Pamela F. Faggert
Vice President and Chief Environmental Officer

Dominion Resources Services, Inc.
5000 Dominion Boulevard, Glen Allen, Virginia 23060
Phone: 804-273-3467

Dominion®

Via Electronic and Overnight Mail

January 9, 2009

Mr. John Winkler
Massachusetts Department of Environmental Protection
Southeast Regional Office
20 Riverside Drive
Lakeville, MA 02347

Mr. Brendan McCahill
U.S. Environmental Protection Agency
New England, Region 1
One Congress Street
Boston, MA 02114-2023

Subject: Dominion Energy Brayton Point, LLC – Brayton Point Station Amended 310 CMR 7.02 Major Comprehensive Plan Approval and Prevention of Significant Deterioration Permit Application for the Closed Cycle Cooling and Unit No. 3 Dry Scrubber and Fabric Filter Projects

Dear Mr. Winkler & Mr. McCahill,

Dominion Energy Brayton Point, LLC (Brayton Point), is submitting the attached Amended 310 CMR 7.02 Major Comprehensive Plan Approval and Prevention of Significant Deterioration Permit Application for the Closed Cycle Cooling and Unit No. 3 Dry Scrubber and Fabric Filter Projects, for Brayton Point Station, located in Somerset, MA.

This amended application addresses comments received from both the U.S. Environmental Protection Agency and Massachusetts Department of Environmental Protection. Dominion is currently finalizing the Noise Analysis and will submit that information under a separate cover.

If you have any questions regarding this application for Brayton Point Station, please do not hesitate to contact Scott Lawton of Dominion Electric Environmental Services at (401) 457-9157.

Sincerely,

Pamela F. Faggert

Pamela F. Faggert

Attachment

REVISED
310 CMR 7.02 Major Comprehensive Plan Approval and Prevention of Significant Deterioration Application for the Closed Cycle Cooling and Unit 3 Dry Scrubber / Fabric Filter Projects at Dominion Energy Brayton Point, LLC

Submitted To:
Massachusetts Department of Environmental Protection
20 Riverside Drive
Lakeville, MA 02347

and

United States Environmental Protection Agency
1 Congress Street
Boston, MA 02114

Submitted By:

Dominion

Dominion Energy Brayton Point, LLC
1 Brayton Point Road
Somerset, MA 02726

Prepared By:

Epsilon

Epsilon Associates, Inc.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

August 2008
REVISED JANUARY 2009

TABLE OF CONTENTS

APPENDICES

List of Figures

List of Tables

1.0 INTRODUCTION

This application is an amendment of the original application, which was submitted to the U.S. Environmental Protection Agency (EPA) Region 1 and the Massachusetts Department of Environmental Protection (Mass DEP) on August 29, 2008 for this project. This amendment addresses comments received from both EPA and Mass DEP after their review of the original application.

1.1 Project Overview

Dominion Energy Brayton Point, LLC (Brayton Point), is a fossil fuel-fired generating facility located in Somerset, Massachusetts (see Figure 1-1). On December 17, 2007, EPA Region 1 signed an Order for Compliance for Brayton Point to implement the National Pollutant Discharge Elimination System (NPDES) permit for Brayton Point Station. In addition, MassDEP issued a similar order on March 27, 2008 (collectively, the Orders).

The Closed Cycle Cooling Project consists of installing two (2) natural draft cooling towers and supporting equipment to convert the entire facility from once through cooling to closed cycle cooling in order to meet the heat and flow effluent limits of the NPDES permit, and related equipment and operating changes.

The natural draft cooling towers will be approximately 497 feet tall and approximately 220 feet diameter at the exhaust exit. Each will be designed to circulate approximately 360,000 gallons per minute of water. A very small fraction of that water will exit the towers as drift droplets. Those drift droplets will contain dissolved solids (e.g., salts), which could become particulate matter when the water evaporates. Some of that particulate matter will be particulate matter less than 10 microns in diameter (PM10) and particulate matter less than 2.5 microns in diameter (PM2.5).

Brayton Point is also proposing a modification to its existing Massachusetts 310 CMR 7.02 Plan Approval for sulfur dioxide (SO2) control on the Unit 3 boiler. Dominion intends to install a Dry Scrubber and Fabric Filter (DS/FF) system, with an additional injection location for Powdered Activated Carbon (PAC). The Unit 3 DS/FF Project is unrelated to the Closed Cycle Cooling Project, but is concurrent with the Closed Cycle Cooling Project.

This January 2009 application revision amends the application submitted on August 29, 2008 and provides additional information regarding Best Available Control Technology (BACT), Prevention of Significant Deterioration (PSD) applicability, additional & expanded application forms, and new air quality dispersion modeling (to reflect changes in guidance and source input changes). It also provides minor updates and corrections throughout the application.

1.2 Regulatory Summary

The air related regulatory requirements applicable to the proposed Project include:

- New Source Review (NSR) which includes a demonstration of compliance with National Ambient Air Quality Standards (NAAQS) (40 CFR 51)
- Prevention of Significant Deterioration (PSD) Regulations including Best Available Control Technology (BACT) (40 CFR 52)
- Clean Air Act Amendments of 1990 (Public Law 101-549)
- Mass DEP Major Comprehensive Plan Approval (310 CMR 7.02 - BWP AQ 02)
- Mass DEP Emission Limits (310 CMR 7.02, 7.09)
- Mass DEP Requirements for BACT, (310 CMR 7.02)
- Mass DEP Noise Control Regulations and Policy (310 CMR 7.10 and Mass DEP Noise Policy 90-001)

Because the potential emission rate of particulate matter from the Closed Cycle Cooling Project exceeds modification thresholds, the Closed Cycle Cooling Project is subject to Mass DEP plan approval regulations (310 CMR 7.02). The Unit 3 DS/FF Project does not exceed modification thresholds but consistent with prior Mass DEP permitting for Brayton Point Station, the Unit 3 DS/FF Project is being included in the plan approval application because stack parameters are different than those evaluated in the prior application.

This application is a joint application and therefore serves as the PSD air permit application, subject to review and approval by EPA and Major Comprehensive Plan Approval application, subject to review and approval by Mass DEP. Specific sections are marked "Air Plan Approval Only" or "PSD Permit Only" as appropriate.

In addition, the Project is subject to Massachusetts Environmental Policy Act (MEPA) review. The MEPA certificates for EOEA No. 14235 (Cooling Tower Project Environmental Notification Form) and EOEA No. 13022 (Unit 3 SDA/FF Notice of Project Change) can be found in Appendix J.

1.3 Regarding Particulate Matter

Since the original application was filed in August 2008, regulations and regulatory interpretations of different classes of airborne particles have changed. This application addresses the different classes of airborne particles, defined below. In addition, throughout this application, Dominion specifies which class of airborne particles is being discussed.

Particulate Matter or PM refers to particles that remain airborne, regardless of size;

PM10 refers to airborne particles less than ten microns in diameter;

PM2.5 refers to airborne particles less than 2.5 microns in diameter;

Filterable particulate matter consists of particles that are solid at stack exhaust conditions, and are captured on a filter inserted into the stack;

Condensable particulate matter consists of material that is vapor at stack exhaust conditions, but promptly condenses to liquid particles at ambient conditions; and

Total particulate consists of filterable and condensable particulate.

1.4 Outline of Application

The remainder of this application is organized as follows.

Section 2 provides a detailed description and estimate of emissions for the proposed Project.

Section 3 describes the Federal, state and local air quality regulations applicable to the Project.

Section 4 is the Best Achievable Control Technology (BACT) Analysis for the Project.

Section 5 describes the air quality modeling methodology and results for compliance demonstration.

Appendix A includes the application forms; Appendix B contains Supporting Calculations; and additional Appendices provide supplemental information.

G:\Projects2\MA\Somerset\2352\Rare_Species\locus_usgs.mxd

Brayton Point Cooling Tower Project **Somerset, Massachusetts**

Epsilon ASSOCIATES INC.

Figure 1-1
Station Location

2.0 PROJECT DESCRIPTION AND EMISSIONS

2.1 Description of Project Site

Brayton Point is New England's largest fossil-fueled power station, with a total installed generating capacity of about 1,600 megawatts (MW) and supplies 16 percent of the electricity used in Massachusetts and 8 percent of New England's needs. The Station has three coal-fired units (Units 1-3), and one oil- and natural gas-fired unit (Unit 4). Units 1 and 2 are ~250 MW tangential-fired units that began commercial operation in 1963 and 1964, respectively, and burn coal as their primary fuel, supplemented with natural gas or No. 6 fuel oil. Unit 3 is a ~650 MW supercritical once through double reheat wall-fired unit that began commercial operation in 1969 and burns coal as its primary fuel, supplemented with No. 6 fuel oil or natural gas. Unit 4 is a ~450 MW wall-fired unit that began commercial operation in 1974 and burns No. 6 fuel oil and natural gas as its primary fuels. Associated facilities include an aboveground fuel oil storage tank farm and associated piping transfer systems, a coal storage pile and coal handling equipment, a marine fuel receiving terminal, a wastewater treatment system, active and closed landfills for wastewater treatment system solids and electric switching and transmission equipment.

Brayton Point Station is situated on approximately 256 acres in Somerset, Massachusetts and is located about 50 miles south of Boston and 13 miles east of Providence, R.I. The station is located south of US I-195 and east of the City of Fall River (Figure 1-1) and is accessed by a public street (Brayton Point Road) and is bounded on the east by the Taunton River, the Lee River to the west, Mt. Hope Bay to the south, and undeveloped fields to the north.

The proposed Closed Cycle Cooling Project will be located in the northwestern portion of Brayton Point's facility. The Unit 3 DS/FF project will be located immediately south of Unit 3.

Figure 2-1 shows an aerial view of the site and surroundings. The figure shows the coastal setting along Mount Hope Bay and the diverse nature of the surrounding land uses. The area surrounding the proposed plant includes a mix of water, industrial, commercial, urban and suburban residential land uses. The preliminary locations for the natural draft cooling towers are shown in the figure. Figure 5-3 is a site plan for Brayton Point Station that shows the locations of the cooling towers and the DS/FF equipment.

2.2 Project Description

2.2.1 Cooling Tower Project

Brayton Point plans to build and operate natural draft cooling tower(s), on an approximate ten-acre portion of the northwest corner of the facility. Supporting activities will include new water storage basins, relocation of the existing wastewater treatment system, and installation of new project piping to convey the cooling water to the new cooling towers.

Figure 2-2 shows a typical natural draft cooling tower schematic. The condenser discharge from Units 1, 2, 3 and 4 will be pumped to the cooling towers, cooled and recirculated back to the condensers. The shell of the tower is constructed of reinforced concrete since it is a strong material that effectively resists corrosion. The warm saltwater from the condensers is pumped up to the hot water distribution system which is just above the towers air inlet. The flow is distributed evenly across the tower at this level and dispersed into small droplets over the top of an internal heat exchange surface (fill). This zone is the heat transfer section and fills the lower cross-section of the tower. The water then falls by gravity through the heat transfer section to a basin at ground level where it is collected and is returned to the condenser. In the process, as the water droplets fall through the heat transfer section, the water is cooled by air contact and the evaporation of a small portion of the water into the ambient air which simultaneously flows up through the tower in the opposite direction of the falling water.

After passing the heat transfer section, the warm air moves through the drift eliminators where most of the entrained droplets of circulating water are removed and returned to the tower basin. The air is induced to move through the tower by the natural chimney effect created by its tall shell and the warmed temperature of the air after is absorbs the waste heat of the condenser discharge. In order to obtain the required chimney effect these towers have to be extremely large both in height and diameter.

2.2.2 Unit 3 DS/FF Project – Unit 3 Modifications

Brayton Point intends to install a DS/FF system on Unit 3. Figure 2-3 shows the Unit 3 Post-Retrofit Configuration Process Flow Diagram. Dry Scrubber (DS) systems are widely utilized in the coal-fired power plant industry to reduce emissions of SO2 from the combustion of coal. The hot flue gas from each boiler will be ducted to a dry flue gas desulfurization (FGD) scrubbing system, which is followed by a fabric filter. The scrubbed flue gas from the discharge of the fabric filter would be emitted to the atmosphere through the existing Unit No. 3 stack.

In the absorber system, SO2 is removed from the flue gas with a slaked lime reagent (CaO). The removal of the SO2 occurs according to the following reactions:

Ca(OH)2 + SO2 => CaSO3 · ½H2O + ½H2O (dominant reaction)

$CaSO_3 \cdot \frac{1}{2}H_2O + \frac{1}{2}O_2 + 1\frac{1}{2}H_2O \Rightarrow CaSO_4 \cdot 2H_2O$ (minimal $CaSO_3$ available)

The resulting cooled flue gas is then ducted to the fabric filter where the dry reaction byproducts are removed from the flue gas. These byproducts are the mixture of unreacted calcium hydroxide, calcium sulfite, calcium sulfate, lime grit, and fly ash, which are all removed from the fabric filter with a pulse-jet cleaning system. Additional SO2 reduction takes place in the baghouse. The pulse jet system sends the solids to the fabric filter hoppers. A portion of the solids are recycled back to the DS system for additional SO2 removal.

Powder Activated Carbon (PAC) injection systems are utilized to reduce emissions of Hg from the combustion of coal. PAC is injected into the hot flue gas upstream of the DS/FF. The gas phase mercury in the flue gas contacts the PAC and attaches to its surface. The PAC with the mercury attached, is then collected by the fabric filter.

The Unit 3 PAC injection system is as-described in the June 2006 Non-Major Comprehensive Plan Approval (NMCPA) application. PAC is currently injected upstream of the electrostatic precipitators (ESPs). That PAC injection point and the Research Cottrell ESPs will remain in-place. This application proposes installing an additional PAC injection location upstream of the DS/FF. This location will serve as the primary injection point once the DS/FF is in service.

2.2.3 Unit 3 DS/FF Project – Material Handling Modifications

The proposed SO_2 and mercury control technologies for Unit 3 at Brayton Point will result in additional dry material handling and storage activities at the facility. Lime is used in the dry scrubber system and a calcium sulphite/sulphate byproduct will be produced by the dry scrubber. Powdered activated carbon (PAC) will be pneumatically injected upstream of the dry scrubber and will be collected with the dry scrubber byproduct. Dry scrubber byproduct will be collected in fabric filter, discharged to storage silos, and transported off site. State-of-the-art control measures (storage silos with bin vents, fully enclosed transfer piping systems and baghouses) will be employed so that the operations are exempt from permitting and the increase in dry material handling emissions is minimal (310 CMR 7.03(12) and (22)). Lime and PAC will be delivered in enclosed bulk trucks and pneumatically discharged through piping to storage silos. Delivery of bulk lime by ship is a future consideration. The ship would unload via pneumatic transport piping system to the storage silos. Dry byproduct will be wetted and discharged into covered trucks or dry unloaded into enclosed bulk trucks, to be transported off site.

Lime will be delivered to the facility via enclosed bulk trucks or possibly by ships in the future. For ship delivery, the lime will be discharged via a pneumatic transport system. The pneumatic lime transport system will be an enclosed piping system to minimize emissions. For truck delivery, the lime will pneumatically conveyed from the truck to the lime storage silos via an enclosed piping system. The pneumatic transfer system will transfer from the ship to lime storage silos that will utilize bin vents.

PAC will be delivered to the facility via enclosed bulk trucks. The pneumatic PAC transport system will be an enclosed piping system to minimize emissions. The PAC will be pneumatically conveyed from the truck to the PAC storage silos via an enclosed piping system. From the storage silo, PAC will injected upstream of the dry FGD process through an enclosed pneumatic piping system.

Dry byproduct from the dry scrubber will be pneumatically conveyed from the fabric filter baghouses to the byproduct storage silos via an enclosed transport piping system. The storage silos utilize bin vents, exhaust fans that are piped back to the silos, and a pug mill that wets byproduct prior to discharge, to minimize any dust. Wetted byproduct is discharged into covered dump trucks, which are partially enclosed within the truck bay. Enclosed bulk trucks may also be loaded, if necessary, via a dry unloading system which utilizes a blower system to minimize dust.

Water use for the Unit 3 dry scrubber is described in Appendix L.

2.3 Cooling Towers - Source Emissions Discussion

EPA, in its AP-42 emission factor document[1], describes cooling tower drift as follows:

> *"Because wet cooling towers provide direct contact between the cooling water and the air passing through the tower, some of the liquid water may be entrained in the air stream and be carried out of the tower as "drift" droplets. Therefore, the particulate matter constituent of the drift droplets may be classified as an emission.*
>
> *Because the drift droplets generally contain the same chemical impurities as the water circulating through the tower, these impurities can be converted to airborne emissions. Large drift droplets settle out of the tower exhaust air stream and deposit near the tower. This process can lead to wetting, icing, salt deposition, and related problems such as damage to equipment or to vegetation. Other drift droplets may evaporate before being deposited in the area surrounding the tower, and they also can produce PM10 emissions. PM10 is generated when the drift droplets evaporate and leave fine particulate matter*

1 "Compilation of Air Pollutant Emission Factors", Office of Air Quality Planning and Standards, US EPA (AP-42), Chapter 13 Section 4, 1/95, available at http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s04.pdf

formed by crystallization of dissolved solids. [EPA AP-42 13.4, 1/95]"

The EPA AP-42 document goes on to say:

*"a **conservatively high** PM10 emission factor can be obtained by (a) multiplying the total liquid drift factor by the total dissolved solids (TDS) fraction in the circulating water and (b) assuming that, once the water evaporates, all remaining solid particles are within the PM10 size range."*

The emphasis on *conservatively high* is in the original document.

Dominion utilized the following EPA AP-42 method for calculating the PM/PM10/PM2.5 emissions from the Brayton Point Closed Cycle Cooling Project:

$$H_2O\ Drift\left(\frac{lb}{hr}\right) = \left(FlowRate\ \frac{gal}{\min}\right)(Drift\ Percent\ (\%))\left(Conversion\ \left(\frac{\min}{hr}\right)\right)\left(DensityH_2O\frac{lb}{gal}\right)(\#\ of\ Cooling\ Towers)$$

$$PM\ Emissions\left(\frac{lb}{hr}\right) = \frac{\left(H_2O\ Drift\ \left(\frac{lb}{hr}\right)\right)(lbTDS)}{1{,}000{,}000\ lbH2O}$$

$$PM\ Emissions\ (TPY) = \left(PM\ Emissions\ \left(\frac{lb}{hr}\right)\right)\left(Hours\ of\ Operation\ \frac{hr}{yr}\right)$$

Table 2-1 Given Parameters and Results

Parameter	Value	Description
Flow Rate	360,000	gallons/minute circulating water flow
# of Cooling Towers	2	
Drift Percent	0.0005%	drift rate (best available drift eliminators)
Density H_20	8.57	pounds/gallon salt water density
Maximum TDS	48,000	maximum dissolved solids concentration (ppmw)
Operating Hours	8,760 hrs	hours/year potential operation
Min to Hour Conversion Factor	60	Minutes per hour
PM/PM10/PM2.5 Emissions (lb/hr)	88.8	pounds/hour solids drift (2 towers)
PM/PM10/PM2.5 Emissions (tons/yr)	389	tons/year potential solids drift (2 towers)

This therefore represents a *conservatively high* PM/PM10/PM2.5 emission rate estimate. The emission rate is a function of:

1. gallons per minute circulating water flow;
2. drift rate; and
3. solids concentration.

As detailed above, the AP-42 calculation method has 3 variables and Dominion proposes to monitor those variables using the following methodology. The circulating water flow will be determined based upon the circulating water pump curves. This is a widely accepted methodology used for the NPDES program. The circulating water pumps will not have variable speed drives and therefore the pump flow is essentially fixed at the design capacity of the pump and the only variable is if the pump is on or off. The circulating water flow will be fixed at the design capacity of the pump. The drift rate will be fixed at 0.0005% based upon the results of the BACT analysis. The total dissolved solids (TDS) will be quantified by using a conductivity monitor capable of measuring TDS. Conductivity is a measure of water's ability to conduct an electric current and is directly related to the total dissolved salt content of the water. This is because the salts dissolve into positive and negative ions that can conduct an electrical current proportionately to their concentration.

All projected PM/PM10/PM2.5 emissions from the Closed Cycle Cooling Project are filterable emissions; no condensable emissions are expected.

2.4 Unit 3 Dry Scrubber / Fabric Filter – Source Emissions Discussion

Regarding Unit 3 emissions after the completion of the DS/FF Project:

- **Potential Emissions** of PM/PM10/PM2.5 will decrease, to comply with the EPA PSD requirement to meet BACT.

- **Potential Emissions** of other pollutants will remain the same.

- **Expected Actual Emissions** of filterable PM/PM10/PM2.5 will increase. The projected increase in filterable PM/PM10/PM2.5 emissions will occur because the proposed dry scrubber and fabric filter, while still meeting BACT, is projected to have higher actual filterable PM/PM10/PM2.5 emissions than the existing ESPs. Stack test data (filterable PM only) for Unit 3 with the existing ESPs shows very low emissions.

- **Expected Actual Emissions** of total PM/PM10/PM2.5 (including condensable PM/PM10/PM2.5) will decrease. Brayton Point Station has no site-specific condensable PM, PM10, or PM2.5 test data for Unit 3. Using EPA AP-42 emission factors to calculate baseline actual condensable particulate emissions, there is a decrease in total PM, PM10 and PM2.5.

- **Expected Actual Emissions** of sulfur dioxide, acid gases, and mercury will decrease. This is the intent of this pollution control project.

- **Expected Actual Emissions** of volatile organic compounds (VOC) will increase by less than one percent. The additional VOC is from organic material in the water used in the dry scrubber.

- **Material Handling** PM/PM10/PM2.5 emissions are not expected to be significant. The additions of the Unit 3 dry scrubber lime and PAC handling and storage, and the increased handling of the dry scrubber byproduct will result in a minimal increase of potential PM/PM10/PM2.5 emissions from equipment that is exempt from permitting. Sources of potential PM/PM10/PM2.5 emissions would be from byproduct loading and building ventilation, but as noted in Section 3, all operations associated with the final design are anticipated to meet plan approval exemption criteria. All projected PM/PM10/PM2.5 emissions from material handling are filterable emissions.

Except for particulate matter, Unit 3 potential emissions after the DS/FF project will remain unchanged from the current emission rates, as described in the June 2006 NMCPA application. A detailed analysis of the potential emissions can be found in Appendix B. The data in the table below are taken from Table 3-2 of that application, with the exception of PM:

Table 2-2 Unit 3 Proposed Potential Emissions (tons/yr)

Pollutant	Unit 3 Existing Potential Emissions (tons/yr)	Unit 3 Proposed Potential Emissions (tons/yr)	Proposed Project Potential Emissions Net Increase / Decrease (tons/yr)
NOx	11,146	11,146	0
CO	4,111	4,111	0
VOC	58.2	58.7	+0.5
SO2	59,941	59,941	0
Filterable PM	1,982	248	-1,734
Filterable PM10[1]	1,982	248	-1,734
Filterable PM2.5[1]	1,982	248	-1,734
Total PM[1]	1,982	619	-1,363
Total PM10[1]	1,982	619	-1,363
Total PM2.5[1]	1,982	619	-1,363
Sulfuric Acid	1,586	1,586	0
Ammonia	25.0	25.0	0
Lead	0.0107	0.0107	0
Mercury	0.0503	0.0503	0

[1] – Brayton Point does not currently have a permit limit for filterable PM10 or PM2.5, total PM, PM10 and PM2.5 but for consistency we have shown these pollutants. We have conservatively assumed that all PM is equal to PM10 which is equal to PM2.5. See Appendix B for a detailed PTE netting analysis.

2.5 Condensable Particulate Emissions

Particulate emissions generally consist of two categories: filterable and condensable.

It is not expected that the particulate emissions from the Closed Cycle Cooling Project will consist of condensable particulate emissions. As described in Section 2.3 above, the expected particulate emissions are salts.

Regarding the Unit 3 DS/FF Project, previous permitting, modeling, and testing have been exclusively on filterable particulate emissions. Based on input from the EPA and the Mass DEP, this permit application amendment includes condensable emissions.

This application includes a modeling demonstration of compliance with ambient air quality standards that addresses emissions from Units 1, 2, and 4 as currently configured. Even though prior permitting and modeling has been based on filterable-only emissions, Dominion accepts that for the purposes of this modeling demonstration the potential emissions have sufficient conservatism that they can be considered to include both filterable and condensable particulate emissions.

G:\Projects2\MA\Somerset\2352\Rare_Species\locus_ortho.mxd

Brayton Point Cooling Tower Project **Somerset, Massachusetts**

Epsilon Associates Inc.

Figure 2-1

Aerial View of Site and Surroundings

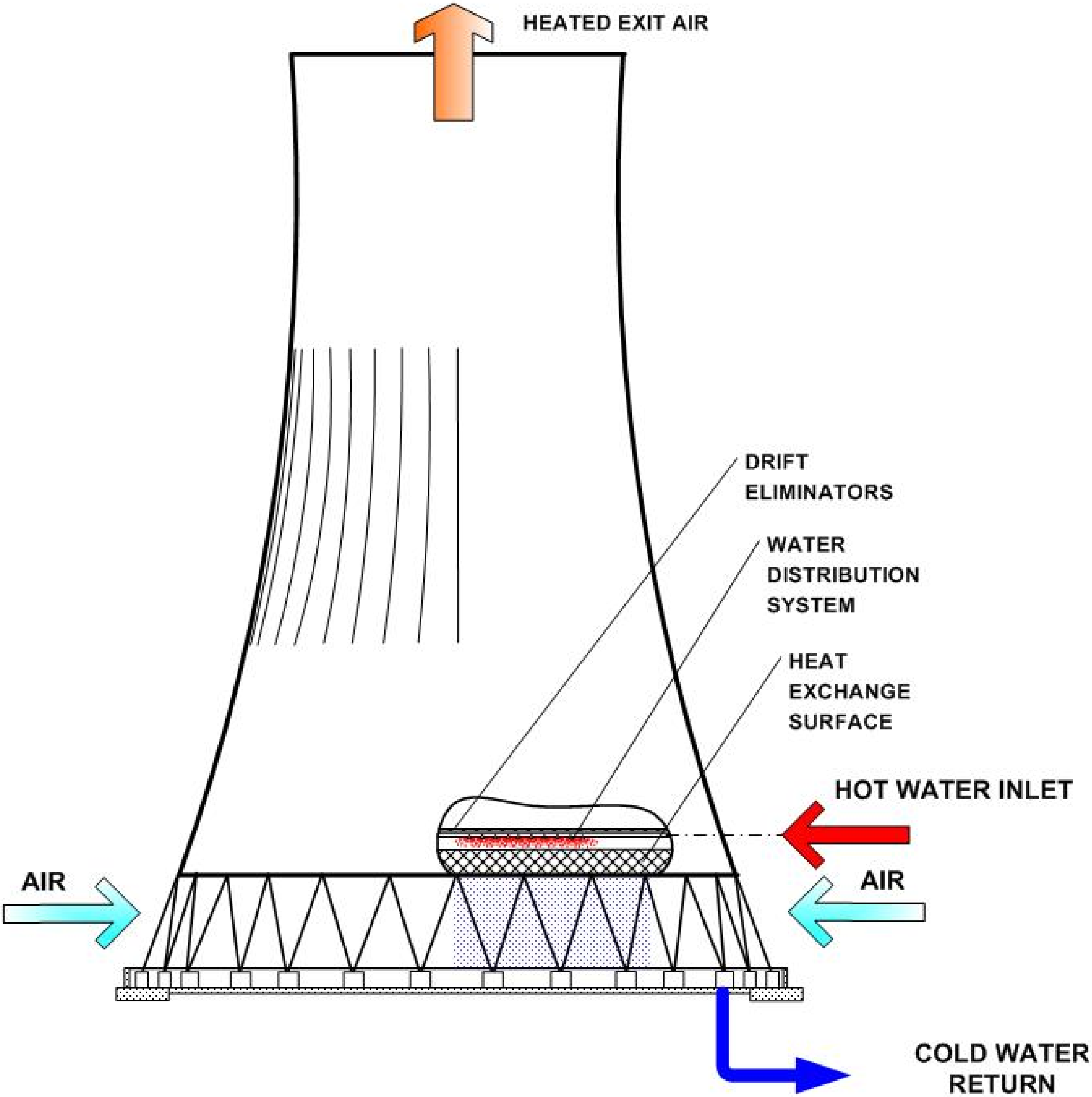
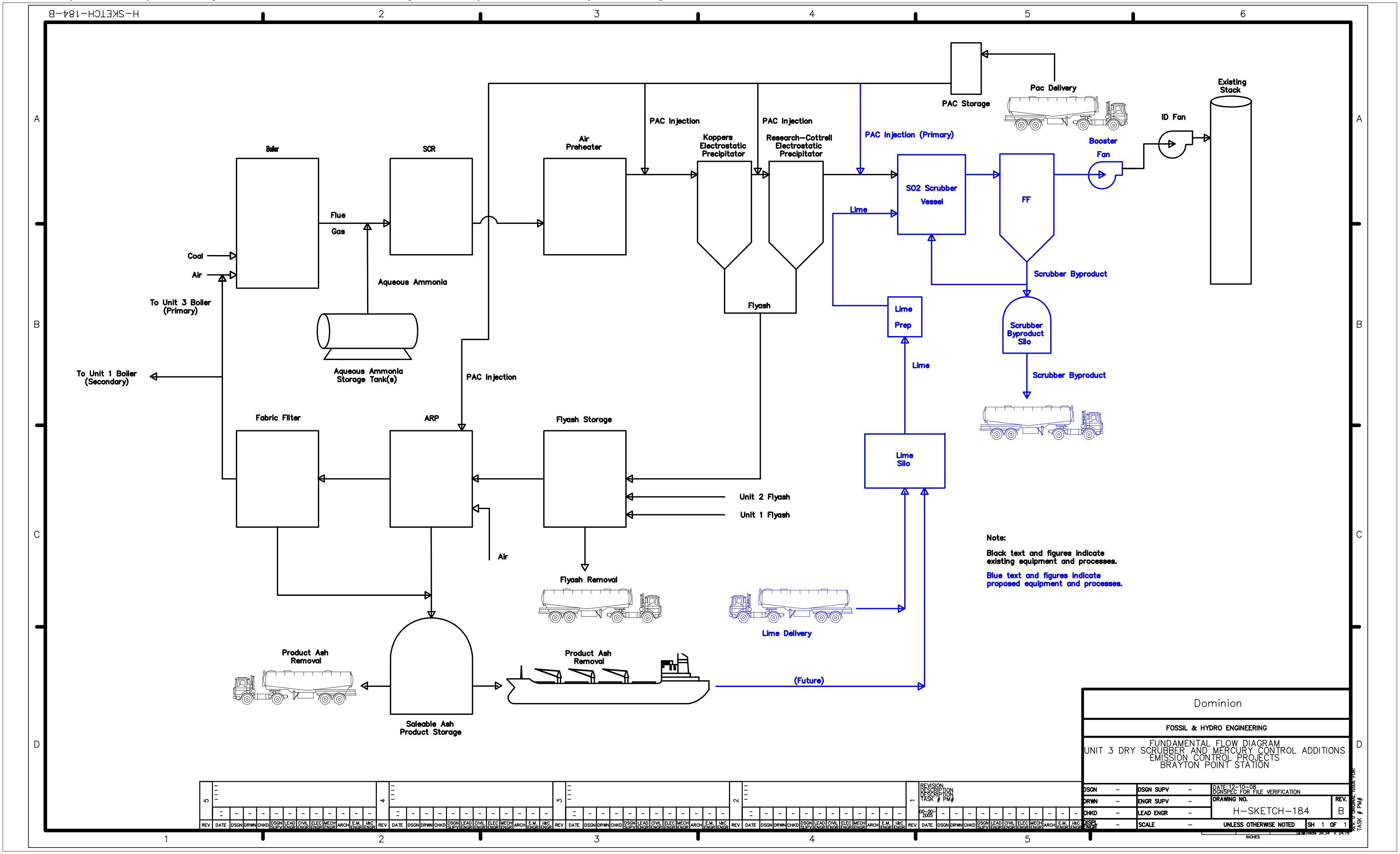


Figure 2-2: Typical Natural Draft Cooling Tower Schematic

Natural Draft Tower Schematic

SPX Cooling Technologies
Balcke | Hamon Dry Cooling | Marley



Brayton Point Cooling Towers Project Somerset, Massachusetts

Epsilon ASSOCIATES INC.

Figure 2-3

Unit 3 Post-Retrofit Configuration Process Flow Diagram

3.0 APPLICABLE REGULATORY REQUIREMENTS

Under federal and state air laws, the Mass DEP and the EPA has promulgated air quality regulations that establish ambient air quality standards and emission limits. These standards and limits impose design constraints on new facilities and provide the basis for an evaluation of the potential impacts of proposed projects on ambient air quality. This section briefly describes these regulations and their relevance to the proposed Project. These regulations include: (1) National Ambient Air Quality Standards (NAAQS); (2) New Source Review (NSR) and Prevention of Significant Deterioration (PSD) requirements; and (3) New Source Performance Standards (NSPS) for criteria pollutants. In Massachusetts, compliance with these regulatory requirements and separate Massachusetts requirements are implemented through the Mass DEP Air Plan Approval process.

Regulatory requirements are summarized in Table 3-1, below:

Table 3-1 Summary of Applicable Requirements

Regulatory Program	Applicability
Ambient Air Quality Standards and Policies	Applies and compliance is documented through air quality dispersion modeling in the PSD permit & air plan approval processes
Prevention of Significant Deterioration (PSD) Review	Applies and is satisfied through this PSD air permit application
Non-Attainment New Source Review	Does not apply
New Source Performance Standards	Does not apply
National Emission Standards for Hazardous Air Pollutants	Does not currently apply
Emissions Trading Programs	Facility is subject to RGGI and CAIR; CAMR has been recently vacated
310 CMR 7.29 – Emissions Standards for Power Plants	Applies and is satisfied through the attached Emission Control Plan approval (Appendix D)
Visible Emissions	Applies and will be complied with
Short-term NO_2 Policy	Does not apply
Noise Control Regulation and Policy	Applies and is satisfied through the noise analysis (Appendix E) in the air plan approval process
Air Plan Approval	Applies and is satisfied through this air plan approval application
Operating Permit	Applies and will be satisfied through an operating permit modification application after PSD permit and air plan approval are issued

3.1 Ambient Air Quality Standards and Policies

The EPA has developed NAAQS for six air contaminants, known as criteria pollutants, for the protection of public health and welfare. These criteria pollutants are sulfur dioxide (SO2); particulate matter having a diameter of 10 microns or less (PM10); particulate matter having a diameter of 2.5 microns or less (PM2.5); nitrogen dioxide (NO2); carbon monoxide (CO); ozone (O3); and lead (Pb). The Mass DEP has also promulgated these limits, plus it has also adopted a 1-hour ambient guideline limit for NO_2 as the Massachusetts Ambient Air Quality Standards (MAAQS). The state and federal ambient air quality standards are listed in Table 3-2.

Table 3-2 National and Massachusetts Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS (μg/m3)		MAAQS (μg/m3)	
		Primary	Secondary	Primary	Secondary
Nitrogen Dioxide	Annual(1)	100	Same	100	Same
Sulfur Dioxide	Annual(1) 24-hour(2) 3-hour (2)	80 365 --	-- -- 1,300	80 365 --	-- -- 1,300
PM10	24-hour(2,4)	150	Same	--	--
PM2.5	Annual(5) 24-hour(6)	15 35	Same Same	-- --	-- --
Carbon Monoxide	8-hour(2) 1-hour(2)	10,000 40,000	Same Same	10,000 40,000	Same Same
Ozone	8-hour(7)	0.08	Same	0.075 ppm	Same
Lead	3-month(1)	1.5	--	1.5	--

(1) Not to be exceeded.
(2) Not to be exceeded more than once per year.
(3) Not to be exceeded more than an average of 1 day per year over 3 years.
(4) Not to be exceeded by the arithmetic average of the annual arithmetic averages from 3 successive years.
(5) Not to be exceeded by the annual arithmetic mean.
(6) Not to be exceeded, the 98th percentile 24-hour concentration.
(7) Not to be exceeded, the average of the annual fourth-highest daily maximum. EPA is reducing the standard to 0.075 μg/m3
Source: 40 CFR 50 and 310 CMR 6.00

The NAAQS consist of primary and secondary standards. Primary standards are intended to protect human health. Secondary standards are intended to protect public welfare from known or anticipated adverse effects associated with the presence of air pollutants, such as damage to property or vegetation. NAAQS have been developed for various durations of exposure. Generally, the NAAQS for short-term periods (24 hours or less) refer to limits that generally cannot be exceeded for exposures averaged over 3 months or longer (typically 1 year).

One of the basic goals of federal and state air regulations is to ensure that ambient air quality, including the impact of background, existing sources, and new sources, is in compliance with ambient standards. Toward this end, all areas of the country have been classified as in "attainment," "non-attainment", or "unclassified" for a particular contaminant.

The Town of Somerset in Bristol County is presently designated as unclassified (treated as attainment) or attainment for SO_2, CO, PM10, PM2.5, and Pb. The entire Commonwealth of Massachusetts, including Bristol County is classified as moderate non-attainment for O_3 (8-hr standard).

Mass DEP regulates compliance with NAAQS and MAAQS through the Massachusetts Air Plan Approval process, discussed below.

3.2 Prevention of Significant Deterioration (PSD) Review

Prevention of Significant Deterioration review is a federally mandated program for review of new major sources of criteria pollutants or major modifications to existing sources. The Closed Cycle Cooling Project qualifies as a major modification to an existing PSD source for PM/PM10/PM2.5. Additionally, this application treats the Unit 3 DS/FF project as a major modification to an existing PSD source for PM/PM10/PM2.5. Details of the PSD netting analysis are included in Appendix N.

Prior permitting of the air pollution control systems at Brayton Point Station have not been subject to PSD review because the modifications qualified under a pollution control exemption. That pollution control exemption is no longer available.

EPA administers the PSD permitting process in Massachusetts. This application serves as both the Mass DEP plan approval application and the EPA PSD permit application; some specific sections are marked "Plan Approval Only" or "PSD Permit Only" as appropriate.

Under the PSD Review program, this documents that both the Closed Cycle Cooling Project and the Unit 3 DS/FF Project meet BACT. This PSD permit application also includes an analysis of primary and secondary NAAQS, a secondary impact analysis, and a growth analysis.

3.3 Non-Attainment New Source Review

If an area is designated as "non-attainment" for a given contaminant and if the proposed facility is a major source of the non-attainment contaminant, a procedure known as Non-Attainment New Source Review (NSR) applies. The Non-Attainment NSR regulations have more stringent requirements than PSD review for source control and for securing emissions offsets.

As discussed in Section 3.1, above, the entire Commonwealth of Massachusetts is classified as a serious non-attainment area for O_3. However, because O_3 is not directly emitted, it is considered a secondary pollutant that is photochemical produced as a function of both VOC and NOx emissions. Therefore, VOC and NO_x are regulated as the precursors of O_3. Non-attainment NSR relative to O_3 is required only for new major sources of VOC and/or NO_x or major modifications at existing major sources.

Brayton Point Station is a major source, however this project is not a major modification for NOx or VOC. Therefore, Non-Attainment NSR does not apply.

3.4 New Source Performance Standards

New Source Performance Standards (NSPS) regulate the amount of air contaminants that may be emitted from a given process. For combustion sources, emission standards are typically expressed in terms of mass emissions per unit of fuel combusted, fuel quality, or exhaust gas concentration. The EPA has established NSPS for various categories of new sources.

The Closed Cycle Cooling project is not subject to any NSPS.

The Unit 3 DS/FF project does not trigger any requirements under 40 CFR 60 Subpart Da. 40 CFR Part 60, Subpart Da, applies to electric utility steam generating units greater than 250 MMBtu/hr, which commence construction (including reconstruction) or modification after September 18, 1978. As described below, the proposed emission control equipment does not trigger NSPS applicability under modification or reconstruction provisions.

A modification is defined in 40 CFR 60.14(a) as "Except as provided under paragraphs (e) and (f) of this section, any physical or operational change to an existing facility which results in an increase in the emission rate to the atmosphere of any pollutant to which a standard applies shall be considered a modification within the meaning of section 111 of the Act." 40 CFR 60.14(e)(5) states that a modification does not include "The addition or use of any system or device whose primary function is the reduction of air pollutants, except when an emission control system is removed or is replaced by a system which the Administrator determines to be less environmentally beneficial".

Installation of the Unit 3 DS/FF project does not increase the maximum short-term (lb/hr) emission rates or potential emissions of any of the pollutants regulated under NSPS Subpart Da (NOx, SO2 and PM); also the Unit 3 DS/FF project involves adding an air pollution control device. As such, Unit 3 is not subject to the requirements of Subpart Da.

Reconstruction is defined in 40 CFR 60.15 as "replacement of components of an existing facility to such an extent that: 1) The fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable entirely new facility, and 2) It is technologically and economically feasible to meet the applicable standards set forth in this part."

Since the addition of pollution control devices does not constitute "replacement of components," the cost calculation does not enter into the applicability determination.

3.5 National Emission Standards for Hazardous Air Pollutants

Realizing that numerous pollutants did not meet the specific criteria for development of a NAAQS, Congress included Section 112 in the 1970 Amendments of the CAA to specifically address this problem. Section 112 provides the EPA with a vehicle for developing standards for potentially hazardous pollutants.

The regulations that have been developed to implement Section 112(b) are presented in 40 CFR Parts 61 and 63.

The Closed Cycle Cooling Project is not subject to any standards under 40 CFR 61 or 63. Note that 40 CFR 63 Subpart Q applies to "industrial process cooling towers that are operated with chromium-based water treatment chemicals." The Closed Cycle Cooling Project serves an electric generating process, not an industrial process, and in any event will not use any chromium-based water treatment chemicals.

Unit 3 is not subject to any standards under 40 CFR 61 or 63. As of March 15, 2005, utility boilers were delisted from Section 112 Maximum Achievable Control Technology (MACT) consideration in conjunction with passage of the Clean Air Mercury Rule. On February 8, 2008, the D.C. Circuit vacated EPA's rule removing power plants from the Clean Air Act list of sources of hazardous air pollutants. At the same time, the Court vacated the Clean Air Mercury Rule. Per EPA's website[2] EPA is reviewing the Court's decisions and evaluating its impacts.

3.6 Emissions Trading Programs

Pursuant to 40 CFR 72, Units 1-4 are affected units under the Acid Rain Program. Neither the Closed Cycle Cooling Project nor the Unit 3 DS/FF project changes Brayton Point Station's status under the Acid Rain Program.

The DC Circuit Court vacated the Clean Air Mercury Rule on February 8, 2008, and the Clean Air Interstate Rule on July 11, 2008. The DC Circuit Court remanded the Clean Air Interstate Rule on December 23, 2008 back to EPA. To address these events, Mass DEP may continue the NOx Budget program (310 CMR 7.28) past its sunset date of 12/31/08. Neither the Cooling Tower Project nor the Unit 3 DS/FF project changes Brayton Point Station's status under CAMR, CAIR, or NOx Budget programs.

---

2 http://epa.gov/air/mercuryrule/

The Brayton Point Station is subject to Regional Greenhouse Gas Initiative (RGGI) requirements per 310 CMR 7.70, a market-based CO_2 reduction program. Neither the Cooling Tower Project nor the Unit 3 DS/FF Project changes Brayton Point Station's status under the RGGI program.

3.7 310 CMR 7.29 – Emissions Standards for Power Plants

310 CMR 7.29 regulations control emissions of NOx, SO2, Hg, and CO2 from affected facilities in Massachusetts, including Brayton Point Station. The Unit 3 DS/FF Project is part of Brayton Point Station's installation of new emission control technology to meet 310 CMR 7.29 standards.

As required by the regulation, Brayton Point filed an Emission Control Plan (ECP) for the Brayton Point Station on December 20, 2001, and subsequently amended on July 29, 2004, December 6, 2005, August 25, 2008 and October 28, 2008. The most recent amendment, filed October 28, 2008, updates Dominion's proposal to comply with Rule 7.29 requirements to reflect installation of the Unit 3 DS/FF rather than a wet scrubber. The ECP amendment was approved on December 29, 2008 and is included in Appendix D.

3.8 Visible Emissions

Opacity from the cooling towers will only consist of condensed water vapor, which is specifically excluded from regulation under 310 CMR 7.06(1)(b).

Opacity from combustion is limited by Massachusetts regulation (310 CMR 7.06) which states opacity shall not exceed 20% opacity for a period or aggregate period of time in excess of two minutes during any one hour provided that, at no time during the said two minutes shall the opacity exceed 40% The Unit 3 DS/FF project will not affect the ability of Unit 3 to comply with this limit.

3.9 Short-term NO_2 Policy

On April 20, 1978 and in an update on November 3, 1980 Mass DEP adopted a policy entitled "New Source Performance Criteria for Allowable Ambient NO_2 Concentrations." The policy applies only to new major sources or modifications to an existing source, which would result in increased emissions of 250 tpy of NO_x. The Cooling Tower Project and the Unit 3 DS/FF Project do not cause increased emissions of NOx; therefore this policy does not apply.

3.10 Noise Control Regulation and Policy

Mass DEP regulations, set forth in 310 CMR 7.10 and as interpreted in the Mass DEP Noise Policy 90-001, limit noise increases to 10 dBA over the existing L_{90} ambient level at the closest residence and at property lines. For developed areas, the Mass DEP has utilized a "waiver provision" at the property line in certain cases. This may occur when the impact is in an area that is not noise-sensitive such as an adjacent industrial parcel. The ambient noise level may also be established by other means with Mass DEP consent. Mass DEP also prohibits "pure tone" sounds, defined as any octave band level that exceeds the levels in the two adjacent octave bands by 3 dB or more. A full discussion of noise considerations is provided in Appendix E.

3.11 Air Plan Approval

The Closed Cycle Cooling Project and the Unit 3 DS/FF Project are subject to Mass DEP Air Plan Approval (permit) requirements under 310 CMR 7.02. The purpose of Air Plan Approval review is to ensure that the new source will be in compliance with all applicable federal and DEP air regulatory requirements, including emission standards and ambient air quality criteria.

In addition to the federal and state limits and standards described above which are implemented through the Mass DEP Air Plan Approval review, Massachusetts regulations require the application of BACT for each regulated pollutant. The proposed Closed Cycle Cooling Project will incorporate BACT for particulate matter (PM, PM10, and PM2.5). The Unit 3 DS/FF Project is not subject to Massachusetts BACT because there is no proposed increase in potential emission rates. A detailed analysis of the potential emissions can be found in Appendix B.

Massachusetts BACT is based on the maximum degree of reduction of any regulated air contaminant that the Mass DEP determines, on a case-by-case basis, is achievable taking into account energy, environmental, and economic impacts. A BACT determination can never result in a less stringent emission limitation than an applicable emission standard. Depending on the circumstances, BACT may parallel with the emission standard or may be more stringent than the emission standard. BACT itself is a standard that balances emission control benefits with costs.

Mass DEP reviews compliance with its noise regulation and policy through the Air Plan Approval process.

3.12 Operating Permit

Brayton Point Station is subject to the operating permit requirements in 310 CMR 7.00, Appendix C. Brayton Point Station has an operating permit pursuant to this program (sometimes referred to as a "Title V" permit because the program was originally initiated by Title V of the Clean Air Act Amendments of 1990). After receipt of an Air Plan Approval, Dominion will apply to modify the operating permit to reflect the conditions of the Air Plan Approval.

4.0 BACT ANALYSIS

The Unit 3 DS/FF project is not subject to Mass DEP BACT because no increase in permitted emission limits is requested; EPA BACT will be met through the use of a fabric filter. The Closed Cycle Cooling Project will meet Mass DEP and EPA BACT through the use of drift eliminators that control drift to 0.0005% of the circulating water flow. Details are described in this Section.

4.1 Best Achievable Control Technology (BACT) Requirement

BACT is defined in the 310 CMR 7.00 as,

> . . . an emission limitation based on the maximum degree of reduction of any regulated air contaminant emitted from or which results from any regulated facility which the Department, on a case-by-case basis taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems and techniques for control of each such contaminant. The best available control technology determination shall not allow emissions in excess of any emission standard established under the New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants or under any other applicable section of 310 CMR 7.00, and may include a design feature, equipment specification, work practice, operating standard, or combination thereof.

BACT is defined in 40 CFR 52.21(b)(12) as,

> …an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of

> such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results.

The Mass DEP and EPA require a "top-down" approach to a BACT analysis. The process begins with the identification of control technology alternatives for each pollutant. Technically infeasible technologies are eliminated and the remaining technologies are ranked by control efficiency. These technologies are evaluated based on economic, energy and environmental impacts. If a technology, starting with the most stringent, is eliminated based on these criteria, the next most stringent technology is evaluated until BACT is selected.

4.2 BACT ANALYSIS – Closed Cycle Cooling

This BACT analysis follows the guidance in the New Source Review Workshop Manual, Prevention of Significant Deterioration and Nonattainment Area Permitting, USEPA Draft October 1990 document. Specific guidance from that document is included in boxes below, followed by Brayton Point's analysis based on the guidance. The BACT analysis follows the guidance in the NESCAUM BACT Guideline dated June 1991, as well as the referenced NSR Workshop Manual.

4.2.1 BACT Applicability

> The BACT requirement applies to each individual new or modified affected emissions unit and pollutant emitting activity at which a net emissions increase would occur. Individual BACT determinations are performed for each pollutant subject to a PSD review emitted from the same emission unit. Consequently, the BACT determination must separately address, for each regulated pollutant with a significant emissions increase at the source, air pollution controls for each emissions unit or pollutant emitting activity subject to review.

The Closed Cycle Cooling Project consisting of two (2) natural draft cooling towers is a new affected emissions unit at which a net emissions increase will occur. The regulated pollutants with significant emissions increases are PM, PM10, and PM2.5. Note that EPA rescinded the national ambient air quality standard for particulate matter in favor of a PM10 standard in 1987, and recent statutory and regulatory provisions impose controls and limitations on PM10, not particulate matter.

All projected PM/PM10/PM2.5 emissions are filterable emissions. Because emissions estimates and control techniques are the same for PM, PM10, and PM2.5, these classes of particulate matter are treated together in this BACT analysis.

4.2.2 Step 1–Identify All Control Technologies

> The first step in a "top-down" analysis is to identify, for the emissions unit in question (the term "emissions unit" should be read to mean emissions unit, process or activity), all "available" control options. Available control options are those air pollution control technologies or techniques with a practical potential for application to the emissions unit and the regulated pollutant under evaluation.

Available control options are:

- Air Cooled Condensers.
- Once-Through Cooling (existing configuration).
- Fresh Water.
- Mechanical Draft Cooling Towers.
- Reduction in Cycles of Concentration.
- Reduction in Air Velocity.
- Drift Eliminators.

For BACT purposes, the use of drift eliminators is divided into three levels of control:

- Drift eliminators achieving 0.001% drift rate (more PM emissions than the proposed case);
- Drift eliminators achieving 0.0005% drift rate (proposed case); and
- Drift eliminators achieving less than 0.0005% drift rate (less PM emissions than the proposed case). This includes drift eliminators achieving 0.0002, 0.0003, or 0.0004% drift rate.

For BACT purposes, the baseline alternative is considered the use of mechanical draft cooling towers with drift eliminators achieving a 0.008% drift rate. This is the highest drift rate (highest emissions) found in a search for recent approvals in the EPA RACT/BACT/LAER Clearinghouse (RBLC). A comprehensive list of relevant approvals from the RBLC can be found in Table 4-1.

> Air pollution control technologies and techniques include the application of production process or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of the affected pollutant.

Of the technologies and techniques listed above, "Reduction in Cycles of Concentration" and "Reduction in Air Velocity" qualify as application of production processes.

> This includes technologies employed outside of the United States.

The list includes technologies employed outside the United States. Dominion engineers have toured facilities in Europe in preparation for this project, and much of the experience with natural draft cooling towers is drawn from Europe.

> As discussed later, in some circumstances inherently lower-polluting processes are appropriate for consideration as available control alternatives.

Of the technologies and techniques listed above, "Once-Through Cooling," "Fresh Water," and "Air-Cooled Condensers" qualify as inherently lower-polluting processes. "Mechanical Draft Cooling Towers" are an alternative process; as discussed below it is not inherently lower-polluting.

> The control alternatives should include not only existing controls for the source category in question, but also (through technology transfer) controls applied to similar source categories and gas streams, and innovative control technologies.

"Drift Eliminators" are existing controls for the source category in question (natural draft cooling towers) but are also used for a similar source category (mechanical draft cooling towers). Brayton Point is not aware of any "innovative control technologies" not listed above.

> Technologies required under lowest achievable emission rate (LAER) determinations are available for BACT purposes and must also be included as control alternatives and usually represent the top alternative.

Brayton Point has reviewed the EPA RACT/BACT/LAER Clearinghouse and other online data sources which include LAER determinations. All applicable determinations have been included in this analysis.

This section reviews potential emissions limiting techniques to determine their applicability to the Closed Cycle Cooling Project.

4.2.3 Step 2–Eliminate Technically Infeasible Options

In the second step, the technical feasibility of the control options identified in step one is evaluated with respect to the source-specific (or emissions unit-specific) factors.

Each identified control option is evaluated with respect to emissions unit-specific factors below.

- Air Cooled Condensers. *Marginally technically feasible as a retrofit (though physical space limitations may cause it to be infeasible – see below).*
- Once-Through Cooling. *Technically infeasible based on the Orders issued by EPA and Mass DEP.*
- Fresh Water. *Technically infeasible based on physical and engineering principles.*
- Reduction in Cycles of Concentration. *Technically infeasible based on physical and engineering principles.*
- Reduction in Air Velocity. *Technically feasible.*
- Mechanical Draft Cooling Towers. *Technically feasible.*
- Natural Draft Cooling Towers. *Technically feasible.*
- Cooling tower with drift eliminators achieving 0.001% drift rate. *Technically feasible.*
- Cooling tower with drift eliminators achieving 0.0005% drift rate (proposed case). *Technically feasible.*
- Cooling tower with drift eliminators achieving less than 0.0005% drift rate (less PM/PM10/PM2.5 emissions than the proposed case). This includes drift eliminators achieving 0.0002, 0.0003, or 0.0004% drift rate. *Technically infeasible based on engineering principles.*

A demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, and engineering principles, that technical difficulties would preclude the successful use of the control option on the emissions unit under review. Technically infeasible control options are then eliminated from further consideration in the BACT analysis.

Clear documentation of technical difficulties is demonstrated below for each technically infeasible control option:

- **Once-Through Cooling**. Brayton Point Station currently uses once-through cooling to reject the heat into the waters of Mount Hope Bay. The Station is under EPA and Mass DEP Orders to discontinue once-through cooling. The use of once-through cooling is technically infeasible because it would violate the Orders.

- **Fresh Water**. The use of water with lower solids content would reduce particulate emissions from the cooling towers. There is no adequate supply of fresh water available. Historically, Brayton Point used some fresh water obtained from the Town of Somerset; this was discontinued to allow more fresh water use for Somerset residents. The quantities of fresh water needed to provide cooling to the station (up to 70 million gallons per day) exceed the volume that could be legally withdrawn from any nearby freshwater source. This technical difficulty precludes the successful use of fresh water as a control option.

- **Reduction in Cycles of Concentration**. Dominion intends to maintain approximately 1.5 cycles of concentration in the cooling tower circulating water. Reducing the cycles of concentration would reduce the salinity in the circulating water, which would in turn reduce particulate emissions. However, reductions in the cycles of concentration would increase the total water intake and discharge to Mount Hope Bay above what is allowed in Brayton Point Station's NPDES permit.

- **Drift eliminators achieving less than 0.0005% drift rate** This includes drift eliminators achieving 0.0002, 0.0003, or 0.0004% drift rate. Engineering limitations prevent consistent drift rates lower than 0.0005%. Specifically, the drift eliminators are designed with a tortuous airflow path that causes droplets to impact on the surface of the drift eliminator. Adding to that tortuous path adds to the pressure drop. Additional pressure drop will prevent the natural draft "chimney" effect that allows proper operation of the natural draft cooling tower. Also, additional pressure drop will make it more likely that airflow will bypass the drift eliminators, exiting through any gaps between the drift eliminator structures and reducing the total effective control. This is supported by the vendor documentation attached in Appendix M.

Also, air cooled condensers should be considered only "marginally feasible" for this project. To Dominion's knowledge, no plants have been retrofitted from once-through cooling to dry cooling. Such a retrofit would be inherently difficult and require especially complicated and expensive engineering, design, and construction work. The retrofit would carry a significant risk of operating failure. In addition, EPA Region 1 concurred with this determination in the July 22, 2002 Draft NPDES Permit Determination for Brayton Point Station because of uncertainty of the retrofit, cost, and energy penalty. (page 7-36 of July 22, 2002 Determination).

For example, in cases where the level of control in a permit is not expected to be achieved in practice (e.g., a source has received a permit but the project was cancelled, or every operating source at that permitted level has been physically unable to achieve compliance with the limit), and supporting documentation showing why such limits are not technically feasible is provided, the level of control (but not necessarily the technology) may be eliminated from further consideration.

Regarding drift eliminators achieving lower than 0.0005% drift rate, Brayton Point has made a good faith effort to compile appropriate information from available information sources (per EPA guidance). Information sources considered included:

- EPA's RACT/BACT/LAER Clearinghouse and Control Technology Center - Information from the Clearinghouse[3] does not show any drift rate achieved in practice below 0.0005%; details are presented below;

- Best Available Control Technology Guideline - South Coast Air Quality Management District - The Guideline[4] does not address cooling towers;

- Control technology vendors - Through the bidding process, Brayton Point determined that qualified control technology vendors would not provide guarantees for drift rates lower than 0.0005%. Correspondence with the selected vendor included in Appendix M confirms this;

- Federal/State/Local new source review permits and associated inspection/performance test reports - a good faith effort to review permits available online did not show any drift rate achieved in practice below 0.0005%, and did not find associated inspection/performance test reports;

- Environmental consultants - Consultants at Epsilon Associates, Inc. are unaware of any cooling tower achieving compliance with a drift rate limit lower than 0.0005%;

- Technical journals, reports and newsletters, air pollution control seminars - a review of papers posted by the Air and Waste Management Association[5] and the Cooling Tower Institute[6] did not document cooling tower drift rates achieved in practice below 0.0005%; and

3 http://cfpub.epa.gov/rblc/

4 http://aqmd.gov/bact/BACTGuidelines.htm

5 http://secure.awma.org/onlinelibrary/AdvancedSearch.aspx, November 26, 2008 search for "drift" and "cooling tower"

6 http://cti.org/tech_papers/drift.shtml, November 26, 2008. The papers "*An Economic Solution to Cooling Tower Drift, G.C. Pederson and Frank Power Kimre, Inc., 2005*" and "*A Review of Drift Eliminator Performance, William C. Miller, Timothy E. Krell, Brentwood Industries, Inc, 2006*" were specifically reviewed and did not document cooling tower drift rates achieved in practice below 0.0005%.

- EPA's policy bulletin board - A review of the online OAR Policy and Guidance[7] website found no references to cooling tower drift.

A review of the EPA RACT/BACT/LAER Clearinghouse (RBLC) finds recent determinations for cooling towers as summarized in Table 4-1, below.

Table 4-1 Recent Determinations for Cooling Towers

Facility	Date Permit Issued	Circulating Water Flow (gpm)	Drift Rate (%)
Ohio River Clean Fuels, LLC	11/20/2008	240	0.0005
Tate & Lyle Ingredients Americas, Inc	9/19/2008	30,000	0.0005
Nellis Air Force Base	2/26/2008	1,200	0.005
Entergy Louisiana LLC Little Gypsy Generating Plant	11/30/2007	5,000	0.001
Basin Electric Power Cooperative Dry Fork Station	10/15/2007	N/A	0.005
Aventine Renewable Energy – Aurora West LLC	9/27/2007	N/A	0.0005
Great River Energy Spiritwood Station	9/14/2007	80,000	0.0005
Minnesota Steel Industries LLC	9/7/2007	N/A	0.005
Homeland Energy Solutions LLC	8/8/2007	50,000	0.0005
Archer Daniels Midland Corn Processing - Cedar Rapids	6/29/2007	150,000	0.0005
Marathon Petroleum Co LLC Garyville Refinery	12/27/2006	up to 96,250	0.005
Progress Energy Florida Anclote Power Plant	12/22/2006	660,000	0.0005
Hillsborough County Dept. of Solid Waste Management	11/3/2006	N/A	0.001
Sunoco Inc. Toledo Refinery	9/29/2006	20,500	0.005
Asalliance Biofuels, LLC Asa Bloomingburg, LLC	8/10/2006	55,000	0.005
Western Greenbrier Co-Generation, LLC	4/26/2006	55,000	0.0005
Progress Energy Florida Crystal River Power Plant	4/4/2006	180,000	0.0015
Cleco Power, LLC Rodemacher Brownfield Unit 3	2/23/2006	301,874	0.005
Aventine Renewable Energy, Inc.	11/1/2005	N/A	0.005
Diamond Wanapa I LP Wanapa Energy Center	8/8/2005	2,783	0.0005
Public Service Company of Colorado Comanche Station	7/5/2005	140,650	0.0005

7 http://epa.gov/ttn/oarpg/new.html and http://epa.gov/ttn/oarpg/ramain.html.

Facility	Date Permit Issued	Circulating Water Flow (gpm)	Drift Rate (%)
Crescent City Power, LLC	6/6/2005	35,000	0.005
		290,200	0.0001
Newmont Nevada Energy, LLC TS Power Plant	5/5/2005	N/A	0.0005
Trigen-Nassau Energy Corp.	3/31/2005	N/A	0.0005
Omaha Public Power District OPPD – Nebraska City Station	3/9/2005	N/A	0.0005
Darrington Energy LLC Darrington Energy Cogeneration Plant	2/11/2005	N/A	0.001
BP West Coast Products LLC BP Cherry Point Cogeneration Project	1/11/2005	N/A	0.001
Dome Valley Energy Partners Welton Mohawk Generating Station	12/1/2004	170,000	0.0005
Nucor Steel, Hertford, NC	11/23/2004	N/A	0.008
Wisconsin Public Service WPS – Weston Plant	10/19/2004	N/A	0.002
Energy New Orleans Michoud Electric Generating Plant	10/12/2004	1,728	0.005 (Design 0.001)
Longview Power LLC Maidsville Station	3/2/2004	N/A	0.0002
Exxon Mobil - Baton Rouge Refinery	2/18/2004	Up to 40,000	0.003
Abengoa Bioenergy Corp. – York	1/21/2004	N/A	0.005
Ace Ethanol, LLC – Stanley	1/21/2004	N/A	0.005
Nucor Steel, Montgomery, IN	11/21/2003	Up to 60,000	0.0005
Allegheny Energy Supply LLC La Paz Generating Facility	9/4/2003	141,400	0.0005
		173,870	0.0005
United Wisconsin Grain Producers UWGP – Fuel Grade Ethanol Plant	8/14/2003	22,000	0.005
Mid American Energy Co.	6/17/2003	349,400	0.0005
Wallula Generation, LLC Wallula Power Plant	1/3/2003	N/A	0.0005
Interstate Power & Light Emery Generating Station	12/20/2002	140,000	0.005
Genova Arkansas I, LLC	8/23/2002	190,000	0.001
PCS Phosphate Co.	7/30/2002	N/A	0.0005
		N/A	0.002
Mustang Power LLC Mustang Energy Project	2/12/2002	N/A	0.004
Mustang Power LLC Horseshoe Energy Project	2/12/2002	94,638	0.001
South Texas Electric Cooperative Inc. Sam Rayburn Generation Station	1/17/2002	N/A	0.0005
Ventures Lease Company, LLC Plaquemine Cogeneration Facility	12/26/2001	N/A	0.005

As shown in the table, the vast majority of projects have drift rates of 0.0005% or greater. The West Virginia DEP permit for Longview Power Maidsville Station (effective 3/2/04) limits the cooling tower drift rate to 0.002%, not 0.0002%; the RBLC entry is apparently in error. The RBLC entry for Crescent City Power states "THIS FACILITY WAS NEVER CONSTRUCTED. THE PSD PERMIT WAS RESCINDED ON 11/1/06." Therefore, the RBLC database does not contain any entries for operating facilities meeting drift rates lower than 0.0005%.

The RBLC database generally does not indicate which cooling tower projects use fresh water and which use salt water. The Crystal River project in Florida uses salt water, with a higher drift rate limit of 0.0015%.

Therefore, following EPA guidance, the level of control (drift rate below 0.0005%) is not expected to be achieved in practice. Supporting documentation showing why such limits are not technically feasible is provided above (increased pressure drop prevents natural draft from occurring and encourages drift eliminator bypass). Therefore, the level of control (drift rate below 0.0005%) is eliminated from further consideration. The drift eliminator technology is still considered.

4.2.4 Step 3–Rank Remaining Control Technologies By Control Effectiveness

In step 3, all remaining control alternatives not eliminated in step 2 are ranked and then listed in order of over all control effectiveness for the pollutant under review, with the most effective control alternative at the top. A list should be prepared for each pollutant and for each emissions unit (or grouping of similar units) subject to a BACT analysis. The list should present the array of control technology alternatives and should include the following types of information:

- control efficiencies (percent pollutant removed);
- expected emission rate (tons per year, pounds per hour);
- expected emissions reduction (tons per year);
- economic impacts (cost effectiveness);
- environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants);
- energy impacts.

The remaining control technologies are ranked and listed in order of control effectiveness for PM/PM10/PM2.5 below, with the most effective control alternative at the top:

1. Air Cooled Condenser

2. Cooling tower with drift eliminators achieving 0.0005% drift rate

3. Cooling tower with drift eliminators achieving than 0.001% drift rate

Two additional remaining control technologies (mechanical draft cooling tower and reduction in exhaust velocity) cannot be directly ranked. The PM/PM10/PM2.5 emission rates of mechanical draft cooling towers are a function of the drift rate, controlled by drift eliminators in the same manner as natural draft cooling towers. Mechanical draft cooling towers are therefore not inherently more- or less-polluting than natural draft cooling towers. The overall control effectiveness for PM/PM10/PM2.5 cannot be quantified for reductions in exhaust velocity. These control technologies are included at the end for completeness.

4.2.4.1 Air Cooled Condenser

Control efficiencies (percent pollutant removed)	100% from baseline
Expected emission rate (tons per year, pounds per hour)	Zero tons per year, zero pounds per hour (although in actuality some small amount of PM/PM10/PM2.5 may be created through entrainment of dust off the ground or from mechanical wear of parts)
Expected emissions reduction (tons per year)	6,227 tons per year reduction from the baseline case. 389 tons per year reduction from the proposed case.
Economic impacts	Air cooled condensers would be considerably more costly. Costs are discussed in Section 4.2.5, below.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	Air cooled condensers would require significant land area, very likely beyond what is available at Brayton Point Station. Significant coastal, floodplain, and wetlands issues are possible. Because the air cooled condensers are less efficient (see energy impacts below), use of air cooled condensers would increase the air pollution rates from Brayton Point Station on pounds per megawatt-hour basis. This increase would include criteria pollutants, toxic or hazardous air contaminants, and carbon dioxide. Air cooled condensers would have additional significant noise impacts.

Energy impacts	Air cooled condensers would use significantly more energy than the baseline and proposed cases. Rough estimates indicate approximately 50 MW of auxiliary power needed.

4.2.4.2 Drift eliminators achieving 0.0005% drift rate (proposed case)

Control efficiencies (percent pollutant removed)	93.8% reduction from baseline case
Expected emission rate (tons per year, pounds per hour)	389 tons per year, 89 pounds per hour
Expected emissions reduction (tons per year)	5,838 tons per year reduction from the baseline case.
Economic impacts	The proposed 0.0005% drift eliminators are more expensive than baseline case drift eliminators. Approximate cost for proposed drift eliminators is $4.2 million for both towers.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	No specific environmental impacts relative to the baseline case.
Energy impacts	No specific energy impacts relative to the baseline case.

4.2.4.3 Drift eliminators achieving 0.001% drift rate

Control efficiencies (percent pollutant removed)	87.5% reduction from baseline case
Expected emission rate (tons per year, pounds per hour)	778 tons per year, 178 pounds per hour
Expected emissions reduction (tons per year)	5,449 tons per year decrease from the baseline case. 389 tons per year increase from the proposed case.
Economic impacts	Marginally more expensive than the baseline case. Marginally less expensive than the proposed case.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	No significant difference from the baseline case. No significant difference from the proposed case.
Energy impacts	No significant difference from the baseline case. No significant difference from the proposed case.

4.2.4.4 Mechanical Draft Cooling Tower

The emission rate for a mechanical draft cooling tower would be a function of the efficiency of the drift eliminator, the same as a natural draft cooling tower. Because a mechanical draft cooling tower has more turbulent air-water contact and higher exhaust velocity, the inherent drift that enters the drift eliminator would be higher in a mechanical draft cooling tower. However, this does not directly reflect an increase in particulate emissions out of the drift eliminator. The drift rate after the drift eliminators is not a direct function of the amount of drift entering the drift eliminators.

Regarding economic impacts, broadly mechanical draft cooling towers have lower capital and higher operating costs than natural draft cooling towers. Given project-specific conditions (e.g. noise and safety – see below), a mechanical draft cooling tower would have a higher economic impact than a natural draft cooling tower at Brayton Point.

Regarding environmental impacts, mechanical draft cooling towers could have higher ambient air quality impacts because of the lower exhaust points. Also, mechanical draft cooling towers will generally cause a slight increase in the air pollution rates from Brayton Point Station on pounds per megawatt-hour basis. This increase would include criteria pollutants, toxic or hazardous air contaminants, and carbon dioxide. Mechanical draft cooled condensers would have additional noise impacts. Ground-level fogging and icing from mechanical draft cooling towers could be a significant safety issue, especially to the nearby interstate highway I-195 and the Braga Bridge.

Mechanical draft cooling towers use more energy than natural draft cooling towers.

4.2.4.5 Reduction in Exhaust Velocity

A reduction in the exhaust velocity in the cooling tower would reduce the amount of drift that enters the drift eliminators. However, this does not directly reflect a decrease in particulate emissions because the drift rate after the drift eliminators is not a direct function of the amount of drift entering the drift eliminators. Reducing exhaust velocity therefore does not reduce particulate emissions in a well-designed system.

Regarding economic impacts, a reduction in exhaust velocity would require building a larger natural draft cooling tower to serve the same heat load. This would increase the economic impact.

Other than impacts associated with building larger towers, the environmental impacts would not be changed.

A reduction in exhaust velocity would not affect the energy used by the natural draft cooling towers.

4.2.5 Step 4–Evaluate Most Effective Controls and Document Results

> After the identification of available and technically feasible control technology options, the energy, environmental, and economic impacts are considered to arrive at the final level of control. At this point the analysis presents the associated impacts of the control option in the listing. For each option the applicant is responsible for presenting an objective evaluation of each impact. Both beneficial and adverse impacts should be discussed and, where possible, quantified. In general, the BACT analysis should focus on the direct impact of the control alternative.

The top level of control, installation of an air-cooled condenser, is a poor alternative due to its greater cost, greater size (potentially posing space constraints), greater noise and greater diminishment of plant power generation capacity. Again, a retrofit from once-through cooling to dry cooling would be unprecedented, would be inherently difficult, would require especially complicated and expensive engineering and design work, and would carry a significant risk of operating failure.

The following order-of-magnitude economic impact analysis documents that the use of air-cooled condensers is not cost-effective compared to the proposed case. This incremental cost is appropriate for this BACT analysis because it is evaluating two control devices with a similar level of control (air cooled condenser 6,227 tons/year reduction from baseline versus proposed natural draft towers 5,838 tons/year reduction from baseline).

$500,000,000	Current project cost estimate	April 15, 2008 Environmental Notification Form
3	Cost multiplier for air cooled condensers	EPA in 65 FR 49081, August 2000: "Dry cooling systems can cost as much as three times more to install than a comparable wet cooling system."
$1,500,000,000	Air cooled condenser installed capital cost	[$500,000,000 * 3]
$1,000,000,000	Incremental capital cost	Difference between proposed case and air cooled condenser case [$1,500,000,000 - $500,000,000]
0.0806	Capital recovery factor	based on 30-year life and 7% interest rate
$80,600,000	Annualized incremental capital cost	[$1,000,000,000 * 0.0806]
389	Tons/year particulate matter emissions avoided	[389 tons proposed case – 0 tons air cooled condenser case]
$207,198	Dollars per ton incremental cost effectiveness	Only accounts for incremental capital costs. Operating costs are also higher. [$80,600,000 / 389]

The second level of control, installation of a cooling tower with 0.0005% drift eliminators, is proposed as BACT.

The use of mechanical draft cooling towers is not selected because it does not decrease emissions from the proposed BACT case, has unresolved technical issues, and would be more expensive.

The implementation of a reduction in air velocity is not selected because it does not decrease emissions from the proposed BACT case, and would be more expensive.

4.2.6 Step 5–Select BACT

The most effective control option not eliminated in step 4 is proposed as BACT for the pollutant and emission unit under review.

Consistent with the analysis presented above, Dominion proposes the use of natural draft cooling tower(s) with 0.0005% drift eliminators as BACT.

The vendor, SPX Cooling Technologies, Inc. will utilize the TU-12 drift eliminator on this project. The drift guarantee of 0.0005% is based on extensive laboratory testing of the TU-12 drift eliminator. This testing was conducted by SPX using the HBIK methodology over a wide range of eliminator velocities, water loadings, and geometrical configurations (i.e. spacing of the eliminators from the spray nozzles). To eliminate any effects of ambient contamination which could adversely affect the test results, a rare element was utilized in the chemical analysis which is used to calculate the drift results (Reference CTI-ATC-140). This is supported by the vendor documentation attached in Appendix M.

4.3 REVISED BACT ANALYSIS – Unit 3 DS/FF (PSD Permit Only)

This revised BACT analysis follows the guidance in the New Source Review Workshop Manual, Prevention of Significant Deterioration and Nonattainment Area Permitting, USEPA Draft October 1990 document (the Manual). Specific guidance from that document is included in boxes below, followed by Brayton Point's analysis based on the guidance.

This analysis is specific to the federal PSD requirements (40 CFR 52.21). Massachusetts BACT does not apply to the Unit 3 DS/FF Project as detailed in section 3.11.

4.3.1 BACT Applicability

> The BACT requirement applies to each individual new or modified affected emissions unit and pollutant emitting activity at which a net emissions increase would occur. Individual BACT determinations are performed for each pollutant subject to a PSD review emitted from the same emission unit. Consequently, the BACT determination must separately address, for each regulated pollutant with a significant emissions increase at the source, air pollution controls for each emissions unit or pollutant emitting activity subject to review.

Brayton Point Station Unit 3 is a modified affected emissions unit at which a net emissions increase will occur (baseline actual to projected actual) as a result of installing a Dry Scrubber and Fabric Filter (DS/FF) system.

This application treats the Unit 3 DS/FF project as a major modification to an existing PSD source for PM/PM10/PM2.5. Details of the PSD netting analysis are included in Appendix B. While "particulate matter" is listed as a regulated pollutant, EPA rescinded the national ambient air quality standard for particulate matter in favor of a PM10 standard in 1987, and recent statutory and regulatory provisions impose controls and limitations on PM10, not particulate matter.

Particulate matter consists of two broad categories: filterable PM and condensable PM. The original BACT analysis submitted with the August 2008 PSD permit application noted that several recent PSD approvals limited BACT requirements to filterable PM only, and proposed a filterable-only BACT emission limit. Based on requests from the EPA and Mass DEP, this revised analysis addresses total particulate, filterable plus condensable. The issue of filterable-only emission limits is discussed separately at the end of this analysis.

PM2.5 is a subset of PM10, there is very limited data on PM2.5 emission limits achieved in practice, and there is considerable uncertainty regarding PM2.5 test methods. Most of the filterable PM10 emissions will be 2.5 microns or smaller, and all of the condensable PM10 emissions are generally considered 2.5 microns or smaller. BACT techniques for PM2.5 control will be the same as for PM10 control. For all of these reasons, this application makes the conservative assumption that all PM10 emitted from Unit 3 is PM2.5. The BACT emission rates reviewed in this analysis are for PM, PM10 and PM2.5.

4.3.2 Step 1–Identify All Control Technologies

The first step in a "top-down" analysis is to identify, for the emissions unit in question (the term "emissions unit" should be read to mean emissions unit, process or activity), all "available" control options. Available control options are those air pollution control technologies or techniques with a practical potential for application to the emissions unit and the regulated pollutant under evaluation.

Available control options are:

- ♦ Fabric filter, specifically two varieties:
    - with felted bags
    - with coated bags
- ♦ Electrostatic precipitator, specifically three varieties:
    - Wet electrostatic precipitator
    - Dry electrostatic precipitator
    - Membrane wet electrostatic precipitator
- ♦ Fabric filter with wet electrostatic precipitator in series
- ♦ Electrostatic fabric filter
- ♦ Electro-catalytic oxidation
- ♦ Wet scrubber
- ♦ Cyclone or multiclone collector
- ♦ Side stream separator

To establish the baseline alternative emission rate, Dominion has evaluated two alternatives based on Mass DEP input:

- <u>Realistic uncontrolled upper bound emission rate from the boiler.</u> For the BACT analysis the uncontrolled total PM rate is 2.56 lb/MMBtu and the uncontrolled total PM10 rate is 0.59 lb/MMBtu based upon AP-42 factors and the coal ash content from the 2007 Source Registration. Total PM2.5 is assumed to be the same as total PM10.

- Realistic upper bound emission rate entering the fabric filter. This addresses both the control associated with the existing ESPs and the additional load associated with the dry scrubber (reaction products and unreacted lime). The lime will be 40 mesh, so lime particles will be about 420 microns in diameter. As such, the lime particles would not contribute to particulate matter emissions because the particles would not stay suspended in the atmosphere.

Therefore the baseline emission rates are based on uncontrolled boiler emissions: 63,400 tons/year total PM; 14,614 tons/year total PM10; and 14,614 tons/year total PM2.5. For simplicity, the analyses discussed below use the 14,614 tons/year baseline value.

> Air pollution control technologies and techniques include the application of production process or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of the affected pollutant.

This project is a retrofit of post-combustion controls to an existing coal-fired boiler equipped with an existing dry ESP. Production processes, fuel cleaning, and innovative fuel combustion techniques are not appropriate for inclusion because the boiler itself is not being modified. The Manual states "Historically, EPA has not considered the BACT requirement as a means to redefine the design of the source when considering available control alternatives."

In any event, Dominion is not aware of any modifications to an existing pulverized coal boiler to limit particulate formation. During normal operation, Dominion intends to continue to operate the existing dry ESP upstream of the dry scrubber in order to collect fly ash that is processed in the on-site Ash Reduction Process (ARP). The ARP produces a product used for the replacement of Portland cement in the production of concrete. By utilizing fly ash as a replacement for Portland cement significant reductions in CO2 emissions from the manufacturing of Portland cement is avoided.

> This includes technologies employed outside of the United States.

The list includes technologies employed outside the United States. Dominion is unaware of technologies employed outside the United States that are not employed inside the United States.

> As discussed later, in some circumstances inherently lower-polluting processes are appropriate for consideration as available control alternatives.

Again, this project is a retrofit of post-combustion controls to an existing coal-fired boiler equipped with an existing dry ESP. No changes are proposed to the coal-fired boiler itself.

In this circumstance it is not appropriate to consider lower-polluting processes as available control alternatives.

> The control alternatives should include not only existing controls for the source category in question, but also (through technology transfer) controls applied to similar source categories and gas streams, and innovative control technologies.

The source category in question is the retrofit of a dry scrubber to an existing pulverized coal fired boiler equipped with an existing dry ESP for air pollution control. Existing controls for the pulverized coal fired boiler source category are limited to fabric filters.

Through technology transfer, controls applied to similar source categories include wet electrostatic precipitators, dry electrostatic precipitators, wet scrubbers, cyclone or multiclone collectors, and side stream separators. Each is listed by the EPA in its AP-42 emission factor document[8] as particulate matter control technologies for bituminous coal combustion. The use of a fabric filter with a wet electrostatic precipitator in series is also control alternative available through technology transfer from similar source categories.

Innovative control technologies include: membrane wet electrostatic precipitator, electrostatic fabric filter, and electro-catalytic oxidation.

> Technologies required under lowest achievable emission rate (LAER) determinations are available for BACT purposes and must also be included as control alternatives and usually represent the top alternative.

Brayton Point has reviewed the EPA RACT/BACT/LAER Clearinghouse and other online data sources which include LAER determinations. All applicable determinations have been included in this analysis and can be found in Appendix K.

4.3.3 Step 2–Eliminate Technically Infeasible Options

> In the second step, the technical feasibility of the control options identified in step one is evaluated with respect to the source-specific (or emissions unit-specific) factors.

Each identified control option is evaluated with respect to emissions unit-specific factors below.

- Fabric filter, specifically two varieties:
    - with felted bags: *technically feasible*

8 "Compilation of Air Pollutant Emission Factors", Office of Air Quality Planning and Standards, US EPA (AP-42), Chapter 1 Section 1, 9/98, available at http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s01.pdf

- with coated bags: *technically feasible*

♦ Electrostatic precipitator, specifically three varieties:

- Wet electrostatic precipitator: *technically feasible*
- Dry electrostatic precipitator: *technically feasible*
- Membrane wet electrostatic precipitator: *technically infeasible based on engineering principles*

♦ Fabric filter with wet electrostatic precipitator in series: *technically feasible*

♦ Electrostatic fabric filter: *technically infeasible based on engineering principles*

♦ Electro-catalytic oxidation: *technically infeasible based on engineering principles*

♦ Wet scrubber: *technically feasible*

♦ Cyclone or multiclone collector: *technically feasible*

♦ Side stream separator: *technically feasible*

> A demonstration of technical infeasibility should be clearly documented and should show, based on physical, chemical, and engineering principles, that technical difficulties would preclude the successful use of the control option on the emissions unit under review. Technically infeasible control options are then eliminated from further consideration in the BACT analysis.

Clear documentation of technical difficulties is demonstrated below for each technically infeasible control option:

♦ **Membrane wet electrostatic precipitator**. This is an emerging technology that is not demonstrated-in-practice for this application. Ohio University researchers have performed industrial-scale tests of a wet electrostatic precipitator that uses polypropylene membranes instead of metal to reduce corrosion and improve long-term performance. No utility-scale demonstrations have been performed and the performance for PM2.5 control has not been evaluated.

♦ **Electrostatic fabric filter**. This is an emerging technology that is not demonstrated-in-practice for this application. The use of a combination of electrostatic precipitation and fabric filtration has been tested on a cyclone boiler firing subbituminous coal[9], and

9 "Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology" (DOE/NETL-2007/1255, February 2007)

similar technology is being marketed by GE Energy[10]. The lack of operating experience would add significant uncertainty to the air pollution retrofit project, as would the need to coordinate its installation and operation with the dry scrubber. Also, it is not clear that this technology would provide any emissions reduction beyond the proposed case.

- Electro-catalytic oxidation. This is an emerging technology that is not demonstrated-in-practice for this application. Powerspan Corporation describes the Electro-Catalytic Oxidation (ECO) process as a multi-pollutant control system consisting of an oxidation reactor followed by an absorber and wet electrostatic precipitator. A demonstration project was conducted on a slipstream of an Ohio coal boiler, funded in part by the Ohio Coal Development Office and the Ohio Air Quality Development Authority. Dominion does not consider this emerging technology an acceptable alternative to the proposed dry scrubber for SO2 control, and it offers no apparent advantages over traditional wet ESPs for particulate control. The technical challenges associated with scale-up of this emerging technology are significant.

> For example, in cases where the level of control in a permit is not expected to be achieved in practice (e.g., a source has received a permit but the project was cancelled, or every operating source at that permitted level has been physically unable to achieve compliance with the limit), and supporting documentation showing why such limits are not technically feasible is provided, the level of control (but not necessarily the technology) may be eliminated from further consideration.

Brayton Point has made a good faith effort to compile appropriate information from available information sources (per EPA guidance). Information sources considered included:

- EPA's RACT/BACT/LAER Clearinghouse and Control Technology Center - Information from the Clearinghouse[11] is was included in Appendix K of the August 2008 application. For this revised BACT analysis those data were reviewed and the Clearinghouse was queried for projects listed since August 2008. Key identified facilities are presented below;

- Best Available Control Technology Guideline - South Coast Air Quality Management District - The Guideline[12] does not address coal fired boilers except to note that new coal fired boilers are not allowed;

---

10 http://www.gepower.com/prod_serv/products/particulate_matter/en/max9/index.htm

11 http://cfpub.epa.gov/rblc/

12 http://aqmd.gov/bact/BACTGuidelines.htm

- Control technology vendors - Through the bidding process, Brayton Point has collected indicative information from qualified control technology vendors regarding emission rates that can be guaranteed. Those data are presented below;

- Federal/State/Local new source review permits and associated inspection/performance test reports - a good faith effort to review permits available online found information as presented below;

- Environmental consultants - Consultants at Epsilon Associates, Inc. reviewed available information on current and past projects;

- Technical journals, reports and newsletters, air pollution control seminars - a review of papers posted by the Air and Waste Management Association[13], and a paper posted on EPA's website[14]; and

- EPA's policy bulletin board - A review of the online OAR Policy and Guidance[15] websites found no references to specific recent BACT emission limits or technologies for particulate matter from coal-fired power plants. References were found related to the development and implementation of new source performance standards for utility boilers under 40 CFR 60. As discussed in Section 3.4 of Dominion's August 2008 application, the Unit 3 DS/FF project does not trigger any requirements under 40 CFR 60. In any event, the particulate matter requirements in 40 CFR 60 Subpart Da only apply to filterable PM.

From a review of the data sources listed above the comparable projects are found, as described in additional detail in Appendix K. Key projects are summarized as follows:

Directly Comparable: Retrofit of air pollution control devices on existing pulverized-coal fired boiler

- *MidAmerican Louisa Station, Iowa*: 2006 permit for very comparable station. Louisa Station installed a spray dryer absorber and fabric filter downstream of an existing dry electrostatic precipitator; this is the same arrangement as is proposed for Brayton Point Unit 3. Louisa Station received a permit limiting PM10 and PM2.5 (total including condensable) to 0.027 lb/MMBtu. Construction completed in 2007. The information is

---

13 http://secure.awma.org/onlinelibrary/AdvancedSearch.aspx, December, 2008. Search for "Coal" and "PM." Eight specific papers were identified and reviewed.

14 2005 paper with table of plants & test methods: http://www.epa.gov/ttn/chief/conference/ei14/session9/andracsek.pdf

15 http://epa.gov/ttn/oarpg/new.html and http://epa.gov/ttn/oarpg/ramain.html.

from state permits identified online[16], and from general knowledge of Dominion engineers.

- *Crystal River Power Plant, Florida*. May 2007 PSD permit for addition of a flue gas desulfurization system and fabric filter to an existing pulverized-coal fired boiler. This project met PSD BACT for several pollutants because it also involved a modest increase in permitted heat capacity. PSD BACT for PM10 is determined to be 0.030 lb/MMBtu based on EPA Method 5 (filterable only). PM2.5 is not specifically addressed. The information is from state permits and from the RACT/BACT/LAER Clearinghouse. Construction is still underway as of December 18, 2008.[17]

Technology Transfer: BACT for new pulverized-coal fired boiler

- The most recent approval on EPA's Clearinghouse is Associated Electric Cooperative's Norborne Plant in Missouri. The total PM10 limit is 0.018 lb/MMBtu (including condensables); PM2.5 is not specifically limited[18]. Construction has been delayed indefinitely[19], and emission limits are not demonstrated in practice.

- The second most recent approval is the American Municipal Power Gen. Station in Ohio. Limit is 0.025 lb/MMBtu total PM10 (including condensables), using a wet ESP. This facility has not yet been constructed, and its limits are not demonstrated in practice.

- Third most recent approval is Dry Fork Station, Wyoming. No condensable limit; test only. This facility has not yet been constructed, and its limits are not demonstrated in practice.

- Based on a review of state and federal permits, and the 2005 Andracsek paper, Kansas City Light & Power's Hawthorn 5 unit was constructed in 2001, and has a total PM10 limit of 0.018 lb/MMBtu (filterable & condensable) limit since about 2001. This is a PC boiler with SCR, dry FGD, and a fabric filter, burning Powder River Basin (PRB) coal exclusively. Hawthorn 5 varies from Brayton Point 3 as this unit is a new unit versus a retrofit unit and utilizes PRB coal versus bituminous coal.

Technology Transfer: BACT for any new coal fired boiler:

[16] http://aq48.dnraq.state.ia.us:8080/airpermit/eeplant.jsp, select "MidAmerican Louisa Generating station," select file "05a31p1.pdf"

[17] http://www.progress-energy.com/aboutus/news/article.asp?id=20402

[18] http://www.epa.gov/region7/programs/artd/air/nsr/archives/2008/finalpermits/aeci_norborne_final_psd_permit.pdf

[19] http://www.aeci.org/NR20080303.aspx

- The most recent approval on EPA's RACT/BACT/LAER Clearinghouse is for Dominion's Virginia City Hybrid Energy Center (CFB). It has a limit of 0.012 lb/MMBtu total PM10/PM2.5 (including condensables), with a fall-back to 0.03 lb/MMBtu if the emission limit can not be met. The PSD permit states that PM2.5 compliance testing will not occur until a test method for PM2.5 has received final approval by the USEPA or the Virginia Department of Environmental Quality. This facility has not yet been constructed, and its limits are not demonstrated in practice.

- Spurlock Station Unit 4 is a mine-mouth CFB in Kentucky that also has 0.012 lb/MMBtu total PM/PM10 (including condensables). PM2.5 is not limited by the permit. Their sulfuric acid mist limit is higher than their condensable PM limit; this raises questions as to whether the condensable PM limit will be achieved in practice because H2SO4 mist is a subset of condensable particulate. This facility has not yet been constructed, and its limits are not demonstrated in practice[20].

- Wolverine Power (CFB) has a Michigan draft approval out for public comment with a limit of 0.026 total PM10 (including condensables). PM2.5 is not limited by the permit. The applicant asserted that the tighter limits are for single-coal-source plants, and are not demonstrated in practice (specifically noting that the Spurlock condensable PM limit is not backed by a vendor guarantee). Facility construction has not commenced, and its limits are not demonstrated in practice.

- In the equipment bidding process, Dominion queried qualified equipment vendors on their ability to provide equipment with guaranteed emission rates for total PM10 and PM2.5 (including condensables). Based on those queries, and pending selection of a technology and vendor as well as negotiation of final contract terms, the Unit 3 DS/FF could obtain a guarantee of 0.025 lb/MMBtu total PM10/PM2.5 (including condensables).

Technical difficulties will prevent the installation of a fabric filter achieving total PM/PM10/PM2.5 emission rates below 0.025 lb/MMBtu. Documentation is as follows:

- Complicated engineering associated with a retrofit offer constraints not found at greenfield sites. In particular, condensable particulate is a complicated combination of organic material, acid gases, and salts; the control of condensable particulate often involves a holistic approach across the combustion unit and its entire air pollution control train. That front-to-back pollution control strategy is not available for a pollution control retrofit project where the combustion equipment is already in-place.

---

20 Per the company website at http://www.ekpc.com/spurlock.html, Spurlock Unit 4 is scheduled to begin operation in 2009.

- Brayton Point receives fuel from multiple sources. Single-fuel-source plants can design more precisely to the fuel being used, and achieve lower limits than are achievable across a range of fuels. Also, plants firing exclusively PRB coal can achieve lower PM/PM10/PM2.5 emission limits because of the unique characteristics of that fuel.

- Continued concerns with test methods for condensable particulate matter make it difficult to commit to consistently achieving emission rates below 0.025 pounds per million Btu in practice. Test errors, positive bias, general test variability, and lack of experience with test methods are technical difficulties that make it more difficult to commit to a lower emission limit. Due to the test method limitations, the fabric filter vendors Dominion has queried will not provide a guarantee for PM2.5 emissions.

Based on the documentation provided above, fabric filtration with a total PM/PM10/PM2.5 emission limit below 0.025 lb/MMBtu is not expected to be achieved in practice for a retrofit of a pulverized coal boiler, and there are technical difficulties and engineering principles why an emission limit below 0.025 lb/MMBtu is not technically feasible for a fabric filter retrofit of a pulverized coal boiler. Therefore, the level of control of total PM/PM10/PM2.5 below 0.025 lb/MMBtu is technically infeasible. The technology of fabric filtration remains technically feasible.

4.3.4 Step 3–Rank Remaining Control Technologies By Control Effectiveness

In step 3, all remaining control alternatives not eliminated in step 2 are ranked and then listed in order of over all control effectiveness for the pollutant under review, with the most effective control alternative at the top. A list should be prepared for each pollutant and for each emissions unit (or grouping of similar units) subject to a BACT analysis. The list should present the array of control technology alternatives and should include the following types of information:

- control efficiencies (percent pollutant removed);
- expected emission rate (tons per year, pounds per hour);
- expected emissions reduction (tons per year);
- economic impacts (cost effectiveness);
- environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants);
- energy impacts.

The remaining control technologies are ranked and listed in order of control effectiveness for PM/PM10/PM2.5 below, with the most effective control alternative at the top:

1. Fabric Filter with wet electrostatic precipitator in series

2. Fabric filter with felted bags (proposed case)

3. Fabric filter with coated bags

4. Wet electrostatic precipitator

5. Dry electrostatic precipitator

6. Wet scrubber

7. Cyclone or multiclone collector

8. Side stream separator

4.3.4.1 Fabric Filter with wet electrostatic precipitator in series

Control efficiencies (percent pollutant removed)	98% from baseline (total PM10/PM2.5). This assumes that the wet electrostatic precipitator is able to reduce emissions of total PM/PM10/PM2.5 from 0.025 lb/MMBtu to some lower number (a 60% reduction to 0.010 is assumed here). This level of control may not be technically feasible because as exhaust gas concentrations approach zero, the ability of a control device to reduce emissions further is limited.
Expected emission rate (tons per year, pounds per hour)	248 tons per year, 57 pounds per hour. The emission rate used for this analysis is not demonstrated in practice.
Expected emissions reduction (tons per year)	14,366 tons per year reduction from the baseline case (total PM10/PM2.5). 372 tons per year reduction from the proposed case.
Economic impacts	Adding a wet ESP in series would involve costs well above what is cost-effective, as demonstrated in Step 4 below.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	Adding a wet ESP in series would require additional land area. Space constraints, coastal, and floodplain issues are possible. Because the wet ESP would add some additional back pressure on the system, and would add additional house electric load (see energy impacts below), use of a wet ESP in series would increase the rates of other pollutants from Brayton Point Station on pounds per megawatt-hour basis. This increase would include criteria pollutants, toxic or hazardous air contaminants, and carbon dioxide. The wet ESP could have additional noise impacts. A wet electrostatic precipitator would also add an additional water use to the project.
Energy impacts	A wet ESP would use more energy than the baseline and proposed cases. Based on EPA OAQPS calculations, approximately 190 kW additional energy is needed. Vendor information to-date indicates the energy impacts could be much higher than the EPA OAQPS calculations.

4.3.4.2 Fabric filter with felted bags (proposed case)

Control efficiencies (percent pollutant removed)	96% reduction from baseline case (total PM10/PM2.5).
Expected emission rate (tons per year, pounds per hour)	619 tons per year, 141 pounds per hour
Expected emissions reduction (tons per year)	13,994 tons per year reduction from the baseline case (total PM10/PM2.5).
Economic impacts	The proposed fabric filter is part of the overall cost of the DS/FF project and will be significantly more costly than the baseline case. Approximate installed cost for the fabric filter portion of the Project is $50 million.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	No specific environmental impacts relative to the baseline case. The fabric filter collects dry reaction byproducts, a portion of which is recycled back to the DS system.
Energy impacts	Additional energy impacts relative to the baseline case, associated with filter cleaning and system back-pressure. Approximate additional power consumption cost is $850,000 per year.

4.3.4.3 Fabric filter with coated bags

Control efficiencies (percent pollutant removed)	95% reduction from baseline case (estimated, total PM10/PM2.5)
Expected emission rate (tons per year, pounds per hour)	669 tons per year, 153 pounds per hour
Expected emissions reduction (tons per year)	13,945 tons per year reduction from the baseline case (total PM10/PM2.5). 50 ton per year *increase* from the proposed case.
Economic impacts	Relative to the use of felted bags, coated bags have a higher per-bag capital cost which can be offset by having a smaller baghouse, and lower operating costs (ash slides off the coated bags providing a lower pressure drop and allowing a higher air-to-cloth ratio).
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	No specific environmental impacts relative to the baseline case. Felted and membrane bags can generally achieve very similar levels of control. Relative to the proposed case, for similarly-designed systems expected control of condensable particulate is reduced. Also, because there is less filter cake, there is less opportunity for the filter cake to act as an additional reaction site for multi-pollutant emissions control. The coated filter bags therefore would be expected to have slightly higher emissions of criteria pollutants, toxic or hazardous air contaminants than the proposed case.
Energy impacts	Slightly higher energy impacts relative to the baseline case. Slightly lower energy impacts relative to the proposed case (reduced operating pressure drop and less effort necessary to remove filter cake).

4.3.4.4 Wet electrostatic precipitator

Control efficiencies (percent pollutant removed)	95% reduction from baseline case (estimated, total PM10/PM2.5)
Expected emission rate (tons per year, pounds per hour)	669 tons per year, 153 pounds per hour
Expected emissions reduction (tons per year)	13,945 tons per year reduction from the baseline case (total PM10/PM2.5). 50 ton per year *increase* from the proposed case.
Economic impacts	Additional costs are expected because a wet electrostatic precipitator is not generally installed downstream of a dry scrubber, and the system would have significant engineering challenges. Raw material costs would increase because there would not be a clear opportunity to recycle the lime reagent back into the dry scrubber.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	Relative to the proposed case, expected control of condensable particulate is reduced. Also, because there is no filter cake, there is reduced opportunity for the control device to act as an additional reaction site for multi-pollutant emissions control. The use of a wet electrostatic precipitator would be expected to have higher emissions of criteria pollutants, toxic or hazardous air contaminants than the proposed case. A wet electrostatic precipitator would also add an additional water use to the project.
Energy impacts	Higher energy impacts relative to the baseline and proposed cases because of the electricity needed to charge the electrostatic precipitator.

4.3.4.5 Dry electrostatic precipitator

Control efficiencies (percent pollutant removed)	93% reduction from baseline case (estimated, total PM10/PM2.5)
Expected emission rate (tons per year, pounds per hour)	991 tons per year, 226 pounds per hour
Expected emissions reduction (tons per year)	13,943 tons per year reduction from the baseline case (total PM10/PM2.5). 372 ton per year *increase* from the proposed case.
Economic impacts	Additional costs are expected because a dry electrostatic precipitator is not generally installed downstream of a dry scrubber, and the system would have significant engineering challenges.
Environmental impacts (includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants)	Relative to the proposed case, expected control of condensable particulate is reduced. Also, because there is no filter cake, there is reduced opportunity for the control device to act as an additional reaction site for multi-pollutant emissions control. The use of a dry electrostatic precipitator would be expected to have higher emissions of criteria pollutants, toxic or hazardous air contaminants than the proposed case.
Energy impacts	Higher energy impacts relative to the baseline and proposed cases because of the electricity needed to charge the electrostatic precipitator.

4.3.4.6 Wet Scrubber, Cyclone or Multiclone Collector, Side Stream Separator

Each of these options is expected to have significantly lower control efficiency than the proposed case. For example, based on the EPA AP-42 emission factor document at table 1.1-6, a fabric filter is 30 times better than a scrubber and 100 times better than a multiclone collector for removing filterable particulate.

Because these technologies are unlikely to achieve top-level emission rates and do not offer significant other economic, energy, or environmental benefits they are not considered further.

4.3.5 Step 4–Evaluate Most Effective Controls And Document Results

After the identification of available and technically feasible control technology options, the energy, environmental, and economic impacts are considered to arrive at the final level of control. At this point the analysis presents the associated impacts of the control option in the listing. For each option the applicant is responsible for presenting an objective evaluation of each impact. Both beneficial and adverse impacts should be discussed and, where possible, quantified. In general, the BACT analysis should focus on the direct impact of the control alternative.

The top level of control, installation of a wet electrostatic precipitator downstream of the fabric filter, is a poor alternative due to its greater cost, greater size (potentially posing space constraints), greater noise and greater diminishment of plant power generation capacity.

Appendix B provides an economic impact analysis using EPA Office of Air Quality Standards Control Cost Manual procedures that documents that the incremental cost for addition of a wet electrostatic precipitator is $68,249 per ton of PM10/PM2.5 removed. This is not cost effective. This incremental cost is appropriate for this BACT analysis because it is evaluating two control devices with a similar level of control (98% versus 96% reduction from baseline).

The second level of control, installation of a fabric filter with felted bags, is proposed as BACT. This technology can meet an emission rate lower than what is demonstrated in practice for comparable projects (retrofit of air pollution control on existing pulverized coal boiler), and can aid in multi-pollutant emissions control.

4.3.6 Step 5–Select BACT

The most effective control option not eliminated in step 4 is proposed as BACT for the pollutant and emission unit under review.

Consistent with the analysis presented above, Dominion proposes the use of a fabric filter with felted bags, achieving a total PM/PM10/PM2.5 emission rate of 0.025 lb/MMBtu as BACT.

Compliance demonstration is proposed to be through the sum of the results using the following test methods, or alternative methods proposed by Dominion and accepted by the EPA or Mass DEP:

- Other Test Method 27 (OTM 27) Determining PM10 and PM2.5 Emissions from Stationary Sources; and
- Other Test Method 28 (OTM 28) Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources.

These test methods were published August 2008, and are available at http://www.epa.gov/ttn/emc/prelim.html.

4.3.7 Startup, Shutdown and Malfunction BACT

Particulate emissions are minimized to the extent feasible during startup, shutdown, and malfunction. The magnitude of the emissions depends on the nature and duration of the transient condition. It is the objective of Brayton Point Station to safely and quickly bring the boiler up to normal operating temperature so that the boiler can start to productively generate steam. It is also the objective to have as few startups, shutdowns, and malfunctions as possible.

Startup will begin when the operator activates the first gas igniter or first warm-up oil gun and startup will be considered complete once the unit is at minimum load and normal oxygen levels. Shut down operations begin when the operator takes the first pulverizer out of service for the purpose of taking the unit off line and the unit shut down will be complete when all fuel burning has been terminated in the boiler.

The fabric filter is not bypassed during startup and shutdown, and provides effective control throughout startup, shutdown, and malfunction processes. Other portions of the air pollution control system (e.g. the existing electrostatic precipitators) are brought online as soon as they can provide effective control. Boiler operation during startup, shutdown, and malfunction is controlled to minimize particulate formation to the extent feasible while protecting the equipment. As such, Unit 3 should meet the full load mass emission limits (pounds per hour) during startup and shutdown.

The proposed BACT for particulate emissions during startup, shutdown, and malfunction is to use the fabric filter (i.e., do not bypass the fabric filter), and reasonable practices to minimize particulate emissions from the boiler during startup, shutdown, and malfunction including implementation of certain specified work practices to minimize emissions.

If needed, an alternate approach that limits the amount of particulate emissions in lb/hr (141 lb/hr total PM/PM10/PM2.5) rather than in lb/MMBtu, is proposed as a numerical BACT limit for periods of startup and shutdown.

4.3.8 Regarding Filterable Particulate

Filterable PM10/PM2.5 is a subset of PM10 and PM2.5, the pollutants for which BACT is addressed in this analysis. Step 1 (identify all control technologies) and Step 2 (eliminate technically infeasible options) have the same results for filterable PM10/PM2.5 as total PM10/PM2.5. For Step 3 (rank remaining control technologies by control effectiveness), fabric filters with felted and coated bags have approximately equivalent control efficiencies depending on other design parameters. For Step 4 (evaluate most effective controls and document results), a wet ESP in series is not cost-effective for filterable particulate control. In Step 5 (Select BACT) fabric filtration is selected as BACT.

Regarding filterable-only PM10 and PM2.5, based on follow-up discussions with vendors (and pending final contract negotiations and design) an emission rate of 0.010 lb/MMBtu could be achievable with the current proposed equipment. This is a reduction from the 0.015 lb/MMBtu proposed as BACT in the August 2008 application and would be tested using OTM 27 as discussed above, or EPA Method 201 or 201a or alternative methods proposed by Dominion and accepted by the EPA or Mass DEP.

To the extent that total filterable PM remains a regulated pollutant, Dominion requests an emission limit of 0.010 lb/MMBtu, tested using EPA Method 5 or 5b. This reflects BACT using the same methodologies discussed elsewhere in this analysis.

4.3.9 Summary

Based on the analysis presented here, Dominion proposes as BACT: a total PM/PM10/PM2.5 emission limit of 0.025 lb/MMBtu, and a filterable PM10/PM2.5 emission limit of 0.010 lb/MMBtu. These proposed limits are lower than what has been achieved in practice for similar retrofit projects.

Dominion will make every effort to ensure that the Unit 3 DS/FF project will achieve compliance with the filterable PM10/PM2.5 limit of 0.010 lb/MMBtu. The DS/FF will be designed to meet the 0.010 lb/MMBtu limit and Dominion will have contractual requirements that will require the selected vendor to meet this limit. The contractual language will have penalties and contractual make good clauses that will require the selected vendor to make good on the 0.010 lb/MMBtu limit and take actions up to the value of the contract.

However, because the filterable PM10/PM2.5 limit is unique for a retrofit project of this type, there is a possibility that despite all efforts compliance may not be achievable. If Brayton Point is not able to achieve compliance with the filterable PM/PM10/PM2.5 limit of 0.010 lb/MMBtu during the compliance testing, Dominion requests that the filterable PM/PM10/PM2.5 limit be increased to a value of 0.012 lb/MMBtu.

5.0 AIR QUALITY DISPERSION MODELING

5.1 Overview

The EPA *Guideline on Air Quality Models* (EPA, 2005) recommends that an air quality dispersion modeling analysis be performed to assess the pollutant impact in the vicinity of the Project. Air quality dispersion modeling was used to document that Project emissions will not cause or contribute to any violation of applicable ambient air quality standards. Methods and results are presented in this Section.

Brayton Point submitted modeling protocols to the EPA and Mass DEP on February 28, 2008. Mass DEP issued an approval on May 5, 2008.

5.2 Ambient Air Quality Standards

The EPA has developed NAAQS for six criteria pollutants, discussed in Section 3.1. Of these, Mass DEP requires ambient air quality modeling for direct emissions of NO2, SO2, PM10, PM2.5, and CO. These state and federal ambient air quality standards are listed in Table 3-1.

The NAAQS consist of primary and secondary standards. Primary standards are intended to protect human health. Secondary standards are intended to protect public welfare from known or anticipated adverse effects associated with the presence of air pollutants, such as damage to property or vegetation. NAAQS have been developed for various durations of exposure. Generally, the NAAQS for short-term periods (24 hours or less) refer to limits that generally cannot be exceeded for exposures averaged over 3 months or longer (typically 1 year).

5.3 Land Use Analysis

The Project site is in the Town of Somerset, Massachusetts on Brayton Point at the confluence of the Lee River and the Taunton River. Figure 5-1 presents the USGS map with a 3-kilometer radius around the Project shown. The area surrounding the Project site includes water, a mix of industrial, commercial, urban and suburban residential land uses. Somerset is located in Bristol County in the southeastern part of the Commonwealth of Massachusetts. The site lies approximately two miles west of the city of Fall River.

5.3.1 Urban/Rural Analysis

The USGS topographic quadrangle maps in the vicinity of the Project were used to determine whether the land-use pattern in the environs of the Project is urban or rural for modeling purposes. The EPA recommended procedure in *Revision to the Guideline on Air Quality Models* (EPA, 2005) was followed to determine urban/rural classification using the Auer (1978) land use technique. The land use within the total area circumscribed by a 3 km radius circle around the facility has been classified using the meteorological land use typing scheme shown in Table 5-1. If the land use types I1, I2, C1, R2 and R3 account for 50 percent or more of the area, then urban dispersion coefficients should be used. Otherwise, rural dispersion coefficients should be used in the modeling analysis.

Table 5-1 Identification and Classification of Land Use

Type	Use and Structures	Vegetation
I1	Heavy Industrial Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs	Grass and tree growth extremely rare; <5% vegetation
I2	Light-Moderate Industrial Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	Very limited grass, trees almost absent; <5% vegetation
C1	Commercial Office and apartment buildings, hotels; >10 story heights, flat roofs	Limited grass and trees; < 15% vegetation
R1	Common Residential Single family dwellings with normal easements; generally one story, pitched roof structures; frequent driveways	Abundant grass lawns and light-moderately wooded; >70% vegetation
R2	Compact Residential Single, some multiple, family dwellings with close spacing; generally <2 story, pitched roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; < 30% vegetation
R3	Compact Residential Old multi-family dwellings with close (<2m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ashpits, no driveways	Limited lawn sizes, old established shade trees; < 35% vegetation
R4	Estate Residential Expansive family dwellings on multi-acre tracts	Abundant grass lawns and lightly wooded; > 95% vegetation
A1	Metropolitan Natural Major municipal, state or federal parks, golf courses, cemeteries, campuses, occasional single story structures	Nearly total grass and lightly wooded; > 95% vegetation
A2	Agricultural Rural	Local crops (e.g.,corn, soybean); > 95% vegetation
A3	Undeveloped Uncultivated; wasteland	Mostly wild grasses and weeds, lightly wooded; > 90% vegetation
A4	Undeveloped Rural	Heavily wooded; > 95% vegetation
A5	Water Surfaces Rivers, lakes	

The land use analysis used the USGS map shading technique to define urban land uses. Figure 5-1 shows the 3-kilometer radius around the Project. The remaining areas are designated as rural. The results of the analysis indicate that greater than 50 percent of the land around the facility is classified as rural. Therefore, rural dispersion coefficients are used in the air quality modeling analysis. This determination is consistent with prior modeling analyses performed for Brayton Point Station.

5.4 Topography

The topography at and immediately adjacent to the Project site is relatively flat, while the surrounding area, other than the water bodies, the terrain is irregular, reaching an elevation of just over 300 feet. The base elevation of the cooling towers will be approximately 32 feet (9.75 meters) above mean sea level (amsl).

The terrain within 10 km of the Project site does not rise above the height of the cooling tower(s) [500 feet (152.4 meters) amsl]. The highest terrain in the modeling domain has an elevation of approximately 306 feet (93 meters) and is located to the south of the site at a distance of approximately 6,500 meters away. A portion of the USGS topographic map, including the site location depicting terrain in the vicinity of the proposed site, is shown in Figure 5-1.

5.5 Meteorological Data for Dispersion Modeling

The regional meteorology in Somerset is best approximated with meteorological data collected by the National Weather Service (NWS) station at TF Green Airport in Warwick, Rhode Island. TF Green Airport, located just south of Providence, is approximately 11 miles to the west of the Project site at an elevation of 58 feet amsl (17.7 meters). There is another NWS surface observation station close by in New Bedford, MA. New Bedford is approximately 12.5 miles to the east-southeast of Brayton Point. New Bedford is very close to the ocean, and Brayton Point is not located along the open ocean; rather it is inland along the Mt Hope Bay. Both the Project site and TF Green Airport locations are in a very similar setting, i.e., near Mount Hope Bay, and a similar distance away from the open ocean. Therefore the TF Green surface observations are representative of similar topographic influences that affect the Brayton Point location.

While limited on-site meteorological data was available from 10-meter and 50-meter stations, insufficient data was available to perform an air quality modeling analysis. The data was not collected with the intention of performing air quality dispersion modeling, and has not been validated or formatted for that use.

The TF Green surface data was processed along with five years of concurrent upper air sounding data from the NWS station in Chatham, Massachusetts. The Chatham station is located approximately 61 miles to the east of Brayton Point. The Gray, Maine upper air station is an alternative site frequently used for projects in New England that are not near the coastline. Gray is located approximately 20 miles north of Portland, ME, at an inland location. For this project, the more representative choice for upper air soundings is Chatham, which is closer and represents the marine/land influence in the atmosphere that would be more typical at Brayton Point than the soundings from an inland station.

The use of Providence (Warwick, RI) surface observations with Chatham, MA upper air soundings were consistent with prior air quality dispersion modeling performed for the

Brayton Point Station. The upper air and surface files have been obtained from the National Climatic Data Center and processed with the AERMET meteorological processing program, which is part of the AERMOD modeling system. Five years (2002, 2004-2007) of hourly surface data collected at the TF Green Airport station were used, which included wind speed and direction, temperature, cloud cover and ceiling height. The 2002, 2004-2007 years were used because they were the most recent years with a sufficient amount of data available for regulatory purposes (greater than 90 %). The year 2003 was found to have less than the required 90 percent available data for modeling. Therefore, following regulatory procedures, the years 2002, 2004-2007 were used in this air quality modeling analysis. Table 5-2 lists the assumptions made in the processing of the data in AERMET.

Table 5-2 AERMET Processing Assumptions

Parameter	Values Used
QA Values (Surface and Upper Air)	Default
Randomizing Parameter	Randomize Wind Directions
Surface Characteristic Frequency	Seasonal
Wind Sector	Sector 1: 0 - 110 degrees Sector 2: 110 - 360 degrees
Land-Use Category	Rural
Anemometer Height	6.1 meters

The AERSURFACE program, a tool provided by EPA, was used to assess the surface characteristics near the meteorological observation site. Table 5-3 shows the seasonal albedo, Bowen ratio and surface roughness derived from each land use category in each wind sector in the vicinity of the meteorological station, T.F. Green Airport, Warwick Rhode Island. The land use pattern in the area around the airport appeared to be more urban to the northeast than the rest of the surrounding area, so two sectors were modeled. The two sectors chosen were from 0 to 110 degrees (Sector 1) and from110 to 360 degrees (Sector 2). AERSURFACE was run for the Winter, Spring, Summer and Fall seasons. AERSURFACE uses a 10 km domain to determine the albedo and Bowen ratio values to be input to AERMET. The surface roughness is based on the region within 1 km of the observation site. The values for albedo, Bowen ratio and surface roughness produced by AERSURFACE were used in the AERMET Stage 3 processing of the meteorological data.

Figure 5-2 is a USGS map that shows the land use within a 10 by 10 km grid centered on the T. F. Green Airport meteorological station.

Table 5-3 Surface Characteristics Derived from AERSURFACE

Season	Sector	Albedo	Bowen Ratio	Surface Roughness
Winter	**1**	0.38	0.39	0.028
Winter	**2**	0.38	0.39	0.028
Spring	**1**	0.15	0.52	0.051
Spring	**2**	0.15	0.52	0.051
Summer	**1**	0.15	0.49	0.060
Summer	**2**	0.15	0.49	0.059
Fall	**1**	0.15	0.63	0.052
Fall	**2**	0.15	0.63	0.051

Annual frequency distributions of the winds (wind roses) were plotted for each of the processed meteorological data sets. Wind rose plots depict incorporate the frequency of occurrence of winds categorized by 16 wind direction sectors and wind speed. The annual wind roses are presented in Appendix F. Winds were most frequent from the southwest in 2002, from the northwest in 2004 and consistently frequent from the West-Northwest for the years 2005-2007.

5.6 Background Air Quality Data

To estimate background pollutant levels representative of the area, the most recent monitoring values were obtained from the following EPA website. Data for 2005 through 2007 were acquired from http://www.epa.gov/air/data/.

Background concentrations were determined from the closest available monitoring stations to the Brayton Point facility. A summary of the background air quality concentrations are presented in Table 5-4.

The closest PM10 monitor is located at 212 Prairie Avenue in Providence, RI, approximately 13 miles to the west-northwest of the Project. For the 24-hour average PM10, the 4th highest 24-hour average highest PM10 concentrations measured over the three most recent years of monitoring were selected as the representative background value. For the annual average PM10 background concentration, the highest yearly observation was used.

There is a PM2.5 monitoring station at 659 Globe Street in Fall River, approximately 2 miles west of Brayton Point. For the 24-hour average PM2.5, the 98th percentile 24-hour average values were averaged from the three most recent years of monitoring. The background annual average PM2.5 is the average of the yearly observation from the three most recent years.

Background concentrations for each year for CO were taken from about 12.5 miles northwest from the Brayton Point facility at the CO monitoring station at Francis School at 64 Bourne Avenue in East Providence, RI. Each year, the second highest CO values for each of the three years (2005-2007) were used to find the background level. The background level was chosen by taking the highest second-high value that occurred within the three years selected (2005-2007).

As with PM2.5, the Fall River, MA station was chosen at 659 Globe Street for SO2. For the short-term averages the second maximum for each year was chosen and the maximum annual measured concentration. Then, the highest value from the years 2005 to 2007 was chosen as the background level.

For NO_2, the closest monitoring station is located in East Providence at the Francis School on 64 Bourne Avenue, which is the same location as the CO monitoring station. The maximum annual measured concentration for each year is summarized in Table 5-4 and the highest value over the three years was chosen as the background level for NO_2.

Table 5-4 Observed Ambient Air Quality Concentrations and Selected Background Levels

	Averaging Period	Station	2005	2006	2007	Background Level	NAAQS
PM10 (μg/m³)	24-Hour	Providence[1]	48/46/39	48/48/33	30/27/27	46	150
	Annual	Providence[1]	19	18	15	19	50
PM2.5 (μg/m³)	24-Hour	Fall River[2]	22	25	26	24	35
	Annual	Fall River[2]	10.1*	8.1	9.1	9.1	15
CO (ug/m3)	1-Hour	East Providence[3]	3,111	2,778	2,000	3,111	40,000
	8-Hour	East Providence[3]	1,778	1,778	1,222	1,778	10,000
SO2 (ug/m3)	3-Hour	Fall River[2]	158	148	121	158	1300
	24-Hour	Fall River[2]	52	52	57	57	365
	Annual	Fall River[2]	13.3	13.3	8.0	13.3	80
NO2 (ug/m3)	Annual	East Providence[3]	15.1	13.2	9.4	15.1	100

Notes:

* Indicates that the mean does not satisfy summary criteria (number of observations for at least one quarter was less than 75%)

For the 24-hr background value, the three highest measured values are listed for each of the 3 years. The background value used is the 4th highest over the 3 year period.

[1] 212 Prairie Avenue in Providence, RI

[2] 659 Globe Street in Fall River, MA

[3] Francis School, 64 Bourne Avenue, East Providence, RI

5.7 Good Engineering Practice (GEP) Stack Height Evaluation

The GEP stack height evaluation of the facility has been conducted in accordance with the EPA revised *Guidelines for Determination of Good Engineering Practice Stack Height* (EPA, 1985). The formula, as defined by the EPA guidelines, for the GEP stack height is:

$H_{GEP} = H_b + 1.5L$

where

H_{GEP} = GEP stack height,

H_b = Height of adjacent or nearby structures,

L = Lesser of height or maximum projected width of adjacent or nearby building, i.e., the critical dimension, and

Nearby = Within 5L of the stack from downwind (trailing edge) of the building.

The natural draft cooling tower(s) proposed for the Project are large and may sometimes cause aerodynamic downwash of the plumes exiting the top of the tower. Previous experience with natural draft towers indicates that downwash is limited to high winds and/or low cooling tower thermal emissions (e.g., at start-up). Therefore a GEP analysis was conducted for each tower so that downwash effects will be considered in the air quality modeling. The Building Profile Input Program, Prime version (BPIP-Prime) was used to determine the wind direction specific inputs to the AERMOD model.

Because the diameter of the towers varies with height, the towers will be entered into BPIP-Prime as 3-tiered tanks. The structure dimensions are based on preliminary engineering designs. The first tier extended from the base to 90 ft high, and was 407.9 ft in diameter. The second tier extended from the base to 234 ft high and was 334.7 ft in diameter. The final tier extended the full height of the cooling tower (497 ft), and the outer shell has a diameter of 233.25 ft. This selection of tiers approximates the tower shape with sufficient accuracy to identify GEP stack height. Application of the GEP formula to each of the proposed cooling towers in BPIP-Prime indicates a GEP height of 847 feet (258 m) with the tallest tier as the controlling structure.

The distance between the cooling towers and the stacks exceeds 5L. Therefore, the plumes from the existing stacks will not experience downwash effects associated with the cooling towers. However, the existing stacks do experience downwash effects from nearby structures.

The BPIP-Prime analysis indicates a GEP height for each of the four stacks at 530 feet (161.57 meters). Boiler 3 is found to be the controlling structure with a height of 212 feet (64.62 meters). In addition to Boiler 3 causing the maximum GEP height, for certain wind directions, Stack 1 is also influenced by the SCR1 structure which has a height of 175.5 feet

(53.49 meters). Boiler 3 is the controlling structure for all directions for Stack 2 and Stack 3. Stack 4 is influenced by both Boiler 3 and Boiler 4 structures at 162.5 feet (49.5 meters).

All four stacks are non-GEP height stacks and direction-specific building downwash parameters were input to AERMOD for each of these sources.

Figure 5-3 is a top-view site plan drawn to scale for all building structures used for the GEP analysis for the two cooling towers and the four existing Brayton Point stacks. Each tier is identified on the drawing and each tier height is specified. A reference UTM coordinate point and north direction is located on the plan.

5.8 Air Quality Model Selection

The EPA approved air quality model used for this analysis is the AERMOD model (07026). Using the regulatory default options, AERMOD was used to identify maximum impact concentrations. The AERMOD model is a steady state plume model using Gaussian distributions that calculates concentrations at each receptor for every hour in the year. The model is designed for rural or urban applications and can be used with a rectangular or polar system of receptors that are allowed to vary with terrain. AERMOD is designed to operate with two preprocessor codes: AERMET processes meteorological data for input to AERMOD, and AERMAP processes terrain elevation data and generates receptor information for input to AERMOD. The AERSURFACE program, a tool provided by EPA, was used to assess the surface characteristics near the meteorological observation site and those data used as input to AERMET. The AERMOD model was selected for the air quality modeling analysis because of several model features that properly simulate the proposed facility environs, including the following:

- Concentration averaging time ranging from one hour to one year;
- Estimating cavity impacts; and
- Use of actual representative hourly average meteorological data.

The AERMOD model incorporates the Plume Rise Model Enhancements (PRIME), the latest EPA building downwash algorithm for the improved treatment of building downwash. PRIME can also account for the stack placement relative to the building thereby allowing for the ability to calculate impacts in the cavity region near the stack.

A complete technical description of the AERMOD model may be found in the *User's Guide for AERMOD* (EPA, 2004).

5.9 Receptor Grid

A polar network of receptors consisting of a discrete receptor grid was used for the AERMOD modeling analysis. The receptors commence at the property line out to

2 kilometers at 100 meter spacing, then 200 meter spacing out to 4 kilometers, 500 meter spacing out to 7 kilometers and 1,000 meter spacing out to 10 kilometers. The terrain elevation for each receptor was obtained electronically from USGS digital terrain data (30m DEM) using the BEE-Line AERMAP program. The terrain processor within the AERMAP software program is used to assign elevations and a height scale for each receptor. During the processing, three receptors were entered by hand (at 10km, 170°, 180° and 190°) because the AERMAP program could not process these receptors due to a lack of USGS data in that area. Receptors were also placed around the Brayton Point property line at a spacing of every 25 meters.

5.10 AERMOD Modeling

The Brayton Point facility was modeled hour-by-hour using refined modeling techniques for the five years of hourly meteorological data from TF Greene Airport. The AERMOD model was used for the refined modeling with the regulatory default option set. This automatically selects the EPA recommended options for stack tip downwash, effects of elevated terrain, calm and missing data processing routines, and uses the upper-bound concentration estimates for sources influenced by building downwash from super-squat buildings.

The predicted air quality levels of the PM10 impacts due to the proposed natural draft cooling towers and all four main stacks were assessed through the modeling analysis. For PM2.5, the impacts for the cooling tower project and all four main stacks is added to the measured (98^{th} percentile for 24-hour) background from the Fall River monitoring station and compared to the NAAQS.

For SO_2, NOx, and CO, the impacts from all four main stacks are added to the measured background (with appropriate averaging time) from the appropriate monitoring station and compared to the NAAQS. This is consistent with the recent Mass DEP approach for documenting that the project will not cause an exceedance of any federal or Massachusetts ambient air quality standard (310 CMR 7.02(3)(j)1), specifically the approach followed in the June 2006 310 CMR 7.02 Non-Major Comprehensive Plan Approval Application as part of 310 CMR 7.29 Air Project, approved by Mass DEP.

5.11 Source Parameters

5.11.1 Cooling Towers

Although the exhaust diameter for the cooling tower(s) is quite large, the exhaust will tend to behave as a more typical "stack." There will be consistent, predictable exhaust flow, with momentum plume rise and thermal plume rise. The plume rise is usually much larger than the source diameter, justifying the assumption that the source diameter does not have a major effect on plume rise. The cooling tower structure itself was considered as the controlling structure for downwash.

Broadly there are two main operating conditions for the cooling towers. In design conditions both towers are in-use. In one-tower operation there is a single tower operating; this would typically occur if one tower was down for maintenance or if operating conditions warrant 1 tower operation. Both operating scenarios were modeled and the results are presented in Section 5.12. Results are consistently lower for the one-tower operation because the per-tower emission rate and exhaust parameters are the same. The cooling tower design conditions used in the air modeling are presented in Table 5-5.

Table 5-5 Cooling Tower Design Conditions

Parameter	Design Conditions (2 towers)
Exit Air Volume Rate:	11,680 cubic meters per second (24,750,000 cubic feet per minute), wet basis
Exit Air Density:	1,090 grams/cubic meter (0.0679 pounds/cubic foot), wet basis
Exit Air Mass Flowrate:	12,700 kilograms/second (1,680,000 pounds/minute), wet basis
Exit Velocity:	3.39 m/s (667 feet/minute)
Particulate Emission Rate:	5.6 grams/second (44.4 pounds/hour) per tower

At design conditions, approximately 420,000 gallons/hour of water exhausts out the top of each tower. The heat rejection is about 4000 MMBtu/hr/tower. Physical cooling tower exhaust parameters are described in Table 5-6, below.

Table 5-6 Stack Characteristics for the Natural Draft Cooling Towers

Units	UTM E (km)	UTM N (km)	Base Elevation	Stack Height	Stack Inner Diameter
Cooling Tower 1	317.604	4620.466	9.75 meters (32 feet)	151.5 meters (497 feet)	67.6 meters (222 feet)
Cooling Tower 2	317.751	4620.332	9.75 meters (32 feet)	151.5 meters (497 feet)	67.6 meters (222 feet)

Coordinates are Zone 19, North American Datum 1927 (NAD27)

The cooling towers were modeled as point sources with stack exit temperatures that vary hourly. The exhaust temperature can vary depending on the temperature and relative humidity of the ambient air. Hourly exhaust temperatures were computed based on the curves provided by the cooling tower vendor and the hourly meteorological observations at TF Green Airport. The cooling tower exit air temperature differential curves are shown in Figure 5-4. The cooling towers were assumed to operate continuously.

5.11.2 Unit 3 DS/FF

Because of the relatively close proximity between the four Brayton Point Station stacks, all four stacks were considered in the modeling analysis. The Unit 3 DS/FF will use the existing Unit 3 stack. Units 1, 2, and 3 have stack heights of 352.8 feet (107.5 meters) above ground-level (AGL) and Unit 4 has a stack height of 500.5 feet (152.6 meters) AGL. Units 1 and 2 have stack diameters of 14.5 feet (4.4 meters), Unit 3 has a stack diameter of 19.5 feet (5.9 meters), and Unit 4 has a stack diameter of 18.5 feet (5.6 meters).

Recent air quality dispersion modeling (June 2006 310 CMR 7.02 Non-Major Comprehensive Plan Approval Application as part of 310 CMR 7.29 Air Project, submitted to Mass DEP) documented that Brayton Point Station does not cause or significantly contribute to the violation of any ambient air quality standard. The June 2006 modeling analysis reviewed a wide range of cases, and Brayton Point Station accepted new sulfur dioxide limitations in order to document that the ambient air standards were protected in all circumstances. The modeling in this current application analyzes the pollutants and operating scenarios specifically affected by the proposed changes (the Cooling Tower Project and the proposed Unit 3 DS/FF project). The current modeling shows that with the proposed changes the ambient air standards will still be protected.

The Unit 1, 2, and 4 emission rates and exhaust parameters are the same as those used in the June 2006 air quality dispersion modeling. The Unit 3 exhaust parameters are new.

Modeled cases are shown in the Table 5-7 below. These five cases were selected from screening evaluations performed in the June 2006 NMCPA, based on two criteria: 1) highest potential overall station impact for particulate matter; and 2) highest potential station impact for other criteria pollutants including cases with the Unit 3 DS/FF operational. Based on comments received from Mass DEP, filterable and condensable emissions are included for both PM10 and PM2.5.

Prior air quality dispersion modeling identified worst-case operating scenarios for Units 1-4; this modeling was presented in the June 2006 310 CMR 7.02 Non-Major Comprehensive Plan Approval Application as part of 310 CMR 7.29 Air Project, submitted to Mass DEP. The dispersion modeling analysis presented in this current application updates the June 2006 analysis to reflect the proposed changes to Unit 3 operation.

Specifically, for NO2, CO, and particulate matter, the June 2006 application did a screening analysis with each Unit at minimum, intermediate, and maximum load to identify the worst-case combination for each pollutant and averaging time. This current analysis provides a new screen evaluation for Unit 3 with the DS/FF exhausted at a lower temperature with the existing stack. The specific pages of the June 2006 application are included in Appendix O along with the screening analysis updates.

For SO2, the June 2006 application included a load analysis that identified 11 cases to model (identified as A-2, B-2, E-1, E-2. F-2, G-2, Y-1, Z-1, H-1, H-2, and H-3). Of these, only two cases (Y-1 and Z-1) are affected by the change in Unit 3 scrubber. Appendix O contains pages from the June 2006 application, marked to identify the cases affected by the current DS/FF Project. The current analysis provides 6 new screening runs with the high, intermediate, and minimum load exhaust parameters for Unit 3 for cases Y-1 and Z-1, to identify the worst-case exhaust combinations.

For consistency, the screening analysis uses the same model and techniques as was used in June 2006. Appendix B provides copies of the pages from the June 2006 application, updated to show the new screening analyses for the new Unit 3 configuration.

The new screening analyses confirmed the worst case operating scenarios for full modeling. These are presented in Table 5-7 and 5-8. Cooling tower emissions are consistent for each of these cases (5.6 grams per second per tower PM10 and PM2.5). Beyond the BACT levels proposed for PM10 and PM2.5 for the Cooling Towers and Unit 3, Dominion does not intend to set any emission limits that are more restrictive than the limits contained in existing approvals. Appendix B includes calculations to document that the emission rates included in Table 5-7 and 5-8 are based on existing emission limits.

Table 5-7 AERMOD Modeling Cases for Brayton Point Boiler Stacks: PM10, PM2.5, CO, NO2

Unit	Fuel	SDA on/off	Boiler Load	Exhaust Temperature, Fahrenheit	Exhaust Velocity, feet/second	PM10, grams/second	PM2.5, grams/second	CO, grams/second	NO2, grams/second
CASE 1: Maximum Emission Rate All Units									
1	Coal	On	Maximum	185	99	22.68	22.68	23.53	107.73
2	Coal	On	Maximum	185	99	22.68	22.68	23.53	107.73
3	Coal	On	Maximum	167	98	17.81	17.81	118.28	320.63
4	Oil	N/A	Maximum	380	111.6	18.14	18.14	47.17	163.29

CASE 2: worst case impact per 2006 NMCPA for: 24-hr PM10, 8-hr CO									
1	Coal	On	Intermediate	150	50.4	14.19	14.19	14.72	67.41
2	Coal	On	Intermediate	150	50.4	14.19	14.19	14.72	67.41
3	Coal	On	Maximum	167	98	17.81	17.81	118.28	320.63
4	Oil	N/A	Intermediate	350	54.6	9.22	9.22	23.97	82.97

CASE 3: worst case impact per 2006 NMCPA for: annual PM & NO2									
1	Coal	On	Intermediate	150	50.4	14.19	14.19	14.72	67.41
2	Coal	On	Intermediate	150	50.4	14.19	14.19	14.72	67.41
3	Coal	On	Intermediate	162	60.7	11.02	11.02	73.20	198.45
4	Oil	N/A	Intermediate	350	54.6	9.22	9.22	23.97	82.97

CASE 4: worst case impact per 2006 NMCPA for: 1-hr CO									
1	Coal	On	Intermediate	150	50.4	14.19	14.19	14.72	67.41
2	Coal	On	Intermediate	150	50.4	14.19	14.19	14.72	67.41
3	Coal	On	Maximum	167	98	17.81	17.81	118.28	320.63
4	Oil	N/A	Maximum	380	111.6	18.14	18.14	47.17	163.29

Table 5-8 AERMOD Modeling Cases for Brayton Point Boiler Stacks: SO2

Unit	Fuel	SDA on/off	Boiler Load	Exhaust Temperature, Fahrenheit	Exhaust Velocity, feet/second	SO2, grams/second	SO2, lb/hr	SO2, lb/MMBtu
CASE Y-1: SO2 scenario from 2006 NMCPA affected by Unit 3 DS/FF project								
1	Coal	Off	Maximum	265	91.8	698	5535	2.46
2	Coal	Off	Maximum	265	91.8	698	5535	2.46
3	Coal	On	Maximum	167	98	175.4	1391	0.246
4	Oil	N/A	Maximum	380	111.6	734.7	5831	1.21
						SO2 total lb/hr:	18292	
CASE Z-1: SO2 scenario from 2006 NMCPA affected by Unit 3 DS/FF project								
1	Coal	Off	Maximum	265	91.8	373.62	2965.3	1.32
2	Coal	Off	Maximum	265	91.8	373.62	2965.3	1.32
3	Coal	On	Maximum	167	98	93.92	745.4	0.132
4	Oil	N/A	Maximum	380	111.6	1463.58	11616	2.420
						SO2 total lb/hr:	18292	

Stack coordinates (NAD27) are:
Unit 1: 317590.0 meters E; 4619806.0 meters N
Unit 2: 317564.0 meters E; 4619829.0 meters N
Unit 3: 317527.0 meters E; 4619847.0 meters N
Unit 4: 317483.0 meters E; 4619899.0 meters N

5.12 Predicted Project Air Quality Impacts

Five operating cases (shown in Table 5-7) were modeled with AERMOD for four pollutants (PM10, PM2.5, CO, and NO2), and two operating cases (shown in Table 5-8) were modeled with AERMOD for SO2. Particulate matter emissions were modeled from the two cooling towers and all four stacks. The other pollutants are not released from the cooling towers; therefore modeling for those pollutants consisted of only stack emissions.

Predicted concentrations for the combined impact from the station are shown in Table 5-9. Modeled impacts were added to ambient measured background levels to document compliance with the National Ambient Air Quality Standards.

A discussion of the meteorological conditions for the periods presented in Table 5-9 are presented in Appendix G. The modeled contributions from each individual source at Brayton Point are shown in Table 5-10.

Table 5-9 Comparison of Full Facility Predicted AERMOD Results with the National Ambient Air Quality Standard

Pollutant	Averaging Period	Project Predicted Concentration ($\mu g/m^3$)	Receptor Location (UTM-E, UTM-N, Elev.) (meters)	Period	Monitored Background Concentration (μg/m3)	Total Impact (μg/m3)	NAAQS (μg/m3)	Operating Scenario (case)
PM10	24-Hr H2H	16.5	317029.0, 4618976.0, 1.5	5/25/05	46	62.5	150	3
	Annual	1.4	318092.5, 4620713.0, 12.9	2002	19	20.4	50	3
PM2.5	24-Hr H8H	9.7	316979.0, 4618889.5, 1.5	11/13/06	24	33.7	35	3
	Annual	1.4	318092.5, 4620713.0, 12.9	2002	9.1	10.5	15	3
NO_2	Annual	5.64	318364.6, 4620838.0, 20.	2002	15.1	20.7	100	3
SO_2	3-Hr H2H	722.3	316929.0, 4618803.0, 1.5	5/10/06 hr 9	158	880.3	1300	Y-1
	24-Hr H2H	289.6	316979.0, 4618889.5, 1.5	5/24/05	57	346.6	365	Y-1
	Annual	14.1	316981.8, 4621345.5, 14.6	2005	13.3	27.4	80	Y-1
CO	1-Hr H2H	88.1	317876.3, 4621811.5, 8.6	9/9/02 hr 9	3,111	3,199	40,000	1
	8-Hr H2H	50.0	316929.0, 4618803.0, 1.5	5/10/06 hr 16	1,778	1,828	10,000	2

Note: H2H means High-Second-High, H8H means High-Eighth-High.

Table 5-10 Predicted AERMOD Source Contributions to Table 5-9 Results

Pollutant	Averaging Period	Project Predicted Concentration ($\mu g/m^3$)	Cooling Tower 1 ($\mu g/m^3$)	Cooling Tower 2 ($\mu g/m^3$)	Unit 1 ($\mu g/m^3$)	Unit 2 ($\mu g/m^3$)	Unit 3 ($\mu g/m^3$)	Unit 4 ($\mu g/m^3$)
PM10	24-Hr H2H	16.5	0.67	1.29	5.68	5.56	3.26	0.06
	Annual	1.4	0.26	0.33	0.37	0.32	0.11	0.01
PM2.5	24-Hr H8H	9.73	0.23	0.36	4.57	3.58	0.99	0.002
	Annual	1.4	0.26	0.33	0.37	0.32	0.11	0.01
NO_2	Annual	5.6	0.00	0.00	2.21	1.27	2.03	0.13
SO_2	3-Hr H2H	722.3	0.00	0.00	335.22	322.34	61.70	3.08
	24-Hr H2H	289.6	0.00	0.00	149.20	119.29	20.47	0.64
	Annual	14.1	0.00	0.00	5.68	5.78	1.24	1.39
CO	1-Hr H2H	88.1	0.00	0.00	14.16	14.18	58.80	0.96
	8-Hr H2H	50.0	0.00	0.00	9.67	9.85	30.13	0.31

Note: H2H means High-Second-High, H8H means High-Eighth-High.

5.13 Cumulative Modeling

Consistent with the approach followed in the June 2006 310 CMR 7.02 Non-Major Comprehensive Plan Approval Application as part of 310 CMR 7.29 Air Project, cumulative impact modeling will not be performed for SO_2, NOx, or CO. These pollutants net emissions increase were below the PSD significant emission rates and therefore are not subject to PSD review.

The Project impacts are above the PM10 24-hour and annual Significant Impact Level (SIL). Per the procedures in the air quality modeling protocols, Dominion sought to identify sources within 10 kilometers of the SIA with actual PM10 emissions greater than 100 tons, and sources with 20 kilometers of the SIA with actual PM10 emissions greater than 1000 tons. Dominion also sought to identify PSD increment-consuming sources. Based on publicly available information[21], Dominion believes there are no sources satisfying these criteria in the area around Brayton Point. Similarly, there are no sources within 10 kilometers of the SIA with actual PM2.5 emissions greater than 100 tons, and sources with 20 kilometers of the SIA with actual PM2.5 emissions greater than 1000 tons.

Therefore no cumulative modeling was conducted and the modeled impacts from the Brayton Point sources (natural draft cooling tower(s) and main stacks) presented in Table 5-9 demonstrate NAAQS compliance.

5.14 Additional Impacts Analysis – Visibility (PSD Permit Only)

Under the Clean Air Act through PSD program, visibility degradation in Class I areas (national parks and wilderness areas) must be addressed. These areas have been designated by the federal government as pristine natural environments, and as such have limits on increases in air pollution levels. Visibility is an Air Quality Related Value (AQRV) under the jurisdiction of the Federal Land Managers (FLM) of Class I areas. The FLMs of the Class I areas are representatives of the National Park Service (NPS) or the U.S. Forest Service (USFS), or the U.S. Fish and Wildlife Service (FWS) depending on the specific Class I area of interest.

A visibility analysis of the proposed project's plume was conducted using the EPA VISCREEN program (Version 1.01 dated 88341). Previous PSD applications for sources in Massachusetts have followed this approach.

The VISCREEN model (EPA, 1988) provides the capability of assessing plume contrast (Cp) and plume perceptibility (Delta E) against two backgrounds, sky and terrain.

---

[21] MA DEP 2005 statewide source registration summary spreadsheet

For the Project, visibility impacts are a function of particle emissions. Particles are capable of either scattering or absorbing light. These constituents can either increase or decrease the light intensity (or contrast) of the plume against its background. VISCREEN plume contrast calculations are performed at three wavelengths within the visible spectrum (blue, green, and red). Plume perceptibility as determined by VISCREEN is determined from plume contrast at all visible wavelengths and "is a function of changes in both brightness and color" (EPA, 1992).

The VISCREEN model provides three levels of analysis; Level 1, Level 2, and Level 3. The first two Levels are screening approaches. The Level 1 assessment uses a series of conservative model-defined values. If the source passes the criteria set forth by the Level 1 assessment (i.e., Delta E 2.0 and Cp (L=0.55 micrometer) 0.05), potential for visibility impairment is not expected and no further analysis is required.

A VISCREEN analysis was performed on the nearest Class I area, Lye Brook Wilderness Area in southern Vermont (approximately 210 km to the northwest of the project). Model inputs for the Level1 VISCREEN analysis for the two Brayton Point natural draft cooling towers and Unit 3 are as follows:

- PM Emissions: 29.01 g/s
- NOx Emissions: 320.63 g/s
- Background Visible Range: 40 km
- Source Observer Distance: 213.1 km
- Minimum Source Distance: 213.1 km
- Maximum Source Distance: 219.7 km

The VISCREEN model assumes two sun angles (scattering angles of 10° and 140°). Further, results are also provided for two tests:

1. The plume is located inside the boundary of the Class I area; and
2. The plume is located outside of the Class I area boundary.

Table 5-11 and Table 5-12 present the model results of the VISCREEN analysis that demonstrate that all visibility impacts at the Lye Brook Wilderness area are acceptable. The VISCREEN output file is presented in Appendix H.

Table 5-11 VISCREEN Model Results for Visual Impacts Inside the Lye Brook Class I Area

Background	Theta (º)	Azimuth (º)	Distance (km)	Alpha (º)	Delta E		Contrast (μm)	
					Criteria	Plume	Criteria	Plume
Sky	10	84	213.1	84	2.00	0.037	0.05	0.000
Sky	140	84	213.1	84	2.00	0.015	0.05	-0.001
Terrain	10	84	213.1	84	2.00	0.002	0.05	0.000
Terrain	140	84	213.1	84	2.00	0.000	0.05	0.000

Table 5-12 VISCREEN Model Results for Visual Impacts Outside the Lye Brook Class I Area

Background	Theta (º)	Azimuth (º)	Distance (km)	Alpha (º)	Delta E		Contrast (μm)	
					Criteria	Plume	Criteria	Plume
Sky	10	75	206.3	94	2.00	0.039	0.05	0.000
Sky	140	75	206.3	94	2.00	0.016	0.05	-0.001
Terrain	10	65	198.8	104	2.00	0.002	0.05	0.000
Terrain	140	65	198.8	104	2.00	0.001	0.05	0.000

5.15 PSD Increment Analysis (PSD Permit Only)

As part of this application, Dominion is requesting that the EPA indicate whether Brayton Point Station is currently within a PSD area. It is our understanding that either 1) the PSD baseline has not been triggered for the area including Brayton Point station, or 2) it has been triggered, but based on an application for a facility that was not constructed (e.g. coal-fired power plant in Taunton, MA).

In either event, the emissions from the Cooling Tower, plus the net emissions increase from Unit 3, would be used in the PSD increment analysis for PM10 and PM2.5. In this analysis, Dominion conservatively does not account for past actual Unit 3 emissions.

In the event that Brayton Point Station is not in a PSD area, this project would establish the minor source PSD baseline for the area associated with a 1 microgram per cubic meter annual average impact from the increment consuming sources (Cooling Towers and Unit 3). The AERMOD modeling demonstrates that the maximum combined annual impact from the two cooling towers and Unit 3 is 0.90 ug/m3 (less than 1 ug/m3, even with the conservative assumption of not taking credit for Unit 3 past actual emissions). Therefore this project does not trigger a PSD baseline area.

In the event that Brayton Point Station is within a previously triggered PSD area, Table 5-13 below documents that the particulate matter PSD increment consumed by the combined Cooling Tower and Unit 3 DS/FF Projects is acceptable.

Table 5-13 AERMOD Predicted PSD Increment Consumption for the Cooling Towers & Unit 3

Pollutant	Averaging Period	Predicted Concentration ($\mu g/m^3$)	Receptor Location (UTM-E, UTM-N, Elev.) (meters)	Period	PSD Increment ($\mu g/m^3$)
Particulate Matter	24-Hr H2H	8.90	317492.0, 4620326.0, 2.1	7./7/05	37
Particulate Matter	Annual	0.90	317520.4, 4620291.0, 2.4	2005	19

5.16 Additional Impacts Analysis – Secondary Impacts (PSD Permit Only)

PSD regulations require analysis of air quality impacts on sensitive vegetation types, with significant commercial or recreational value, or sensitive types of soil. Evaluation of impacts on sensitive vegetation is typically performed by comparison of predicted project impacts with screening levels presented in *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals* (EPA, 1980). These procedures specify that predicted impact concentrations used for comparison account for project impacts to ambient background concentrations.

Particulate concentrations, and deposition, are not addressed in this screening procedure. PSD Review is only triggered for particulate matter. Therefore, the screening procedure is not needed for the Closed Cycle Cooling Project or the Unit 3 DS/FF Project.

Salt deposition has not been analyzed in prior PSD air quality modeling demonstrations to our knowledge, and is not an appropriate subject for EPA review through this PSD permit application. Salt deposition modeling, described in Appendix I for informational purposes only, documents salt deposition rates within the range of normal background for marine environments, and below available benchmarks for significance.

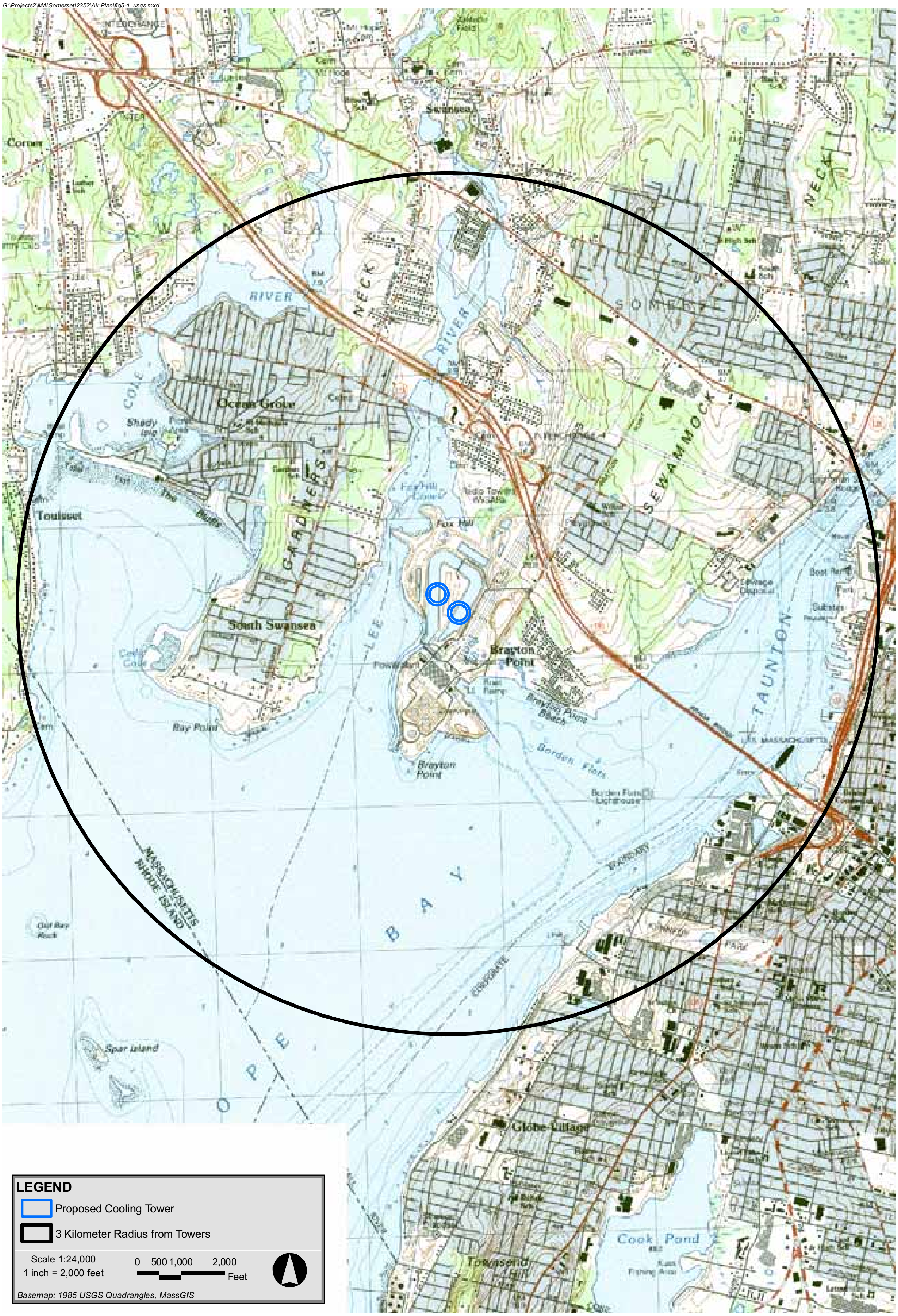
5.17 Additional Impacts Analysis – Growth Analysis (PSD Permit Only)

PSD regulations also include requirements for a growth analysis, which includes: a projection of the associated industrial, commercial, and residential source growth that will occur in the area due to the source; and an estimate of the air emissions generated by the above associated industrial, commercial, and residential growth.

The peak construction work force is estimated to be 600 persons. A very sizeable skilled construction force is available for this project in the greater Boston area and eastern Massachusetts. Because the area can readily support the Project's construction labor needs, new housing, commercial and industrial construction will not be necessary to support the Project during the construction period.

Once the Closed Cycle Cooling and Unit 3 DS/FF Projects are ready for commissioning, Brayton Point may add a few operators to its permanent staff. Should any new personnel move to the area, a significant housing market is already established and available. Therefore, no new housing or support services are expected.

Thus, no new significant emissions from secondary growth during either the construction phase or operations are anticipated.



Brayton Point Cooling Tower Permitting Project **Somerset, Massachusetts**

Epsilon

Figure 5-1

USGS Locus Map

G:\Projects2\MA\Somerset\2352\usgs.mxd

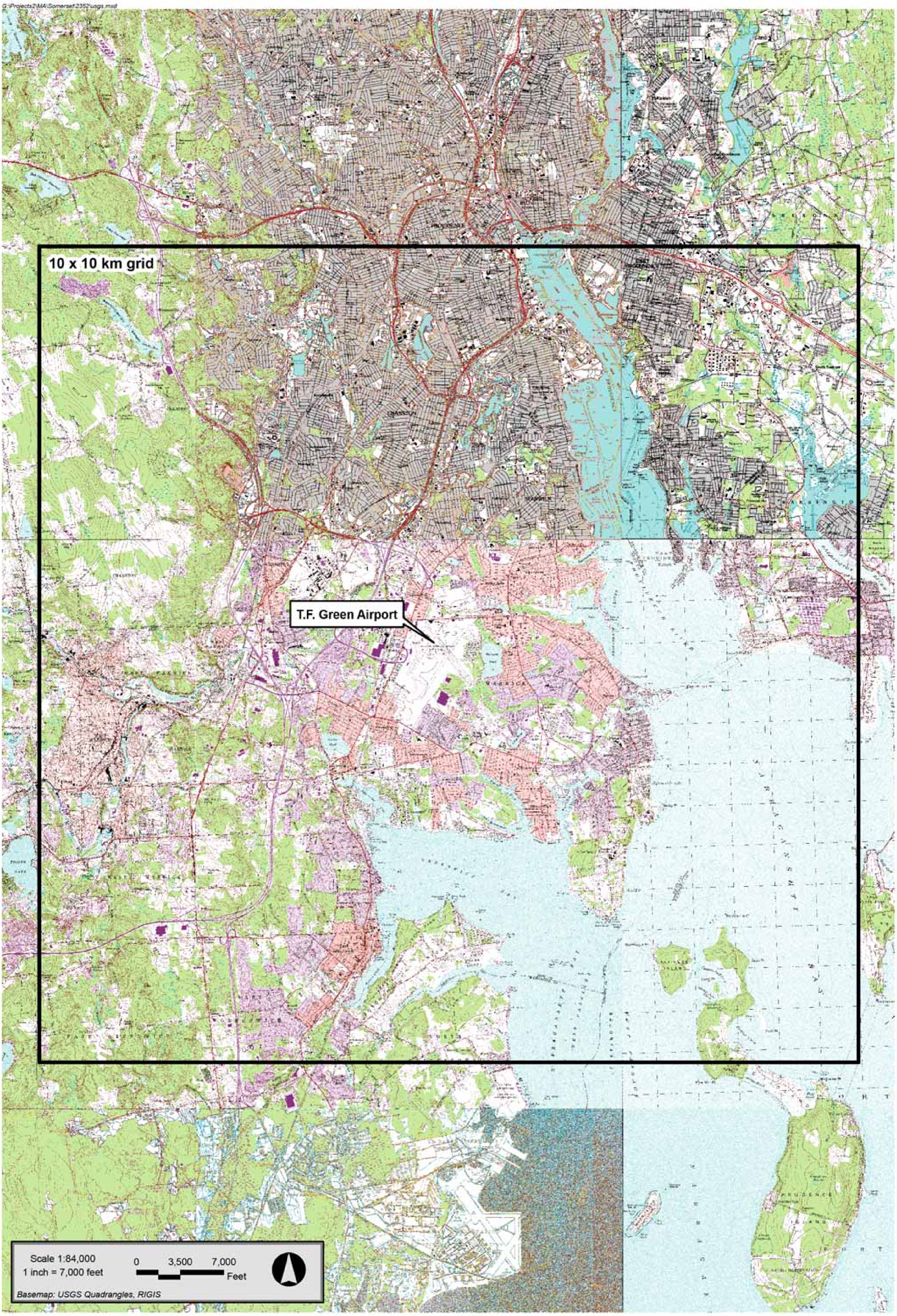


Figure 5-2

USGS Map Showing Land Use within a 10 by 10 km Grid Centered on the T.F. Green Airport

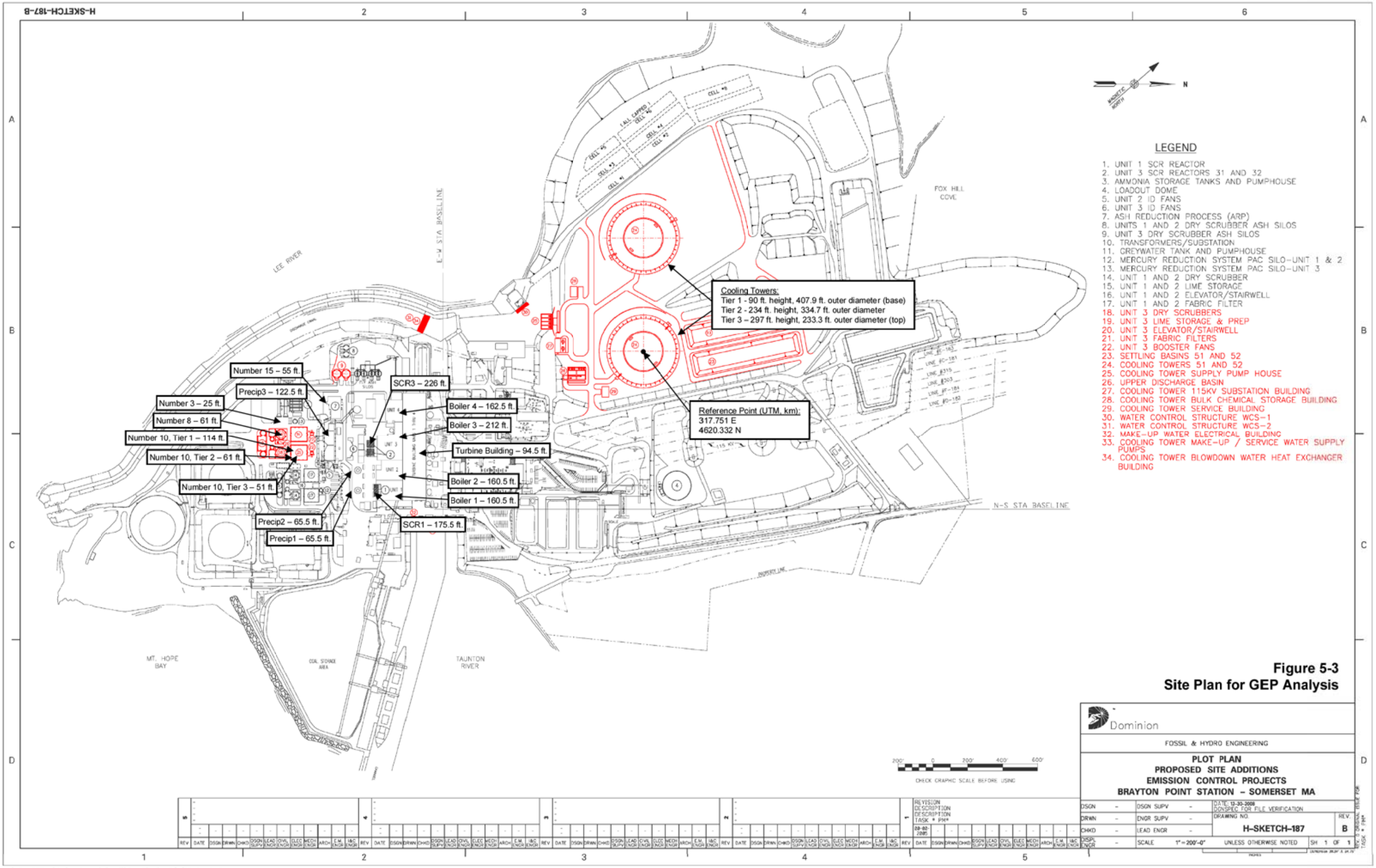


Figure 5-3
Site Plan for GEP Analysis

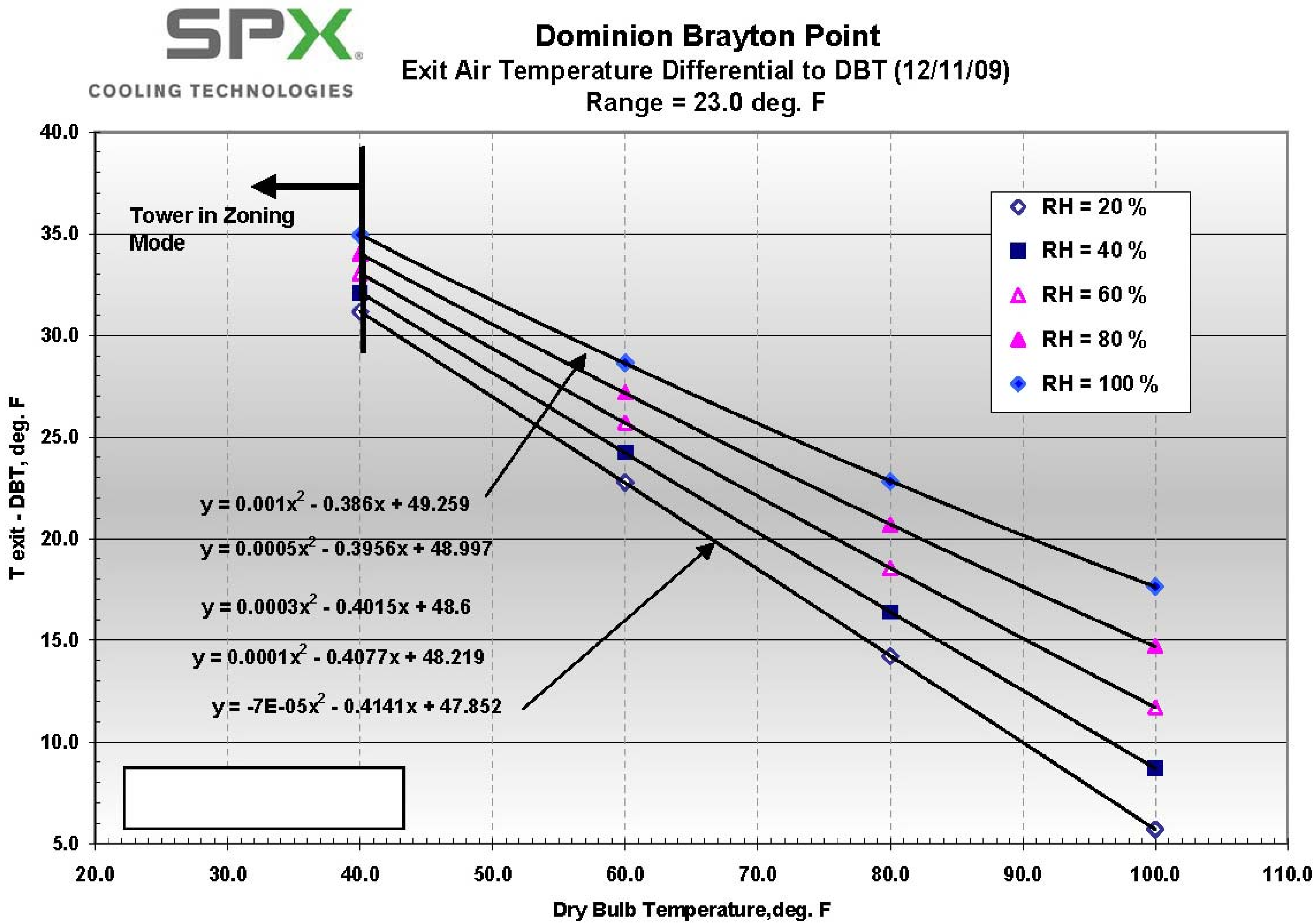


Figure 5-4

Cooling Tower Exhaust Temperature Curves