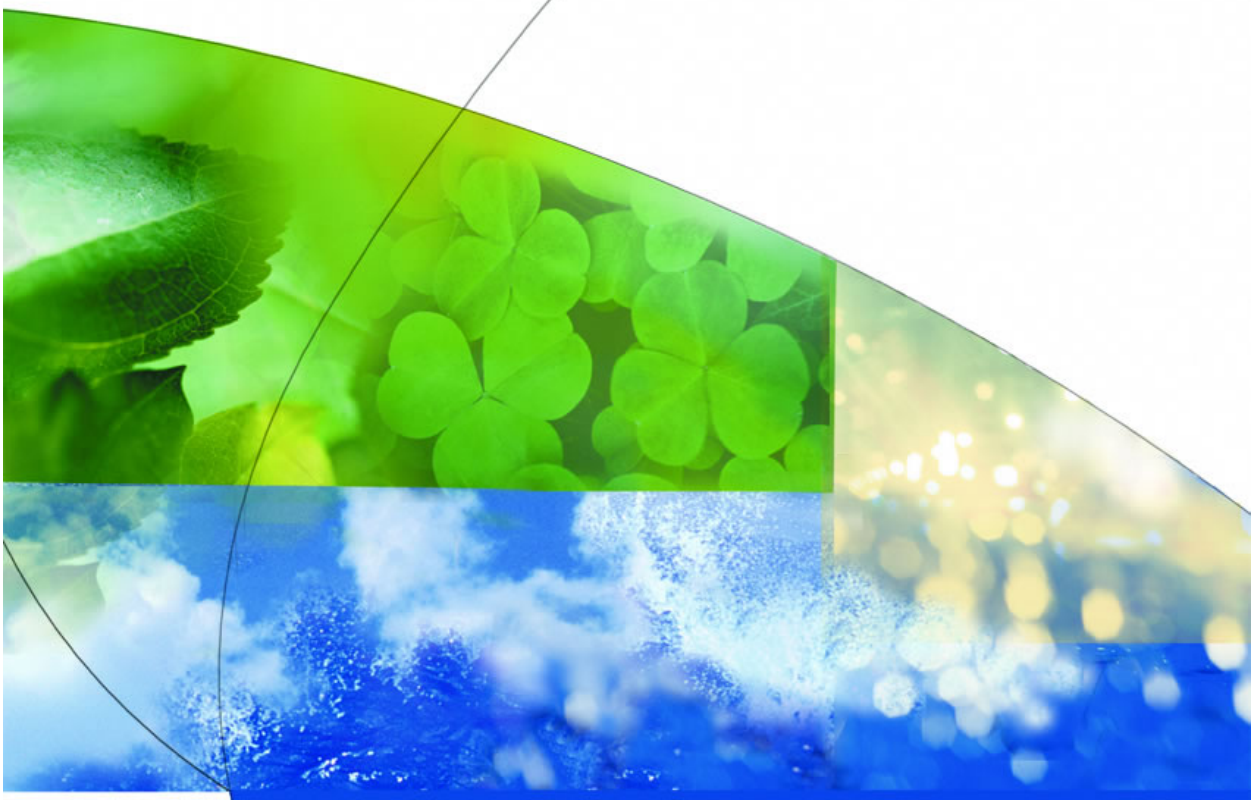
MERCURY INFORMATION CLEARINGHOUSE



Quarter 7 – Mercury Regulations in the United States: Federal and State

July 2005

Canadian Electricity Association
Association canadienne de l'électricité

EERC
Energy & Environmental Research Center

Center for Air Toxic Metals

MERCURY INFORMATION CLEARINGHOUSE

QUARTER 7 – MERCURY REGULATIONS IN THE UNITED STATES: FEDERAL AND STATE

ACKNOWLEDGMENT AND DISCLAIMERS

This report was prepared under contract with the Canadian Electricity Association (CEA) and supported by funding from that organization, the Canadian Council of Ministers of the Environment, the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) Cooperative Agreement No. DE-FC26-98FT40321, and the Center for Air Toxic Metals® Program at the Energy & Environmental Research Center (EERC). However, any opinions, findings, conclusions, or recommendations expressed herein are the author(s) and do not necessarily reflect the views of any of the above-mentioned organizations.

REPORT AVAILABILITY

This report is available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; phone orders accepted at (703) 487-4650 and the CEA Mercury Program Web site (www.ceamercuryprogram.ca).

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

MERCURY INFORMATION CLEARINGHOUSE

QUARTER 7 – MERCURY REGULATIONS IN THE UNITED STATES: FEDERAL AND STATE

EXECUTIVE SUMMARY

On March 15, 2005, the U.S. Environmental Protection Agency (EPA) announced the new Clean Air Mercury Rule for coal-fired power plants. The rule makes the United States the first country in the world to regulate mercury emissions from coal-fired power plants. It was the decision of the EPA to regulate mercury under Section 111 rather than Section 112 of the Clean Air Act. Under Section 111, a cap-and-trade rule was established. The Clean Air Mercury Rule is viewed by EPA to function in conjunction with the Clean Air Interstate Rule (CAIR) to reduce mercury emissions nationwide. It is expected that the additional wet flue gas desulfurization (FGD) and selective catalytic reduction (SCR) systems that will be installed to comply with the CAIR SO_2 and NO_x requirements in 28 eastern states will provide a substantial mercury cobenefit.

Based on the 1997 Information Collection Request (ICR) data, it has been established that current U.S. mercury emissions from coal-fired electric utilities total 48 tons a year. The cap-and-trade provision of the new rule would reduce that to 38 tons of mercury a year in 2010, a reduction of 20.8%. It is fully expected that the addition of new wet FGD and SCR systems to reduce SO_2 and NO_x under CAIR will allow the states to meet the 2010 mercury reduction requirements without additional mercury controls. By 2018, coal-fired power plants will be required to make further reductions to 15 tons a year, a total reduction of 68.8% from 1997 emissions. To ensure the required mercury reduction is met and to facilitate trading, EPA has established emission budgets for each state based on the baseline heat input adjusted for the coal burned for each plant in a given state.

The new Clean Air Mercury Rule has proven to be very controversial, as ten state attorneys general have filed suit against EPA and the mercury rule. Three of these states, New Jersey, Massachusetts, and Connecticut, have promulgated much more restrictive regulations. The state of Wisconsin also passed a mercury reduction rule; however, it has been superseded by the federal Clean Air Mercury Rule. A summary of the requirements for the three states with regulations are shown in Table ES-1.

Table ES-1. Summary of State Mercury Regulations

State	Date	Emission Limit	Nominal Removal	Date	Emission Limit	Nominal Removal
Massachusetts	01/01/2008	0.0075 lb/GWh	85%	10/01/2012	0.0025 lb/GWh	95%
New Jersey	12/15/2007	3 mg/MWh	90%	–	–	–
Connecticut	07/01/2008	0.6 lb/10^{12} Btu	90%	–	–	–

In addition to the states that have passed legislation, several other states have had legislative activity, although it is not expected that legislation will pass in any of those states this year.

MERCURY INFORMATION CLEARINGHOUSE

QUARTER 7 – MERCURY REGULATIONS IN THE UNITED STATES: FEDERAL AND STATE

INTRODUCTION

The Canadian Electricity Association (CEA) identified a need and contracted the Energy & Environmental Research Center (EERC) to create and maintain an information clearinghouse on global research and development activities related to mercury emissions from coal-fired electric utilities. With the support of CEA, the Center for Air Toxic Metals® (CATM®) Affiliates, and the U.S. Department of Energy (DOE), the EERC is developing comprehensive quarterly information updates to provide a detailed assessment of developments in mercury monitoring, control, policy, and research.

Recent developments in the area of mercury regulations for coal-fired power plants in Canada in the form of Canada-Wide Standards (CWS) and the United States in the U.S. Environmental Protection Agency's (EPA's) Clean Air Mercury Rule (CAMR) illustrate the need for effective mercury control strategies for coal-fired electric utilities as well as standard and reliable means of measuring mercury emissions. A review of mercury regulations in the United States at both the federal and state levels are provided in this quarterly report.

In order to adequately address the many topics and provide the detail necessary for the various stakeholders to make informed decisions, selected topics are discussed in detail in each quarterly report. Issues related to mercury from coal-fired utilities include the general areas of measurement, control, policy, and transformations. Specific topics that have been addressed in previous quarterly reports include the following:

- Quarterly 1 – Sorbent Control Technologies for Mercury Control
- Quarterly 2 – Mercury Measurement
- Quarterly 3 – Advanced and Developmental Mercury Control Technologies
- Quarterly 4 – Rerelease of Mercury from Coal Combustion By-Products
- Quarterly 5 – Mercury Fundamentals
- Quarterly 6 – Mercury Control Field Demonstrations

Specific topics that will be addressed in future quarterly reports include, but are not limited to, the following:

- Mercury policy
  - Upcoming events and news releases
  - Regulation, policy, compliance strategies, and health developments

- Mercury measurement
  - Continuous mercury monitors
  - Advanced mercury-sampling systems
  - Wet-chemistry mercury measurement techniques

- Baseline mercury levels and emissions

- Mercury control
  - Sorbent technologies and control in unscrubbed systems
  - Advanced and developmental mercury control technologies
  - Summary of large-scale test activities and associated economics
  - Mercury oxidation and control for scrubbed systems
  - Multipollutant control strategies
  - Impact of mercury control on combustion by-products/fate of captured mercury
  - Summary of mercury-related economics for commercial systems

- Mercury chemistry and transformations
  - Mercury chemistry fundamentals, modeling, prediction, and speciation
  - Mercury fate and transport – impacts on health

One objective of the quarterly reports is to provide timely information on developments in the broad field of mercury. In order to address timely issues as well as provide necessary detail on selected topics, additional subject headings will be provided as necessary to summarize recent developments not related to the quarterly topic. In this manner, updated information can be provided on topics previously covered or in advance of topics not yet discussed. The primary subject area for this quarterly report is a review of the mercury regulations in the United States at both the federal and state levels.

MERCURY POLICY

The primary subject area for this quarterly is a review of mercury policy in the United States. In Canada, a Draft Canada-Wide Standard for Mercury Emissions from Coal-Fired Electric Power Generation Plants was recently released that will result in a reduction of mercury emissions by 58% by 2010 based on estimated emissions. These estimated emissions were based on data obtained between 2002 and 2004 through a utility-monitoring program. Significant data have been compiled from coal, ash, and stack testing at facilities across Canada. Results from these activities can be viewed on the CEA Web site at www.ceamercuryprogram.ca/index.html.

The draft CWS, which is available at www.ccme.ca/assets/pdf/canada_wide_standards_hgepg.pdf, provides provincial caps on mercury emissions from existing coal-fired electric power generation (EPG) plants to result in 65% capture of mercury, Canada-wide, from coal burned. In the second phase, the CWS may explore additional capture from EPGs of more than 80% from coal burned beginning in 2018. A summary of estimated mercury emissions resulting from coal firing and proposed caps for each province is summarized in Table 1.

Requirements for new coal-fired EPG units will include 85% capture from burning bituminous and blended coals and 75% capture for subbituminous and lignite fuels.

Following review of this draft rule in the fall of 2005, final endorsement by the Canadian Council of Ministers of the Environment would occur in November 2005.

Table 1. Province Mercury Emission Estimates and Proposed Caps for 2010

Province	Estimated Emission, kg/yr[a]	2010 Cap, kg/yr
Alberta	1180[b]	590
Saskatchewan	710	430[c]
Manitoba	20	20
Ontario	495	0
New Brunswick	140	25
Nova Scotia	150	65
Total	2695	1130

[a] Based on 2002 to 2004 utility-monitoring program results.

[b] Alberta's commitment is through the implementation of the Clean Air Strategic Alliance Electricity Project Team recommendations. Alberta emissions are based on a 90% capacity factor.

[c] Saskatchewan's early actions, between 2004 and 2009, will be used to meet its provincial caps for the years 2010 to 2013. Examples of early actions include a mercury switch collection program and early mercury controls at the Poplar River Power Station.

QUARTER 7 FOCUS: MERCURY REGULATIONS IN THE UNITED STATES: FEDERAL AND STATE

U.S. FEDERAL MERCURY REGULATIONS

In December 2000, EPA decided that regulation of mercury from coal-fired electric utility steam-generating units was appropriate and necessary under Section 112 of the Clean Air Act (1). EPA determined that mercury emissions from power plants pose significant hazards to public health and must be reduced. The EPA *Mercury Study Report to Congress* (1997) (2) and the *Utility Hazardous Air Pollutant Report to Congress* (1998) (3) both identified coal-fired boilers as the largest single category of atmospheric mercury emissions in the United States, accounting for about one-third of the total anthropogenic emissions. On January 30, 2004, EPA published the proposed Utility Mercury Reduction Rule 40 CFR 60 and 63 (4) in order to solicit comments for two approaches for mercury emission control. Under one approach, coal-fired power plants in the United States would be required to install currently available control devices defined as maximum achievable control technologies (MACT) under Section 112 of the Clean Air Act. The second approach, proposed under Section 111 of the Clear Air Act, would create a market-based "cap-and-trade" program. This alternative would apply to both new and existing sources and take advantage of copollutant mercury control associated with SO_2 and NO_x reductions required by the Interstate Air Quality Rule that was also proposed by EPA on January 30, 2004, in 40 CFR 51, 72, 75, and 96 (5). Under this approach, a mandatory declining cap would be set for total mercury emissions from all U.S. coal-fired power plants. Implementation of this alternative would require EPA to revise its December 2000 finding that it is appropriate and necessary to regulate utility hazardous air emissions under the MACT standard of the Clear Air Act.

The EPA received over 680,000 comments on the Proposed Utility Mercury Reduction Rule and the related supplemental proposal issued in March 2004. As follow-up, EPA published a Notice of Data Availability (NODA) in the Federal Register (Vol. 69, No. 230, pp 69864–69878) on December 1, 2004. The NODA summarized the comments received by EPA (January 2004) and solicited further comment to help EPA evaluate what regulatory approach would best reduce mercury emissions from power plants.

On March 15, 2005, EPA announced the new CAMR for coal-fired power plants (6). The rule makes the United States the first country in the world to regulate mercury emissions from coal-fired power plants. It was the decision of EPA to regulate mercury under Section 111 rather than Section 112 of the Clean Air Act. As such, it was required that EPA rescind its December 2000 finding that it was appropriate and necessary to regulate mercury under Section 112(d), which would have necessitated the MACT standard. Under Section 111, a cap-and-trade rule was established. The CAMR is viewed by EPA to function in conjunction with the Clean Air Interstate Rule (CAIR) to reduce mercury emissions nationwide (7). It is expected that the additional wet flue gas desulfurization (FGD) and selective catalytic reduction (SCR) systems that will be installed to comply with the CAIR SO_2 and NO_x requirements in 28 eastern states

will provide a substantial mercury cobenefit. Following is a brief overview of the CAMR. The actual rule and the preamble can be found at www.epa.gov/air/mercuryrule/rule.htm and the CAIR rule at www.epa.gov/CAIR/rule.html.

For purposes of the CAMR rule, an affected utility is defined as a fossil fuel-fired combustion unit that serves a generator that produces electricity for sale that is >25 MW_e in size. A cogeneration facility that produces at least one-third of its electricity for sale during any portion of the year and is >25 MW_e in size is also considered a utility.

Based on the 1997 Information Collection Request (ICR) data, it has been established that current U.S. mercury emissions from coal-fired electric utilities total 48 tons a year. The cap-and-trade provision of the new rule would reduce that to 38 tons of mercury a year in 2010, a reduction of 20.8%. It is fully expected that the addition of new wet FGD and SCR systems to reduce SO_2 and NO_x (under CAIR) will allow the states to meet the 2010 mercury reduction requirements without additional mercury controls. EPA is of the opinion that full-scale mercury control technologies cannot be developed and widely implemented within the next 5 years but will be available by 2018. Therefore, the rule will require further reductions to 15 tons by 2018, a total reduction of 68.8% from 1997 emissions. By 2018, it is expected that a number of plants will have employed mercury control strategies.

To ensure the required mercury reduction is met and to facilitate trading, EPA has established emission budgets for each state based on the baseline heat input adjusted for the coal burned by each plant in a given state. The adjustment factors were 1 for bituminous, 1.25 for subbituminous, and 3 for lignite coals. Table 2 shows the emission budget for each state for both phases of the rule. The ten states with the lowest emission budgets are highlighted; this reflects those states that have the least coal-fired electrical generation. Each state has the right to promulgate stricter mercury standards and/or decline to participate in the trading program. If a state declines to participate in trading, the caps shown in Table 2 become hard emission limits for that state for the targeted years. If the state participates in the trading program, it must submit a model trading plan to EPA.

Similar to the existing SO_2 trading program, the banking of mercury allowances (1 allowance = 1 ounce mercury) will be allowed at the beginning of the cap-and-trade program. Although EPA admits that early banking of allowances will most likely lead to less reduction in later years, it is expected that it will allow for greater reductions prior to 2010.

Under the CAMR, new coal-fired generation sources (built after January 30, 2004) must also meet a new source emission standard. The requirements for new sources have been subcategorized according to coal rank and, in the case of subbituminous coal, for the type of SO_2 control technology employed. These emission standards are shown in Table 3.

The new rule also provides detailed information on how and when mercury is to be measured and what record keeping is needed in order to comply with the trading rules. Two

Table 2. State Mercury Emission Budgets

State	2010–2017, tons Hg/yr	After 2018, tons Hg/yr
Alabama	1.289	0.509
Alaska	0.005	0.005
Arizona	0.454	0.179
Arkansas	0.516	0.204
California	0.041	0.016
Colorado	0.706	0.279
Connecticut	0.053	0.021
Delaware	0.072	0.028
Florida	1.233	0.487
Georgia	1.227	0.484
Hawaii	0.024	0.009
Idaho	0	0
Illinois	1.594	0.629
Indiana	2.098	0.828
Iowa	0.727	0.287
Kansas	0.723	0.285
Kentucky	1.525	0.602
Louisiana	0.601	0.237
Maine	0.001	0.001
Maryland	0.490	0.193
Massachusetts	0.172	0.068
Michigan	1.303	0.514
Minnesota	0.695	0.274
Mississippi	0.291	0.115
Missouri	1.393	0.550
Montana	0.378	0.149
Nebraska	0.421	0.166
Nevada	0.285	0.112
New Hampshire	0.063	0.025
New Jersey	0.153	0.060
New Mexico	0.299	0.118
New York	0.393	0.155
North Carolina	1.133	0.447
North Dakota	1.564	0.617
Ohio	2.057	0.812
Oklahoma	0.721	0.285
Oregon	0.076	0.030
Pennsylvania	1.780	0.702
Rhode Island	0	0
South Carolina	0.580	0.229
South Dakota	0.072	0.029
Tennessee	0.944	0.373
Texas	4.657	1.838
Utah	0.506	0.200
Vermont	0	0
Virginia	0.592	0.234
Washington	0.198	0.078
West Virginia	1.394	0.550
Wisconsin	0.890	0.351
Wyoming	0.952	0.376

Table 3. New Source Mercury Emission Standards

Unit	ng/J	lb/10^6 MWh
Bituminous Units	0.00260	21.0
Subbituminous Units		
Wet FGD	0.00550	42.0
Dry FGD	0.01030	78.0
Lignite Units	0.01830	145.0
Coal Refuse Units	0.00017	1.4
IGCC*	0.00250	2.0

* Integrated gasification combined cycle.

mercury measurement methods are allowed; the first is 40 CFR, Part 60, Appendix K (previously proposed EPA Method 324 or the sorbent trap method). The second method is to use continuous mercury monitors (CMMs). Although no specifics are provided such as what sorbent or monitors are to be used, very detailed initial certification procedures are listed as well as specifications for quality assurance/quality control (QA/QC).

It is the expectation of EPA that compliance with SO_x and NO_x requirements of the CAIR will provide substantial cobenefit for mercury capture and result in compliance with the CAMR Phase I mercury budgets by 2010. As such, very little specific mercury control technology implementation will be required in the near term to meet federal requirements. Where mercury control is necessary, activated carbon injection may be implemented for additional mercury capture. A significant amount of work has been done through industry, utility, and DOE efforts to demonstrate the effectiveness of carbon injection, the results of which have been presented in previous CEA reports, including Quarterly 1 and 6. Phase II mercury budgets will require additional mercury control technology by 2018; however, advancements in control technologies over the next several years will have a significant impact on utility plans to meet their mercury emission limits.

Although mercury control is not likely to be required for compliance with Phase I federal regulations, several states have developed mercury emission requirements more stringent than the federal CAMR and, as such, will require near-term implementation of control technologies. Specific activities to control mercury are presented in subsequent sections.

The new CAMR has proven to be very controversial, and several environmental organization as well as ten state attorneys general have filed suit in the U.S. District of Columbia Court of Appeals against EPA and the mercury rule. The ten states are as follows (four of the states are highlighted in Table 2, and with the exception of Wisconsin, all are on the lower end of the annual mercury allocation):

- New Jersey
- New Hampshire
- Maine
- New York
- California

- New Mexico
- Connecticut
- Wisconsin
- Vermont
- Massachusetts

The states are challenging EPA's authority to remove power plants from the list of pollution sources subject to Section 112 requiring MACT, and secondly, they are challenging the cap-and-trade system, asserting that it is not protective of public health. These states are alleging that under a cap-and-trade system, some plants will actually increase mercury emissions, thereby creating "hot spots" of mercury deposition and contamination.

All of the states filing suit, with the exception of California, New Mexico, and Wisconsin, are in the northeastern part of the United States. Even though these states do not have many coal-fired electric utilities, their concern is that substantial deposition occurs within their boundaries from plants outside their states. For example, a mercury task force in New Jersey determined wet deposition to be 14–18 μg/m^2/yr (8). Somewhat less deposition (10–12 μg/m^2/yr) was reported in a 2003 study by the Mercury Deposition Network (MDN) (9). For comparison purposes, the MDN results indicated wet deposition in the northeastern part of the United States to be 4–12 μg/m^2/yr; 20–30 μg/m^2/yr in parts of Florida, Georgia, Alabama, and Louisiana; and, although the database is not extensive, 2–6 μg/m^2/yr in the western portion of the United States. A map of mercury wet disposition is shown in Figure 1. It has also been estimated that dry deposition may be 40%–45% of wet deposition (10).

STATE REGULATIONS

Under the Clean Air Amendments of 1990, each state is free to promulgate stricter emission regulations than are provided for by the federal rule-making process. To date, three states, Massachusetts, Connecticut, and New Jersey, have imposed mercury emission limits more restrictive than the CAMR. In New Hampshire, a bill limiting emissions has been introduced and is currently in committee. Wisconsin has also issued a mercury rule; however, the rule contained a clause that would not allow it to be more restrictive than the federal rule. Therefore, some provisions of the Wisconsin rule will have to be amended. The state regulations that are currently in place or under consideration are discussed below.

Massachusetts

On May 26, 2004, the Executive Office of Environmental Affairs and the Massachusetts Department of Environmental Protection (DEP) announced the adoption of new regulations that limit mercury emissions from coal-fired power plants in Massachusetts. These regulations took effect on June 4, 2004. Massachusetts has four affected facilities, shown in Table 4. The rule in Massachusetts requires that by January 1, 2008, or 15 months after complying with existing SO_2 and NO_x regulations, mercury emissions from the four plants must be less than 0.0075 lb/GWh

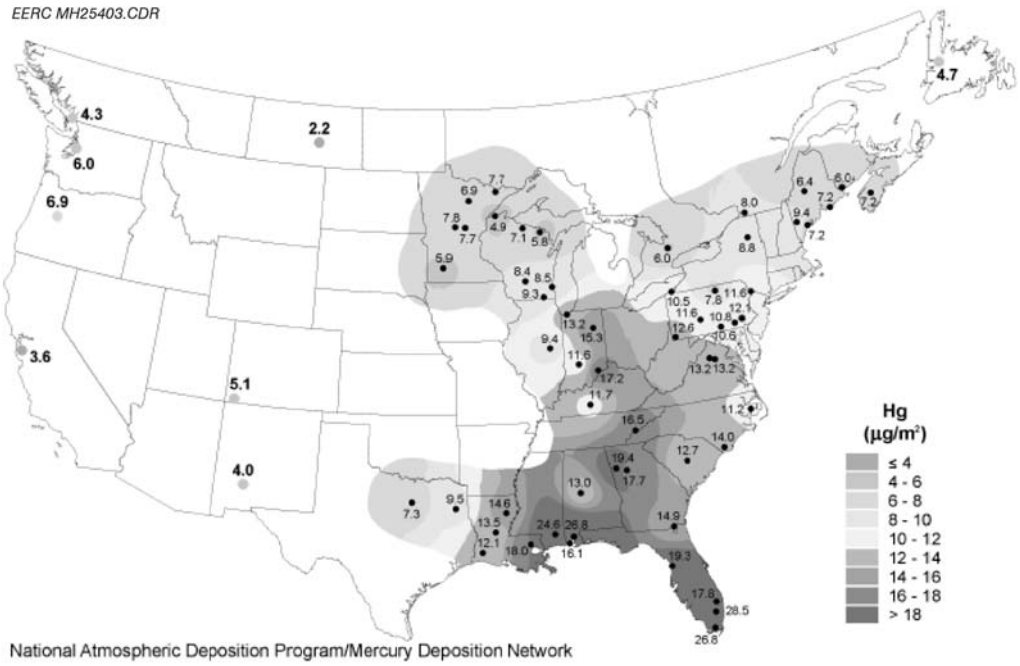


Figure 1. Mercury wet deposition map.

(2.20 lb/10^{12} Btu), or the average total mercury removal efficiency must be 85% or greater. The removal efficiency, based on CMMs, is to be calculated based on the average historic mercury inlet concentration and is determined on a rolling 12-month basis. Effective October 1, 2012, mercury emissions must be reduced to 0.0025 lb/GWh (0.73 lb/10^{12} Btu), or the average total mercury removal efficiency must be greater than 95%. Two Massachusetts plants have multiple units: Salem Harbor and Brayton Point. Mercury testing for these facilities can be conducted at one location, representative of full-load operation and applied to the entire facility. Beginning January 1, 2008, the affected plants must have installed certified CMMs. Prior to this date, other compliance methods can be used (as approved by the Massachusetts DEP), but triplicate measurements must be made on a quarterly basis. The rule allows for variances when testing new technologies, and trading will be allowed on a very limited basis. If a plant terminates operations before January 1, 2010, it must demonstrate compliance by using early or off-site reductions. Also, any plant that emits less than 5 lb of mercury on an annual basis may demonstrate compliance by using early or off-site reductions through September 30, 2012. A summary of the expected emission reduction in Massachusetts is shown in Figure 2.

Although testing using activated carbon has been done at Salem Harbor and Brayton Point (11) it is expected that the addition of SCRs and wet scrubbers that is being mandated for SO_2 and NO_x control, along with the natural mercury capture in the fly ash, will allow the Massachusetts plants to meet state regulations without additional mercury controls for the first phase. However, additional controls may be required to meet the second phase.

Table 4. Power Plants Affected by the Massachusetts Mercury Rule

Plant	No. of Affected Units	Coal	Total MW
Brayton Point	3	Bituminous	1132
Salem Harbor	3	Bituminous	325
Mount Tom	1	Bituminous	146
Sommerset	1	Bituminous	112

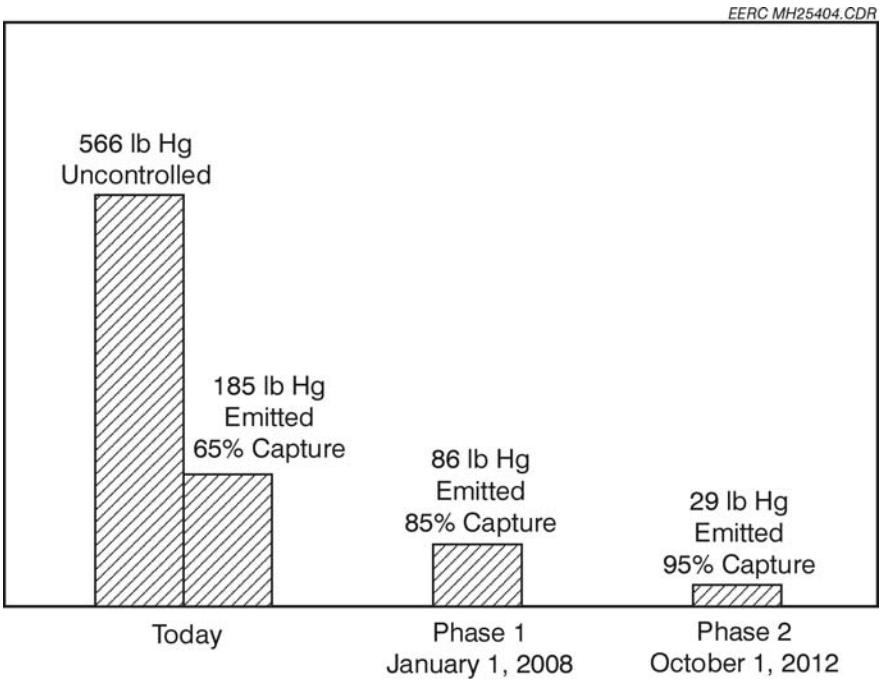


Figure 2. Anticipated mercury emissions for Massachusetts.

New Jersey

On December 6, 2004, a mercury rule was established in New Jersey applicable to coal-fired boilers. A total of seven facilities (ten units) are impacted by the rule and are listed in Table 5. The rule will require the facilities to meet a 3-mg/MWh (1.94-lb/10^{12} Btu) annual emission limit or achieve a minimum 90% mercury removal efficiency (annual basis). This must be accomplished by December 15, 2007.

Alternately, a multipollutant strategy that meets the state's approval can be implemented by December 15, 2012. PSEG Fossil recently reached a settlement with the New Jersey Department of Environmental Protection and the EPA to resolve allegations of noncompliance with federal and New Jersey New Source Review (NSR) regulations. The NSR provisions of the Clean Air Act are designed to ensure that power plants and other sources of air emissions install best available emissions control technologies when they undergo major expansions or refurbishments that significantly increase emissions. As part of the settlement, PSEG Fossil is

Table 5. Power Plants Affected by the New Jersey Mercury Rule*

Plant	No. of Affected Units	Coal	Total MW
Logan	1	Bituminous	230
Mercer	2	Bituminous	653
Carneys Point	2	Bituminous	590
B.L. England	2	Bituminous	300
Deepwater	1	Bituminous	74
Hudson	1	Bituminous	660
Vineland	1	Bituminous	25

* It is expected that the B.L. England and Vineland facilities will be shut down prior to December 15, 2007.

expected to spend $340 million over the next 10 years to reduce emissions of NO_x, SO_2, and mercury at the Hudson and Mercer Generating Stations. These emission reductions will be achieved by installing SCR and dry scrubber technology at Hudson and Mercer Generating Stations. In addition, a baghouse will be installed at Hudson. PSEG Fossil is expecting a 90% reduction in mercury emissions at these plants through the cobenefits of these control technologies. However, it may be necessary to add small amounts of activated carbon to ensure compliance with the New Jersey mercury rule.

At Carneys Point Power Plant, a dry scrubber and fabric filter are already installed, resulting in a natural mercury capture of > 65%. It is expected that additional mercury controls will be needed to meet the New Jersey regulations. Mercury testing has been conducted by Consol at Carneys Point using activated carbon, and >90% mercury control has been achieved (12).

The New Jersey Mercury Rule does not allow trading or averaging between sites; however, the rule does allow averaging mercury from multiple coal-fired boilers at a site for compliance purposes. It is expected that the rule will reduce current mercury emissions from coal-fired power plants from 700 ± 300 lb/yr to less than 75 lb/year.

Stack testing will be required for each unit at both the inlet of the first pollution control device and at the stack. The tests must be conducted using an approved method on a quarterly basis. If a facility maintains compliance for eight consecutive quarters, the frequency of sampling may be reduced to once every fourth quarter. The state of New Jersey is also strongly recommending the use of CMMs once they become commercially available and can meet the performance specifications published by EPA in the CAMR.

Connecticut

In March 2003, environmental organizations including Clean Water Action, the Connecticut Coalition for Clean Air, and the Clean Air Task Force along with electric utility PSEG Power Connecticut (owner of the 375-MW Bridgeport Harbor coal-fired power plant) issued a joint recommendation to the Connecticut General Assembly for legislation establishing stringent new mercury emission standards for the state's coal-fired power plants. The joint

proposal, unanimously adopted and signed into law in June 2003, requires coal-fired power plants in Connecticut to achieve either a mercury emission standard of 0.6 lb/10^{12} Btu or a 90% mercury removal efficiency. The requirements become effective in July 2008. There are two affected plants in the state of Connecticut, as shown in Table 6.

Table 6. **Power Plants Affected by the Connecticut Mercury Rule**

Plant	No. of Affected Units	Coal	Total MW
Bridgeport Harbor	1	Bituminous	375
Thames*	1	Bituminous	200

* The Thames unit is a circulating fluid bed.

If the owner or operator of any affected unit properly installs and operates mercury control technology designed to achieve the required mercury removal and fails to achieve that desired performance, the owner of the plant must notify the Connecticut Commissioner of Environmental Protection by February 1, 2009. Quarterly stack sampling will need to be performed and reported for evaluation and establishment of an alternative emission limit for that unit based upon the optimized performance of the properly installed and operated control technology. The Commissioner of Environmental Protection will establish an alternative emission limit for that unit no later than April 1, 2010.

Any stack test used to demonstrate compliance with the mercury emission rate requirement is to be based on an average of stack tests conducted during the two most recent calendar quarters. The method to be used for measuring mercury is EPA Method 29; however, an alternative method may be used if approved by the Commissioner of Environmental Protection.

If the Commissioner of Environmental Protection determines that CMMs are commercially available and can perform in accordance with the specification as published in the CAMR, the plant must install the monitors but will not need to conduct stack testing except as required by the CMM QA/QC specifications written in the federal mercury rule.

In addition to establishing the new mercury emission limits in 2008, the law also directs the Connecticut Department of Environmental Protection in 2012 to review all stationary sources of mercury emissions in the state. As part of this review, the Department of Environmental Protection will consider new emission standards based on available technology, the cost of achieving additional reductions, and public health and environmental benefits associated with further reductions from each source reviewed.

New Hampshire

In New Hampshire, a bill has been introduced that would provide a multipollutant reduction program that limits emission of mercury, SO_2, NO_x, and CO_2. Two coal-fired power plants in New Hampshire (shown in Table 7) would be affected by these regulations.

Table 7. Power Plants Affected by the Proposed New Hampshire Mercury Rule

Plant	No. of Affected Units	Coal	Total MW
Merrimack*	2	Bituminous	510
Schiller	3	Bituminous	180

* The two Merrimack boilers are wet-bottom cyclone units.

It is estimated that the plants in New Hampshire are currently emitting mercury at a rate of 129 lb/yr. This legislation would cap mercury emissions at 50 lb/yr beginning July 1, 2009, and then 24 lb/yr beginning July 1, 2013. In the initial bill, a modified cap-and-trade program within the state was proposed; however, the trading portion of the bill was eliminated in the senate.

The baseline theoretical inlet mercury concentration for each plant would be determined through coal analysis on a monthly basis. Stack testing would be required to determine removal from the theoretical inlet concentration. Stack testing would be conducted at both units at Merrimack and one unit at Schiller.

Wisconsin

In June 2003, the Wisconsin Natural Resources Board approved new regulations that would require the state's coal-fired utilities to reduce mercury emissions. The intent of the rule was to reduce mercury emission by 40% by January 1, 2010, and 75% by January 1, 2015, for all coal-fired power plants >25 MW. However, included in the rule was section NR 446.029, "Adoption of Federal Mercury Standard," which states the following:

> *If a federal emission standard limiting mercury emissions from a major utility is promulgated under Sections 111 or 112 of the federal Clean Air Act, the department shall adopt a similar standard, including administrative requirements that are consistent with federal administrative requirements. The standard adopted by the department may not be more restrictive in terms of emission limitations than the federal standard.*

The result is that the Wisconsin mercury rule has been superseded by the federal CAMR, and no specific mercury removal technology is being planned in Wisconsin.

STATES WITH INTRODUCED LEGISLATION

Legislation has been introduced recently in seven other states as well:

- Minnesota
- Indiana
- Maryland
- Montana
- New York
- Ohio
- Virginia

The legislation being considered by these states is preliminary and provides for a wide range of emission requirements and compliance strategies. It is unclear at this time what type of mercury control will be required in these states.

STATES WITH NONLEGISLATIVE ACTIVITIES

In states where legislation is not in place nor been introduced, other activities, including air permitting, investigations by state environmental departments, and voluntary programs, have been ongoing to address the concerns of mercury emissions from coal combustion. The following describes these activities in Iowa, North Carolina, Minnesota, and Delaware.

Iowa

In June 2003, the Iowa Department of Natural Resources issued a permit to MidAmerican Energy Company for construction of a 765-MW coal-fired boiler at the Council Bluffs Energy Center that will require mercury control. It is expected that the unit will begin operation early in 2007 and will fire a Powder River Basin (PRB) subbituminous coal. Based on the permit, the unit will require best available control technology (BACT) for a range of pollutants. The BACT emission limits for this boiler are shown in Table 8. The allowed mercury emission rate (highlighted) would require 80%–85% removal based on the average mercury content of PRB

Table 8. BACT Emission Limits for the New Boiler at the Council Bluffs Energy Center

Pollutant	tons/yr[1]	Limits, lb/10^6 Btu (unless otherwise noted)
Particulate Matter (PM)	NA[2]	0.027
PM_{10}	NA	0.025
Opacity	NA	5%
Sulfur Dioxide (SO_2)	3362	0.1
Nitrogen Oxides (NO_x)	2353	0.07
Volatile Organic Compounds	121	0.0036
Carbon Monoxide	5177	0.154
Lead	NA	0.000026
Fluorides	NA	0.0009
Sulfuric Acid Mist (SO_3 and H_2SO_4)	NA	0.00421
Mercury	NA	1.7×10^{-6}
Hydrogen Chloride (HCl)	NA	0.0029
Total Selected Metals[3]	NA	1.04×10^{-4}

[1] Twelve-month rolling average.
[2] Not applicable.
[3] Total selected metals are arsenic, beryllium, cadmium, chromium, lead, manganese, nickel, and selenium.

coal. To meet the requirements shown in Table 8, the unit will have the following pollution control systems:

- Spray dryer
- Baghouse
- Low-NO_x burners with overfire air
- SCR
- Activated carbon injection

Activated carbon injection for mercury control is specifically identified in the permit. A minimum activated carbon feed rate of 10 lb/10^6acf or a rate specified by optimization trials is required. Optimization testing (maximum of 9 months) is to begin immediately after start-up to determine the level of activated carbon needed to ensure that emission limits are achieved. During each test period, in addition to stack testing, the mercury is to be measured in the coal and the bottom ash. Also, the coal feed rate and bottom ash generation rates are to be determined.

Compliance is to be ensured through stack testing consisting of an average of three stack tests using the ASTM D6784-02 method (the Ontario Hydro method) on an annual basis. In addition, EPA Method 29 will be required to measure trace elements. There are no requirements in the permit for continuous monitoring for mercury.

North Carolina

In North Carolina, the Clean Smokestacks Act requires new controls for NO_x and SO_2 and is expected to provide a cobenefit of 55% mercury reduction. Also, the North Carolina State Department of Environmental and Natural Resources is required to submit a report to the legislature in 2005 on whether mercury-specific controls should be adopted after implementation of the SO_2 and NO_x controls.

Minnesota

In 1999, Minnesota passed a law requiring the Minnesota Pollution Control Agency to solicit voluntary reduction agreements from all sources that emit more than 50 lb of mercury annually. The law set a goal of reducing mercury releases in the state by 70% from 1990 levels by 2006. A 2002 progress report indicated very little reductions had occurred under the voluntary initiative. Progress is to be assessed again in 2005, and a report is expected to be issued in October 2006. In response to the slow rate of voluntary mercury reduction, a bill was submitted to the Minnesota legislature in March 2005 that would cut mercury emissions by 90% by 2009 or 2011, depending on the plant configuration.

Delaware

The governor of Delaware has asked the Delaware Department of Natural Resources and Environmental Control to begin a process to reduce mercury from the two power plants located in Delaware (Indian River and Edge Moor). A formal rule-making process is expected to begin in fall 2005.

UPCOMING EVENTS

230th ACS National Meeting
August 28–September 1, 2005, Washington, D.C.
http://oasys.acs.org/acs/230nm/topics.html

International Pittsburgh Coal Conference
September 11–15, 2005, Pittsburgh, PA
www.engrng.pitt.edu/pcc/

Mercury Measurement in Combustion Flue Gases Short Course
September 12–14 and September 14–16, 2005, Grand Forks, ND
www.undeerc.org

Air Quality V: Mercury, Trace Elements, SO_3, and Particulate Matter Conference
September 18–21, 2005, Washington, D.C.
www.undeerc.org

Pittcon 2006
March 12–17, 2006, Orlando, FL
www.pittcon.org

Coal Ash Professionals Training Course
April 19–21, 2006, Memphis, TN
www.undeerc.org

A&WMA Annual Conference & Exhibition
June 20–23, 2006, New Orleans, LA
www.awma.org

Eighth International Conference on Mercury as a Global Pollutant
August 6–11, 2006, Madison, WI
www.mercury2006.org/Default.aspx?tabid+1393

AUTHORS

Dennis L. Laudal and Chad A. Wocken

CONTACT INFORMATION

For more information, please contact:

Michael J. Holmes
Deputy Associate Director for Research
Energy & Environmental Research Center
PO Box 9018
Grand Forks, ND 58202-9018
mholmes@undeerc.org
(701) 777-5276

John H. Pavlish
Senior Research Advisor
Energy & Environmental Research Center
PO Box 9018
Grand Forks, ND 58202-9018
jpavlish@undeerc.org
(701) 777-5268

Chad A. Wocken
Research Manager
Energy & Environmental Research Center
PO Box 9018
Grand Forks, ND 58202-9018
cwocken@undeerc.org
(701) 777-5273

REFERENCES

1. U.S. Congress. U.S. Public Law 101-549, U.S. Government Print Office, 1990, 314 p.

2. U.S. Environmental Protection Agency. *Mercury Study Report to Congress*; EPA-452/R-97-003; U.S. EPA Office of Air Quality Planning and Standards, U.S. Government Printing Office: Washington, DC, Dec 1997.

3. U.S. Environmental Protection Agency. *A Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units: Final Report to Congress*; EPA-453/R-98-004a; U.S. EPA Office of Air Quality Planning and Standards, U.S. Government Printing Office: Washington, DC, Feb 1998.

4. U.S. Environmental Protection Agency. *Proposed National Emission Standards for Hazardous Air Pollutants;* 40 CFR Parts 60 and 63; U.S. EPA Office of Air Quality Planning and Standards, U.S. Government Printing Office: Washington, DC, Jan 2004.

5. U.S. Environmental Protection Agency. *Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone;* 40 CFR Parts 51, 72, 75, and 96; U.S. EPA Office of Air Quality Planning and Standards, U.S. Government Printing Office: Washington, DC, Jan 2004.

6. U.S. Environmental Protection Agency. *Final Clean Air Mercury Rule*; www.epa.gov/air/mercuryrule/rule.htm (accessed April 2005).

7. U.S. Environmental Protection Agency. *Clean Air Interstate Rule*; www.epa.gov/CAIR/rule.html (accessed April 2005).

8. New Jersey Department of Environmental Protection. *New Jersey Mercury Task Force Report, Volumes I, II and III*, January 2002; www.state.nj.us/dep/dsr/mercury_task_force.htm (accessed April 2005).

9. Sweet, C.W.; Prestbo, E. Wet Deposition of Mercury in the U.S. and Canada. Presented at the Mercury in the Environment Specialty Conference, September 15–17, 1999, Minneapolis, MN. Proceedings published by Air and Waste Management Association, Pittsburgh, PA, Mercury Deposition Network Deposition Data, http://nadp.sws.uiuc.edu/mdn (accessed April 2005).

10. Fitzgerald, W.F. Presentation to New Jersey Mercury Task Force, Trenton, NJ, Dec 12, 1999.

11. Durham, M.; Bustard, J.; Starns, T.; Sjostrom, S.; Lindsey, C.; Martin, C.; Schlager, R.; Renninger, S.; Chang, R.; Afonso, R. Full-Scale Evaluation of Mercury Control by Injecting Activated Carbon Upstream of ESPs. Presented at the Air Quality IV: Mercury, Trace Elements, and Particulate Matter Conference, September 22–24, 2003, Arlington, VA.

12. Winberg, S.E.; Withum, J.A.; Tseng, S.C.; Locke, J.E. Evaluation of Mercury Emissions from Coal-Fired Facilities with SCR-FGD Systems. Presented at the Mercury Control Technology R&D Program Review Meeting, July 14–15, 2004.