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# Proposed Revision to Massachusetts Regional Haze State Implementation Plan

February 17, 2012

## Executive Summary

On December 30, 2011, the Massachusetts Department of Environmental Protection (MassDEP) submitted a Regional Haze State Implementation Plan (SIP) to the U.S. Environmental Protection Agency (EPA) for approval. The SIP is available on MassDEP's website at www.mass.gov/dep/air/priorities/sip.htm#haze. As explained in the Executive Summary of that SIP, MassDEP had originally proposed to meet certain SIP requirements regarding electric generating units (EGUs) by relying on emissions reductions in Massachusetts proposed in EPA's draft Transport Rule. However, EPA did not include Massachusetts in its final Transport Rule ("Cross-State Air Pollution Rule," 76 FR 48208, August 8, 2011), which necessitated a revision to the SIP. MassDEP now is proposing this SIP revision to amend the December 30, 2011 SIP to address Best Available Retrofit Technology (BART) requirements for EGUs by adding Section 8.10: Alternative to BART and Section 8.11: BART for $PM_{10}$ Emissions, and to revise the *Targeted EGU Strategy* in Section 10.5: Additional Reasonable Strategies. These revisions include:

Best Available Retrofit Technology – EPA's Regional Haze Rule requires the control of emissions from certain stationary sources placed into operation between 1962 and 1977 through the implementation of Best Available Retrofit Technology (BART) or an alternative to BART that achieves greater emission reductions. As described in Section 8 of the December 30, 2011 SIP, MassDEP identified 5 electric generating unit (EGU) facilities, 1 municipal waste combustor, and 1 industrial boiler as BART-eligible facilities whose 2002 emissions (the baseline year for this SIP) contributed significantly to visibility impairment. MassDEP originally proposed to rely on EPA's draft Transport Rule as an Alternative to BART for EGUs, but could not finalize its proposal because Massachusetts was not included in EPA's final Cross-State Air Pollution Rule. MassDEP now proposes a different Alternative to BART for EGUs that includes the following measures:

1. Existing regulation 310 CMR 7.29, *Emissions Standards for Power Plants*, which establishes $NO_x$ and $SO_2$ emissions rates (as well as mercury emission rates and carbon dioxide caps) for certain EGUs.
2. The retirement of Somerset Power.
3. Permit restrictions for Brayton Point, Salem Harbor, and Mt. Tom Station that limit/retire $SO_2$ and/or $NO_x$ emissions.
4. Existing regulation 310 CMR 7.19, *Reasonably Available Control Technology (RACT) for Sources of Oxides of Nitrogen* $NO_x$, which establishes $NO_x$ emission rates for various sources, including EGUs.
5. MassDEP's proposed amendments to its low sulfur fuel oil regulation, which would require EGUs that burn residual oil to limit the sulfur content to 0.5% by weight beginning July 1, 2014.

This Proposed Revision to the Massachusetts Regional Haze SIP also addresses BART for $PM_{10}$. However, MassDEP has determined that no additional controls are warranted for primary $PM_{10}$ because controls have been added to all but one of the facilities, and the additional cost of further control is not justified since there would be no significant visibility improvement.

Targeted EGU strategy – Massachusetts is a member of the Mid-Atlantic Northeast Visibility Union (MANE-VU), comprised of Mid-Atlantic and Northeast states, tribes, and federal agencies, and participated in a regional planning process led by MANE-VU to develop strategies for reducing regional haze. MANE-VU identified 167 EGU stacks at power plants in the MANE-VU region and adjacent Mid-West and Southeast regions of the U.S. whose sulfur dioxide ($SO_2$) emissions significantly impaired visibility at one or more MANE-VU Class I areas (national parks, forests and wilderness areas). The "167 Stacks" included stacks at 5 Massachusetts power plants. Massachusetts, along with other MANE-VU states, agreed to reduce $SO_2$ emissions from the power plant stacks by 90 percent from 2002 levels by 2018, or to pursue equivalent alternative measures. MassDEP originally proposed to rely on EPA's draft Transport Rule to meet the Targeted EGU strategy, but could not finalize its proposal because Massachusetts was not included in EPA's final Cross-State Air Pollution Rule.

MassDEP now proposes a revised Targeted EGU Strategy. Taking into account 310 CMR 7.29 $SO_2$ emission rates, permit restrictions and retirements, and MassDEP's proposed low-sulfur oil regulation, described above, MassDEP conservatively projects $SO_2$ emissions in 2018 would represent at least a 67% reduction in $SO_2$ emissions compared to 2002 emissions. However, taking into account the addition of EPA's recently finalized Mercury and Air Toxics Standards (MATS) rule[1], including the $SO_2$ compliance option and incentives for low utilization of oil-fired units, MassDEP believes there is a likelihood that $SO_2$ emissions in 2018 will be up to 87% lower than 2002 emissions. Therefore, MassDEP believes that existing regulatory programs will lead to $SO_2$ emission reductions that fulfill the MANE-VU Targeted EGU Strategy for Massachusetts. MassDEP will review emissions and individual facility MATS compliance strategies in a mid-course planning review in 2013, and if emissions reductions are not projected to be close to 90%, MassDEP will assess whether other equivalent $SO_2$ reduction strategies may be necessary.

MassDEP is soliciting public comment on this Proposed Revision to the Massachusetts Regional Haze SIP (the public hearing notice is available at www.mass.gov/dep/public/publiche.htm). After public hearing and comment, MassDEP must make any necessary changes and submit a final Regional Haze SIP Revision to EPA by June 2012[2] to meet the requirements for addressing regional haze contained in Section 169A of the Clean Air Act and in EPA's Regional Haze Rule at 40 CFR 51.308(b).

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[1] www.gpo.gov/fdsys/pkg/FR-2012-02-16/pdf/2012-806.pdf

[2] Submittal of the final Regional Haze SIP to EPA by this date is necessary so EPA can finalize action on the SIP by July 13, 2012, as required by a proposed federal Consent Decree (available at www.epa.gov/visibility/pdfs/20111109consentdecree.pdf).

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**Appendices** (Note to reviewers: lettering is continued from the Appendices in the December 30, 2011 Regional Haze SIP. Appendices prior to DD are available at www.mass.gov/dep/air/priorities/hazeapps.htm).

DD: 310 CMR 7.29, *Emissions Standards for Power Plants*

EE: Mt. Tom Station - Amended Emission Control Plan Final Approval; MassDEP, May 2009.

FF: Salem Harbor – Amended Emission Control Plan Draft Approval; MassDEP, February 2012

GG: Brayton Point – Amended Emission Control Plan Draft Approval; MassDEP, February 2012

HH: Somerset Power – Letter Revoking Permits; MassDEP, June 2011.

II: Proposed Amendments to 310 CMR 7.00: *Definitions* and 310 CMR 7.05: *Fuels All Districts*; MassDEP, February 2012

## 8.10. Alternative to BART

EPA's Regional Haze Rule at 40 CFR 51.308(e)(3) gives states the authority to implement an alternative measure that achieves greater reasonable progress towards improving visibility at Class I areas than source-specific Best Available Retrofit Technology (BART). A state can establish a BART benchmark (i.e., emissions reductions that would result from the application of source-specific BART), and then can compare the emissions reductions achieved from the alternative measure with the emissions reductions that would be achieved from the BART benchmark. If the reductions from the alternative measure are greater than the BART benchmark, the state can assume that the alternative measure results in greater reasonable progress than BART.

MassDEP proposes an alternative to BART that covers all of the BART-eligible electric generating units (EGUs) plus all additional coal- and oil-fired EGUs subject to MassDEP's regulation 310 CMR 7.29, *Emissions Standards for Power Plants*. This includes the BART-eligible EGUs (Brayton Point Units 1–4, Canal Station Units 1–2, Mystic Unit 7, Salem Harbor Unit 4, and Cleary Flood Units 8–9), plus additional units subject to 310 CMR 7.29, which include Salem Harbor Units 1–3, Mt. Tom Station Unit 1, and Somerset Power Unit 8. MassDEP's proposed alternative to BART includes the following measures:

1. Existing regulation 310 CMR 7.29, *Emissions Standards for Power Plants*, which establishes $NO_x$ and $SO_2$ emissions rates (as well as mercury emission rates and carbon dioxide caps) for certain EGUs.
2. The retirement of Somerset Power.
3. Permit restrictions for Brayton Point, Salem Harbor, and Mt. Tom Station that limit/retire $SO_2$ and/or $NO_x$ emissions.
4. Existing regulation 310 CMR 7.19, *Reasonably Available Control Technology (RACT) for Sources of Oxides of Nitrogen $NO_x$*, which establishes $NO_x$ emission rates for various sources, including EGUs.
5. MassDEP's proposed amendments to its low sulfur fuel oil regulation, which would require EGUs that burn residual oil to limit the sulfur content to 0.5% by weight beginning July 1, 2014.

As demonstrated below, MassDEP's alternative to BART will achieve greater emission reductions of $SO_2$ and $NO_x$ than would be achieved through the installation and operation of BART alone. The following sections establish a BART benchmark, provide estimated emission reductions that will be achieved by the alternative to BART measures listed above, and show that reductions from these alternative measures exceed reductions from the application of BART alone.

***BART benchmark***

Massachusetts has used a most-stringent-case BART as the BART benchmark, based on EPA's Guideline for BART Determinations and the MANE-VU Workgroup recommended emissions limits for $SO_2$ and $NO_x$, which take into consideration the currently available cost-effective $SO_2$ and $NO_x$ control technologies for EGUs.

EPA's Guideline for BART Determinations (40 CFR 51, Appendix Y) establishes presumptive $SO_2$ emission limits for 750 megawatt (MW) and larger power plants. Four facilities (Brayton, Canal, Mystic, and Salem Harbor) are greater than 750 MW, while Cleary Flood is below 750 MW. Seven of the BART-eligible units are primarily oil-fired, while Brayton Point Units 1, 2, and 3 are primarily coal-fired.

For each oil-fired EGU at a 750 MW or larger power plant, regardless of size, EPA recommends that, for $SO_2$ control purposes, states evaluate limiting the sulfur content of the fuel oil burned to 1 percent or less by weight. For $NO_x$ control purposes at power plants with a generating capacity in excess of 750 MW currently using SNCR or SCR for part of the year, EPA suggests that use of such controls year round is BART.

For each uncontrolled coal-fired EGU greater than 200 MW at a 750 MW or larger power plant, EPA recommends $SO_2$ control levels of either 95% or 0.15 lbs/MMBtu. For $NO_x$, EPA recommends using selective non-catalytic reduction (SNCR) or selective catalytic reduction (SCR) year round. For coal-fired EGUs operating without post-combustion $NO_x$ controls, EPA provides presumptive $NO_x$ emission rates differentiated by boiler design and type of coal burned.

As part of the regional consultation process, the MANE-VU BART Workgroup established recommended BART emission limits for various types of sources (see Appendix R, Five-Factor Analysis of BART-Eligible Sources). Table 15 includes the MANE-VU BART Workgroup recommended BART emission limits for non-CAIR EGUs. (The BART-eligible units in Massachusetts are considered non-CAIR EGUs because Massachusetts was not subject to the CAIR $SO_2$ and $NO_x$ annual programs.) The MANE-VU BART workgroup's recommended BART emission limits are the same as EPA's recommended limits for $SO_2$ for coal, but are more stringent than the EPA recommended limits for $SO_2$ for oil and for $NO_x$. Therefore, Massachusetts used the MANE-VU recommended emission limits to establish the BART benchmark.

**Table 15: MANE-VU BART workgroup recommended BART emission limits for $SO_2$ and $NO_x$ for non-CAIR EGUs**

| | $SO_2$ | $NO_x$ |
|---|---|---|
| | 95% control or 0.15 lb/MMBtu (coal) and 0.33 lbs/MMBtu (oil) | o In $NO_x$ SIP call area, extend use of controls to year-round, and<br>o 0.1 – 0.25 lbs/MMBtu, depending on boiler and fuel type |

***Massachusetts' Alternative BART Program for $SO_2$***

MassDEP's Alternative to BART for $SO_2$ relies on:

1. 310 CMR 7.29, *Emissions Standards for Power Plants*, which establishes $SO_2$ emissions standards for certain EGUs.
2. Permit restrictions for Mt. Tom Station, Brayton Point, and Salem Harbor that disallow the use of 310 CMR 7.29 $SO_2$ Early Reduction Credits and federal Acid Rain Allowances for compliance with 310 CMR 7.29.
3. An annual cap of 300 tons of $SO_2$ for Salem Harbor Unit 2, and a shutdown of Units 3 and 4 beginning June 1, 2014.
4. The retirement of Somerset Power in 2010.
5. MassDEP's proposed low sulfur fuel oil regulation, which would require EGUs that burn residual oil to limit the sulfur content to 0.5% by weight beginning July 1, 2014.

Each is described below:

310 CMR 7.29, *Emissions Standards for Power Plants*: MassDEP's existing regulation 310 CMR 7.29 (Appendix DD) establishes a facility-wide rolling 12-month $SO_2$ emissions rate of 3.0 pounds per megawatt-hour and a monthly average emissions rate of 6.0 pounds per megawatt-hour. This regulation allows the use of 310 CMR 7.29 $SO_2$ Early Reduction Credits (on a 1 ton credit to 1 ton excess emission basis) and the use of federal Acid Rain $SO_2$ Allowances (on a 3 ton allowance to 1 ton excess emission basis) for compliance with the 3.0 pounds per megawatt-hour emissions rate. 310 CMR 7.29 applies to Brayton Point, Canal Station, Mt. Tom Station, Mystic, Salem Harbor, and Somerset Power.

Mt. Tom Station: On May 15, 2009, MassDEP issued an amended Emission Control Plan Final Approval (Appendix EE) for Mt. Tom Station that prohibits the use of 310 CMR 7.29 $SO_2$ Early Reduction Credits and federal Acid Rain Allowances for compliance with 310 CMR 7.29.

Brayton Point: On February 16, 2012, at Brayton Point's request, MassDEP issued an Amended Emission Control Plan Draft Approval (Appendix GG) that would prohibit the use of Early Reduction Credits and federal Acid Rain Allowances for compliance with 310 CMR 7.29 after June 1, 2014.

Salem Harbor: On February 17, 2012, at Salem Harbor's request, MassDEP proposed an Amended Emission Control Plan (ECP) Approval (Appendix FF) that would prohibit the use of 310 CMR 7.29 $SO_2$ Early Reduction Credits and federal Acid Rain Allowances for compliance with 310 CMR 7.29, after June 1, 2014. The ECP also would establish an annual cap of 300 tons of $SO_2$ for Salem Harbor Unit 2[3] and the shutdown of Units 3 and 4 effective June 1, 2014.

Somerset Power Retirement: Somerset Power ceased operating in 2010, and on June 22, 2011, at Somerset Power's request, MassDEP issued a letter (Appendix HH) that revoked all air approvals and permits for the facility and deemed all pending permit applications withdrawn.

[3] Salem Harbor Units 1 and 2 were removed from service as of December 31, 2011, which means that these units can no longer generate electricity for the power grid. These units are not restricted from operating for other purposes; therefore, MassDEP must establish permit restrictions in order for emission reductions at these units to be counted in the Alternative to BART.

Low sulfur oil: On February 17, 2012, MassDEP proposed amendments to 310 CMR 7.00: *Definitions* and 310 CMR 7.05, *Fuels All Districts* (Appendix II) to lower the allowable sulfur content of distillate oil and residual oil combusted by stationary sources. For residual oil, 310 CMR 7.05 currently limits sulfur content to 0.5% to 2.2%, depending on the area of the state (most areas are limited to 1% or lower). The proposed amendments would establish a 1% limit statewide beginning July 1, 2014, but for power plants would establish a 0.5% limit by that date (equivalent to 0.56 lbs $SO_2$/MMBtu). The proposed amendments would require all stationary sources to meet a 0.5% limit statewide beginning July 1, 2018.[4]

### *Analysis of Alternative BART Program for SO2*

Table 16 shows the BART benchmark projected $SO_2$ emissions for the BART-eligible units, which were calculated by multiplying the MANE-VU BART workgroup recommended BART $SO_2$ emission rates in lbs/MMBtu (see Table 15 above) by each unit's 2002 heat input in MMBtu. The BART benchmark results in a projected emissions reduction of 50,752 tons of $SO_2$ from 2002 emissions.

**Table 16: BART Benchmark for $SO_2$**

| BART Eligible Facility | Unit | 2002 $SO_2$ Emissions (Tons) | 2002 Heat Input (MMBtu) | MANE-VU Recommended $SO_2$ BART Emission Rate (lbs/MMBtu) | BART Benchmark Projected $SO_2$ Emissions (Tons) |
|---|---|---|---|---|---|
| Brayton Point | 1 | 9,254 | 17,000,579 | 0.15 | 1,275 |
| Brayton Point | 2 | 8,853 | 15,896,795 | 0.15 | 1,192 |
| Brayton Point | 3 | 19,450 | 36,339,809 | 0.15 | 2,725 |
| Brayton Point | 4 | 2,037 | 4,787,978 | 0.33 | 790 |
| Canal Station | 1 | 13,066 | 27,295,648 | 0.33 | 4,504 |
| Canal Station | 2 | 8,948 | 19,440,919 | 0.33 | 3,208 |
| Cleary Flood | 8 | 39 | 92,567 | 0.33 | 15 |
| Cleary Flood | 9 | 68 | 2,123,819 | 0.33 | 350 |
| Mystic | 7 | 3,727 | 15,172,657 | 0.33 | 2,503 |
| Salem Harbor | 4 | 2,886 | 6,137,412 | 0.33 | 1,013 |
| **Total** | | **68,328** | | | **17,576** |
| | | | | **$SO_2$ Reduction** | **50,752** |

Table 17 shows the Alternative to BART projected $SO_2$ emissions, which were calculated by multiplying MassDEP's proposed low-sulfur fuel oil regulation $SO_2$ emission rates in lbs/MMBtu by the 2002 heat input in MMBtu, multiplying the 310 CMR 7.29 $SO_2$ rolling 12-

[4] Except that allowable sulfur content in residual oil would remain at 2.2% in Berkshire County due to a 1974 legislative exemption. None of the power plants in the Alternative to BART are located in Berkshire County.

month emissions rate in lbs/MWh by the 2002 megawatt-hours electrical generation, and accounting for permit restrictions in effect at Mt. Tom Station and proposed for Brayton Point and Salem Harbor, as well as the retirement of Somerset Power. The Alternative to BART results in a projected emissions reduction of 54,986 tons from 2002 emissions, which is 4,234 tons more than the projected emissions reductions from the BART benchmark.

**Table 17: Alternative to BART for $SO_2$**

| Facility | Unit | 2002 $SO_2$ Emissions (Tons) | 2002 Heat Input (MMbtu) or Generation (*MWh)* | Alternative BART Emission Rate (lbs/MMBtu or *lbs/MWh*) | Alternative BART Projected $SO_2$ Emissions (Tons) |
|---|---|---|---|---|---|
| Brayton Point | 1 | 9,254 | *1,951,839* | *3.0* | 2,928 |
| Brayton Point | 2 | 8,853 | *1,855,515* | *3.0* | 2,783 |
| Brayton Point | 3 | 19,450 | *4,294,957* | *3.0* | 6,442 |
| Brayton Point | 4 | 2,037 | 4,787,978 | 0.56 | 1,341 |
| Canal Station | 1 | 13,066 | 27,295,648 | 0.56 | 7,643 |
| Canal Station | 2 | 8,948 | 19,440,919 | 0.56 | 5,443 |
| Cleary Flood | 8 | 39 | 92,567 | 0.56 | 25 |
| Cleary Flood | 9 | 68 | 2,123,819 | 0.56 | 595 |
| Mount Tom | 1 | 5,282 | *1,047,524* | *3.0* | 1,571 |
| Mystic | 7 | 3,727 | 15,172,657 | 0.56 | 4,248 |
| Salem Harbor | 1 | 3,425 | *631,606* | *3.0* | 947 |
| Salem Harbor | 2 | 2,821 | *527,939* | *3.0* | 300 |
| Salem Harbor | 3 | 4,999 | *974,990* | Retired | 0 |
| Salem Harbor | 4 | 2,886 | *6,137,412* | Retired | 0 |
| Somerset | 8 | 4,399 | *8,910,087* | Retired | 0 |
| **Total** | | **89,254** | | | **34,268** |
| | | | | **$SO_2$ Reduction** | **54,986** |

40 CFR 51.308(e)(3) provides a process for determining whether an alternative measure makes greater reasonable progress than would be achieved through the installation and operation of BART. If the geographic distribution of emissions reductions is similar between an alternative measure and BART, the comparison of the two measures may be made on the basis of emissions alone. The alternative measure may be deemed to make greater reasonable progress than BART if it results in greater emissions reductions than requiring sources subject to BART to install, operate and maintain BART. In this case, the Alternative to BART achieves greater emissions reductions than BART and the geographic distribution of emissions reductions is nearly identical since all of the units subject to BART are included in the Alternative to BART.

***Massachusetts' Alternative BART Program for $NO_x$***

MassDEP's Alternative to BART for $NO_x$ relies on:

1. 310 CMR 7.29, *Emissions Standards for Power Plants*, which establishes $NO_x$ emissions rates for certain EGUs.
2. An annual cap of 276 tons of $NO_x$ for Salem Harbor Unit 1 and an annual cap of 50 tons of $NO_x$ for Unit 2, and a shutdown of Units 3 and 4 beginning June 1, 2014.
3. The retirement of Somerset Power in 2010.
4. 310 CMR 7.19, *Reasonably Available Control Technology (RACT) for Sources of Oxides of Nitrogen $NO_x$,* which establishes $NO_x$ emissions standards for various sources, including EGUs.

Each is described below:

310 CMR 7.29, *Emissions Standards for Power Plants*: MassDEP's existing regulation 310 CMR 7.29 establishes a rolling 12-month average $NO_x$ emission rate of 1.5 lbs/MWh and a monthly average emission rate of 3 lbs/MWh. 310 CMR 7.29 applies to Brayton Point, Canal Station, Mt. Tom Station, Mystic, Salem Harbor, and Somerset Power.

Salem Harbor: On February 17, 2012, at Salem Harbor's request, MassDEP proposed an Amended Emission Control Plan (ECP) Approval (Appendix FF) that would require an annual cap of 276 tons of $NO_x$ for Salem Harbor Unit 1 and an annual cap of 50 tons of $NO_x$ for Unit 2, and a shutdown of Units 3 and 4 beginning June 1, 2014.

Somerset Power Retirement: Somerset Power ceased operating in 2010, and on June 22, 2011, at Somerset Power's request, MassDEP issued a letter (Appendix HH) that revoked all air approvals and permits for the facility and deemed all pending permit applications withdrawn.

310 CMR 7.19, *Reasonably Available Control Technology (RACT) for Sources of Oxides of Nitrogen $NO_x$*: MassDEP's existing regulation 310 CMR 7.19 establishes $NO_x$ emissions rates for various stationary sources, including EGUs. Under 310 CMR 7.19, Cleary Flood Units 8 and 9 are subject to a $NO_x$ emission rate of 0.28 lbs/MMBtu. Mystic Unit 7 is subject to a $NO_x$ emission rate of 0.25 lbs/MMBtu. Mystic also is subject to 310 CMR 7.29 on a facility-wide basis; however, Mystic Unit 7 could exceed the 310 CMR 7.29 $NO_x$ rate of 1.5 lbs/MWh while the facility as a whole complies with the rate because the other units at Mystic are natural gas-fired with low $NO_x$ emissions, and therefore the 310 CMR 7.19 unit-specific $NO_x$ rate of 0.25 lbs/MMBtu is the controlling factor for Unit 7.

### *Analysis of Alternative BART Program for $NO_x$*

Table 18 shows the BART benchmark projected $NO_x$ emissions for the BART-eligible units, which were calculated by multiplying the lowest MANE-VU BART workgroup recommended BART emission rate of 0.1 lb/MMBtu (from Table 15 above) by the 2002 heat input in MMBtu. The BART benchmark results in projected emissions reductions of 12,820 tons of $NO_x$ from 2002 emissions.

**Table 18: BART Benchmark for $NO_x$**

| BART-Eligible Facility | Unit | 2002 $NO_x$ Emissions (Tons) | 2002 Heat Input (MMBtu) | MANE-VU Recommended BART $NO_x$ Emission Rate (lbs/MMBtu) | BART Benchmark Projected $NO_x$ Emissions (Tons) |
|---|---|---|---|---|---|
| Brayton Point | 1 | 2,513 | 17,000,579 | 0.10 | 850 |
| Brayton Point | 2 | 2,270 | 15,896,795 | 0.10 | 795 |
| Brayton Point | 3 | 7,335 | 36,339,809 | 0.10 | 1,817 |
| Brayton Point | 4 | 552 | 4,787,978 | 0.10 | 239 |
| Canal Station | 1 | 3,339 | 27,295,648 | 0.10 | 1,365 |
| Canal Station | 2 | 2,260 | 19,440,919 | 0.10 | 972 |
| Cleary Flood | 8 | 12 | 92,567 | 0.10 | 5 |
| Cleary Flood | 9 | 161 | 2,123,819 | 0.10 | 106 |
| Mystic | 7 | 805 | 15,172,657 | 0.10 | 759 |
| Salem Harbor | 4 | 787 | 6,137,412 | 0.10 | 307 |
| **Total** | | **20,034** | | | **7,214** |
| | | | | **$NO_x$ Reduction** | **12,820** |

Table 19 shows the Alternative to BART projected $NO_x$ emissions, which were calculated by multiplying MassDEP's 310 CMR 7.29 $NO_x$ emission rate in lbs/megawatt hour (MWh) and 310 CMR 7.19 $NO_x$ emission rate in lbs/MMbtu by the 2002 electricity generation in MWh and 2002 heat input in MMBtu, respectively, and accounting for permit restrictions proposed for Salem Harbor and the retirement of Somerset Power. The Alternative to BART results in projected emission reductions of 13,117 tons from 2002 emissions. The estimated $NO_x$ reductions from the Alternative to BART are 297 tons more than estimated reductions from BART alone.

**Table 19: Alternative to BART for $NO_x$**

| Facility | Unit | 2002 $NO_x$ Emission (Tons) | 2002 Heat Input (MMBtu) or Generation (*MWh*) | Alternative BART Emission Rate (lbs/MMBtu or *lbs/MWh*) | Alternative BART Projected $NO_x$ Emissions (Tons) |
|---|---|---|---|---|---|
| Brayton Point | 1 | 2,513 | *1,951,839* | 1.5 | 1,464 |
| Brayton Point | 2 | 2,270 | *1,855,515* | 1.5 | 1,392 |
| Brayton Point | 3 | 7,335 | *4,294,957* | 1.5 | 3,221 |
| Brayton Point | 4 | 552 | *401,305* | 1.5 | 301 |
| Canal Station | 1 | 3,339 | *2,945,578* | 1.5 | 2,209 |
| Canal Station | 2 | 2,260 | *1,910,079* | 1.5 | 1,433 |
| Cleary Flood | 8 | 12 | 92,567 | 0.28 | 13 |
| Cleary Flood | 9 | 161 | 2,123,819 | 0.28 | 297 |
| Mount Tom | 1 | 1,969 | *1,047,524* | 1.5 | 786 |
| Mystic | 7 | 805 | 15,172,657 | 0.25 | 1,897 |
| Salem Harbor | 1 | 920 | 631,606 | Cap | 276 |
| Salem Harbor | 2 | 755 | 527,939 | Cap | 50 |
| Salem Harbor | 3 | 1,331 | 974,990 | Retired | 0 |
| Salem Harbor | 4 | 787 | 508,342 | Retired | 0 |
| Somerset | 8 | 1,445 | *8,910,087* | Retired | 0 |
| | | **26,455** | | | **13,338** |
| | | | | **$NO_x$ Reduction** | **13,117** |

As with $SO_2$, the Alternative to BART achieves greater $NO_x$ emission reductions than BART and the geographic distribution of $NO_x$ emissions reductions is nearly identical since all of the units subject to BART are included in the Alternative to BART.

## 8.11. BART for $PM_{10}$ Emissions

MassDEP's proposed Alternative to BART does not cover $PM_{10}$ emissions. An overview of 2002 and 2009 $PM_{10}$ emissions and PM controls at the EGU BART sources is contained in Table 20. Collectively, these facilities emitted 1,531 tons of $PM_{10}$ in 2002 that diminished visibility in New England Class I areas by 0.032-0.037 deciviews (ddv). Through installation of controls, these facilities have significantly reduced PM emissions, so that in 2009 these facilities emitted a total of 109 tons of $PM_{10}$.

CALPUFF modeling of 2002 PM emissions at these facilities shows an impact that was well below 0.1 ddv on the worst day at affected Class I areas[5], for each unit and cumulatively, which is the level MANE-VU has identified that the degree of visibility improvement is so small (<0.1 ddv) that no reasonable weighting could justify additional controls under BART. The visibility impact would be even lower today based on the emissions reductions achieved since 2002 as shown in Table 20. MassDEP considered MANE-VU's evaluation of PM control options; [6] however, MassDEP has determined that no additional controls are warranted for primary $PM_{10}$ because controls have been added to all but one of the facilities, and the additional cost of further control is not justified since there would be no significant visibility improvement.

**Table 20: Massachusetts $PM_{10}$ BART Sources, Emissions and Controls**

| I.D. | Source | Unit | $PM_{10}$ ddv[7] | 2002 $PM_{10}$ Emissions (tpy) | 2009 $PM_{10}$ Emissions (tpy) | PM Controls | PM Emission Limits lbs/MMBtu as of 2009 |
|---|---|---|---|---|---|---|---|
| 1200061 | Brayton Point | 1 | 0.031, 0.026 | 386 | 39 | Fabric Filter Baghouse | 0.08 |
| 1200061 | Brayton Point | 2 | | | | Fabric Filter Baghouse | 0.08 |
| 1200061 | Brayton Point | 3 | | | | Fabric Filter Baghouse (Planned) | 0.08 |
| 1200061 | Brayton Point | 4 | 0.000, 0.000 | 6 | 0 | ESP | 0.03 |
| 1200054 | Canal Station | 1 | 0.000, 0.000 | 672 | 60 | ESP | 0.02 |
| 1200054 | Canal Station | 2 | | | | ESP | 0.02 |
| 1190128 | Mystic Station | 7 | 0.002, 0.003 | 131 | 4 | ESP | 0.05 |
| 1190194 | Salem Harbor | 4 | 0.001, 0.001 | 316 | 0 | ESP | 0.04 |
| 1200067 | Cleary Flood | 8 | 0.003, 0.002 | 20 | 6 | None | 0.12 |
| 1200067 | Cleary Flood | 9 | | | | None | 0.12 |

[5] For further discussion of CALPUFF modeling, see Sections 8.6 and 8.7 of the Regional Haze SIP.
[6] As described in Appendix R (*Five-Factor Analysis of BART-Eligible Sources*) and Appendix U (*Assessment of Control Technology Options for BART-Eligible Sources*).
[7] Values for MM5 and NWS meteorological modeling platforms; see Tables 12 and 13.

## 10.5. Additional Reasonable Strategies

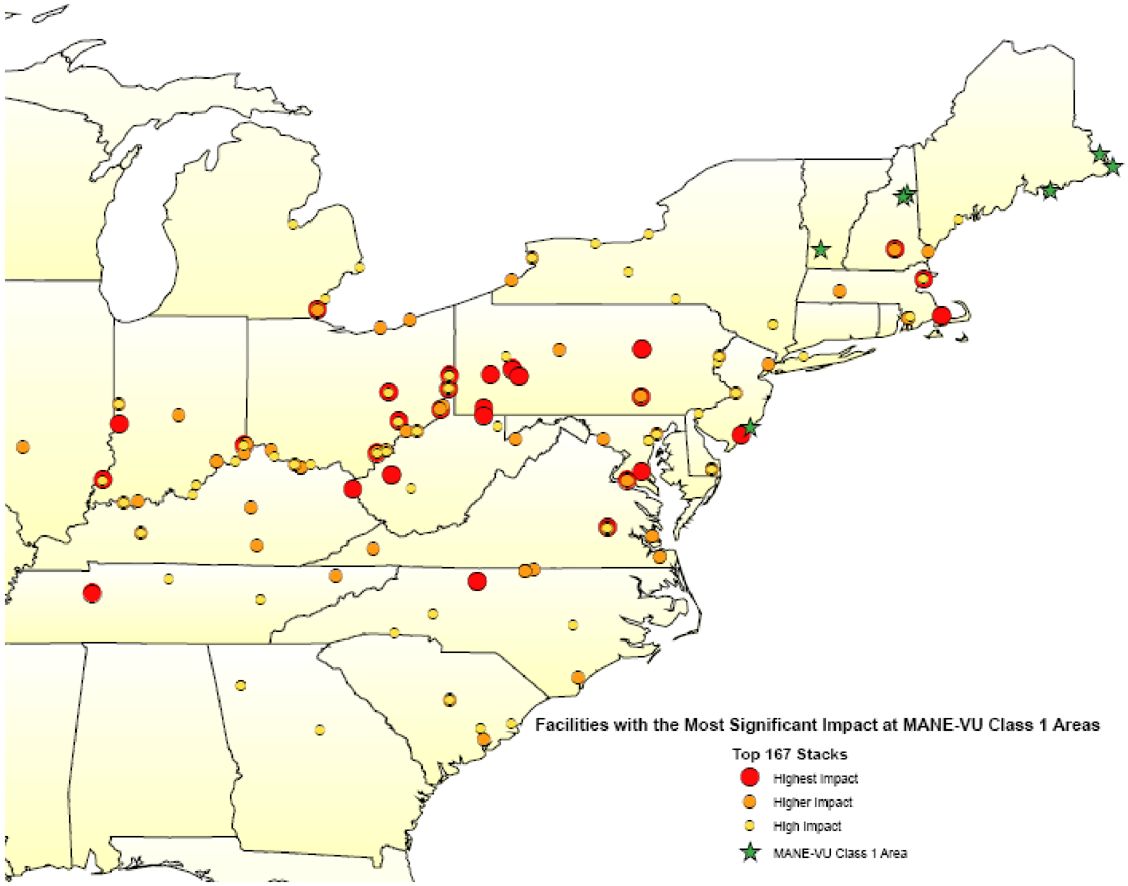
***Targeted EGU Strategy***

$SO_2$ emissions from power plants (electric generating units or EGUs) are the single largest sector contributing to the visibility impairment experienced in the Northeast's Class I areas. The $SO_2$ emissions from power plants continue to dominate the inventory. Sulfate formed through atmospheric processes from $SO_2$ emissions are responsible for over half the mass and approximately 70-80 percent of the light extinction on the worst visibility days (Contribution Assessment, Appendix A).

In order to properly target controls on EGUs, modeling was conducted to identify those EGUs with the greatest impact on visibility in MANE-VU. A list was developed that includes the 100 largest impacts at each MANE-VU Class I site during 2002. These emissions were from 167 EGU stacks and are illustrated below (a complete list can be found in Appendix W; see Appendix A). Some of the stacks identified as important were outside the states identified as contributing at least 2 percent of the sulfate at MANE-VU Class I areas and were dropped from the list. Massachusetts sources identified in the list include Brayton Point, Canal Station, Mt. Tom Station, Salem Harbor, and Somerset Power. Given the magnitude of their potential impact, controlling emissions from these stacks is important to improving visibility at MANE-VU Class I areas.

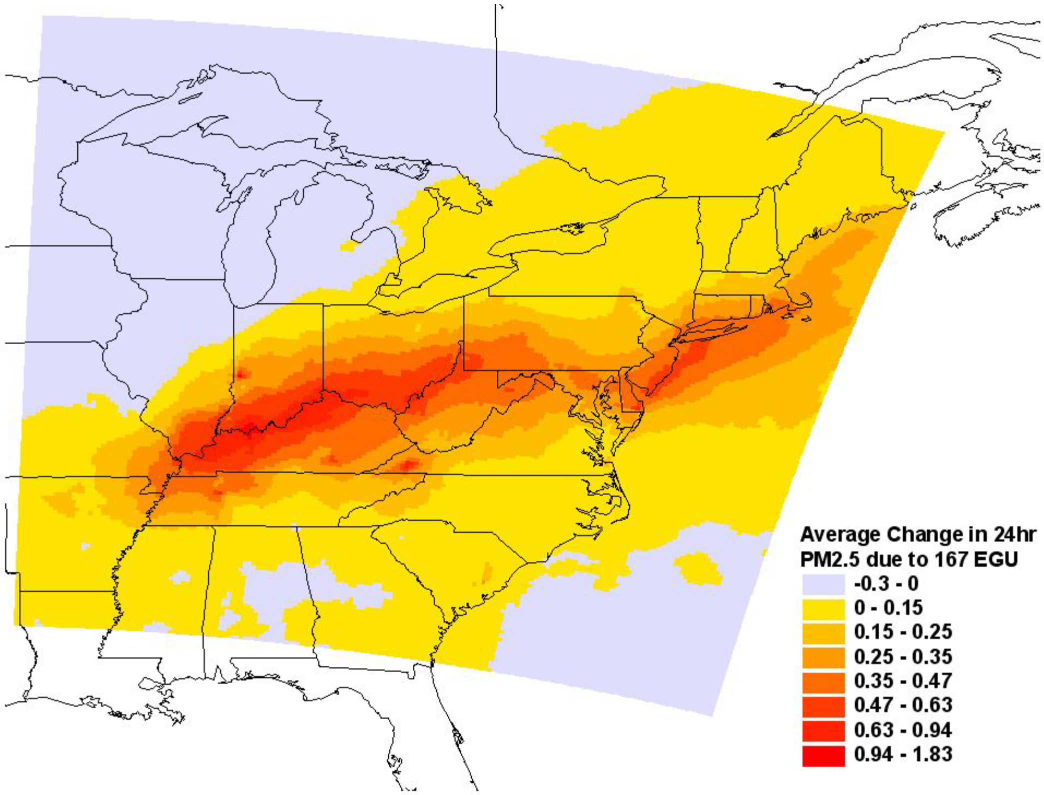
MANE-VU's agreed to regional approach for the EGU sector is to pursue a 90 percent reduction in $SO_2$ emissions (from 2002 emissions) from these 167 targeted stacks by 2018 as appropriate and necessary. MANE-VU concluded that pursuing this level of sulfur reduction is both reasonable and cost-effective. Even though current wet scrubber technology can achieve sulfur reductions greater than 95 percent, historically a 90 percent sulfur reduction level includes lower average reductions from dry scrubbing technology. The cost for $SO_2$ emissions reductions will vary by unit, and the MANE-VU Reasonable Progress report (Appendix T) summarizes the various control methods and costs available, ranging from $170 to $5,700 per ton, depending on site-specific factors such as the size and type of unit, combustion technology, and type of fuel used.

**Figure 41: 167 Targeted EGU Stacks Affecting MANE-VU Class I Areas**




To evaluate the impact of reducing emissions from the 167 EGU stacks, NESCAUM used CMAQ to model sulfate concentrations in 2018 after implementation of this control program. 2018 $SO_2$ emissions for these stacks were modeled at levels equal to 10 percent of their 2002 $SO_2$ emissions; sulfate concentrations were then converted to $PM_{2.5}$ concentrations. This preliminary modeling showed that requiring $SO_2$ emissions from the 167 EGU stacks to be reduced by 90 percent from 2002 emission levels could reduce 24-hour $PM_{2.5}$ concentrations. Figure 42 shows the reduction in fine particle pollution in the Eastern U.S. that would result from implementing the targeted EGU $SO_2$ strategy. Improvements in $PM_{2.5}$ concentrations would occur throughout the MANE-VU region as well as for portions of the VISTAS and Midwest RPO regions, especially the Ohio River Valley.

**Figure 42: Average Change in 24-hr $PM_{2.5}$ due to 90 Percent Reduction in $SO_2$ Emissions from 167 EGU Stacks Affecting MANE-VU**




Although the reductions are potentially large, MANE-VU determined, after consultation with affected states, that it was unreasonable to expect that the full 90-percent reduction in $SO_2$ emissions would be achieved by 2018. Therefore, additional modeling was conducted to assess the more realistic scenario in which emissions would be controlled by the individual facilities and/or states to levels already projected to take place by that date. At some facilities, the actual emission reductions are anticipated to be greater or less than the 90 percent benchmark. For details, see Appendix W "*Documentation of 2018 Emissions from Electric Generating Units in the Eastern United States for MANE-VU's Regional Haze Modeling*."

Massachusetts has five sources (Table 19) with a total of 10 EGUs on the 167 Stacks list, including Brayton Point (Units 1-3), Canal Station (Units 1-2), Mt. Tom Station (Unit 1), Salem Harbor (Units 1, 3, 4), and Somerset Power (Unit 8). Each of these facilities is subject to MassDEP's 310 CMR 7.29, which limits $SO_2$ emissions facility-wide.

Several of the Massachusetts EGUs already have installed $SO_2$ controls or are planning additional $SO_2$ controls to help them meet 310 CMR 7.29 limits. Brayton Point has installed spray dryer absorbers on Units 1 and 2 and plans to operate a dry scrubber on Unit 3 in 2013; Mt. Tom Station has installed a dry scrubber. Salem Harbor is currently using lower sulfur coal and oil to meet its 310 CMR 7.29 limits (Unit 4 would be subject to MassDEP's proposed low sulfur oil regulation) and plans to shut down all units by June 2014. Somerset Power shut down in

2010. Canal Station is using lower sulfur oil to comply with 310 CMR 7.29, and would be subject to MassDEP's proposed low sulfur oil regulation.

Table 19 shows that $SO_2$ emissions were reduced by 72% from 2002 to 2011 at the targeted units. Additional reductions will occur in the 2012-14 timeframe as the Salem Harbor units retire and the Brayton Point Unit 3 scrubber becomes operational.

MassDEP believes that there will be further emissions reductions at the targeted units as a result of EPA's recently issued Mercury and Air Toxics Standards (MATS) rule.[8] MATS gives coal units with scrubbers a compliance option to meet an $SO_2$ emissions rate of 0.2 lbs/MMBtu as an alternative to a hydrogen chloride emissions rate, which is more stringent than MassDEP's 310 CMR 7.29 annual $SO_2$ emissions rate (3.0 lbs/MWh, which is roughly equivalent to 0.3 lbs/MMBtu). Brayton Point and Mt. Tom Station may choose this option for their coal units, thereby further reducing their permitted $SO_2$ emissions.

To be subject to MATS in a given year, an EGU must fire coal or oil for more than 10 percent of the average annual heat input during the 3 previous consecutive calendar years, or for more than 15 percent of the annual heat input during any one of the 3 previous calendar years. This provision provides an incentive to Canal Unit 2, which can burn oil or natural gas, to limit the amount of oil it burns so that it is not subject to MATS, which would result in future $SO_2$ emissions continuing to be lower than permitted emissions. MATS also establishes work practices (versus emissions rates) for oil-fired units with an annual capacity factor of less than 8% of its maximum heat input. Canal Station Unit 1's utilization was 1% in 2011, and thus has an incentive to remain below 8%, which would result in future $SO_2$ emissions continuing to be lower than its permitted emissions. Even without MATS, oil-fired combustion at Canal Units 1 and 2 is expected to be low well into the future because of the high cost of oil relative to natural gas. This cost differential is why Canal's utilization currently is very low.

In addition, EPA's 1-hour $SO_2$ National Ambient Air Quality Standards (NAAQS) may require MassDEP to establish new $SO_2$ emission rates that are more stringent than 310 CMR 7.29 for Brayton Point, Mt. Tom Station, and Canal Station, as well as to establish emission rates for other large emitters of $SO_2$. MassDEP will be working with facilities in 2012 to determine whether their potential emissions could result in exceedances of the 1-hour $SO_2$ NAAQS, and to develop permit conditions where necessary to limit $SO_2$ emissions in order to meet the NAAQS.

Taking into account 310 CMR 7.29 $SO_2$ emission rates, permit restrictions and retirements, and MassDEP's proposed low-sulfur oil regulation, MassDEP conservatively projects $SO_2$ emissions in 2018 would represent at least a 67% reduction in $SO_2$ emissions compared to 2002 emissions (see Table 19).[9] However, taking into account EPA's MATS, including the $SO_2$ compliance option and incentives for low utilization of oil-fired units, MassDEP believes there is a likelihood that $SO_2$ emissions in 2018 will be up to 87% lower than 2002 emissions (see Table 19). Therefore, MassDEP believes that existing regulatory programs will lead to $SO_2$ emission

[8] www.gpo.gov/fdsys/pkg/FR-2012-02-16/pdf/2012-806.pdf

[9] The 67% projection is less than the 72% reduction already achieved in 2011 because it assumes the same unit utilization as in the 2002 baseline year, whereas the reduction achieved in 2011 is due in part to low utilization of several units, including Canal Units 1 and 2 and Mt. Tom Station.

reductions that fulfill the MANE-VU Targeted EGU Strategy for Massachusetts. MassDEP will review emissions and individual facility MATS compliance strategies in a mid-course planning review in 2013, and if emissions reductions are not projected to be close to 90%, MassDEP will assess whether other equivalent $SO_2$ reduction strategies may be necessary.

**Table 19: Massachusetts Targeted EGUs**

| **Facility** | **Unit** | **2002 $SO_2$ Emissions** | **2011 $SO_2$ Emissions** | **2018 Projected $SO_2$ Emissions (Conservative)** | **2018 Projected $SO_2$ Emissions (Likely)** | ***2018 Projected $SO_2$ Emissions (90% Target)*** |
|---|---|---|---|---|---|---|
| Brayton Point | 1 | 9,254 | 4,298 | 2,928 | 1,700 | *925* |
| Brayton Point | 2 | 8,853 | 3,535 | 2,783 | 1,590 | *885* |
| Brayton Point | 3 | 19,450 | 10,769 | 6,442 | 3,634 | *1,945* |
| Canal Station | 1 | 13,066 | 99 | 7,643 | 1,069 | *1,307* |
| Canal Station | 2 | 8,948 | 29 | 5,443 | 1,479 | *895* |
| Mt Tom | 1 | 5,282 | 129 | 1,571 | 1,033 | *528* |
| Salem Harbor | 1 | 3,425 | 893 | 0 | 0 | *343* |
| Salem Harbor | 3 | 4,999 | 2,344 | 0 | 0 | *500* |
| Salem Harbor | 4 | 2,886 | 69 | 0 | 0 | *289* |
| Somerset | 8 | 4,399 | 0 | 0 | 0 | *440* |
| **Total** | | **80,562** | **22,165** | **26,811** | **10,505** | ***8,057*** |
| **Reduction** | | | **59,396** | **53,751**[10] | **70,057** | ***72,505*** |
| **Percent Reduction** | | | **72%** | **67%** | **87%** | ***90%*** |

It should be noted that even the conservative projection of a 67% reduction in $SO_2$ emissions from the targeted EGUs is more than enough to meet the level of $SO_2$ emissions projected from Massachusetts EGUs that was used in the MANE-VU 2018 regional modeling, as documented in NESCAUM's *2018 Visibility Projections* (Appendix G). Emission results from the 2018 Inter-Regional Planning Organization CAIR Case Integrated Planning Model v. 2.1.9 estimated

[10] Note that this $SO_2$ emissions reduction is less than the $SO_2$ emissions reduction under the Alternative to BART (Table 17 in Section 8.10) because fewer units are included in the Targeted EGU Strategy.

17,486 tons of $SO_2$ emissions for Massachusetts (See Appendix W, Table 1). However, MANE-VU planners recognized that CAIR allows emissions trading, and that reductions at one unit could offset increases at another unit within the CAIR region. Because most states do not restrict trading, MANE-VU decided that projected emissions should be increased to represent the implementation of the strategy for the 167 stacks within the limits of the CAIR program, and therefore increased the projected emissions from states subject to the CAIR cap and trade program. For Massachusetts, this modification resulted in projected $SO_2$ emissions of 45,941 tons for Massachusetts (see Appendix W, Table 9), effectively doubling Massachusetts' $SO_2$ emissions inventory for EGUs. As shown in Table 19, MassDEP's conservative 67% reduction projection for targeted EGUs results in 2018 emissions of 26,811 tons of $SO_2$[11], well below the 45,941 tons of $SO_2$ that is needed to meet the modeled 2018 reasonable progress goals for the Class I areas Massachusetts affects.

### *Other State EGU Programs Assumed in 2018 EGU Modeling*

Several other states have implemented state-specific EGU emission reduction programs. These commitments, identified below, are included in the long-term strategy as reasonable measures to meet MANE-VU's reasonable progress goals and were used in the Best and Final 2018 CMAQ modeling (Appendix G).

<u>Maryland Healthy Air Act</u>: Maryland adopted the following requirements governing EGU emissions:

1. For $NO_x$:
    a. Phase I (2009): Sets unit-specific annual caps (totaling 20,216 tons) and ozone season caps (totaling 8,900 tons).
    b. Phase II (2012): Sets unit-specific annual caps (totaling 16,667 tons) and ozone season caps (totaling 7,337 tons).
2. For $SO_2$:
    a. Phase I (2010): Sets unit-specific annual caps (totaling 48,818 tons).
    b. Phase II (2013): Sets unit-specific annual caps (totaling 37,235 tons).
3. For mercury:
    a. Phase I (2010): 12-month rolling average of a minimum of 80% removal efficiency.
    b. Phase II (2013): 12-month rolling average of a minimum of 90% removal efficiency.

The specific EGUs covered are: Brandon Shores (Units 1 and 2), C.P.Crane (Units 1 and 2), Chalk Point (Units 1, and 2), Dickerson (Units 1, 2, and 3), H.A. Wagner (Units 2 and 3) Morgantown (Units 1 and 2) and R. Paul Smith (Units 3 and 4). No out-of-state trading, no inter-company trading, and no banking from year to year is permitted.

<u>New Hampshire EGU Regulations</u>: New Hampshire adopted the following regulations governing EGU emissions: Chapter Env-A 2900 requires the installation of scrubbers on Merrimack Station

[11] Two additional EGUs beyond the "167 Stack" Targeted EGUs were projected to have 2018 $SO_2$ emissions, totaling 3,588 tons, which would bring the total 2018 emissions to 30,399 tons, which is still well below the 45,941 tons used in the 2018 modeling.

(Units 1 and 2) by July 1, 2013 to control $SO_2$ and mercury emissions with state-level $SO_2$ credits for over- or early- compliance.

New Jersey Hg MACT Rule: All coal-fired EGUs must have a mercury removal efficiency of 90%.

Consent Agreements in the VISTAS region: The impacts of the additional following consent agreements in the VISTAS states were reflected in the emissions inventory used for those states:

- EKPC: A July 2, 2007 consent agreement between EPA and East Kentucky Power Cooperative requires the utility to reduce its emissions of $SO_2$ by 54,000 tons per year and its emissions of $NO_x$ by 8,000 tons per year by installing and operating selective catalytic reduction (SCR) technology, low-NOx burners, and PM and mercury Continuous Emissions Monitors at the utility's Spurlock, Dale and Cooper Plants. According to EPA, total emissions from the plants will decrease between 50 and 75 percent from 2005 levels. As with all federal consent decrees, EKPC is precluded from using reductions required under other programs, such as CAIR, to meet the reduction requirements of the consent decree. EKPC is expected to spend $654 million to install pollution controls.
- AEP: American Electric Power agreed to spend $4.6 billion dollars to eliminate 72,000 tons of $NO_x$ emissions each year by 2016 and 174,000 tons of $SO_2$ emissions each year by 2018 from sixteen plants located in Indiana, Kentucky, Ohio, Virginia, and West Virginia.