited by elevated terrain.

As with the Class II visibility modeling, the two metrics that were evaluated in the PLUVUE II modeling were plume contrast (|C|) and plume perceptibility (ΔE). There were two approaches used to calculate plume impairment:

- **FLAG Approach:** PLUVUE II was run for each hour identified from the 5-year meteorological period for meteorological conditions associated with the Class I Levels of Concern (an absolute value of at least 0.02 for |C| and 1.0 for ΔE). The results of the PLUVUE II analyses were summarized for each viewpoint and the probability of potential future occurrences during peak project emission periods were calculated by reviewing the frequency of hours determined to be above perceptible visibility thresholds, especially during periods of peak park visitation.

- **Refined Approach:** A refined plume impairment analysis was conducted to account for effects on plume perceptibility due to the apparent plume width. As noted by Richards et al. (2007),

  > *"In the real world, plumes are viewed against a background of sky or terrain that does not have a uniform luminance and color, even when there are no clouds. For faint plumes, the effect of a plume is to introduce a small distortion in the luminance and color profile of the background. As the angle subtended by a plume increases (i.e., the plume fills a larger portion of the observers total field of view), the plume is spread over a larger change in the luminance and color of the background sky. For a given value of the plume contrast or color difference, the changes in luminance and color attributable to the plume become a smaller fraction of the naturally occurring variations in the luminance and color of the background sky. Thus, it is reasonable to believe that the adjustment needed to convert laboratory contrast thresholds into thresholds appropriate for the real world increases as the plume subtended angle increases."*

The procedures for implementing an adjustment to |C| and ΔE are described by Richards et al. (2007) as well as Zell et al. (2007). This involves computation of the plume angle subtended for each line of sight and simulated PLUVUE hour, computing appropriate threshold values for |C| and ΔE, and then comparing the modeled plume parameter to this threshold.

A summary of the PLUVUE II modeling results at each observer location as provided by NPS, along with the number of hours where each of the visibility criteria is exceeded, is presented in Table 10.

Table 10
Summary of the PLUVUE II Modeling Results

View Point	Total During 5-Year Period			Annual Average		
	Days	**|C| Hours**	**ΔE Hours**	**Days**	**|C| Hours**	**ΔE Hours**
Signal Knob Overlook	26	29	5	5	6	1
Dickey Ridge	14	16	3	3	3	1
Compton Gap Road	14	15	0	3	3	0
Lands Run Road Gate	8	8	5	2	2	1
Shenandoah Valley Overlook	3	3	0	1	1	0
Totals	65	71	13	14	15	3

The NPS evaluates the coherent plume impacts based on three criteria, namely (1) frequency, (2) duration, and (3) magnitude. The NPS concludes that the coherent plume impacts occur infrequently. They also state that, with the exception of a few 2-hour events, the duration of the impacts is not more than one hour. The NPS' concern with respect to the coherent plume impacts is based on the magnitude of the impacts. The NPS and DEQ agree that the values calculated for a few of the hours are large. For example, six of the hourly impacts over the 5-year period at the Signal Knob Overlook, as predicted by PLUVUE II, are an order of magnitude over the applicable thresholds. The largest |C| impact is 40 times the threshold and the largest ΔE impact is four times the threshold. DEQ also concurs with the NPS that some of these predicted impacts occur during September and October during the peak visitation period in the SNP.

It is important to note that the PLUVUE II modeling results are based on conservative assumptions. The model uses a monochromatic background (e.g., white, grey, black or sky (blue)) and the SNP background consists of a multi-colored background. This would result in the plume being less visible than predicted by the model. Additionally, the modeling results indicate that the plume is much less visible against the sky background than the terrain background. The applicant speculates that due to the elevated nature of the proposed facility's combined-cycle stack plumes, it is more likely to be viewed against the sky background.

The NPS concluded the visibility impacts adversely affect visibility along Skyline Drive as a result of the magnitude of the impacts. The NPS also acknowledges that these impacts would be infrequent. The conclusion that the coherent plume from the proposed plant adversely affects visibility based on the magnitude of the impacts is a value judgment made by the NPS. DEQ agrees that the visible plume impacts cannot be directly mitigated by emission reductions from other sources in other locations.

In order to address the NPS concerns, all parties (NPS, DEQ and Dominion) have reached a mutually acceptable emissions reduction plan that will result in a net environmental benefit in the SNP. As previously noted, plume impacts cannot be directly offset with emissions reductions in other locations. However, visibility impact concerns have been alleviated because all parties agree that sufficient emission reductions are included in the permit that result in a net environmental benefit to the SNP.

The detailed visibility impairment results are provided in Attachment B. The results are summarized for each viewpoint and the probability of potential future occurrences during peak project emission periods are calculated by reviewing the frequency of hours determined to be above perceptible visibility thresholds.

Summary of Class I Area Analysis

Based on DEQ's review of the modeling analyses, the proposed Warren County Power Station does not cause or significantly contribute to a predicted violation of any applicable NAAQS or Class I area PSD increment.

The PSD regulations provide reviewing authority to the FLM. The 60-day FLM review period began on September 7, 2010. In accordance with 9 VAC 5-80-1765 D, the FLM has an opportunity to notify DEQ of any adverse impact on the AQRVs. The FLM's authority to make a determination of an adverse impact on the AQRVs is invoked most frequently in the context of the preconstruction permit review procedure specified in Section 165 of the Clean Air Act.

The NPS, in its comments to DEQ, concludes that the impact of the project's emissions constitutes an adverse impact upon visibility in the SNP. The NPS is also concerned about the contribution of additional acidifying pollutants into the aquatic ecosystems and state that the project, as proposed, would have an adverse impact on the aquatic systems in the SNP.

The NPS acknowledges that all parties (NPS, DEQ and Dominion) have reached a mutually acceptable emissions reduction plan that will result in a net environmental benefit in the SNP. The NPS concludes that although plume impacts cannot be directly offset with emissions reductions in other locations, visibility impact concerns are alleviated when sufficient emission reductions are achieved to demonstrate a net environmental benefit to the SNP.

The three major elements of the mitigation plan, as identified in the NPS comments, are as follows:

1. Dominion shall permanently cease all permitted SO_2 and NO_X emissions at North Branch Power Station in Grant County, West Virginia. Based on the actual emissions in 2007-2008 and the distance and direction of North Branch Power Station from the Park, these reductions shall result in an Emission Offset of 243 tons per year (TPY) that is applied to the total annual NO_X limit. Specifically, these

emissions are being offset at a ratio of 10:1 based on the modeling conducted by the NPS. Neither the permitted nor actual SO_2 and NO_X emission reductions from the North Branch Power Station may be used as Emissions Offsets for any other purpose.

2. Dominion shall retire permanently the 175 TPY of NO_X offsets procured from World Kitchen in Martinsburg, West Virginia, as approved by the DEQ by letter of 11/17/07. Based on the distance and direction of World Kitchen from the Park, this retirement of emission reduction credits shall result in 17.5 TPY emission offsets toward the total annual NO_X limit. Specifically, these emissions are being offset at a ratio of 10:1 based on the modeling conducted by the NPS.

3. Dominion shall secure and retire Eligible SO_2 Allowances, Eligible NO_X Allowances, or Emission Reduction Credits in the amount equivalent to 70.2 TPY of Emission Offsets toward the total annual NO_X limit.

D. Other Modeling Considerations

Facilities Locating within 10 Kilometers (km) of a Class I Area

PSD regulations require that modeling should be performed for any emissions rate at a new PSD major stationary source or net emissions increase associated with a modification at an existing PSD major stationary source located within 10 kilometers (km) of a federal Class I area to determine if the maximum 24-hour average impact of the regulated pollutant in the Class I area is equal to or greater than 1.0 micrograms per cubic meter ($\mu g/m^3$) on a 24-hour basis. If the 24-hour impact is equal to or greater than 1.0 $\mu g/m^3$, the emissions rate associated with the new major stationary source or the net emissions increase associated with a modification at an existing major stationary source is considered significant and the regulated pollutant would be subject to PSD review.

The proposed facility will be located approximately 7.1 km from SNP. Therefore, all regulated pollutants to be emitted from the proposed facility that were not initially identified as subject to PSD review based on their annual emission rate (i.e., tons per year) were evaluated. The maximum 24-hour average impacts for all other regulated pollutants are less than 1.0 $\mu g/m^3$ and are not subject to PSD review.

Ozone

Warren County is currently designated attainment for ozone based on the 1997 standard (0.08 parts per million (ppm)) and the 2008 standard (0.075 ppm). The 2008 standard is currently being reconsidered by EPA. Specifically, on January 6, 2010, EPA proposed to strengthen the NAAQS for ground-level ozone, the main component of smog. The proposed revisions are based on scientific evidence about ozone and its effects on people and the environment. EPA is proposing to strengthen the 8-hour "primary" ozone standard, designed to protect public health, to a level within the range of 0.060-0.070 ppm. EPA is also proposing to establish a distinct cumulative, seasonal "secondary" standard, designed to protect sensitive vegetation and ecosystems, including forests, parks, wildlife. At this point, the final outcome of this proposal is not known. The latest information at the time of public notice suggests that the new ozone standards may be finalized by the end of 2010.

The mitigation plan outlined in Condition 23 of the draft permit provides for NO_X emissions offsets or emissions reductions which are at least equivalent to those required in moderate ozone nonattainment area permitting (i.e., ratio of at least 1.15 to 1). The Best Available Control Technology (BACT) permit requirements are also at or near the Lowest Achievable Emission Rate (LAER) for the subject source as required in a nonattainment area.

VOC offsets are not required by current air regulations and are not contained in the permit. It is important to note that recent research demonstrates that rural regions and, in fact, most if not all of Virginia, are considered "NO_X limited" for the purposes of ozone formation. In other words, the concentration of ozone depends on the amount of NO_X in the atmosphere. This occurs when there is a lack of NO_2, thus inhibiting ozone titration when oxygen mixes with VOCs. In these regions, controlling NO_X would reduce ozone concentrations whereas controlling VOCs would have little if any effect on ozone formation.

Rural areas are usually NO_X limited due to the large amount of trees that produce relatively high concentrations of VOCs. For instance, the Blue Ridge Mountains are named in part because the high VOC levels reflect blue light. Regions that are "VOC limited" lack trees and are usually congested with high vehicular activity.

$PM_{2.5}$ Increment Analysis for Class I and Class II PSD Areas

EPA recently issued a final rule for PSD increment for $PM_{2.5}$ ("$PM_{2.5}$ Increment Rule", 40 CFR 52.12(b)(14(c)), 75 Federal Register 64864, 64890 (Oct. 20, 2010)). The $PM_{2.5}$ Increment Rule has a "trigger date" of one year from that publication (i.e., on October 20, 2011), at which time the increment will commence to be implemented through the PSD permitting process (*Id.* at 64887). After that date, a PSD permit applicant must demonstrate that emissions from the proposed source will not cause or contribute to a violation of PSD increment for $PM_{2.5}$ (*Id.* at 64887-64888). Computer modeling is used to determine in the permitting process whether a project causes or contributes to a predicted violation of PSD increment. EPA has stated to DEQ that the applicant is legally not required to make that demonstration if the permit is issued before the trigger date.

Even though the trigger date is not until October 20, 2011, the $PM_{2.5}$ Increment Rule establishes the date of publication, October 20, 2010, as the "major source baseline date." (*Id.* at 64887). New emissions from major stationary sources that occur after this date (i.e., the proposed Dominion Warren facility) will not be included in the.baseline, but instead, will consume increment even though they are permitted before the trigger date (*Id.* at 64868 and 64887). Similarly, any reduction in emissions from a unit in the baseline after the major source baseline date will expand increment (*Id.* at 64868).

As previously stated, the applicant is not required to model for compliance with $PM_{2.5}$ increment before the trigger date. Furthermore, an increment analysis would typically not be initiated in the future unless an additional application is filed after the trigger date to permit a source located in an area that would require the inclusion of the proposed plant in future modeling, as a nearby increment-consuming source. In fact, should the proposed plant be approved and commence operations, its emissions would be included in the modeling inventory of existing sources at its actual operating rate (40 CFR, Part 51 App W Table 8-2).

Dominion volunteered to do the $PM_{2.5}$ increment modeling analysis at the suggestion of DEQ to get an understanding of what conditions would be necessary to comply upon the effective date of October 20, 2011. DEQ has reviewed and approved this analysis which is consistent with the approved modeling methodology contained in the permit application. The proposed facility has voluntarily accepted the limit below to comply with the $PM_{2.5}$ increment:

- The duct burners shall not operate between the hours of 10 pm and 5 am during the period between September and April.

DEQ advised the applicant that modeling could be required to demonstrate compliance after the trigger date. The applicant conducted the modeling early and has accepted the aforementioned conditions. DEQ has reviewed and approved this modeling and concurs that the restrictions will achieve compliance with the $PM_{2.5}$ increment at this time. The results of the analysis are provided in Table 11.

Table 11
$PM_{2.5}$ Increment Analysis for Class I and Class II PSD Areas

Pollutant	Averaging Period	Model Concentration ($\mu g/m^3$)(1)	PSD Increment ($\mu g/m^3$)	Complies (Y/N)?
Class II Area Modeling				
$PM_{2.5}$	24-hour(2)	2.17	9	Y
$PM_{2.5}$	Annual(3)	0.25	4	Y
Class I Area Modeling				
$PM_{2.5}$	24-hour(2)	1.95	2	Y
$PM_{2.5}$	Annual(3)	0.10	1	Y

(1) Worst-case modeled concentration over all ambient temperature/load conditions evaluated.
(2) Highest second highest modeled concentration over the five modeled years.
(3) Highest annual average modeled concentration over the five modeled years.

Attachment A

Emission Rates and Stack Parameters

Worst-Case Data for Proposed Natural Gas-Fired Combined-Cycle Combustion Turbine Operation

Parameter		Value[1]			
Load (%)		100 w/ Duct Firing	100	75	60
Stack Height (ft)		175.0	175.0	175.0	175.0
Stack Diameter (ft)		22.0	22.0	22.0	22.0
Exit Temperature (°F)		191.20	197.70	191.50	185.00
Exit Velocity (ft/sec)		57.83	57.74	48.32	41.16
Heat Input (MMBtu/hr)		3,496	2,996	2,302	1,966
Pollutant Emissions Per Combustion Turbine (lb/hr)	SO_2	(2)	(2)	(2)	(2)
	PM_{10} 24 hour	21.16	15.51	11.92	10.18
	PM_{10} Annual[3]	19.38	19.38	19.38	19.38
	$PM_{2.5}$ 24 Hour	21.16	15.51	11.92	10.18
	$PM_{2.5}$ Annual[3]	19.38	19.38	19.38	19.38
	NO_X Annual[3]	24.18	24.18	24.18	24.18
	CO	17.41	9.91	7.61	6.50

(1) The values in the table represent the worst-case stack parameters and the emission rates for the four operating loads.

(2) Emission estimates indicate that SO_2 was not subject to PSD review. Therefore, an SO_2 modeling analysis was not performed.

(3) Annual emissions based on the worst-case emissions across all normal operations or normal operating plus SUSD. The following worst-case annual emissions will be annualized and modeled across all operating loads:

- PM_{10} – 84.89 tpy / 8760*2000 = 19.38 lb/hr
- NO_X – 105.90 tpy / 8760*2000 = 24.18 lb/hr

Source Parameters and Criteria Pollutant Emission Rates[1] For the Auxiliary Equipment

Source ID	Stack Height (ft)	Stack Diameter (ft)	Exit Temp. (°F)	Exit Velocity (fps)	Hourly Emissions (lb/hr)				
					NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2
Inlet Turbine Chiller1[2]									
CHLR1	42.88	12.00	70.00	24.50	--	--	5.99E-03	1.84E-05	--
Inlet Turbine Chiller2[2]									
CHLR2	42.88	12.00	70.00	24.50	--	--	5.99E-03	1.84E-05	--
Inlet Turbine Chiller3[2]									
CHLR3	42.88	12.00	70.00	24.50	--	--	5.99E-03	1.84E-05	--
Auxiliary Boiler									
AUX_BLR	115.00	3.00	300.00	61.00	0.97	3.26	0.44	0.44	(3)
Fuel Gas Heater									
FGH	45.00	3.33	300.00	32.00	0.57	1.92	0.39	0.39	(3)

(1) Data provided by Dominion.
(2) The hourly emissions represent the emissions from a single cell of the 6-cell inlet turbine chiller.
(3) Emission estimates indicate that SO_2 was not subject to PSD review. Therefore, an SO_2 modeling analysis was not performed.

Source Parameters and Criteria Pollutant Emission Rates[1] For the Emergency Equipment

Source ID	Stack Height (ft)	Stack Diameter (ft)	Exit Temp. (°F)	Exit Velocity (fps)	Hourly Emissions (lb/hr)[2]							
					NO_X	CO		PM_{10}		$PM_{2.5}$		SO_2
						1-hour	8-hour	24-hour	Annual	24-hour	Annual	
Diesel-Fired Emergency Generator												
DSL_GEN	115.00	1.23	987.00	135.00	0.14	12.62	1.58	0.06	0.0086	0.06	0.0086	(3)
Diesel-Fired Fire Water Pump Engine												
FWP	20.00	0.44	845.00	135.00	0.012	1.72	0.22	0.0083	0.0012	0.0083	0.0012	(3)

(1) Data provided by Dominion.
(2) Emissions rates were normalized based on the following equations:
Short-term Averaging Period – Emission Rate * (1/ Hours of Averaging Period)
Annual Averaging Period – Emission Rate * 52 hours per year / 8,760
(3) Emission estimates indicate that SO_2 was not subject to PSD review. Therefore, an SO_2 modeling analysis was not performed.

Short-Term Averaging Period Startup Summary[1]

	Offline min	Start min	Normal min	Total min	Start lb	Normal lb	Total Lb
CO 1-hour							
Turbine 1	0	60	0	60	813.90	0	813.90
Turbine 2	60	0	0	60	0	0	0
Turbine 3	60	0	0	60	0	0	0
Startup Total							813.90
Normal Operation Total[2]							52.23
CO 8-hour							
Turbine 1	0	252	228	480	2205.30	66.16	2271.46
Turbine 2	252	101	127	480	804.20	36.85	841.05
Turbine 3	353	101	26	480	804.20	7.54	811.74
Startup Total							3924.25
Normal Operation Total[2]							417.84
PM_{10} 24-hour							
Turbine 1	0	252	1188	1440	23.30	418.97	442.27
Turbine 2	252	101	1087	1440	8.90	383.35	392.25
Turbine 3	353	101	986	1440	8.90	347.73	356.63
Startup Total							1191.15
Normal Operation Total[2]							1523.52
$PM_{2.5}$ 24-hour							
Turbine 1	0	252	1188	1440	23.30	418.97	442.27
Turbine 2	252	101	1087	1440	8.90	383.35	392.25
Turbine 3	353	101	986	1440	8.90	347.73	356.63
Startup Total							1191.15
Normal Operation Total[2]							1523.52
NO_X 24-hour[3]							
Turbine 1	0	252	1188	1440	115.10	501.34	616.44
Turbine 2	252	101	1087	1440	77.00	458.71	535.71
Turbine 3	353	101	986	1440	77.00	416.09	493.09
Startup Total							1645.24
Normal Operation Total[2]							1823.04
SO_2 24-hour[3]							
Turbine 1	0	252	1188	1440	1.28	19.40	20.68
Turbine 2	252	101	1087	1440	0.49	17.75	18.24
Turbine 3	353	101	986	1440	0.49	16.10	16.59
Startup Total							55.52
Normal Operation Total[2]							70.56

(1) Startup emissions presented are for the proposed combustion turbines.
(2) Normal operation emissions correspond to those for 100% load with duct burners.
(3) NO_X 24-hour and SO_2 24-hour calculated for determining if additional Class I visibility modeling is needed for startup.

Stack Parameters and Modeled Emission Rates

Operating Mode	Exit Velocity (fps)	Exit Temp. (°F)	CO 1-hour (lb/hr)			CO 8-hour (lb/hr)			$PM_{10}/PM_{2.5}$ 24-hour (lb/hr)		
			Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3
Startup											
Cold Start[(1),(2)]	37.92	185.00	813.90	NA	NA	275.66	NA	NA	0.97	NA	NA
Warm Start[(1),(2)]	37.93	185.00	NA	NA	NA	NA	100.53	100.53	NA	0.37	0.37
Normal Operation[(3)]	57.83	191.20	NA	NA	NA	8.27	4.61	0.94	17.46	15.97	14.49

(1) Average exhaust velocity during startup, provided by vendor and/or Dominion.
(2) Lowest exit temperature for 60% load from performance data provided by vendor and/or Dominion.
(3) Exit velocity and temperature for the 100% load with duct burner from performance data provided by vendor and/or Dominion.

Annual Averaging Period Startup Summary

Operating Mode	hr/yr	NO_X		PM_{10}	
		lb/hr	tpy	lb/hr	tpy
Startup					
Offline	1,728	0.00	0	0.00	0
Without duct burning	811	21.70	8.8	15.51	6.3
With duct burning	6,000	25.32	76.0	21.16	63.5
Hot start	125	83.86	5.2	5.72	0.4
Warm start	25	45.74	0.6	5.29	0.1
Cold start	25	27.40	0.3	5.55	0.1
Shutdown	46	102.00	2.3	5.57	0.1
TOTALS	8,760		**93.2**		**70.4**
Normal Operation					
100% load					
Without duct burning	2,760	21.70	29.9	15.51	21.4
With duct burning	6,000	25.32	76.0	21.16	63.5
TOTALS	8,760		**105.9**		**84.9**
100% load w/o duct burners	8,760	21.70	**95.0**	15.51	**67.9**

Stack Parameters and Modeled Emission Rates for Annual Pollutants

Operating Mode	Exit Velocity (fps)	Exit Temp. (°F)	NO_X Annual (lb/hr)			$PM_{10}/PM_{2.5}$ Annual (lb/hr)		
			Turbine 1	Turbine 2	Turbine 3	Turbine 1	Turbine 2	Turbine 3
Startup[(1),(2)]	32.375	184.90	1.93	1.93	1.93	0.14	0.14	0.14
Normal Operation[(3)]								
100% with Duct Burner	57.83	191.20	19.35	19.35	19.35	15.93	15.93	15.93
100%	57.74	197.71	19.35	19.35	19.35	15.93	15.93	15.93
75%	48.32	191.50	19.35	19.35	19.35	15.93	15.93	15.93
60%	41.16	185.00	19.35	19.35	19.35	15.93	15.93	15.93

(1) Average exhaust velocity across all types of startups and shutdown, provided by the vendor and/or Dominion.
(2) Lowest exit temperature for 60% load from performance data provided by vendor and/or Dominion.
(3) Exit velocity and temperature from performance data provided by vendor and/or Dominion.

Attachment B

Class I Area Visibility Analysis Results

Number of Excursion Hours for Each Viewpoint Using FLAG Visibility Thresholds

Predicted Number of Excursion Hours Over 5 Years (at least one visibility parameter exceeding significance threshold) 3 Gas-Fired Turbines						
Wind from (degrees) -->	**0**	**10**	**20**	**30**	**Total**	**Percentage of Daytime Hours (%)**
Shenandoah Valley Overlook	5	(1)	(1)	0	5	0.02%
Dickey Ridge	94	(1)	(1)	0	94	0.43%
Signal Knob Overlook	99	(1)	(1)	16	115	0.52%
Compton Gap Road	(1)	32	16	2	50	0.23%
Lands Run Road Gate	(1)	(1)	26	0	26	0.12%
Excursion Hours(2)	114	32	27	16	189	

(1) Indicates that results for the given wind direction and viewpoint were not taken into account because the viewpoint is within 10° of the downwind axis of the source.
(2) Number of non-overlapping hours with a parameter excursion at one or more observation points.

Distribution of Excursion Hours for |C| and ΔE

Predicted Number of Excursion Hours Over 5 Years (|C| and ΔE for sky or terrain exceeding significance threshold) 3 Gas-Fired Turbines											
Observation Point -->	**Compton Gap Road**			**Dickey Ridge**		**Signal Knob Overlook**		**Lands Run**		**Shenandoah Valley Overlook**	
Wind from degrees/north -->	**10**	**20**	**30**	**0**	**30**	**0**	**30**	**20**	**30**	**0**	**30**
Hours with Contrast Excursions											
Sky Background	3	0	0	2	0	3	0	5	0	5	0
Terrain Background	32	16	2	94	0	99	16	26	0	0	0
Contrast Total	32	16	2	94	0	99	16	26	0	5	0
Hours with delta E Excursions											
Sky Background	0	0	0	7	0	9	0	5	0	4	0
Terrain Background	15	5	1	22	0	36	11	15	0	0	0
Delta E Total	15	5	1	25	0	36	11	16	0	4	0
Total Excursion Hours	**32**	**16**	**2**	**94**	**0**	**99**	**16**	**26**	**0**	**5**	**0**

Refined Number of Excursion Hours for Each Viewpoint Accounting for Realistic Visibility Parameter Thresholds

Predicted Number of Excursion Hours Over 5 Years Based on the Apparent Plume Width (at least one visibility parameter exceeding significance threshold) 3 Gas-Fired Turbines						
Wind from (degrees) -->	**0**	**10**	**20**	**30**	**Total**	**Percentage of Daytime Hours (%)**
Shenandoah Valley Overlook	3	(1)	(1)	0	3	0.01%
Dickey Ridge	16	(1)	(1)	0	16	0.07%
Signal Knob Overlook	27	(1)	(1)	2	29	0.13%
Compton Gap Road	(1)	13	4	0	17	0.08%
Lands Run Road Gate	(1)	(1)	8	0	8	0.04%
Excursion Hours(2)	33	13	8	2	56	

(1) Indicates that results for the given wind direction and viewpoint were not taken into account because the viewpoint is within 10° of the downwind axis of the source.
(2) Number of non-overlapping hours with a parameter excursion at one or more observation points.

Summary of PLUVUE II Modeling Results as Provided by the National Park Service

	Total During 5-Year Period			**Annual Average**		
View Point	**Days**	**|C| Hours**	**ΔE Hours**	**Days**	**|C| Hours**	**ΔE Hours**
Signal Knob Overlook	26	29	5	5	6	1
Dickey Ridge	14	16	3	3	3	1
Compton Gap Road	14	15	0	3	3	0
Lands Run Road Gate	8	8	5	2	2	1
Shenandoah Valley Overlook	3	3	0	1	1	0
Totals	65	71	13	14	15	3