Second Interim Report

Mercury Emissions and Mercury Controls For Coal-fired Electrical Utility Boilers

SEPTEMBER 1, 2004

NCDENR

North Carolina
Department of Environment and Natural Resources
Division of Air Quality

REQUIREMENT FOR THIS REPORT

Excerpted from the *North Carolina Clean Smokestacks Act*

[**Title**: An Act to Improve Air Quality in the State by Imposing Limits on the Emission of Certain Pollutants from Certain Facilities that Burn Coal to Generate Electricity and to Provide for Recovery by Electric Utilities of the Costs of Achieving Compliance with Those Limits]

SECTION 12. The General Assembly anticipates that measures implemented to achieve the reductions in emissions of oxides of nitrogen (NO_x) and sulfur dioxide (SO2) required by G.S. 143-215.107D, as enacted by Section 1 of this act, will also result in significant reductions in the emissions of mercury from coal-fired generating units. The Division of Air Quality of the Department of Environment and Natural Resources shall study issues related to monitoring emissions of mercury and the development and implementation of standards and plans to implement programs to control emissions of mercury from coal-fired generating units. The Division shall evaluate available control technologies and shall estimate the benefits and costs of alternative strategies to reduce emissions of mercury. The Division shall annually report its interim findings and recommendations to the Environmental Management Commission and the Environmental Review Commission beginning 1 September 2003. The Division shall report its final findings and recommendations to the Environmental Management Commission and the Environmental Review Commission no later than 1 September 2005. The costs of implementing any air quality standards and plans to reduce the emission of mercury from coal-fired generating units below the standards in effect on the date this act becomes effective, except to the extent that the emission of mercury is reduced as a result of the reductions in the emissions of oxides of nitrogen (NO_x) and sulfur dioxide (SO_2) required to achieve the emissions limitations set out in G.S. 143-215.107D, as enacted by Section 1 of this act, shall not be recoverable pursuant to G.S. 62-133.6, as enacted by Section 9 of this act.

GENERAL ASSEMBLY OF NORTH CAROLINA - SESSION 2001 – (SENATE BILL 1078)

Ratified the 19th day of June 2002. (Ch. SL 2002-4 S.13)

Marc Basnight - President Pro Tempore of the Senate
James B. Black - Speaker of the House of Representatives
Michael F. Easley- Governor

AN INVITATION FROM SECRETARY ROSS

TO: Environmental Review Commission
Environmental Management Commission

FROM: William G. Ross, Jr.

DATE: September 1, 2004

SUBJECT: Mercury and CO_2 Reports Required by Clean Smokestacks Act

On March 23, 2004, the United States Environmental Protection Agency recognized North Carolina and the Clean Smokestacks Act for outstanding, innovative efforts in improving air quality through regulatory and policy innovations and presented our state with a Clean Air Excellence Award. I had the privilege of saying a few words at the award ceremony in Washington, D.C., on behalf of our state, Governor Easley, and all the other partners who played vital roles in the passage of the law. It was a pleasure for me to describe the story of the Clean Smokestacks Act as a story about the power of innovation, partnerships, teamwork, and leadership.

The act, in addition to providing for major reductions in $S0_2$ and NO_X emissions from NC's 14 coal-fired power plants, directed our Division of Air Quality, over a three year period, to study and make recommendations concerning emissions of mercury and carbon dioxide.

As you know, these are important, controversial issues. For example, Donald Kennedy, the Editor of *Science*, has called climate change "the most serious issue" we face.

Last year, 2003, the Division, working with a broad group of interested parties, put together reports reviewing and summarizing the state of scientific research on mercury and carbon dioxide emissions. This year, 2004, the Division has updated the review of research, and has inventoried options for the recommendations we must make next year (2005). We now ask all interested parties to read this year's report and give us their views, questions and suggestions about it.

> In the upcoming year, as we consider what to recommend, we will evaluate options for action with a number of criteria and principles in mind. As a starting point for those criteria and principles, we plan to use ones suggested in a report of a November, 2003 Aspen Institute policy dialogue chaired by Eileen Claussen and Robert W. Fri. The title of the report is: *A Climate Policy Framework: Balancing Policy and Politics*. As adapted for use in the task that the General Assembly has given us, the criteria and principles are as follows:

1. Environmental effectiveness: How effective is the option in meeting its environmental and public health and welfare target, whether that target is public awareness, information collection and evaluation, or emission reduction?
2. Cost effectiveness: Will the option design allow cost-effective compliance? How will it affect the ability of business to compete?
3. Administrative feasibility: Can the option be administered and does it minimize administrative and transaction costs?
4. Distributional equity: Is the burden of compliance with the option fairly apportioned?
5. Political acceptability: Are there elements of option design that affect its political acceptability?
6. Technology development and diffusion: Will the option help provide a platform for technology development and diffusion?
7. Adaptability: Will the option be able to adapt to changing circumstances and incorporate new information?
8. Monitoring and counting: Will the option include things that can be monitored and are verifiable?
9. Encouraging long term success: Will the option encourage long-term progress and success?

As I mentioned above, we invite your input with respect to whether these are the appropriate criteria and principles and how the various options for recommendations come out when judged against the appropriate criteria and principles. Also, we invite you to suggest options that are not in our inventory and to tell us why such options should be considered.

In the interest of giving every citizen of our State, now and in the future, a reasonable opportunity to live a happy, healthy, and prosperous life, we solicit your input and appreciate your help.

PREFACE

The goal of this report is to present information concerning the state of knowledge for controlling mercury emissions and to begin establishing the cost/benefits relationships. This information needs to be openly considered, evaluated, discussed, and corrected where necessary. In other words, information contained in this report is anticipated to become the basis for the final report on September 1, 2005. In that report, the Department of Environmental and Natural Resources will present the Department's final findings and recommendations concerning mercury emissions from coal-fired electrical utility boilers. Stakeholders and all other interested parties are encouraged to comment on information contained in this report at their earliest convenience.

This 2004 report is based on informational updates, the three-day workshop at North Carolina State University sponsored by the Department of Environmental and Natural Resources, Stakeholders and other resources. The Department appreciates the efforts of all the workshop presenters, stakeholders and other individuals who committed their time and effort to the three-day workshop and the development of this 2004 report. This open process will continue in the development of the final report on this topic.

Portions of this document were taken directly from other government (non-copyrighted) documents in the interest of time and completeness. Some of these sections may have only minor wording changes from the original documents. Quotations are not strictly used to identify these parts, but a strong effort has been made to reference these documents and acknowledge them. The purpose has not been to claim credit for original work of others, but to provide as much detail and accuracy as possible within a limited time. Additional portions of this document have been transferred and condensed from the first interim report for document integrity.

"The greatest obstacle to discovery is not ignorance - it is the illusion of knowledge."
Daniel J. Boorstin (1914-2004)[1]

[1] Provided by O. Russell Bullock, Jr., NOAA Air Resources Laboratory, (On assignment to the U.S. EPA Office of Research and Development), Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

Acronyms Used In This Report

AC – Activated carbon
ACI – Activated carbon injection
ALAPCO - Association of Local Air Pollution Control Officials
CAA – Clean Air Act – Primary federal clean air statute
CAIR – Clean Air Interstate Rule
CESP – Cold-side electrostatic precipitator
CEM – Continuous Emission Measurement
COHPAC™ - Compact Hybrid Particulate Collector
CO_2 – Carbon Dioxide
CSA – NC Clean Smokestacks Act
DAQ – NC Division of Air Quality
DENR – NC Department of Environment and Natural Resources
DHHS − NC Department of Health and Human Services
DMF − Division of Marine Fisheries
DOE – U. S. Department of Energy
DWQ − Division of Water Quality
EEI - Edison Electric Institute
EMC − NC Environmental Management Commission
EPA – U. S. Environmental Protection Agency
EPRI – Electric Power Research Institute
EU/ICR- Electric Utility Steam Generating Unit Mercury Information Collection Request
FF – Fabric filter
FGD – Flue gas desulfurization
Hg - mercury
HAP – hazardous air pollutant
IAQR – Interstate Air Quality Rule
IGCC - Integrated Coal Gasification Combined Cycle
kWh – Kilowatt hour (1000 watts for one hour)
MACT – Maximum Achievable Control Technology
MW - megawatts (million watts)
NC – North Carolina
NCSU – North Carolina State University
NESHAP - national emission standards for hazardous air pollutants
NHANES −National Health and Nutrition Examination Survey
NMA - National Mining Association
NO_x – Oxides of Nitrogen, including NO_2, the primary nitrogen species from combustion.
NPR – Notice of Proposed Rulemaking
PAC – Powdered Activated Carbon
PM – Particulate matter
RGM − Reactive Gaseous Mercury
SCR − Selective Catalytic Reduction
SIP − State Implementation Plan
SNCR − Selective Non-Catalytic Reduction
SO_2 – Sulfur Dioxide
SO_3 – Sulfur Trioxide
SO_x – Oxides of Sulfur, including SO_2, the primary combustion product of sulfur
STAPPA - State and Territorial Air Pollution Program Administrators
TBtu – trillion British thermal units
TMDL − Total Maximum Daily Load

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CHAPTER I EXECUTIVE SUMMARY

This executive summary provides highlights of this 2004 interim mercury report. Chapter II discusses the human risks of mercury species in different environments. The status of state and federal legislative and regulatory action is covered in Chapter III. A discussion of various mercury control devices for use at coal-fired electrical utility boilers is found in Chapter IV. Chapter V explains the use and limitations of two existing mercury emission estimating tools. Arguments concerning the influences of local atmospheric mercury emissions are presented in Chapter VI, including findings and views concerning the Florida Everglades study. Chapter VII reports North Carolina's coal-fires utility boiler characteristics and presents a comparison of speciated mercury emissions before and after the installation of emission control equipment to control of oxides of nitrogen and sulfur dioxide. A discussion follows in Chapter VIII of three options or directions that the Division of Air Quality may take when reporting its final findings and recommendations to the Environmental Management Commission and the Environmental Review Commission by September 2005.

Methylmercury is a serious health threat to humans, particularly to unborn and young children. Mounting scientific evidence and public concern argue strongly that mercury emissions must be reduced. The mercury health concern is primarily related to the existence of methylmercury in fish, resulting in fish advisories and associated health effects. These elevated levels are caused by mercury in the environment being converted to organic mercury, primarily methylmercury, which accumulates in predatory fish. Total mercury concentrations in North Carolina's rainwater are currently above levels believed necessary to allow natural processes to restore acceptable levels of methylmercury in fish.

North Carolina is one of the leading electricity producing states with 46 coal-fired utility boilers, with a total electrical generating capacity of approximately 13,300 megawatts. These coal-fired generating units currently account for up to 66 percent of total mercury emissions estimated to be emitted into the air in North Carolina.

In response to the Clean Smokestacks Act (CSA) of 2002, Progress Energy and Duke Power are required to reduce their nitrogen oxide (NO_x) emissions 77 percent by 2009 and their sulfur dioxide (SO_2) emissions 73 percent by 2013. While the CSA addresses NO_x and SO_2, the General Assembly recognized mercury emission issues and that reducing NO_x and SO_2 from utility boilers has the co-benefit of significant mercury emission reduction. The General Assembly, through the CSA, directed the Division of Air Quality (DAQ) to study mercury emission control performance and to make recommendations as to the course of further actions needed. In response, DAQ has calculated the estimated emissions for each NC utility boiler under its current and future configuration and highlights the following emission changes from current and future mercury emissions using conventional wet scrubber technology:

- Improvement in total mercury emission removal (from pre-CSA conditions) from 33% to 64%

- Nearly two-fold decrease in total mercury emissions from 2730 to 1460 lb/yr
- Nearly five-fold drop in oxidized mercury emissions from 1810 to 380 lb/yr.

Of the three species of mercury (elemental, oxidized, and particulate), it can be argued that oxidized mercury represents the most important species to control from the State's perspective because of its tendency to be deposited within the State. This significant reduction in oxidized mercury emissions suggests the possibility of considerable reductions in mercury deposition across NC.

A dramatic drop in oxidized mercury emissions could have major implications for reduced methylmercury contamination in fish. However, the relative contribution of global versus statewide and local mercury emissions to atmospheric mercury deposition is poorly understood and remains an area of scientific debate.

DAQ's estimated mercury reduction numbers should be considered conservative. Greater mercury reductions are anticipated from improvements in scrubber efficiency. Additionally, both mercury emission estimating tools did not include effects of possible mercury oxidation by selective catalytic converters. Recent studies indicate selective catalytic converters oxidize some elemental mercury, increasing mercury capture in scrubbers.

The electrical power sector is not the only industrial sector that would need to make significant reductions. The EPA is requiring a variety of industries to meet new maximum achievable control technology (MACT) standards, which will create emission reductions of both criteria and air toxics pollutants, including mercury. In addition, various changes and trends in industry are reducing other sources of mercury to the environment in rather dramatic proportions (e.g. changes in incineration processes, changes in the metallurgical industries, recycling changes, reductions in fluorescent bulb mercury content, etc.).

There are mercury emission sources in North Carolina that are not subject to the CSA. These non-CSA mercury sources currently represent approximately 34 percent of the total 2002 mercury emissions in North Carolina. From 2005 to 2012, the installation of SO_2 controls to meet the SO_2 cap are estimated to reduce CSA mercury sources to 43 percent of the total of mercury emissions in North Carolina. Non-CSA mercury sources percentage increases to 57 percent of a greatly reduced number of pounds of mercury then expected to be emitted in North Carolina.

There are two sources of mercury deposition: the "global pool" of elemental mercury that stays in the atmosphere for a number of months or years and speciated (elemental, oxidized, and particulate) mercury emissions generated by local sources. The United States presently accounts for three to five percent of total global mercury air emissions. Experts disagree on the relative effect of mercury deposition from the global pool and deposition from local emission sources. Atmospheric mercury models are under development at several institutions around the world, with a concerted effort on model

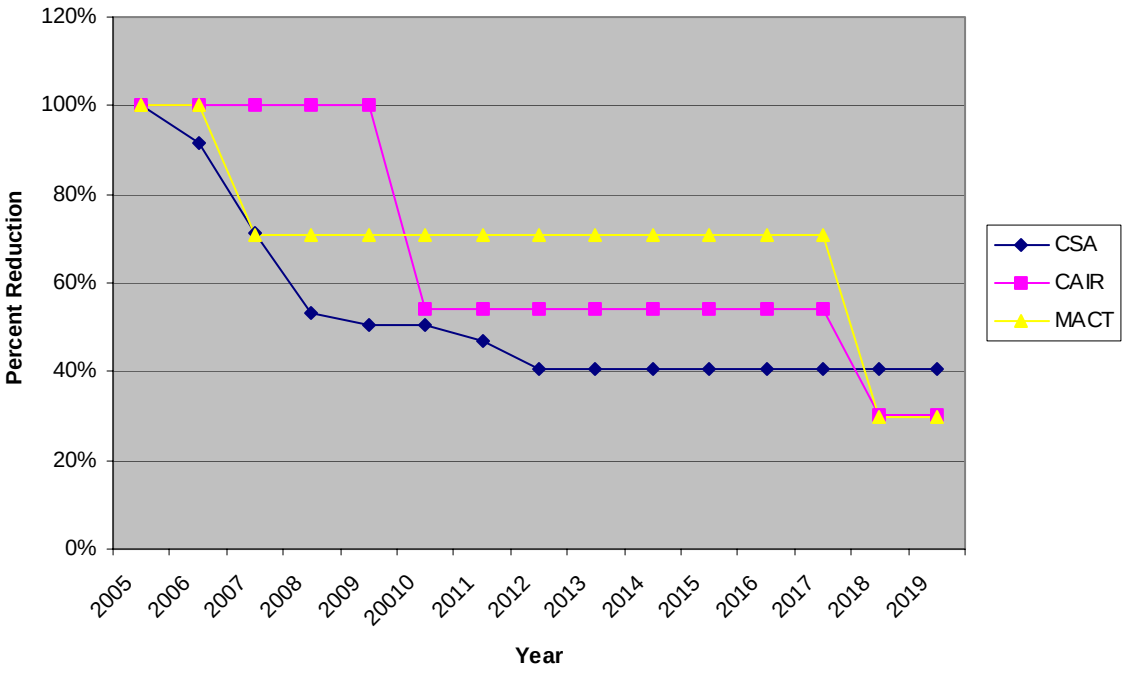
inter-comparison to identify important uncertainties in relative effects of global versus local mercury pollution.

However, at least one recently completed study indicates controlling local mercury emission sources may be important to local mercury deposition. In that study, the Florida Department of Environmental Protection examined an area of the Florida Everglades in an attempt to establish a link between airborne mercury emissions and methylmercury concentrations in top predator fish. This study provides the best example so far of the potential importance of dry deposition of mercury to total ecosystem impacts. Report findings point to a linear relationship existing between airborne mercury emissions and methylmercury concentrations in largemouth bass. The actual reduction of atmospheric sources of mercury in Florida was monitored. Since the peak deposition, monitoring showed a 60 percent decline in methylmercury in Everglades fish and wildlife in less than 15 years. The time required to achieve 50 percent of the ultimate response in fish tissue mercury concentrations is estimated to be approximately 10 years.

It is unknown if the results of this study are applicable in North Carolina as a predictive tool. South Florida's meteorology differs from that found in this State. There are also major differences in mercury sources (such as stack height and mercury emission speciation), topography, soil structure, and exposure to pollution affects across state borders. However, this study does demonstrate a strong direct correlation between decreases in mercury emissions and decreases in methylmercury in Everglade predatory fish.

The EPA has offered three approaches (proposals) to mercury emission reductions from coal-fired utility boilers. The first is to pursue traditional command-and-control of the federal Clean Air Act, section 112 MACT requirements for utility units. This proposal is estimated to reduce mercury emissions from 48 to 34 tons by January 2008. The second proposal is a cap-and-trade approach under guidelines outlined in the Clean Air Act, section 112(n)(1)(A). The third proposal involves a market-based, cap-and trade approach under section 111. The final rule is scheduled to be signed on or before March 2005.

The EPA mercury emission tool was used to estimate mercury emission reductions from the co-benefits of meeting requirements of the CSA. Credit for mercury reductions are credited for the year's planned project completion date. The following graph indicates the estimated CSA utility emissions are at or below both the proposed MACT and Clean Air Interstate Rule (CAIR) mercury reduction percentages until 2018.



The study of the complex and evolving science regarding mercury emission controls and their affects is not complete. Many (seemingly) conflicting theories on mercury chemistry and deposition exist. Within this unsettled legislative and scientific environment, DAQ is proposing three options to be considered for making specific mercury reduction recommendations in 2005.

1. Option one is to continue to study the problem and to defer any rulemaking action until a later time. The federal government, electric power industry, and pollution control industry are advancing the technology and state-of-the-science on the measurement, control, fate, and health effects of mercury emissions. The EPA is scheduled to finalize similar federal standards for controlling mercury emissions from coal-fired power plants in March 2005. The format of the federal requirements may add to the significant mercury emission reductions to be realized from the CSA. Additionally, it may be premature to accurately predict mercury emission reductions and corresponding deposition from in-state power plants resulting from co-benefits of the NOx and SO_2 control device installations that will result from the CSA.

2. The second option is to follow the lead of other states and set mercury emission standards. These states take the position that, while the science and technology are not fully developed, they are adequately developed to initiate rulemaking requirements. States with mercury standards appear to be acting from the basis that, since rulemaking has a history of forcing cost-effective technological developments, rulemaking will again be the engine for development.

3. Option three is to continue the study further, and then expect to set specific mercury emission standards at a later time. Upon completion of more comprehensive studies, DAQ would recommend that the General Assembly direct the Environmental Management Commission to initiate rulemaking. This option is based on the premise that it would be beneficial for all stakeholders to wait until additional information is available for additional future mercury control than to propose standards soon that may need to be revised later.

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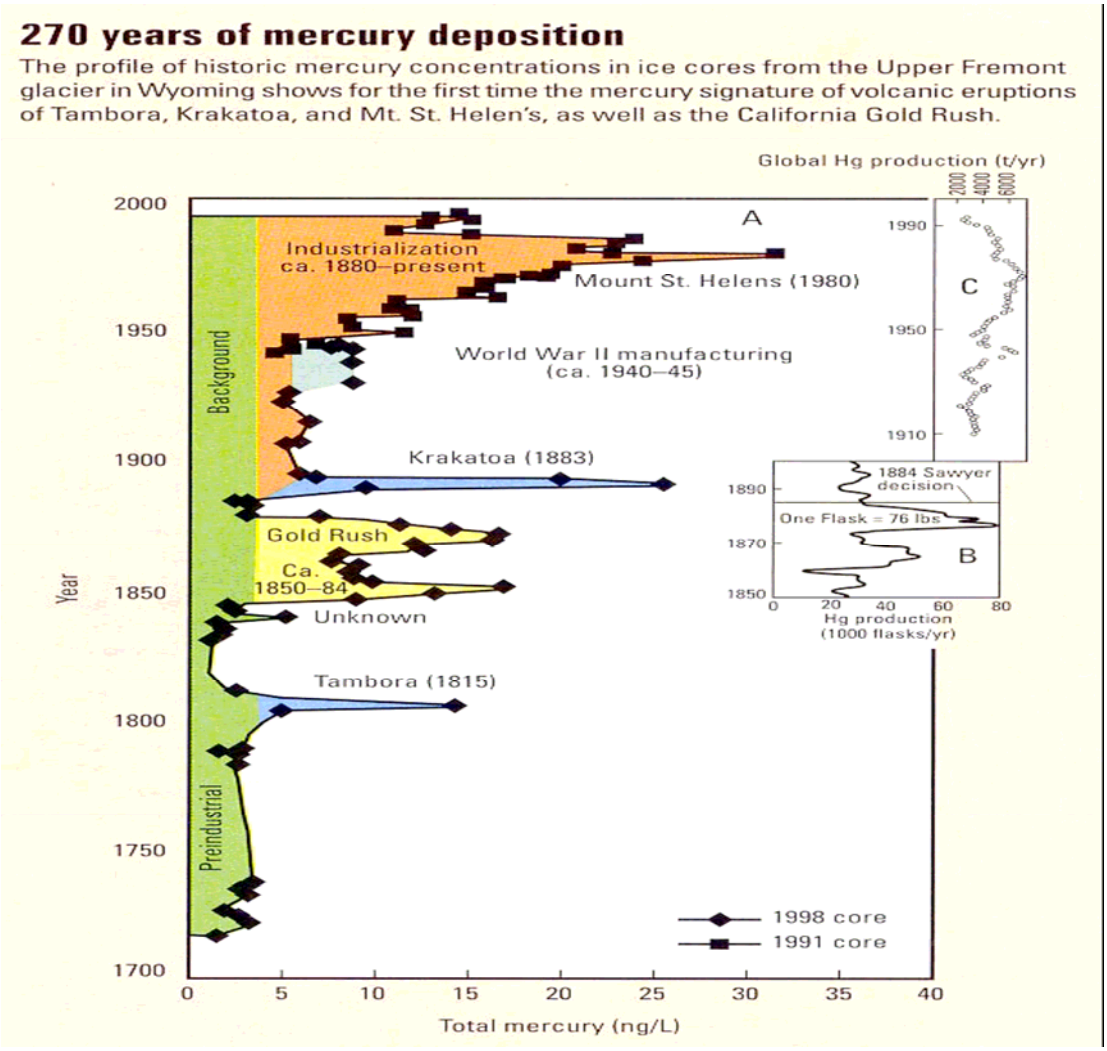
CHAPTER II MERCURY, METHYLMERCURY, AND RISKS

The United States presently accounts for 3 to 5 percent of total global mercury air emissions. Natural sources of mercury, such as volcanic eruptions and emissions from the ocean, are estimated to contribute about 40 percent of current worldwide mercury air emissions, whereas human-made sources account for the remaining 60 percent. Figure II-1 is a graphic representation of the connection between historical events and the age of deposits in the Upper Fremont glacier in Wyoming. The growth of Industrial mercury contributions is striking.

FIGURE II-1
270 YEARS OF MERCURY DEPOSITION



Courtesy of USGS.

ATMOSPHERIC MERCURY

Mercury in the atmosphere comes both from natural sources and from global emissions from human activities. Most of the mercury in the atmosphere is elemental mercury vapor, which may circulate in the atmosphere for years ("global pool") in a dynamic deposition and re-emission state of flux, and hence, can be transported thousand of miles from the source.[2] However, modeling studies recently have suggested that the rate of oxidation of elemental mercury in the atmosphere may be occurring twice as fast (half-life of six months instead of one year) as previously believed.

Mercury transformation processes from smokestack to earth are not yet well understood. Recent experiments using plume chemistry in a static plume dilution chamber, developed by the Electric Power Research Institute, may change the interpretation of chemistry used to calculate percentages of elemental mercury and oxidized (inorganic) mercury transported in the plume. [3] This study suggests that oxidized mercury rapidly converts to elemental mercury near the stack. This finding may explain measurements made near a large coal-fired power plant in Georgia. Based on mercury concentrations in coal burned at the plant, scientists predicted that the stack gases would contain 60-percent oxidized mercury and 40 percent elemental mercury. Mercury measured in air 15 miles downwind was found to be 9 percent oxidized mercury and 91 percent elemental mercury.[3] Mercury in an oxidized form is more amenable to removal by controls on the boiler (e.g., Scrubbers) and also believed to be deposited down wind of the plant than elemental mercury.

Information presented at the workshop on Mercury and CO_2 during April 19-21, 2004 is italicized.

Update On DAQ's Air Quality Measurements & Mercury Studies[4]

NC has relatively high mercury, well above US average, in terms of:

- *Emissions into ambient air*
- *Measurements in specific ambient airsheds*
- *Modeling in specific ambient airsheds*
- *Wet deposition levels*
- *Fish of selected species*
- *People who eat selected fish species*

Power Generation Is a Major Contributor to National Air Pollutant Emissions[5]

- *SO_2: 63%*
- *NOx: 22%*

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[2] Ref. 3, page 1.

[3] Ref. 18

[4] **Update On DAQ's Air Quality Measurements & Mercury Studies**, Steve Schliesser & Todd Crawford, NC Division of Air Quality, Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

[5] **Mercury And CO_2 Emissions From The Power Generation Sector**, C.V. Mathai, Ph. D., Manager for Environmental Policy, Arizona Public Service Company, Phoenix, Arizona, Electricity and Fuel Diversity, Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

- *Hg: 37%*
- *CO_2: ~40%*

A diverse fuel mix is critical to ensure electrical reliability, minimize price volatility, and strengthen national security

MERCURY IMPACT ON LAND

Mercury modeling efforts initially made an assumption that all inorganic mercury compounds that settled on the ground would eventually enter the surface water drainage system and accumulate in rivers, streams, and lakes. Contrary to that assumption, inorganic mercury compounds have been shown to have a strong propensity to attach to and remain on leafy vegetation and soil particles. The majority of inorganic mercury compounds found in water bodies arrive directly from the atmosphere. Mercury deposited on soil and vegetation does not appear to result in exposures believed to be detrimental to health through terrestrial exposure pathways.[6]

MERCURY IMPACT IN WATER

To be converted to organic mercury, elemental mercury must first combine with another element (such as sulfur, chlorine or oxygen) or combine with other compounds to form inorganic mercury compounds, and then undergo further reactions. Recent investigations suggest that a substantial portion of what is often considered "dissolved" mercury is actually mercury associated with macromolecular colloidal organic matter (submicroscopic particles that do not settle out). Either a living organism must act on this inorganic mercury compound or an organic compound must react with it to obtain organic mercury (methylmercury) and then undergo biological interactions.

METHYLMERCURY

The main pathway of introducing methylated mercury forms into aquatic systems is mediated by sulfate-reducing bacteria. While the amount of inorganic mercury is indeed an important factor, it is not the only important factor; nor is it necessarily the controlling factor. A number of parameters have been identified as important in influencing the production rates and abundance of methylmercury in aquatic systems. They include inorganic mercury loading, chemical speciation, water temperature, the availability of an organic substrate for sulfate-reducing bacteria, mercury demethylation activity (by bacteria), natural reduction-oxidation conditions, and in some cases photo-demethylation (light induced).[7] Demethylation is the opposite action of methylation, the creation of methylmercury.

To complicate the issue further, many of these parameters vary temporally and spatially in aquatic systems. Any of these parameters can potentially limit the abundance of bio-available methylmercury in an aquatic system.[8] Demethylation eliminates the toxic

[6] Ref. 7, page 18.
[7] Ref. 4, page 1.
[8] Ref. 4, page 1.

methylmercury molecule. Some types of bacteria, naturally occurring reduction-oxidation chemical reactions, and light break the molecular bonds of the methylmercury molecule. Mercury methylation and demethylation are constantly taking place at the same time in the same body of water.

Two lakes that are similar biologically, physically, and chemically have been shown to have different methylmercury concentrations in water, fish, and other aquatic organisms.[9] Additional factors influence the bioaccumulation of mercury in aquatic biota. They include the acidity (pH) of the water, length of the aquatic food chain, temperature, and dissolved organic material. Physical and chemical characteristics of a watershed, such as soil type and erosion or proportion of area that is wetlands, can affect the amount of mercury that is transported from soils to water bodies. Interrelationships among these factors are poorly understood and are likely to be site-specific. No single factor has been correlated with the extent of mercury bioaccumulation in all cases examined.

FOOD CHAIN

Organic mercury, primarily methylmercury, accumulates in long-lived animals. Predatory fish at the top of the food chain accumulate increasing concentrations of methylmercury in their body tissues (bioaccumulation), which becomes a health threat to humans who eat unsafe quantities of these fish.

MERCURY IMPACT ON PEOPLE'S HEALTH

HEALTH RISKS FROM ELEMENTAL AND INORGANIC MERCURY IN AIR

The elemental and inorganic mercury that exits the smoke stack becomes part of the global pool of mercury in the atmosphere or falling on land or water. Elemental and inorganic mercury are not believed to represent major health hazards in the ambient air environment.

HEALTH RISKS FROM ELEMENTAL AND INORGANIC MERCURY IN WATER

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine safe levels of chemicals in drinking water that do or may cause health problems. These non-enforceable levels, based solely on possible health risks and exposure, are called Maximum Contaminant Level Goals (MCLG). The MCLG for mercury has been set at 2 parts per billion (ppb) because EPA believes this level of exposure would not cause potential health problems.

Based on this MCLG, EPA has set an enforceable standard called a Maximum Contaminant Level (MCL). MCLs are set as close to the MCLGs as possible, considering the ability of public water systems to detect and remove contaminants using suitable treatment technologies. The MCL for total mercury in drinking water has also been set at 2 ppb because EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water.

[9] Ref. 5, Chapter 2, page 6.

These drinking water standards and the regulations for ensuring these standards are met, are called National Primary Drinking Water Regulations. All public water supplies must abide by these regulations. EPA has found mercury to potentially cause kidney damage when people are exposed to it at levels above the MCL for relatively short periods of time.[10]

The U.S. Environmental Protection Agency (EPA) has announced the availability of a recommended fish tissue residue criterion for methylmercury to protect human health. This water quality criterion describes the maximum advisable concentration of methylmercury in freshwater and estuarine fish and shellfish tissue to protect consumers of fish and shellfish among the general population. EPA expects the criterion recommendation to be used as guidance by States, authorized Tribes, and EPA in establishing or updating water quality standards for waters of the United States. Because consumption of contaminated fish and shellfish is the primary route of human exposure to methylmercury, EPA is expressing this water quality criterion as a fish and shellfish tissue value rather than as a water column value. EPA is providing suggested approaches for relating this criterion to water column concentrations, and also plans to develop more detailed guidance to help water quality managers implement the methylmercury criterion in water pollution control programs.[11] The current EPA's recommended fish tissue residue criterion for freshwater and estuarine fish is 0.3 mg methylmercury per kilogram of fish.[12]

HEALTH RISKS FROM METHYLMERCURY IN AIR

Methylmercury is very unstable and breaks down rapidly when exposed to oxygen and sunlight. It is not believed to represent a health risk in ambient air because it is unable to exist there.

HEALTH RISKS FROM METHYLMERCURY IN WATER

Several fishing village epidemiological studies have been conducted to assess the neurodevelopment of children. Results show that the developing human nervous system to be particularly sensitive to methylmercury. The Seychelles Islands and Faroes Islands fishing village epidemiology studies of the 1980s and 1990s assessed the neurodevelopment of children from birth to several years old following maternal consumption of fish or whale meat on a routine basis during pregnancy. The Seychelles Islands are located in the Indian Ocean near Africa. The Seychelles Islands study was conducted by the University of Rochester School of Medicine and Dentistry. The Faroes Islands are located in North Atlantic between Scotland and Iceland. That study was conducted by the Harvard School of Public Health.[13]

[10] http://www.epa.gov/safewater/contaminants/dw_contamfs/mercury.html
[11] http://www.epa.gov/waterscience/criteria/methylmercury/factsheet.html
[12] N.C. DHHS, Occupational and Environmental Epidemiology Branch, August 5, 2004
[13] Toxicological Effects of Methylmercury, National Research Council, 2000, National Academy Press.

The Seychelles Islands study evaluated approximately 740 mother-infant pairs where the mothers consumed 12 meals per week of fish with low levels of methylmercury of less than 0.3 ppm, which is less than the North Carolina's fish advisory action level of 0.4 ppm. The mercury levels in the mothers' hair during pregnancy were on average 6.8 ppm (range 0.5 – 27 ppm). A broad range of cognitive-behavioral tests were given to the children at approximately 6 months, 1 ½ years, 2 ½ years, 5 ½ years and 9 years. No effects were detected among the children. Based on this study, maternal consumption during pregnancy of fish with low methylmercury levels (less than 0.3 ppm) is accepted as safe. [15,14,]

The Faroes Islands study evaluated approximately 700 mother-infant pairs where the mothers consumed 1-3 meals per week of fish with low levels of methylmercury (less than 0.3 ppm) and 1 meal a month of pilot whale meat containing high levels of methylmercury (1 ppm and greater), which is higher than the North Carolina's action level of 0.4 ppm. The average hair levels of the Faroes mothers during pregnancy was 4.3 ppm (range 0.2 – 39 ppm), which is similar to Seychelles. When children were evaluated at 7 years of age, researchers detected deficits in attention, language, and memory. A maternal hair level of 10 ppm, a cord blood of 58 ppb, and a daily dose of 1 microgram per kilogram per day were found to be associated with a 10 percent risk of abnormalities in language, attention, and memory in children. Based on this study, maternal consumption of seafood with high methylmercury levels may be associated with an increased risk to the developing child.[15]

According to the American Academy of Pediatrics, the differences in the results of these studies may be due to the bolus or high doses that the Faroes Islands fetuses received from maternal consumption of pilot whale meat monthly verses the low doses that the Seychelles Islands fetuses received from maternal consumption of fish weekly. Additional studies are needed to further evaluate the issue of whether the bolus doses of methylmercury that were received by the Faroes children during the sensitive time periods of development are more likely to cause neurodevelopmental damage than the same doses given cumulatively over a period of several months. The average maternal hair levels and range of maternal hair levels for these two studies were similar but the doses were delivered differently.[16]

CURRENT NCDENR WATER AND AIR SAMPLING EFFORTS

DIVISION OF WATER QUALITY

The Division of Water Quality (DWQ) has two long-term programs that monitor mercury in surface waters. These two programs, the Ambient Water Quality Monitoring Program and the Fish Tissue Monitoring Program perform assessments of total mercury on a continual basis. Additional special studies are conducted in tandem with these long-term

[14] Prenatal Methylmercury Exposure From Ocean Fish Consumption in the Seychelles Child Development Study, Myers G et al., 2003, *The Lancet* 361, pp 1686-1692

[15] EPA Mercury Report To Congress, Vol. 1 Summary, No.EPA-452/R-97-001

[16] Technical Report, *Mercury in the Environment: Implications for Pediatricians*, American Academy of Pediatrics, *Pediatrics* 108:1, pp 197-205, Goldman, l, Shanon, M, 2001.

programs in order to address specific questions or issues.

The Ambient Water Quality Monitoring Program involves the long-term water sampling of surface waters. Under this program, quarterly surface water samples are collected and analyzed for total mercury using EPA Method 245.1. With a reporting limit of 200 ng/L, this method typically identifies relatively large releases of mercury to surface waters and would not describe background or typical conditions. The DWQ chemistry laboratory is in the process of constructing a Class 1000 Clean Room in order to perform the new, low-level total mercury analytical methods described in EPA Method 1631. The DWQ expects that sample analysis will begin early 2005. With a total mercury reporting limit of 0.5 ng/L, EPA Method 1631 should allow the DWQ to determine background and typical levels of total mercury in surface waters, as well as begin to establish a database to determine trends.

The Ambient Water Quality Monitoring Program does not include the measurement of methylmercury in surface waters. Current methodology to determine methylmercury in surface waters is expensive and would require major equipment purchases for DWQ to perform the analyses.

The Fish Tissue Monitoring Program has collected thousands of fish tissue samples for mercury, and tens of thousands of fish tissue samples that includes a suite of other pollutants (e.g., PCBs, dioxin, pesticides). Since January 2000, the DWQ has processed over 800 fish tissue samples for total mercury from locations across the state. However, a majority of the samples were collected from eastern North Carolina. The DWQ continues to process up to 300 samples per year for fish tissue analysis, including total mercury. Multiple sizes and species of fish are collected and analyzed in order to provide a representation of those fish typically caught and consumed by fishermen. Presently, it is assumed that 100 percent of total mercury measured in higher trophic level fish is methylmercury (EPA 2001). This is a reasonable assumption since freshwater fish currently under advisory (i.e., bowfin, largemouth bass, chain pickerel) are high on the food chain. However, for smaller fish (e.g., sunfish), this may be an overestimation of the fraction of total mercury that is methylmercury.

In 2003, DWQ completed sampling and analysis for the Eastern Regional Mercury Study (ERMS). This study included the analysis of total mercury and methylmercury in surface water and sediment, and total mercury in fish from eastern North Carolina. Study sites tended to focus on the coastal plain physiographic region of the state (Figure II-2), however two sites were located in the piedmont. The ERMS study indicated that total mercury and methylmercury concentrations in surface water, sediment, and fish are similar to those found in other water bodies in the southern Atlantic drainage. Southern Atlantic drainage tends to have higher levels of methylmercury in surface waters than other northern and western states. The U.S. Environmental Protection Agency funded the laboratory analysis of total mercury and methylmercury.

The DWQ is currently conducting several special studies associated with mercury. This includes a special study near Riegelwood, NC (Cape Fear River Basin), additional marine

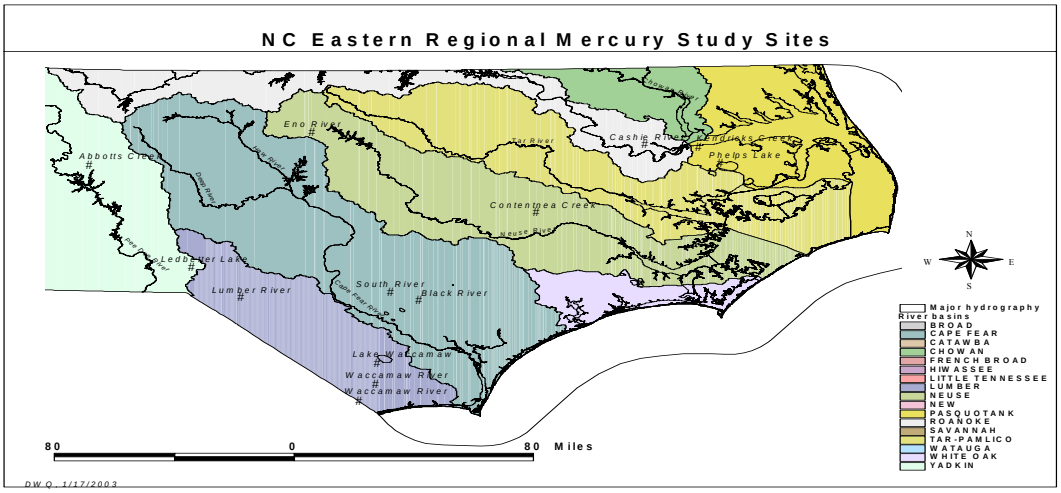
fish sampling and additional low-level mercury studies:

- The Riegelwood area monitoring study began in 2001 as a result of the closing of a chlor-alkali facility. The study seeks to evaluate the potential changes to fish tissue levels of total mercury as a result of the removal of a known atmospheric source. This study includes fish sampling and tissue analysis for total mercury at six downwind locations in the Cape Fear River Basin. Regular fish tissue sampling and analysis will continue as resources allow.

- Additional marine fish species analysis will be conducted as a joint effort between the DWQ, Division of Marine Fisheries, and the Department of Health and Human Services (DHHS). This follow-on study plans to focus on total mercury levels in spot, croaker, speckled trout, and bluefish. Additional species may be added if resources allow.

- Additional low-level mercury studies will be conducted to continue work begun in the ERMS. The additional studies will continue monitoring key DWQ-DAQ locations (i.e., Lakes Waccamaw, Lumber River Basin, and Lake Phelps, Pasquotank River Basin) and add new monitoring locations. New monitoring locations will be added to characterize total mercury and methylmercury west of the Yadkin River. The laboratory portion of this additional monitoring will be funded from a USEPA grant.

Figure II-2



DIVISION OF AIR QUALITY

The Division of Air Quality (DAQ) operates two North Carolina mercury wet (precipitation) deposition sites. The Pettigrew State Park site is located near Phelps Lake in Washington County, while the Waccamaw State Park site is stationed next to the atmospheric mercury monitoring unit near Lake Waccamaw.

Mercury levels in samples of eastern North Carolina rainwater vary widely from week to week but are comparable to data from sites across the United States. Volume-weighted average rainwater mercury levels are consistently higher at Lake Waccamaw than at a comparable site 150 miles to the north in remote northeastern North Carolina (Pettigrew State Park). Recent data from both sites during 1999 and 2000 suggests that mercury levels in precipitation may be declining in these areas. Levels declined to values typical of the more remote location at Pettigrew State Park between 1998 and 1999 at Lake Waccamaw State Park. In the years following however, the levels have crept back up. The reasons for this are definitively clear. Cleanup activities at the chlor-alkali facility have generated a considerable amount of fugitive mercury emissions. It is possible these "cleanup" emissions are to blame for the rise in mercury levels following the drop that was observed after the plant shut down in 1999. Continued sampling throughout the cleanup process and beyond should help to answer that question.

A new North Carolina mercury wet deposition measurement site is being planned. This sampling represents a joint venture by DAQ and DWQ. The existing air monitoring site is known as Condor, a CASTNET site. It is located inland from the coast in Montgomery County. The purpose of the new monitoring site is to collect background mercury concentrations. New mercury wet deposition equipment is being purchased for the site. The current schedule has valid data collection underway by late winter of 2004.

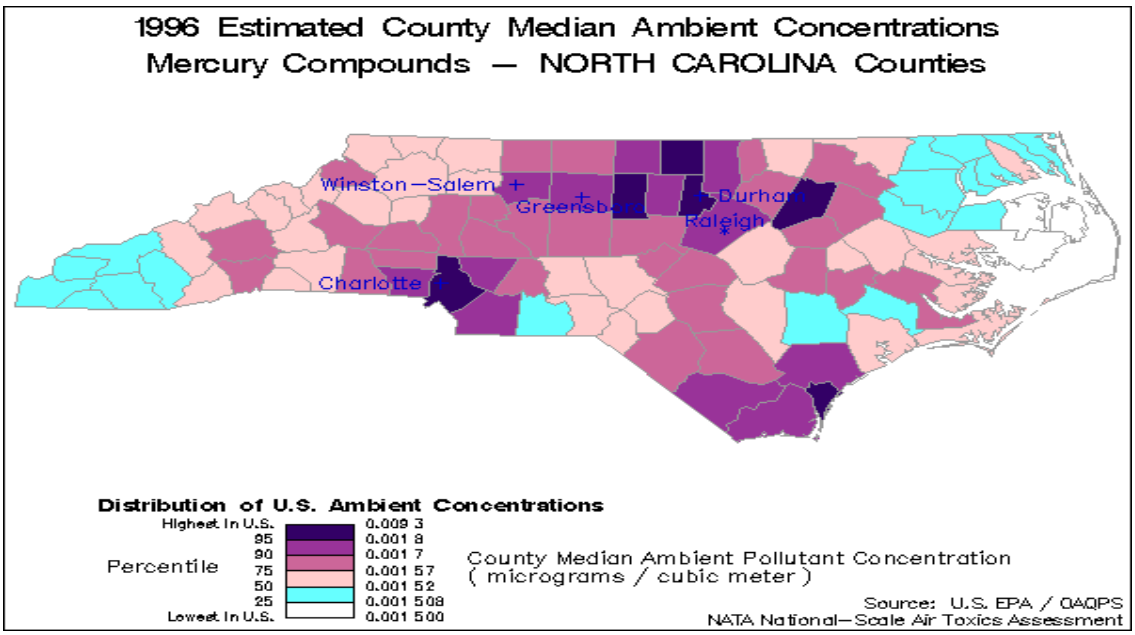
Additional DAQ mercury monitoring sites were located in the vicinity of Charlotte, North Carolina, to help define temporal and geographic trends in atmospheric mercury. To achieve this, two sampling equipment groups were operated continuously for one calendar year beginning March 2002. The first sampling site was a permanent site near the center of downtown Charlotte. Continuous data on total gaseous mercury and meteorological conditions was generated at this site. The downtown site also houses a variety of other instruments providing data for other DAQ atmospheric monitoring initiatives. It is anticipated that the data will create a snapshot of "urban" air quality conditions. Figure II-3 shows the estimated 1996 ambient mercury compound concentrations in North Carolina.

The second sampling equipment group is installed in a mobile monitoring trailer. The trailer was shared at three site locations on the perimeter of Charlotte over the course of the year. It is equipped to monitor for total gaseous mercury, reactive gaseous mercury, and elemental mercury, with the capability to also monitor for VOCs and carbonyls. These three site locations were selected to capture air quality conditions on the rapidly changing periphery of Charlotte. The final data collected are currently undergoing DAQ internal review.

At the July 30, 2004 stakeholder meeting, there was discussion about conducting a fish, air, and water sampling study to determine the mercury levels in these media before, during and after the utilities have made the CSA installments. The NC Division of Air Quality, NC Division of Public Health, NC Division of Water Quality, Duke Power, Progress Energy, Electric Power Research Institute and Research Triangle Institute could participate in the study design. Funding will be solicited to support this study. The study

length is anticipated to occur over 10-15 years. The progress of the study will be provided to the stakeholders and General Assembly on a biannual basis or sooner if needed.[17]

FIGURE II-3



NORTH CAROLINA FISH ADVISORIES

The most recent safe fish eating guidelines issued by the Department of Health and Human Services (DHHS) were prepared by the Medical Evaluation and Risk Assessment Unit (MERAU) and dated August 29, 2001. Women of childbearing age (15-44 years), pregnant women, nursing women, and children under 15 years may eat two meals per week of fish low in methylmercury, like farm-raised fish, canned tuna and other canned fish, fish sticks, shrimp, crab, lobster, clams, oysters, scallops, salmon, trout, cod, whitefish, pollock, mahi-mahi, ocean perch, halibut, haddock, flounder, croaker, herring, crappie, sunfish, white perch, yellow perch, and bream.[18] They should not eat any shark, swordfish, tilefish, or king mackerel.[19] Also, they should not eat bowfin (blackfish), chain pickerel (jack fish) or largemouth bass caught in North Carolina waters south and east of Interstate 85.

According to the guidelines, other women, men, and children over 15 years old may eat four meals per week of fish low in methylmercury, such as farm-raised fish, canned light tuna and other canned fish, fish sticks, shrimp, crab, lobster, clams, oysters, scallops, salmon, trout, cod, whitefish, pollock, mahi-mahi, ocean perch, halibut, haddock,

[17] N.C. DHHS, Occupational and Environmental Epidemiology Branch, August 5, 2004
[18] All fish and shellfish should be properly prepared and cooked.
[19] On January 12, 2001 EPA and FDA issued national fish consumption advisories due to high levels of mercury in some marine fish. These advisories recommend that women of childbearing age and children should not eat shark, swordfish, king mackerel or tilefish.

flounder, croaker, herring, crappie, sunfish, white perch, yellow perch, and bream.[20]. They should eat no more than one meal per week of shark, swordfish, tilefish, or king mackerel. Also, they should eat no more than one meal per week of bowfin (blackfish), chain pickerel (jack fish), or largemouth bass caught in North Carolina waters south and east of Interstate 85.

[20] All fish and shellfish should be properly prepared and cooked.

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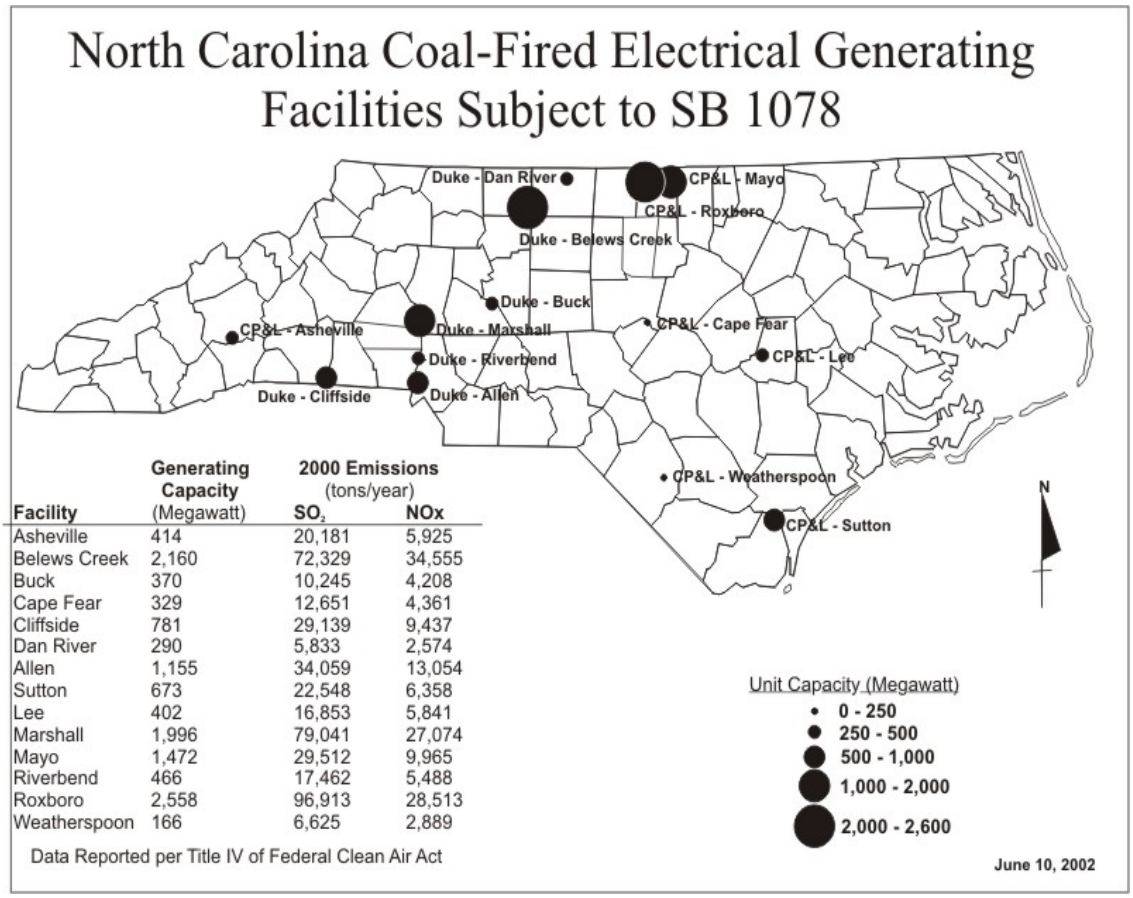
CHAPTER III LEGISLATIVE AND REGULATORY EFFORTS TO REDUCE MERCURY EMISSIONS

NORTH CAROLINA'S CLEAN SMOKESTACKS ACT (CSA)

In response to the CSA of 2002, the utility companies are required to reduce their NO_x emissions 78 percent by 2009 and their SO_2 emissions 73 percent by 2013. In order to achieve these requirements, Duke Energy and Progress Energy are in the process of installing flue gas desulfurization (FGD) wet and/or dry scrubbers to reduce SO_2 emissions, and combustion controls and post-combustion controls to lower NO_x emissions. Figure III-1 indicates the location and relative emissions of CSA boilers.

Figure III-1



Facility	Generating Capacity (Megawatt)	2000 Emissions (tons/year) SO_2	NOx
Asheville	414	20,181	5,925
Belews Creek	2,160	72,329	34,555
Buck	370	10,245	4,208
Cape Fear	329	12,651	4,361
Cliffside	781	29,139	9,437
Dan River	290	5,833	2,574
Allen	1,155	34,059	13,054
Sutton	673	22,548	6,358
Lee	402	16,853	5,841
Marshall	1,996	79,041	27,074
Mayo	1,472	29,512	9,965
Riverbend	466	17,462	5,488
Roxboro	2,558	96,913	28,513
Weatherspoon	166	6,625	2,889

CSA BOILER EMISSIONS

Coal-fired generating units currently account for approximately 66 percent of mercury emissions estimated to be emitted into the air in North Carolina. Emission control equipment planned for installation to meet the North Carolina Clean Smokestacks Act (CSA) are estimated to capture about 65 percent of mercury emissions from Duke

Power's and Progress Energy's coal-fired generating units in North Carolina by 2012.[21] Although the Act does not prescribe mercury-specific controls, these substantial mercury emission reductions are achieved as a secondary benefit (co-benefits). The proposed addition of wet scrubbers to control sulfur oxides (SO_2) is expected to reduce total mercury emissions from CSA coal-fired electrical generating units from an estimated 3,056 pounds per year (ppy) to 1,416 ppy.

Figure III-2 shows the relative percentage of each CSA affected electrical generating plant's contribution of mercury into the atmosphere in 2002 by Coal-fired boilers covered under CSA. The Roxboro, Marshall, and Belews Creek facilities combined mercury emissions are estimated to represent 60 percent of the total CSA mercury emissions.

There are mercury emission sources in North Carolina that are not subject to the CSA. A list of all sources reporting mercury emissions, including coal-fired boilers covered under CSA, was truncated with Craven County Wood Energy, who reported emissions of 6.91 pounds of mercury emissions in 2002 (see Appendix D). These non-CSA mercury sources represent approximately 34 percent (1,737 pounds) of the total 2002 (5,111 pounds) of mercury emissions in North Carolina. CSA boilers represent 66 percent (3,374 pounds). Figure III-3 graphically shows the predominance of the CSA boilers.

From 2005 to 2012, the installation of SO_2 controls to meet the SO_2 cap are estimated (EPA's Mercury Emission tool) to reduce CSA mercury sources to 43.5 percent (1,340 pounds) of the total (3,077 pounds) of mercury emissions in North Carolina. The assumption is that non-CSA mercury sources mercury discharge remains constant at 1,737 pounds of mercury per year. Figure III-3 shows that the remaining contribution of the non-CSA mercury sources percentage increases to 56.4 percent from 34 percent of a reduced number of pounds of mercury (5,111 to 3,077 pounds in 2012). Figure III-4 shows the new predominance of the non-CSA mercury sources in the State.

[21] See Appendix C

FIGURE III-2
PERCENT OF TOTAL MERCURY PRE-CSA BY FACILITY

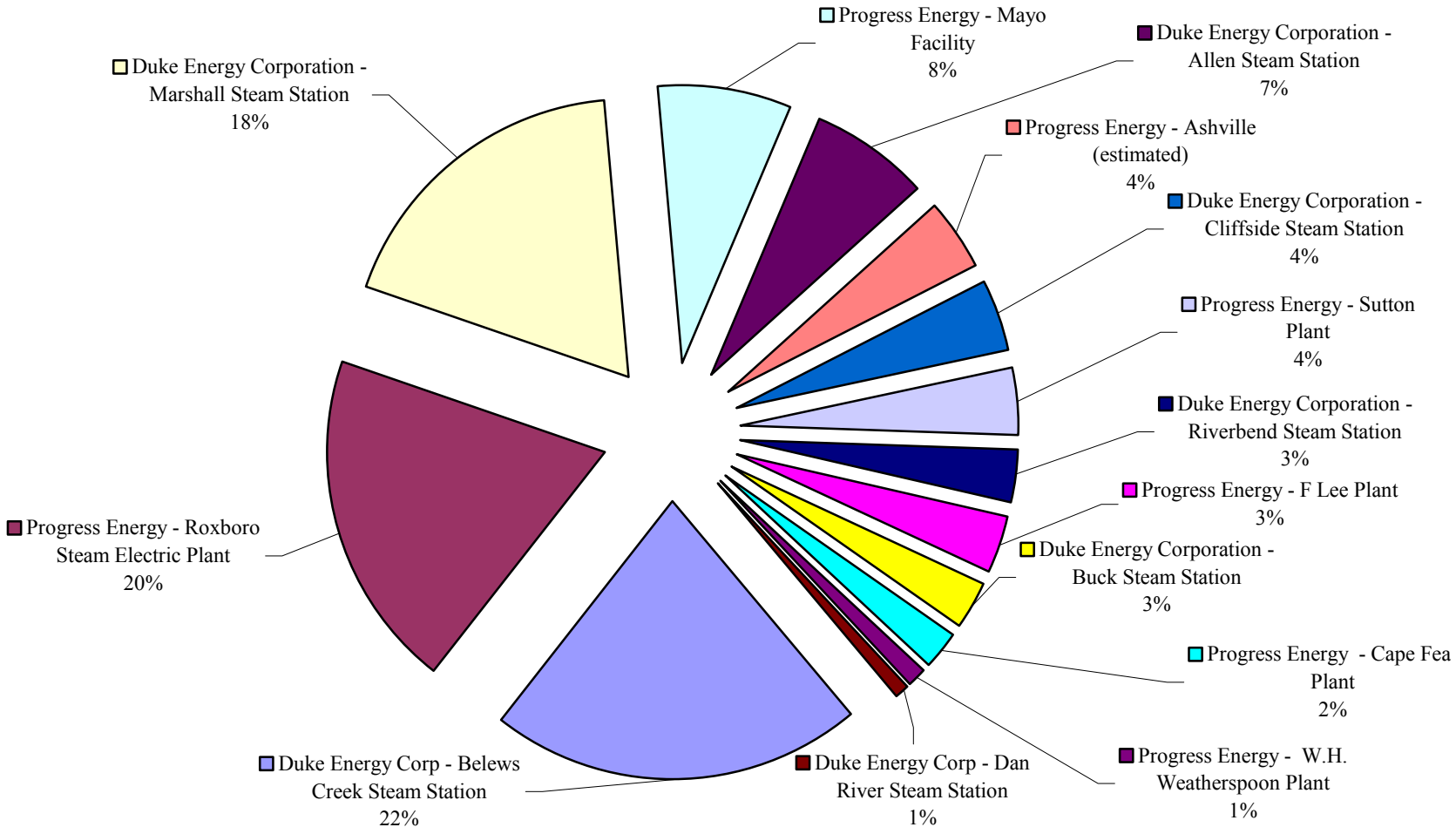


FIGURE III-3
PRE- CSA UTILITIES MERCURY CONTRIBUTION
66 PERCENT OF 5,111 LBS. MERCURY

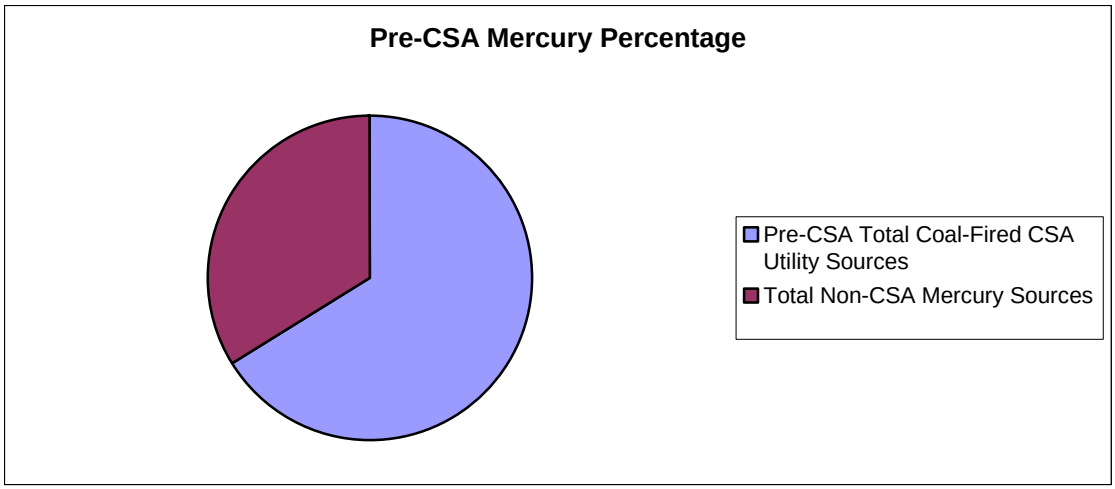
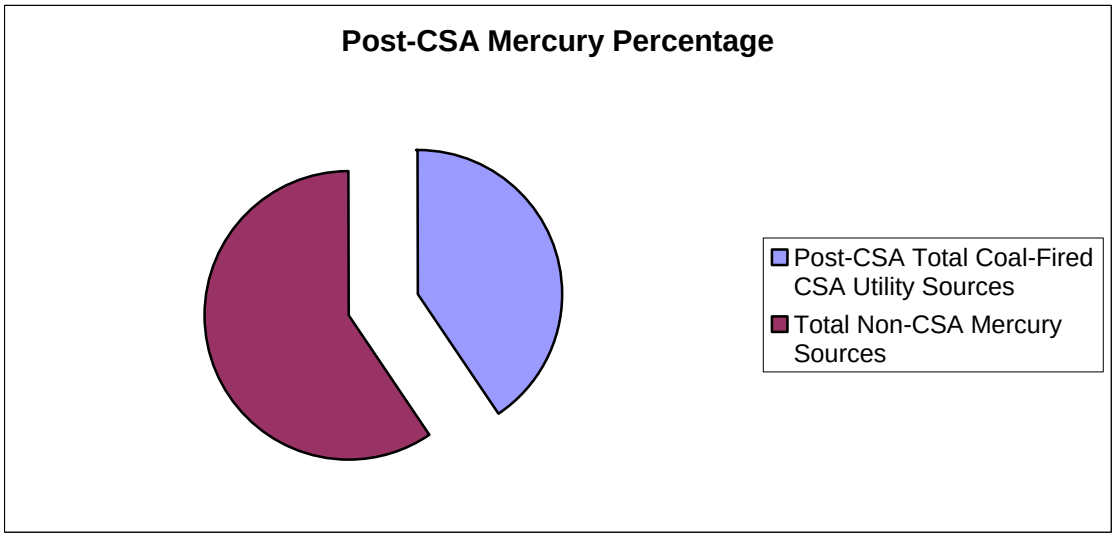


FIGURE III-4
POST- CSA UTILITIES MERCURY CONTRIBUTION
43.5 PERCENT OF 3,077 LBS. MERCURY



Information presented at the workshop on Mercury and CO_2 during April 19-21, 2004 is italicized.

CURRENT AND PROJECTED MERCURY EMISSIONS[22]

- *Current Emission Estimates*

[22] New North Carolina Coal-fired Utility Multiple Pollutant Regulations,2004 Electric Utilities Environmental Conference, Tucson, AZ, January 20, 2004, Steve Schliesser, QEP, Senior Engineer, NC Division of Air Quality

a. *Uncontrolled Emissions ~ 4,100 lb/yr*

b. *Cold-side ESP Efficiency – 29%*

c. *Hot-side ESP Efficiency – 11%*

d. *Controlled Emissions ~ 3,050 lb/yr*

e. *Overall Statewide Reduction – 25%*

- *Future Emission Estimates*

a. *Cold-side ESP / FGD Efficiency – 78%*

b. *Hot-side ESP /FGD Efficiency – 39%*

c. *Controlled Emissions ~ 1,370 lb/yr*

d. *Overall Statewide Reduction– 65%*

CURRENT CSA PROGRESS BY THE UTILITIES

Progress Energy reported to the North Carolina Utility Commission on April 1, 2004, that the total project cost in future dollars remains at $813 million. The company observed that the projected SO_2 removal rates have increased for scrubbed units, resulting in a cancellation of a planned scrubber for Lee 3. Significant construction at the Asheville and Roxboro plants is taking place in 2004.

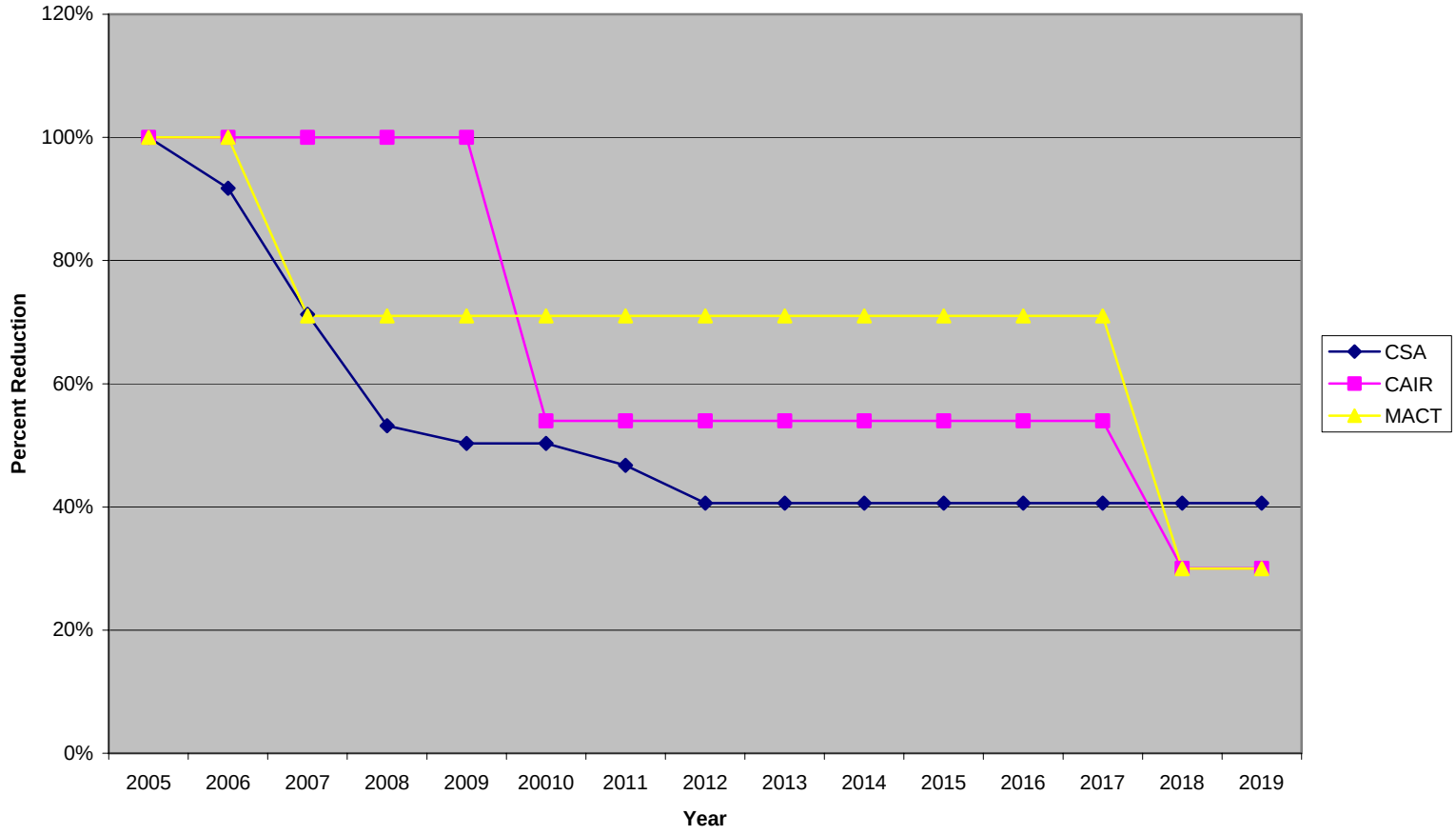
Duke Energy reported April 1, 2004, that its estimated compliance costs to be $1.526 billion. The company reported that the technologies expected to be required to support compliance have not changed.

The North Carolina Department of Environment and Natural Resources and the North Carolina Utilities Commission certified that "the actions taken to date by Progress Energy Carolinas, Inc. and Duke Power, a Division of Duke Energy Corporation, appear to be in accordance with the provisions and requirements of the Clean Smokestacks Act."[23]

The EPA Tool was used to estimate mercury emission reductions from the co-benefits of meeting requirements of the CSA. Credit for mercury reductions are credited for the year's planned completion date. Figure III-5 indicates the CSA utility emissions are at or below both the proposed MACT and Clean Air Interstate Rule (CAIR) mercury reduction percentages indicated until 2018.

[23] *The Implementation of the "Clean Smokestacks Act"*, A Report to the Environmental Review Commission and the Joint Legislative Utility Review Committee, June 1, 2004.

FIGURE III-5
COMPARISON OF CSA TO FEDERAL MACT AND CAIR PROPOSALS



CLEAN SMOKESTACKS & DUKE POWER'S MERCURY EFFORTS[24]

Power Plants in the US:

- *About 1/3 of Total US Non-Natural Emissions.*
- *About 1 % of Total Global Emissions.*
- *Mercury in coal is a "trace" element and concentrations emitted are very small.*
- *Low concentration makes control difficult.*
- *Control technologies not commercially ready. Extended run times needed to determine full impact.*
- *Inhalation of mercury from power plants is not an issue.*

Mercury types from coal combustion.

- *Elemental (Hg°), 40 to 60% (Bituminous Coal)*
- *Oxidized (HgCl), 40 to 60% (Bituminous Coal)*
- *Particulate Mercury, 0.05% Bituminous Coal)*

Co-Benefits

- *Case 1: SCR, ESP, & FGD*
- *Three Units 39% of projected system MW-hrs*
- *SCR oxidizes Hg to HgCl (80 – 90+%)*
- *Cold Side ESP 25 – 35% Hg collection*
- *FGD collects 80-90+% of oxidized Hg*
- *Expected overall Mercury removal of 80 to 90% reduction*

Duke Research:

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[24] Mercury - Power Plants, Clean Smokestacks & Mercury Efforts, Duke Power Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

- *2001 – Collection efficiency across ESP (Marshall & Allen).*
- *2002 – Mercury oxidation with & without SCR (Cliffside 5).*
- *2004 – August: Mercury collection from pilot FGD (Marshall).*

Co-Benefits

- *Case 2: ESP, & FGD*
- *9 Units 43% of projected system MW-hrs*
- *Cold Side ESP 25 – 35% mercury collection*
- *FGD collects 50 to 60+% of remaining mercury*
- *Expected overall Mercury removal of 55 to 65% reduction*

Duke Research:

- *2005 – DOE: Pilot of oxidation catalyst downstream of ESP (Marshall).*
- *2004 – 1/04: Impact of Low NOx combustion on oxidation & ESP Collection efficiency (Marshall) – Increased oxidation & collection eff.*
- *2004 – 5/04: Verification of the impact of Low NOx combustion with different coals and unit (Allen).*

Co-Benefits Case 3: Cold Side ESP

- *1 Units .01% of projected system MW-hrs*
- *Cold Side ESP 25 – 35% mercury collection*

Duke Research:

- *2004 – DOE: Southern Co testing with activated carbon & impregnated carbon. Results to date 60-70% removal with activated carbon. Impregnated carbon may increase removal with less injection.*

Co-Benefits

- *Case 4: Hot Side ESP*
- *18 Units 17 % of projected system MW-hrs*

- *Hot Side ESP 0 – 9 % mercury collection*

Duke Research:

- *1999 – EPA ICR data request stack test on Cliffside 1.*
- *2003-2005 DOE: Impregnated carbon injection on Hot Side ESP.*
- *9/03 – 1 wk trial Cliffside 2*
- *Reduction: 30% full load, 70+% low load*
- *9/04 – 1 wk trial Cliffside 2 (verification of 9/03 results)*
- *2/05 – 1 month trial Buck 5*
- *Cliffside Unit 2 Hot Side ESP mercury Control, September 2003 trial.*

Continuous measurement of mercury is in the very early stage of development.

LEGISLATION TO CONTROL MERCURY EMISSIONS IN OTHER STATES[25]

The following bills were introduced in state legislatures for the 2003-2004 sessions to reduce mercury emissions and other pollutants from power plants.

Colorado – SB 140 sponsored by Senators Grossman and Williams – Requires large electrical power plants to install best available control technology by the later of 1/1/2014, or the date that is 40 years after the date on which the plant begins operation.

***Connecticut** (law) – HB6048 (Public Act 03-72) HB 6048 requires coal-fired power plants to comply with an emissions rate equal to or less than 0.6 pound of mercury per trillion BTU of heat input, or alternatively, an emissions rate comparable to a 90 percent reduction in mercury emissions. The legislation would achieve compliance through the installation of best available control technology (the act notes that if a facility installs and properly maintains the best available control technology and still fails to meet the emissions rate, it can request an alternative emissions rate from the Department of Environmental Protection

***Hawaii** – HB195 sponsored by Representative Morita - The purpose of this part is to regulate the emissions of nitrogen oxide, sulfur dioxide, mercury, and carbon dioxide by power plants, in order to protect the public health and safety and to enhance

[25] The National Caucus of Environmental Legislators, Compiled 2-4-04, http://www.ncel.net/news_uploads/96/Mercury.Power%20Plant%20emissions%20bills.doc,

environmental quality of life. The bill would reduce aggregate mercury emissions by an amount equal to ninety per cent from 1999 levels not later than January 1, 2007.

***Iowa** – HF435 sponsored by Representative Don Shoulz – Directs the state to set mercury emissions limits for coal fired power plants and waste incinerators by 2010.

***Maryland** – (DRAFT awaiting bill number) sponsored by Delegate James Hubbard – Sets emission limits from coal-fired power plants for nitrogen oxide, sulfur dioxide, mercury and carbon dioxide.

***Michigan** – HR187 sponsored by Representative Jack Minore - A resolution to urge the Environmental Protection Agency to reconsider and reverse its proposal to ease restrictions on mercury emissions.

***Minnesota** - HF803 sponsored by Representatives Johnson, S., Ozment, Ellison, Wagenius, Cox & SB1032 sponsored by Senators, Anderson**,** Pogemiller**,** Marty, Metzen - By July 1, 2010,an electric generation facility that uses coal as its primary fuel shall install applicable best available control technology identified by the United States Environmental Protection Agency for controlling criteria pollutants under the federal Clean Air Act, if installation of such technology is economically feasible. If installation of such technology is not economically feasible at a particular facility, the facility shall instead upgrade the facility to comply with the new source performance standards promulgated under the federal Clean Air Act applicable to a new coal-fired power plant of that type. The owner of a facility subject to this bill may opt to convert the facility to one that uses natural gas as the primary fuel to comply with that paragraph.

***New York** – AB479 sponsored by Assemblyman Pete Grannis – Directs the state to set mercury emissions limits for coal fired power plants and waste incinerators by 2010.

***New York** – AB5933 sponsored by Assemblyman Richard Brodsky - This bill requires the Department of Environmental Conservation ("DEC") to establish air pollution standards for power plants regarding nitrogen oxide, sulfur dioxide, carbon dioxide and mercury. Requires the commissioner to promulgate emergency regulations within thirty days such that electric generators of a 15MW capacity or more shall emit no more than 1.5 pounds per MW hour of Nitrogen oxide (NO_x) by 2004 and no more than 3 pounds per MW hour of sulfur dioxide (SO_2) by 2007. Requires the department to promulgate regulations for reductions in emissions of carbon dioxide and establish a cap by January 1, 2007, that is 7 percent less than the total 1990 CO_2 emissions. Requires the department to promulgate regulations for reduction in emissions of mercury from electric generators that is no more than 10 percent of the mercury emissions generated in 1999 by January 1, 2007.

***New York** – SB3172 sponsored by Senator Eric Schneiderman – This bill directs the state to set regulations reducing power plant emission of NO_x, SOx, CO_2 and mercury. The bill calls for a 90 percent reduction in mercury emissions.

Virginia – HB1472 sponsored by Representative Jack Reid - Establishes a schedule by which investor-owned public utilities that own or operate coal-fired generating units are required to reduce by specific amounts their emissions of oxides of nitrogen, sulfur dioxide and mercury. The utilities are to determine what technologies will be used to achieve the emission limits established by the bill. Any permit issued by the Air Pollution Control Board for a coal-fired generating unit, which is subject to this new law, will have to provide for testing, monitoring, record keeping and reporting to assure compliance with the reduction requirements. The bill also authorizes the Governor to enter into agreements with the utilities to transfer to the state any emissions allowance that may be acquired by the utilities under federal law. The Department of Environmental Quality and the State Corporation Commission (SCC) are to report annually to the status of the emissions reduction and cost recovery efforts to the committees having jurisdiction over the subject matter. In addition, the Department of Environmental Quality is required to conduct an ongoing analysis of the issues related to the development and implementation of standards and plans to control carbon dioxide (CO_2) from coal-fired generating units. The Department is also to evaluate available control technologies and perform a cost-benefit analysis of alternative strategies to reduce emissions of CO_2, and report its findings to the committees with jurisdiction

***Washington** - SB582 sponsored by Senator Keiser, Fraser and Kline – Requires the state to develop a toxic air emissions strategy that includes: 1) establishing a ten-year schedule to adopt emission reduction standards that significantly reduce emissions for the top ten toxic air pollutants and 2) undertaking actions, including any necessary rule making, to begin emission reductions for the six toxic air pollutants posing the greatest relative risk, as determined by the department, no later than January 1, 2006.

***Wisconsin –** On February 4, state legislators will request that the DNR reintroduce rules seeking an 80 percent reduction in mercury emissions by 2018. The rules were rejected by a legislative committee last December and were being held in limbo by the DNR Board, a group that has oversight over the DNR.

Other States' Actions

Massachusetts – On September 19, 2003, Governor Mitt Romney announced regulations that will require the state's oldest power plants to significantly reduce mercury emissions. The Executive Office of Environmental Affairs (EOEA) and the Massachusetts Department of Environmental Protection (DEP) have proposed a two-phase mercury emissions standard. The first phase requires facilities to capture 85 percent of the mercury contained in combusted coal by October 1, 2006. The second phase requires facilities to capture 95 percent of the mercury by October 1, 2012. In total, the regulations will cut mercury emissions by over 130 pounds per year. (Source: Massachusetts Dept. of Enviro. Protection news release, 9/13/03; http://www.state.ma.us/dep/pao/news/mercregs.htm)

***New Hampshire** – In 2002, New Hampshire passed the nation's first 4-pollutant law requiring reductions in NO_x, SO_2, CO_2, and mercury. The law requires an annual cap applicable to total mercury emissions from all affected sources burning coal as a fuel, to be recommended by the department not more than 60 days following the U.S.

Environmental Protection Agency's proposed regulation establishing a Maximum Achievable Control Technology (MACT) standard for mercury emissions from utility boilers, but in no case later than March 31, 2004, with timely consideration by the legislature expected by July 1, 2005. (Source: HB284 sponsored by Rep. Jeb Bradley)

*Sponsored or co-sponsored by a participant in the National Caucus of Environmental Legislators.

FEDERAL ACTIONS AND STATUS

In the January 30, 2004 Federal Register, EPA proposed new air rules for reducing emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and mercury. EPA proposed the Interstate Air Quality Rule, which focuses on states whose SO_2 and NO_x emissions are significantly contributing to fine particle and ozone pollution problems in other downwind states. The proposed Interstate Air Quality Rule would cover 29 states in the Eastern United States and the District of Columbia. In a separate but closely related action, EPA proposed the Utility Mercury Reduction Rule for controlling mercury emissions from power plants. Together, the Interstate Air Quality Rule proposal and mercury proposal create a multi-pollutant strategy to improve air quality throughout the U.S.[26]

INTERSTATE AIR QUALITY RULE[27]

EPA Administrator Mike Leavitt signed the proposed Interstate Air Quality Rule on December 17, 2003. The proposed Interstate Air Quality Rule would reduce emissions of SO_2 and NO_x in 29 eastern states and the District of Columbia in two phases. SO2 emissions would be reduced by 3.6 million tons in 2010 (approximately 40 percent below current levels) and by another 2 million tons per year when the rules are fully implemented (approximately 70 percent below current levels). NO_x emissions would be cut by 1.5 million tons in 2010 and 1.8 million tons annually in 2015 (about 65 percent below today's levels).

Each affected state would be required to revise its state implementation plan to include control measures to meet specific statewide emission reduction requirements. To achieve the required reductions in the most cost effective way, the proposal suggests that states regulate power plants under a cap and trade program similar to EPA's highly successful Acid Rain Program. Emissions would be permanently capped and could not increase.

CLEAN AIR INTERSTATE RULE (CAIR)[28]

On May 18, 2004, the Environmental Protection Agency proposed additional details and rule text supplementing its January 2004 proposal (and renaming it) to reduce interstate transport of fine particulate matter and ozone. The CAIR would require 29 eastern states and the District of Columbia to significantly reduce and permanently cap emissions of sulfur dioxide (SO_2) and/or nitrogen oxides (NO_x). In 2015, NO_x emissions from the

[26] http://www.epa.gov/oar/interstateairquality/
[27] http://www.epa.gov/oar/interstateairquality/basic.html
[28] http://www.epa.gov/oar/interstateairquality/pdfs/cairsuppfs51804final.pdf, Supplemental Proposal for Reducing Interstate Transport of Fine Particulate Matter and Ozone.

power sector would be 65 percent below today's levels. SO2 emissions from that sector would be 50 percent below current levels by 2015 and approximately 70 percent below current levels when fully implemented.

Reducing emissions of these pollutants will significantly address these health issues, in addition to improving visibility and protecting sensitive ecosystems. EPA's modeling predicts that when combined with existing emissions reduction requirements, this rule would help approximately 90 percent of "nonattainment areas" meet national air quality standards for ozone and particle pollution.

By addressing air pollutants from electric utilities in a cost-effective fashion, EPA's Clean Air Interstate Rule proposal would protect public health and the environment without interfering with the steady flow of affordable energy for American consumers and businesses. Each of the 29 states affected by the program and the District of Columbia must submit a plan to EPA that demonstrates it will meet its assigned statewide SO_2 and/or NO_x emissions budget (i.e., emissions reduction requirements). States can meet the emissions reduction requirements by either: joining the EPA-managed cap-and-trade programs for power plants, or achieving reductions through other emissions control measures.

UPDATE ON MACT PROPOSAL[29]

The proposed new proposed rulemaking (NPR) Clean Air Act (CAA), section 112 MACT rule would limit emissions of mercury from coal-fired EGUs and Ni from oil-fired EGUs. Exposure to mercury or nickel above identified thresholds has been demonstrated to cause a variety of adverse health effects. The NPR also proposed an alternative to regulate mercury from coal-fired EGUs and Ni from oil-fired EGUs under Section 111. In the January 30, 2004 NPR, EPA also proposed, in the alternative, standards of performance under CAA section 111 to establish a mechanism by which mercury emissions from new and existing coal-fired Utility Units would be capped at specified, nation-wide levels. A first phase cap would become effective in 2010 and a second phase cap would become effective in 2018. Facilities would demonstrate compliance with the standard by holding one ''allowance'' for each ounce of mercury emitted in any given year.

DESCRIPTION OF MERCURY EMISSION CREDIT TRADING RULE PROPOSAL

Allowances would be readily transferrable among all regulated facilities. EPA believes that such a ''cap and trade'' approach to limiting mercury emissions is the most cost effective way to achieve the reductions in mercury emissions from the power sector that are needed to protect human health and the environment. The added benefit of this cap-and trade approach is that it dovetails well with the sulfur dioxide (SO_2) and nitrogen oxides (NO_x) Interstate Air Quality Rule (IAQR) that was also proposed through a notice January 30, 2004 (69 FR 4565). That proposed rule would establish a broadly applicable Federal Actions and Status.

[29] Federal Register / Vol. 69, No. 51 / Tuesday, March 16, 2004 / Proposed Rules

In the January 30, 2004 Federal Register, EPA proposed new air rules for reducing emissions of SO_2, nitrogen oxides NO_x, and mercury. EPA proposed the Interstate Air Quality Rule, which focuses on states whose SO_2 and NO_x emissions are significantly contributing to fine particle and ozone pollution problems in other downwind states. The proposed Interstate Air Quality Rule would cover 29 states in the Eastern United States and the District of Columbia. In a separate but closely related action, EPA proposed the Utility Mercury Reduction Rule for controlling mercury emissions from power plants. Together, the Interstate Air Quality Rule proposal and mercury proposal create a multi-pollutant strategy to improve air quality throughout the U.S.[30]

REDUCING POWER PLANT EMISSIONS: EPA'S NEW PROPOSED RULES FOR MERCURY[31]

EPA Proposes to Reduce Utility Emissions through Current Clean Air Act (CAA) Authorities

1. *Interstate Air Quality Rule (IAQR) to address the contribution of transported SO_2/NO_x emissions to ozone (smog) and fine particle ($PM_{2.5}$) nonattainment problems in the Eastern U.S.*

Standards to Reduce Mercury Emissions and Deposition

1. *Section 112 standards*
   - *Maximum achievable control technology (MACT)*
   - *Command-and-control*
   - *Take comment on trading options*

2. *State-implemented section 111 standards*
   - *Emissions Guidelines and New Source Performance Standards*
   - *Market-based, cap-and-trade program*

Proposed Alternatives to Reduce Mercury Emissions from the Power Sector

- *Three individual approaches outlined in the January 30, 2004 proposal*

  1. *Propose traditional, command-and-control section 112 MACT requirements for utility units. Reduces mercury emissions from 48 to 34 tons by January 2008*

  2. *Propose cap-and-trade approach under guidelines outlined in section 112(n)(1)(A)*

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[30] http://www.epa.gov/oar/interstateairquality/

[31] Reducing Power Plant Emissions: EPA's New Proposed Rules For Mercury, William H. Maxwell, Combustion Group, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, Workshop on Mercury and CO2, Raleigh, NC, April 19-21, 2004

3. *Propose market-based, cap-and trade approach under section 111*

   a. *Revises December 20, 2000 finding that it is "appropriate and necessary" to regulate Utility Units under section 112*

   b. *Caps mercury emissions at 15 tons in 2018; interim cap for 2010 proposed to encourage early reductions in SO_2 and NO_x, generating additional mercury emissions reductions*

   c. *Final approach to be determined following completion of public hearings and close of public comment period*

Final rule signed on/before March 2005

SECTION 112 MACT

A. *Affected source definition*

1. *Electric Utility Steam Generating Unit (Utility Unit)*

   a. *Any fossil fuel-fired combustion unit of more than 25 MWe that serves a generator that produces electricity for sale*

   - *Cogeneration Utility Unit – unit that generates steam and electricity and supplies more than one-third of its potential electric output capacity and more than 25 MWe output to any utility power distribution system for sale*

   - *Cogeneration is defined as the simultaneous production of power (electricity) and another form of useful thermal energy (usually steam or hot water) from a single fuel-consuming process*

2. *Non-Utility Units, not subject to this rule*

   - *Any unit that meets the above definition, <u>but</u> combusts natural gas >98% of the time*

   - *Simple- and combined-cycle turbine units*

   - *Industrial boilers*

SECTION 111(D) – EMISSION GUIDELINES (EG)

1. *Requires EPA to prescribe regulations that outline a procedure by which <u>each State</u> shall submit plans which create standards of performance for existing sources for which air quality criteria have not been set but for which NSPS have been established.*

2. *Cap-and-Trade program reduces the overall amount of emissions by:*
   - *Requiring sources to hold allowances to cover their emissions on a <u>one-for-one basis</u>*
   - *Limiting overall allowances so that they cannot exceed specified levels (i.e., the "cap level"*
   - *Reducing the cap to less than the amount of emissions actually emitted, or allowed to be emitted, at the inception of the program*
   - *Allowing for a declining cap over time*
   - *Creating market-based incentives for early reductions*

SECTION 111 – REGULATORY APPROACH

1. *Primary goal is to reduce Utility Unit mercury emissions from current levels*
   - *2018 cap is permanent*

2. *Effectively becoming more stringent as more plants are required to keep their collective emissions below 15 tons*
   - *Near-term interim cap in 2010*

3. *Level will reflect the maximum level of mercury reductions achievable through FGD and SCR installations (for SO_2 and NO_X emission reductions) on units covered under the IAQR*

4. *Level is not prescribed in current proposal because of uncertainties associated with the ability of these controls to reduce mercury emissions*

5. *EPA seeks comment and technical information on the Phase I cap level*

6. *EPA believes that a carefully designed "multi-pollutant" approach – a program designed to control NO_X, SO_2, and mercury at the same time – is the most effective way to reduce emissions from the electric power sector*

Details of section 111 trading program are outlined in a Supplemental Notice of Proposed Rulemaking (SNPR), which was published on March 16, 2004

SNPR: MERCURY PROGRAM REQUIREMENTS UNDER SECTION 111

1. *Each State must submit a plan that demonstrates it will meet its assigned statewide mercury emissions budget*

    a. *States may join the trading program by adopting or referencing the model trading rule in State regulations; or, adopting regulations that mirror the necessary components of the model trading rule*

    b. *States can choose not to join the federal trading program and meet their budget through intra-state trading or no trading*

    c. *States can also choose to implement more stringent mercury emissions requirements*

2. *EPA has taken comment on a proposal to promulgate, under section 112(n)(1)(A), a cap-and-trade program for mercury from coal-fired utility units*

    a. *Trading program would be federally implemented with the EPA, instead of states, serving as the permitting authority*

SNPR: MONITORING MERCURY EMISSIONS

1. *Monitoring of mercury will resemble current monitoring of SO_2 and NO_x under the Acid Rain and NO_x SIP Call programs*

2. *A comprehensive QA/QC program ensures the adequacy of emissions data*

3. *Current monitoring in the Acid Rain and NO_x SIP Call programs averages over 98% availability*

4. *A petition process enables monitoring flexibility and facilitates the resolution of issues*

5. *Commensurate with the SO_2 and NO_x cap-and-trade programs, regulated sources would have the flexibility of using alternative monitoring approaches as long as such approaches meet the performance requirements in the rule*

SUMMARY

1. *Recent proposals are based on 3 major points regarding public health*

   - *Science continues to tell us to move aggressively on fine particles*
   - *There is growing evidence that ozone may be a larger problem than previously expected*
   - *Mounting scientific evidence and public concern/interest indicate that mercury emissions must be controlled*

2. *Administration strongly prefers the Clear Skies Act legislation instead of controlling NO_x, SO_2 and Hg under the existing CAA*

   - *EPA will stay with the current package of proposals, absent any movement on the legislation*
   - *EPA is committed to action*

3. *Power sector is not the only industrial sector EPA is looking towards to make significant reductions*

   - *Petroleum refining, car/truck/engine manufacturing, and construction equipment industries are making reductions through the Tier II, Heavy Duty Diesel, and Non-road Diesel rules*
   - *EPA is also requiring a variety of industries to meet new MACT standards, which will create emission reductions of both criteria and air toxics pollutants*

NEXT STEPS

Finalize Mercury Rule	*December 2004*
Finalize Interstate Air Quality Rule	*December 2004*

PROPOSED UTILITY MACT MERCURY EMISSION LIMITS[32]

	New Unit		*Existing Unit*	
Coal Rank	*10^{-6} lb/MWh or lb/TBtu*		*10^{-6} lb/MWh or lb/TBtu*	
Bituminous	*6*	*0.57*	*21*	*2.0*
Subbituminous	*20*	*1.90*	*61*	*5.8*
Lignite-Fired	*62*	*5.82*	*98*	*9.2*

[32] Summary of Proposed Regulations: Mercury, Paul Farber, Sargent & Lundy, LLC Chicago, IL, Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

IGCC Unit	*20*	*1.90*	*200*	*19*
Coal Refuse	*1.1*	*0.102*	*4.1*	*0.38*

Note: Emission limits for new units are proposed in 10^{-6} lb/MWh units only (12-month rolling average).
Equivalent lb/TBtu limits are provided for reference.
Existing units have the option of complying with either the lb/TBtu or lb/MWh emission limit.

INSIGHTS ON ECONOMIC IMPACTS OF UTILITY MERCURY AND CO_2 CONTROLS[33]

Mercury trading is very cost-effective compared to mercury unit-specific targets

EPA's proposed MACT would cost 5-10 times more than its proposed mercury Cap on NPV basis:

- *Mercury trading is far more cost-effective*
- *MACT achieves ~32 tons by 2008*
- *Mercury Cap achieves 15 tons by 2020 (32 tons at ~2012)*

Cost-effectiveness advantages of proposed trading rule would be heightened by technical improvements in mercury control options:

- *Timing flexibility gives opportunities for technology to improve before it must be implemented broadly.*
- *Trading "places a price" on mercury emissions which also incentivizes technical improvements better than MACT.*
- *Mercury trading tends to concentrate reductions on the largest sources.*

OTHER OPINIONS CONCERNING THE CONTROL OF MERCURY EMISSIONS

EDISON ELECTRIC INSTITUTE

In comments by Edison Electric Institute (EEI) to Environmental protection agency in response to 40 CFR Parts 60 and 63, Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units; Proposed Rule 40 CFR Parts 60, 72, and 75 Supplemental Notice for the Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility

[33] Insights on Economic Impacts of Utility Mercury and CO2 Controls, Anne Smith Charles River Associates, North Carolina DENR/DAQ Workshop on Mercury and CO2, Raleigh, NC, April 19-21, 2004

Steam Generating Units; Proposed Rule, June 29, 2004, the following major points were addressed:[34]

- EEI believes that, despite dramatic decreases in emissions from the electric generating sector in recent decades, further cost-effective reductions in emissions may be achieved under the proper framework, especially under a properly designed national cap-and-trade program.

- Legislation provides greater certainty for business and the environment, while regulation generally fails to address the overlapping nature of more than a dozen existing interconnected air programs.

- There are inconsistencies in the proposed rule. The preamble states that a unit is considered to be an oil-fired unit and subject to the nickel MACT if it is equipped to fire oil and/or natural gas, and if "it fires oil in amounts greater than or equal to two percent of its annual fuel consumption." However, the same preamble states that the nickel MACT would not apply to units that combust natural gas "greater than 98 percent of the time."

- Integrate and streamline these programs if the mercury rule is to achieve the desired emission reductions at reasonable cost to the American consumer. A cap-and-trade approach is the best way to reduce emissions from the electric utility industry. Such a rule would be protective of public health, scientifically sound, flexible, and cost-effective – all components of reasonable and sensible public policy.

- EPA should establish subcategories for the source category of electric utility steam generating units. Fluidized bed combustion units should be in a separate category and Integrated Gas Combined Cycle (IGCC) units should be exempt. Conventional boilers must be subcategorized by coal rank (bituminous, subbituminous and lignite); other considerations could include process differences and coal chemistry for further subcategorization.

- MACT floors for subcategories must account for the inherent variability in mercury emissions from the best performing units. There are numerous methods for addressing variability, and more than one approach may be necessary to account for variability related to fuel and variability related to plant operations.

- There is currently no justification for regulation beyond the MACT floor.

- There should be no additional requirements beyond what is required to meet the MACT floor for existing units and to satisfy NSPS requirements.

[34] http://www.eei.org/about_EEI/advocacy_activities/Environmental_Protection_Agency/EEI_mercury_final_040629.pdf

- There should be a choice between the least stringent of either a percent reduction standard (percent mercury removed as difference between mercury in coal and mercury emitted from stack) or input-based emission rate (stack concentration in lb/TBTU) standard.

ENVIRONMENTAL DEFENSE

Environmental Defense Recommends: [35]

- Reducing power plant pollution is critical to lowering local mercury deposition and avoiding the dangerous contamination of fish, wildlife and people.

- The EPA should issue strong mercury standards for power plants to reduce mercury pollution from 48 tons today to about 5 tons, or a 90 percent reduction. These reductions are consistent with national standards for other source sectors and achievable through available pollution-control technology.

- States with mercury deposition hot spots should pursue their own mercury pollution standards to protect local water bodies and public health, and all states should press for rigorous national standards.

THE NATIONAL MINING ASSOCIATION

Mr. Jack Gerard, president and CEO of the National Mining Association (NMA), said that after studying the Environmental Protection Agency's emissions data, NMA concludes that EPA's statistical analysis, sampling and methodology are inadequate for determining mercury reduction values for any coal type and for setting emissions limits. "In the absence of adequate emissions data for the wide variety of US coal types and power plants, and without demonstrated technologies for reducing mercury emissions, EPA cannot implement an effective MACT [maximum achievable control technology] rule for power plants, nor set accurate emissions allowances for a cap-and-trade program," Gerard went on to say that EPA's data represents at best only a partial snapshot of the industry. "We don't think it's wise to base decisions that will have far-reaching economic implications on inadequate data that reflect neither the differences among coal types nor the differences among power plant operations," NMA suggestions for mercury proposals include:

- A modification of EPA's cap-and-trade proposal that would allow for greater certainty in setting achievable emissions reductions. Under this proposal, hard data from actual mercury reductions achieved under EPA's new interstate air quality rule would lead to a fairer allocation of emissions allowances for coal types, allow for a more thorough assessment of

[35] http://www.environmentaldefense.org/documents/3370_MercuryPowerPlants.pdf

mercury abatement technologies commercially available, and form the basis of interim emissions allowances in 2015.

- New units should not be forced to rely on purchased credits alone for meeting emissions targets, but should be granted modest allowances to minimize the possibility that power plants would switch to more costly fuels and raise energy costs further.

- NMA suggests that banking of emissions credits be deferred until 2015, stating the later date would better ensure that target reductions in 2018 would be achieved without heavy use of credits banked throughout the longer, eight-year period proposed by EPA.

STAPPA/ALAPCO ORGANIZATION

The State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) are the two national associations representing air pollution control agencies in 54 states and territories and over 165 major metropolitan areas across the United States. State and local air pollution control officials formed STAPPA and ALAPCO over 30 years ago to improve their effectiveness as managers of air quality programs. The associations serve to encourage the exchange of information among air pollution control officials, to enhance communication and cooperation among federal, state and local regulatory agencies, and to promote good management of our air resources.

With respect to mercury, STAPPA and ALAPCO based their analysis on state actions to reduce mercury emissions. State mercury limits proposed or adopted in Connecticut, Massachusetts and New Jersey will achieve control efficiencies on the order of 90 percent or more, while in Wisconsin, where mostly western coal is used, limits are 80 percent. Accordingly, STAPPA and ALAPCO extrapolated such reductions nationwide and arrived at a recommended national mercury emission cap range of 5 to 10 tons per year by 2013; such a range accommodates both eastern and western coal. Further, this range is consistent with STAPPA and ALAPCO's October 2002 recommendation to the EPA Utility MACT Working Group, which, if implemented nationwide, would result in mercury emissions of less than 7.5 tons per year.

The associations also identified a range for an interim mercury emission cap of 15 to 20 tons per year, to be achieved by 2008. Mercury levels in this interim cap range they project to be should be largely achievable through the application of the same air pollution control equipment needed to achieve compliance with the interim NO_x and SO_2 caps that STAPPA and ALAPCO have identified in this analysis. Traditional control technologies for criteria pollutants have been shown to be effective for mercury reduction, especially when used in combination; the most effective for mercury is a combination of low-NO_x burner, selective catalytic reduction, baghouse and scrubber technologies. This interim cap range is also intended to encourage the use of mercury specific control technologies, such as activated carbon injection (ACI), by some facilities. ACI has low capital cost, especially with an existing baghouse, has been proven on

incinerators, and has been piloted and demonstrated and is currently available for coal. The 20-ton-per-year level results if mercury reductions are achieved in the same proportion as NO_x and SO_2 reductions under the recommended interim caps for those pollutants. The 15-tonper-year level reflects a desire to be more progressive in controlling mercury, because it is a hazardous air pollutant. Approximately twice the level that STAPPA and ALAPCO recommended for MACT, a 15-ton-per-year level for mercury is appropriate in the context of a harmonized strategy addressing multiple pollutants.[36]

On June 29, 2004, STAPPA and ALAPCO addressed problems they found with the "National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units: Proposed Rule," A copy of the letter is in Appendix B of this report. Primary concerns as cited in their letter include:

- STAPPA and ALAPCO are extremely dismayed with EPA's proposals to regulate hazardous air pollutants from electric utilities. "We do not believe the rule will adequately protect public health and the environment, a concern that is shared by many others," they said.

- STAPPA and ALAPCO strongly urge the agency to abandon its proposed strategy and, instead, develop final Maximum Achievable Control Technology (MACT) standards, with stringent emission limits and expeditious deadlines, as required by Section 112(d) of the Clean Air Act.

- The Clean Air Act clearly calls for emissions of hazardous air pollution from electric utilities to be regulated under Section 112. Therefore, EPA's proposal to regulate those sources under Section 111, instead, is totally inappropriate.

- The limits contained in the Section 111 proposal are not nearly stringent enough. The proposal calls for an interim emissions cap, expected to be 34 tons per year to be achieved by 2010 that, in fact, does not require any additional control of mercury beyond the co-benefits expected from other programs aimed at reducing emissions of sulfur dioxide and nitrogen oxide, such as the Interstate Air Quality Rule (IAQR).

- The EPA proposal sets MACT levels that would result in national emissions of 34 tons per year, which is clearly not consistent with the legislative mandate for calculating MACT under Section 112.

- EPA should establish a MACT standard that reflects *at least* "the average emission limitation achieved by the best performing 12 percent of the existing sources" or "the emission control that is achieved in practice by the best controlled similar source." Rather than recommending a specific

[36] http://www.4cleanair.org/Multi-P%20Analysis-FINAL-031504-lthd.pdf

technology, STAPPA and ALAPCO suggest a performance standard. Also, we prefer a common standard for bituminous and subbituminous coal, but different percent limits can be considered for the coal types, as long as the limits provide for very good controls of mercury emissions and do not promote fuel switching or blending to avoid controls.

- STAPPA and ALAPCO are extremely concerned that EPA is proposing on a national basis to allow trading of mercury emissions between utilities. "Not only do we question the legality of mercury trading, we are also very concerned that trading could lead to serious hotspot problems around the country."

- The concern about local sources causing local mercury hotspots must not be dismissed. Mercury emissions can travel great distances, some of the pollutant can also be deposited near its source. In fact, there is recent evidence that sources of mercury can have significant local impacts.

- STAPPA and ALAPCO believe it is reasonable to consider 90-percent control for sources using bituminous coal and 80-percent control for units firing subbituminous coal. These limits would result in a national emission reduction between 85-90 percent, which is much more stringent than the decreases expected from EPA's proposal.

- STAPPA and ALAPCO strongly urge EPA to abandon its proposed strategy, and, instead, develop final MACT standards with stringent limits as required by Section 112(d) of the Clean Air Act.

THE NORTH CAROLINA DIVISION OF AIR QUALITY

On June 29, 2004, the North Carolina Division of Air Quality (DAQ) addressed problems found with the EPA's proposed and supplemental proposed rules addressing national emission standards for hazardous air pollutants (NESHAP) for mercury and nickel, which were published in the Federal Register January 30, 2004 and March 16, 2004. A copy of the letter is in Appendix B of this report. DAQ's primary concerns extracted from the letter include:

1. The health effects of mercury in North Carolina

    - Mercury is a significant health problem in North Carolina. Methylmercury levels in fish from eastern North Carolina continue to be elevated above all of the existing toxicological benchmarks provided by the federal government.

    - The Department of Health and Human Services has advised women of childbearing age and small children not to consume these three species of fish when caught from surface waters south

and east of Interstate-85, and reduced consumption rates are recommended for the general public.

- Total mercury concentrations in rainwater are at or above levels that water quality agencies would seek in order to restore the ability to eat locally caught fish without an increased risk of neurological effects.

- Significant reduction in mercury emissions to the atmosphere is necessary for public health protection.

2. Comparison of the EPA Proposal with Existing Measures in North Carolina

   - In 2002, North Carolina passed the Clean Smokestacks Act (CSA), which substantially cuts the state's coal-fired power plants emissions of multiple air pollutants that cause smog, haze and other pollution problems. The speed and amount of reduction of EPA's proposal are less than those for North Carolina's own requirements.

   - The pollution controls required under the CSA are projected, as a co-benefit, to reduce mercury emissions in North Carolina by more than 50 percent by 2012.

   - Under the proposed MACT, the reductions projected are 29 percent until 2018 nationally. In addition, there is no guarantee of site-specific reductions due to EPA's proposed Cap-and-Trade system.

1. Relationship Between the EPA Proposal and the Future Steps Required to be taken by North Carolina.

   - DAQ encourages EPA to consider in its final rule the process North Carolina already has in motion for evaluating the health needs and available technologies for achieving additional mercury reductions.

   - Given the significant early reductions from implementation of the CSA, North Carolina hopes EPA will pass regulations that require similar reductions in other States.

   - The EPA rule needs to offer explicit right and authority for States to deal with residual local issues and to avoid preempting State programs.

- Compliance should be monitored using EPA Method 101A, since mercury continuous emission measurements (CEM)s will most likely not be commercially available, accurate, or reliable by the time that a mercury MACT rule is to be implemented. Title V permits will include compliance assurance monitoring (CAM) plans for periods between compliance tests. There should be an initial compliance demonstration followed by annual testing for large sources and biennial testing for small sources to demonstrate compliance with mercury MACT limits.

- Compliance with MACT limits should be on a facility basis rather than on a boiler-by boiler basis.

- The presumptive three-year compliance period contained in § 112(d) is too short to bring all coal-based units into compliance with mercury MACT limits. Several practical concerns limit the ability to design, build and finance the pollution control equipment that would need to be installed or retrofitted for the entire electric utility industry to comply with a MACT standard in only three years.

CHAPTER IV COAL-FIRED BOILER MERCURY CONTROLS

This chapter discusses mercury controls available to the electric utility coal-fired boiler industry. Information presented at the workshop on Mercury and CO_2 during April 19-21, 2004 is italicized.

INSIGHTS ON ECONOMIC IMPACTS OF UTILITY MERCURY AND CO_2 CONTROLS[37]

Various retrofit controls are possible
"Co-benefits" from PM, SO_2 and NO_X control equipment, especially for bituminous (eastern) coals:

- *Cold-side electrostatic precipitator (*CESP) *–removes ~35% of mercury; FF removes 75-90% of mercury*
- *Wet FGD + CESP removes 60-70% of mercury*
- *SCR with WFGD + CESP removes 85-90% of mercury*

Activated carbon injection (ACI):

- *Cheap to install, expensive to operate, for removals of 60-80%*

ACI with small baghouse:

- *Substantial capital cost, but lower operating costs 85%-90% removal appears possible*

All mercury controls still have uncertain removal potentials
Co-benefits are likely, but magnitude still speculative
ACI still being developed; not "commercialized" yet

PERFORMANCE AND COSTS OF MERCURY CONTROL TECHNOLOGY FOR BITUMINOUS COALS[38]

Status of Technologies for Oxidizing Mercury:

SCRS: DOCUMENTING PERFORMANCE ON FULL-SCALE INSTALLATIONS

- *Better performance on bituminous than subbituminous coals.*

[37] Insights on Economic Impacts of Utility Mercury and CO2 Controls, Anne Smith Charles River Associates, North Carolina DENR/DAQ Workshop on Mercury and CO2, Raleigh, NC, April 19-21, 2004

[38] Performance and Costs of Mercury Control Technology for Bituminous Coals:, Michael D. Durham, Ph.D.,MBA , ADA-ES, Inc., NC DAQ Mercury and CO2 Workshop April 19-21, 2004 Raleigh, NC

- *Possibility of aging effects.*

- *Possibility of interferences from other chemicals.*

- *Catalysts are being designed to reduce oxidation of SO_3; this may impact oxidation of mercury.*

- *Oxidizing Catalysts: Pilot-scale testing under way.*

- *Oxidizing Chemicals: Some very short-term full-scale tests. Concerns with corrosion.*

SORBENT INJECTION UPSTREAM OF A WET SCRUBBER

- *Injection of AC and capture in ESP will provide an additional mechanism to reduce mercury emissions.*

- *Oxidation of mercury produced by carbon could enhance capture in FGD.*

- *Decreased mercury levels in scrubber could reduce potential for reemission of elemental mercury from scrubber.*

- *Two DOE/Industry full-scale field tests are scheduled:*

    1. *Georgia Power Yates; currently on-going, medium-sulfur bituminous coal, and*

    2. *AEP Conesville; Spring 2005, high-sulfur bituminous.*

ASH ISSUES

- *The mercury captured by PAC, LOI, and ash appears to be very stable and unlikely to reenter the environment.*

- *The presence of PAC will most likely prevent the sale of ash for use in concrete.*

- *Several developing technologies to address the problem:*

    1. *Separation*

    2. *Combustion*

    3. *Chemical treatment*

    4. *Non-carbon sorbents*

5. Configuration solutions such as EPRI TOXECON™

Costs of mercury control depend on plant size not on amount removed.

Costs of mercury control are unrelated to the amount of mercury captured.

CONCLUSIONS ON ACI PERFORMANCE

- *AC injection can effectively capture elemental and oxidized mercury from bituminous coals.*
- *There will be difference in site to site performance of ACI due to differences in coal, equipment, and flue gas characteristics.*
- *Fabric filters provide better contact between the sorbent and mercury than ESPs, resulting in higher removal levels at lower sorbent costs.*
- *Long-term results are promising showing consistent mercury removal greater than 85%.*
- *New COHPAC™ fabric filters will have to be designed to handle higher loadings of PAC to insure high (>90%) mercury removal.*

Commercial Status of Technology: Equipment

- *Similar equipment has been used successfully in the waste industry to inject AC into flue gas.*
- *It has successfully been scaled up for full-scale utility applications.*
- *Operating continuously for nearly a year at Gaston.*
- *Three AC injections systems currently operating.*

Supply of Activated Carbon and Other Sorbents:

- *Sufficient supply available to meet several State regulations.*
- *Additional production needed to meet Federal regulations.*
- *Tremendous progress being made with improved sorbents.*

Performance:

- *Will vary with type of equipment (FF vs. ESP).*

- *Will vary from site to site due to flue gas characteristics (temperature, acid gases).*

WET SO_2 SCRUBBERS

Wet scrubbers are similar to dry scrubbers in that both use an alkaline solution to collect SO_2 and both are located downstream of a particulate air pollution control. However, wet scrubbers saturate the flue gas stream with water, as the complete scrubbing process, including by-products, remains liquid or in a slurry form. They are also referred to as wet FGD scrubbers and normally achieve a SO_2 control efficiency of 90+ percent. In this study it was estimated that wet scrubbers downstream of cold-side ESPs would remove almost 80 percent of total mercury emissions and wet scrubbers downstream of hot-side ESPs would remove nearly 40 percent of total mercury emissions. This decrease in mercury control performance in hot-side ESP is due to the relatively lower amount of mercury oxidized at elevated temperatures. Relative to other air pollution controls, wet scrubbers downstream of cold-ESPs show higher mercury removal performance because the gas temperature favors more oxidized mercury, with the oxidized fraction being more effectively removed in the scrubber. The challenge to improve performance of mercury capture in wet FGD is to find a way to oxidize the elemental mercury vapor before it reaches the scrubber or to modify the liquid phase of the scrubber to cause oxidation to occur. Wet FGD scrubbers are installed on about 15 percent of utility boilers nationwide, most of which are on the larger boilers, as these scrubbers control roughly 25 percent of the US power generating capacity. No wet FGDs are currently installed on any NC boilers, but 22 boilers will have their emissions scrubbed by wet FGDs as a result of the CSA.

SELECTIVE CATALYTIC REDUCTION

The SCR process uses a catalyst with ammonia gas to reduce the nitric oxide (NO) and NO_2 in the flue gas to molecular nitrogen and water. Ammonia gas is diluted with air or steam, and this mixture is injected into the flue gas stream upstream of a metallic catalyst bed composed of vanadium, titanium, platinum, or zeolite. In the reactor, the reduction reactions occur at the catalytic surface. The SCR catalyst bed reactor is usually located between the economizer outlet and the air heater inlet, where temperatures range from 450 – 750 °F. Recent data suggests that SCRs tend to promote additional mercury oxidation, thereby enhancing mercury removal with most existing and emerging particulate / SO_2 control technologies. Eleven SCRs are being installed in North Carolina as a result of the NO_x SIP Call and the CSA.

COLD-SIDE ESP RETROFIT OPTIONS

ADD FLUE GAS COOLING

Lowering the flue gas temperature entering the ESP assists natural fly ash sorption of mercury, improves the performance of any sorbents injected upstream for mercury control, and inherently enhances particulate control performance by reducing gas velocity and lengthening residence time. However, the acid dew point temperature limits the

extent of gas cooling when the flue gas has significant formation potential of hydrochloric acid or sulfuric acid that greatly reduces the service life of steel ducts.

POWDERED ACTIVATED CARBON BASED CONTROL[39]

Conventional Powdered Activated Carbon (PAC)

- *Control requires a fabric filter to achieve acceptable mercury removal efficiency.*
- *Bromated powdered activated carbon (bpac) is much more reactive and has to potential to provide acceptable mercury control with an ESP*

Gaseous mercury can be converted to particle–bound mercury by adsorption onto solid particles in the flue gas. Injecting suitable sorbents into the flue gas upstream of the ESP increases the amount of mercury captured. This modification may also require additional ducting between the injection location and the ESP inlet, and adding a gas absorber / humidifier upstream of the ESP. This approach may be limited to ESPs with a wide compliance margin, as boilers with marginally performing ESPs may have difficulty meeting existing particulate-related emission requirements due to the increased loading of sorbent and likely high resistivity levels.

ADD DOWNSTREAM FABRIC FILTER WITH SORBENT INJECTION

Installing a fabric filter after the ESP allows most of the native collected fly ash in the ESP without reacted sorbent and enhances overall particulate control for marginally performing ESPs. Furthermore, due to the low particulate loading, the filter dust cake porosity is reduced, allowing use of a smaller, less expensive fabric filter with long cleaning cycles and high sorbent and bag life performance.

COHPAC OPTION™

There is a patented variation of adding a downstream fabric filter (baghouse) to a cold- or hot-side ESP known as COHPAC™ (Compact Hybrid Particulate Collector) developed by the Electric Power Research Institute. It involves retrofitting a baghouse either in the space of the last field (or section) of an ESP or in a separate housing downstream of an ESP with a precharger located immediately upstream of the baghouse. In either case, the residual or induced charge on the particulate produces a marked effect in lowering the porosity of the filter dust cake. Such an arrangement allows use of a much smaller, less expensive fabric filter with long cleaning cycles and high sorbent and bag life performance. For example, COHPAC™ units are designed with filtration velocities of 8-12 feet per minute (fpm) as compared to the filtration velocities of 3-5 fpm typically used for pulse-jet fabric filters on coal-fired utility boilers.

[39] Mercury Monitoring, Barrett Parker, EPA Emissions Measurement Center, Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

HOT-SIDE ESP RETROFIT OPTION.

This entails conversion of a hot-side ESP to a cold-side ESP, and could then include any of the other cold-side ESP retrofit options mentioned above. Several hot-side ESPs in the US, including a few in NC (such as Duke Energy Allen Units 3-5), have been converted to cold-sides to improve particulate collection performance and ESP reliability. Depending on plant layout and design, this may be possible by reconfiguring the ducting, retuning the ESP to operate at lower temperatures, and perhaps installing a SO_3 or NH_3 gas conditioning system to restore performance.

WET FGD SCRUBBER RETROFIT OPTIONS

Previous research has shown that much of the mercury released during coal combustion is either removed with the flyash or can be absorbed in FGD units, if it is in the oxidized form. Oxidation of the gaseous elemental mercury is more readily captured by wet FGDs than gaseous elemental mercury. Several flue gas additives and scrubbing liquid additives are being developed to oxidize more of the gaseous elemental mercury and to prevent any re-conversion of oxidized mercury to gaseous elemental mercury. However, there is the caution that increasing oxidants in the flue gas or in the scrubbing liquid may also oxidize other species such as SO_2 and NO_x to sulfuric acid and nitric acid aerosols. Other options under development include use of oxidizing catalysts upstream of scrubbers, higher scrubber liquid-to-gas ratios, and scrubber tower design changes.

DRY SORBENT INJECTION.

For boilers with dry air pollution controls without FGD, injection of dry sorbents (such as powdered activated carbon [PAC] or less costly alternatives) offer a candidate control technology. Because of the added contact on the filter dust cake, it is estimated that FFs would require 1/10 of the sorbent rate as ESPs. Full scale tests with a small FF downstream of a hot-side ESP showed 90 percent mercury control with PAC injection. Such performance was achieved with a significant increase in bag cleaning frequency (a reliable surrogate indicator for a decrease in bag life and increase in bag replacement cost) with the suggestion of rather high overall cost for the PAC injection system. Further full scale tests have been performed at a Wisconsin electric utility. [Reference: “Full Scale Evaluation of Mercury Control with Sorbent Injection and COHPAC…”] Other tests have/ are being performed with Darco FGD™ carbon injection upstream of ESPs. Results with low sulfur bituminous coal show total mercury capture vary from 20 – 80 percent depending on ESP operating temperature ranging from 220 – 275 °F.

Sorbent collection performance for mercury is expected to depend on 5 key parameters, including sorbent size, sorbent capacity, residence time, type of dry air pollution control, and mercury level. Predicted costs for PAC using representative values for these parameters range from $4-12 million/year for ESPs and from $4-6 million/year for FFs for a 500 MW boiler. (Since these levels are considered prohibitive by some, many other candidate technologies target cost levels as ¼ to ½ of PAC costs.). Title: “Predicted Cost of Mercury Control at Electric Utilities Using Sorbent Injection”

CALCIUM-BASED SORBENT INJECTION

An alternative to PAC is calcium-based sorbent, such as limestone. EPA laboratory tests indicated that injection of calcium-based sorbents into flue gas could result in significant mercury removal and a small amount of SO_2 and SO_3 removal. Further testing by McDermott Technology, Inc. produced results slightly above 50 percent mercury capture. Comparison of these results with PAC results indicate that while PAC is a more effective sorbent than limestone on a mass basis, limestone is a more effective sorbent than PAC on a cost basis.

In summary, there are several emerging potential retrofit mercury control technologies at various stages of investigation and development. Further efforts to study and validate full-scale performance are underway, but it appears premature to obtain a complete set of definitive cost data for performing a robust cost analysis for many/most of the competing mercury control technologies.

IGCC: WHAT IS IT?[40]

INTEGRATED COAL GASIFICATION COMBINED CYCLE (IGCC)

- *Chemical conversion of coal to synthetic gas for combustion in a modified gas turbine.*

- *Inherently cleaner process because coal is not combusted and the relatively small volumes of syngas are easier to clean up than the much larger volumes of flue gases at a coal combustion plant.*

IGCC ENVIRONMENTAL IMPACTS - AIR POLLUTION

- *Commercially available IGCC power plant technologies can have much lower air pollution emissions than new conventional coal plants.*

- *Actual air emissions performance will likely depend, at least in part, on what control technology and performance levels are required by regulators.*

Mercury capture at IGCC plants is quite feasible and much less costly than at conventional coal plants and the potential exists to indefinitely sequester mercury captured at IGCC facilities.

Commercially available IGCC power plant technologies produce substantially smaller volumes (about one half) of solid wastes than do new conventional coal plants using the same coal

[40] Integrated Coal Gasification Combined Cycle (IGCC) Power Plants and Geologic Carbon Sequestration, Joe Chaisson, April 21, 2004, Revised. Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

IGCC solid wastes are less likely to cause environmental damage than fly ash from conventional coal plants because IGCC ash melts in the gasification process, resulting in an ash much less subject to leaching pollutants than is conventional coal combustion fly ash.

COAL GASIFICATION AND MERCURY MANAGEMENT

- *Proven, low cost mercury controls can remove most of the mercury from coal syngas produced (14 years experience at Eastman Chemical).*

- *Mercury is captured in a small volume activated carbon bed. Bed contents are currently managed as hazardous wastes (due to other toxics captured), but could be sequestered in a long-term mercury storage facility or the mercury contained could be economically recycled.*

Thus coal IGCC with a carbon bed plant mercury control is today the only technology that can convert coal to power and capture nearly much of the coal mercury in a form and volume suitable for permanent sequestration.

CHAPTER V TWO MERCURY EMISSION ESTIMATING TOOLS

In 1999, the U.S. Environmental Protection Agency (EPA) conducted the Electric Utility Steam Generating Unit Mercury Information Collection Effort (EU/ICE) to gather information about mercury emissions from the coal-fired electric utility industry**.** This effort led to the collection of stack test and coal mercury content reports on 80 furnace or boiler units. Two computer tools have been used in this report to estimate mercury emissions leaving the smokestacks of coal-fired electrical utility boilers. Both tools are based on the same data. For this report, the two tools are differentiated as the EPA tool and the EPRI tool.

The EPA tool, "Electric Power", "*EUCFF*" (Version 3.0.1) was developed for EPA by the Research Triangle Institute in June 2001 for estimating mercury emissions from coal combustion at electrical utilities in the United States. *Electric Power* allows permitting authorities and others to evaluate the impact on mercury emissions if certain parameters including type of coal, boiler, or pollution control device are changed.[41] This program does not account for any additional mercury capture if selective catalytic reduction (SCR) equipment is installed in the flue gas stream. Therefore, if an SCR is installed, the actual mercury emissions may be lower (more captured) than emissions otherwise reported. The EPA tool results are more conservative that the EPRI tool results because the EPRI tool program algorithms incorporates the affects of high chlorine in coal combusted in North Carolina. Chlorine combines with mercury to form inorganic molecules that can be captured.

The EPRI tool was used to develop EPRI's technical Report "An Assessment of Mercury Emissions from U.S. Coal-Fired Power Plants," in October 2000. Due in part to the reason cited above, the EPRI tool normally estimated higher mercury capture rates than the EPA tool. However, in light of data variability and other uncertainties that may exist during the massive data collection and testing effort, DAQ believes it prudent to report estimated mercury capture with a range of values instead of exact numbers.

Information presented at the workshop on Mercury and CO_2 during April 19-21, 2004 is italicized.

A SOFTWARE TOOL FOR ESTIMATING MERCURY EMISSIONS AND REDUCTIONS FROM COAL-FIRED ELECTRIC UTILITIES (EU)[42]

- *Tool for evaluating alternatives for mercury control.*
- *Case-by-case MACT is applicable until nationally applicable MACT standard*

[41] Ref. 21

[42] A Software Tool for Estimating Mercury Emissions and Reductions from Coal-Fired Electric Utilities (EU), Jeffrey D. Cole, C. Clark Allen, Ph.D. Presented at the Mercury and CO_2 Control Options Assessment Workshop Raleigh, NC April 19-21, 2004

- *Tool is not required for a case-by-case analysis.*

Software for Electric Utility Mercury Controls, Sponsored by U.S. EPA.
Coal-burning electric utilities.

- *Predicts the amount of mercury control for conventional electric utility pollution control devices.*
- *Allows the use of site-specific information.*
- *Provides very detailed reports of the results.*

Basis of the Model's Electric Utility Equipment Configurations

- *1999 EPA ICR Part III emission test reports (79 separate units, 80 total [1 tested twice]).*
- *Follow up telephone interviews.*
- *Information provided by the EU company.*
- *Company review and feedback.*

Fuel Usage and Characterization

- *Provided by the EU company throughout 1999.*
- *Fuel characterization.*
- *Fuel type (bituminous, subbituminous, lignite..)*
- *Fuel amount combusted for each unit*
- *Fuel characterization, mercury content, other characteristics*
- *Allows the use of site-specific information.*

Stack Tests for Electric Utility Mercury Controls

- *Sponsored by EU companies.*
- *Different types of conventional pollution controls were evaluated.*
- *Measured mercury rates in coal, in gas going into the control unit, and in the gas leaving the control unit.*

- *Formal reports with quality assurance.*

Types of Furnaces and Conventional Air Pollution Controls Tested

- *Conventional furnace, Fluidized-Bed Combustion (FBC), and Integrated Gasification Combined-Cycle (IGCC).*
- *Particulate controls:*
- *Electrostatic Precipitators (both hot-side and cold-side)*
- *Fabric filters*

Particulate scrubbers

- *Mechanical collectors (multiclone).*
- *Sulfur controls: Wet Flue Gas Desulfurization (FGD), Spray Dryer Absorber.*
- *Nitrogen oxide controls: Selective Catalytic Reduction, Selective Non-Catalytic Reduction.*

Method for Estimating the Effectiveness of the Mercury Controls, II Speciation Method.

- *Evaluate the mercury speciation for the coal type and furnace type: particulate, ionic, and elemental.*
- *Evaluate the control effectiveness of each control type for each mercury species.*
- *Apply these factors to the 1999 site-specific conditions.*
- *Sum the remaining mercury species for the controls you have selected to estimate the total mercury emission rate.*

Uncertainty Analysis for the Result.

- *Expected mercury air emissions from the analysis.*
- *Range of results due to uncertainty.*
- *Detailed report of the statistics.*

ESTIMATED MERCURY EMISSION REDUCTIONS IN NC FROM CSA CO-CONTROL[43]

Mercury Emissions and Control Study for Electric Utilities
Electric Utility Industry Is Primary Mercury Emission Source in NC (75% mercury emissions) Current Statistics

- *48 Utility Boilers with 13,300 MW*
- *Duke Power with 8,200 MW*
- *Progress Energy with 5,100 MW*
- *Variety of Conventional Boilers*
- *No mercury-specific emission controls*

NC Electric Utility Boiler Characteristics:
Current Design and Operation

- *All Eastern Bituminous Low-S Coal*
- *Favorable mercury Controllability Coal*
- *All T-Fired or Wall-Fired Boilers*
- *Most larger units with Cold-side ESPs*
- *Several small Hot-side ESPs*
- *No Wet FGD Scrubbers*

DAQ Estimated Mercury Emissions Based on EPA and EPRI Correlations

- *EPA Estimates*
- *Based on 1999 ICR data (1100 boilers & 80 tests)*
- *Results by category (e.g., bituminous coal, cold-side ESP)*
- *Averaged category data without coal variables*
- *Used Sound Science*

[43] **Estimated Mercury Emission Reductions in NC from Co-control as a Result of CSA,** Steve Schliesser, NC Division of Air Quality, Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

- *Results applicable for large data sets*
- *Predict 48 tons mercury emissions in USA*

EPRI Estimates:

- *Based on 1999 ICR data (1100 boilers & 80 tests)*
- *Results by category (e.g., bituminous coal, cold-side ESP)*
- *Correlated category data on key coal variables*
- *Used Sound Science*
- *Results applicable for large data sets*
- *Predict 45 tons mercury emissions in USA*

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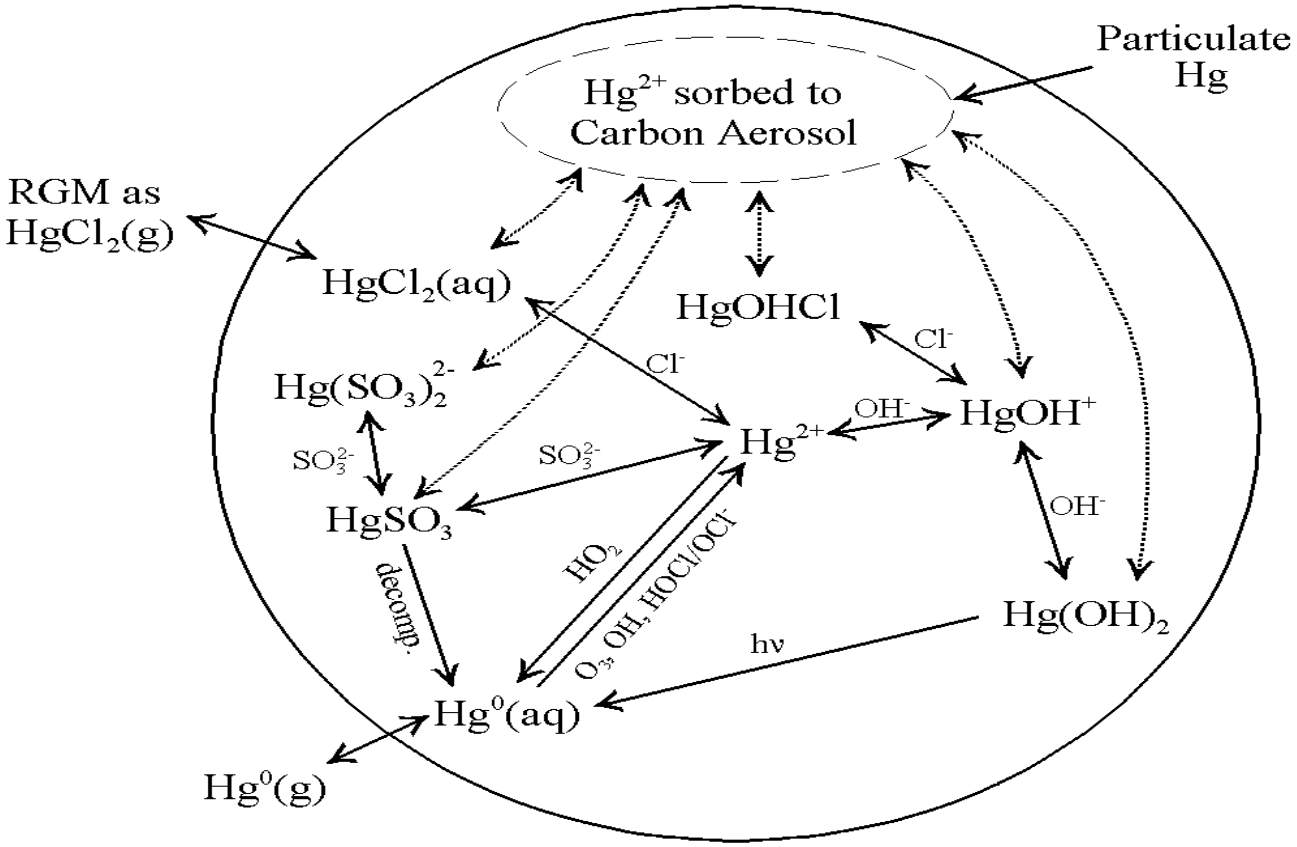
CHAPTER VI LOCAL MERCURY SOURCES AND INFLUENCES

Information presented at the workshop on Mercury and CO_2 during April 19-21, 2004 is italicized.

MODELING ATMOSPHERIC MERCURY DEPOSITION[44]

It is well known that particulate matter deposits from the atmosphere through dry processes, but gaseous constituents also dry deposit. It appears that dry deposition of RGM is especially important near combustion sources. Figure VI-1 graphically illustrates the complex chemical reactions taking place in the atmosphere resulting in dry mercury deposition.

FIGURE VI-1
CLOUD CHEMISTRY MECHANISM FOR THE CMAQ-MERCURY MODEL



[44] Modeling Atmospheric Mercury Deposition to the Sounds and Other Water BodiesO. Russell Bullock, Jr., NOAA Air Resources Laboratory,(On assignment to the U.S. EPA Office of Research and Development), Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

- *The Florida everglades experience provides the best example so far of the likely importance of dry deposition of mercury to total ecosystem impacts.*

- *Atmospheric mercury models are under development at a number of institutions around the world, and a concerted effort of model inter-comparison is being made to identify important uncertainties.*

- *Sparse and incomplete observational data is hampering model evaluation efforts, especially the lack of closure on the total deposition flux.*

- *Atmospheric mercury models will continue to evolve as our understanding of mercury chemistry in air and cloud water evolves.*

The greatest obstacle to discovery is not ignorance - it is the illusion of knowledge.

Daniel J. Boorstin (1914-2004)

ATMOSPHERIC MERCURY: PANDORA'S BOX?[45]

Comparison of mercury inputs to the Everglades, depicted is the Everglades Protection Area, i.e. the remaining 'natural' portions of the Everglades:

- *Two years' monitoring of surface water inflows of mercury from all of the 'into' structures were 1.8 and 3.2 kg/year, during which atmospheric deposition from 4 years of rainfall mercury collection ranged from 125 to 140 kg/year.*

- *Thus, greater than 95% of the annual mercury budget of the Everglades comes from atmospheric deposition via rainfall.*

- *Atmospheric modeling of sources within southern Fla. indicates that dry deposition adds approximately 30% additional mercury load to WCA-3A, not included in these estimates.*

The Bottom Line

- *Reduction of atmospheric sources of mercury from within Florida has led to ~ 60% declines in mercury in Everglades fish and wildlife in less than 15 years since peak deposition.*

- *To the extent that mercury emissions are in the reactive form (RGM) one can expect to see benefits at local or regional scale within years to decades.*

[45] Atmospheric Mercury: Pandora's Box?, Tom Atkeson, Coordinator Mercury & Applied Science, Workshop on Mercury and CO_2, Raleigh, NC, April 19-21, 2004

- *The main driver of the Everglades mercury problem is mercury load - overwhelmingly from atmospheric deposition.*

- *There is synergy with co-deposition of mercury and sulfate, which combine to exacerbate mercury methylation.*

Figure VI-2 reflects annual mercury deposition rates from approximately 1810 to 1996 that was analyzed from a sedimentary core sample collected in the Everglades. Mercury dropped back to 1980 deposition rates from a high in the early 1990s.

Figure VI-3 shows the reduction of mercury use throughout the world's economy. This decline has been of the order of 80 percent.

Figure VI-2
Mercury Concentrations Over Time
Everglades, Florida

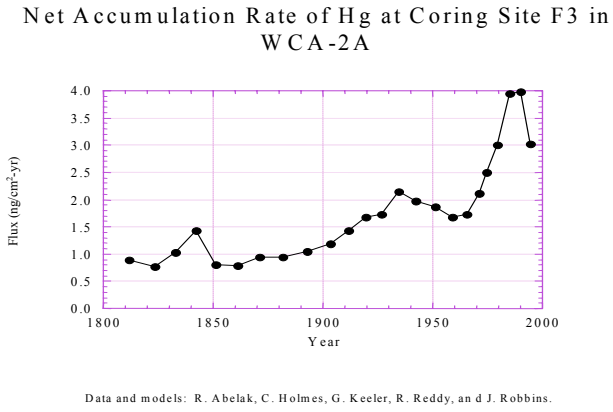
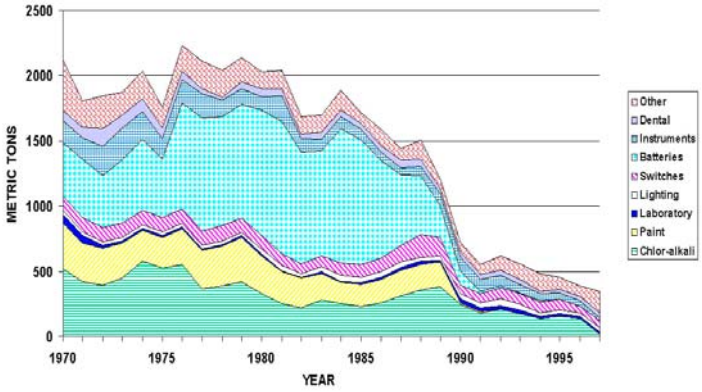


FIGURE VI-3
TRENDS IN WORLD MATERIAL FLOWS OF MERCURY.



Sznopek and Goonan. USGS

THE FLORIDA EVERGLADES STUDY RESULTS[46]

The Florida Everglades study goal was to understand and simulate how changes in local atmospheric mercury emissions in south Florida would influence mercury concentrations in top predator fish, thus demonstrating the potential of combining air and water modeling approaches in Total Maximum Daily Load (TMDL) involving air deposition of mercury. This study focuses on mercury, and incorporates extensive field data into a framework combining atmospheric mercury deposition and aquatic mercury cycling models to demonstrate the feasibility of the approach. The data year studied for this project is from June 22, 1995 to June 21, 1996.

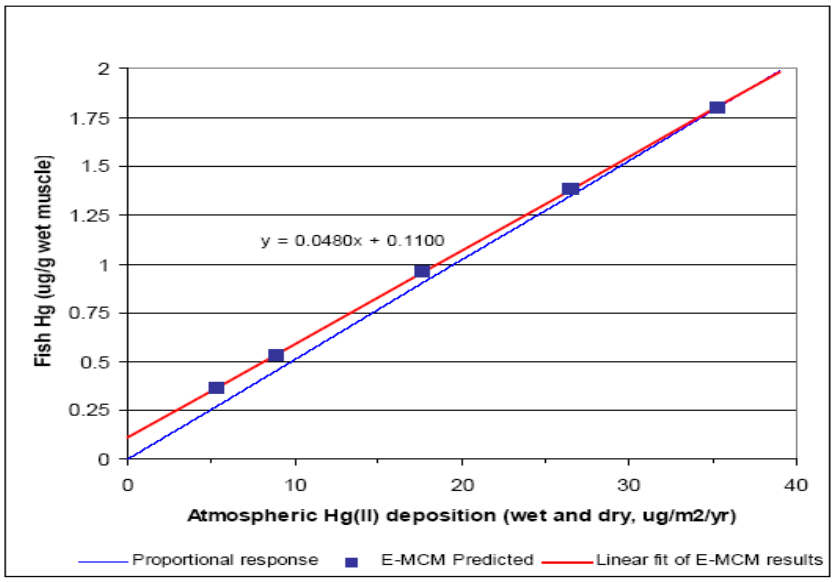
A fundamental question to examine in this pilot TMDL study was the relationship between atmospheric reactive gaseous mercury (RGM) deposition and long term fish mercury concentrations. Once the model was calibrated to the current atmospheric RGM deposition estimate of 35 μg/m2/yr, simulations were also carried out with loadings at 75, 50, 25 and 15percent of current levels. In these simulations, RGM and methylmercury concentrations in inflows were adjusted in proportion to RGM deposition. Atmospheric loadings of methylmercury also were changed proportionally. Predicted fish mercury concentrations were compared after each simulation had run 200 years, producing essentially steady state conditions. Annual cycles of site conditions and mercury deposition were repeated Inorganic mercury throughout the simulation period.

The purpose of including the results of this Florida Department of Environmental Protection study is an attempt to establish a link between airborne mercury emissions and methyl mercury concentrations in top predator fish. The findings point to a linear relationship existing between airborne mercury emissions and methyl mercury concentrations in three-year-old big mouth bass. See Figure VI-4.

A fundamental question to examine in this pilot TMDL study was the relationship between atmospheric inorganic mercury deposition and long term fish mercury concentrations. Once the model was calibrated to the current atmospheric inorganic mercury deposition estimate of 35 μg/m2/yr., simulations were also carried out with loadings at 75, 50, 25 and 15 percent of current levels. In these simulations, Inorganic mercury and methylmercury concentrations in inflows were adjusted in proportion to Inorganic mercury deposition. Atmospheric loadings of methylmercury also were changed proportionally. Predicted fish mercury concentrations were compared after each simulation had run 200 years, producing essentially steady state conditions. Annual cycles of site conditions and mercury deposition were repeated throughout the simulation period. See Figure VI-5

[46] Integrating Atmospheric Mercury Deposition with Aquatic Cycling in South Florida: An approach for conducting a Total Maximum Daily Load analysis for an atmospherically derived pollutant, Florida Department of Environmental Protection, October, 2002, Revised November, 2003

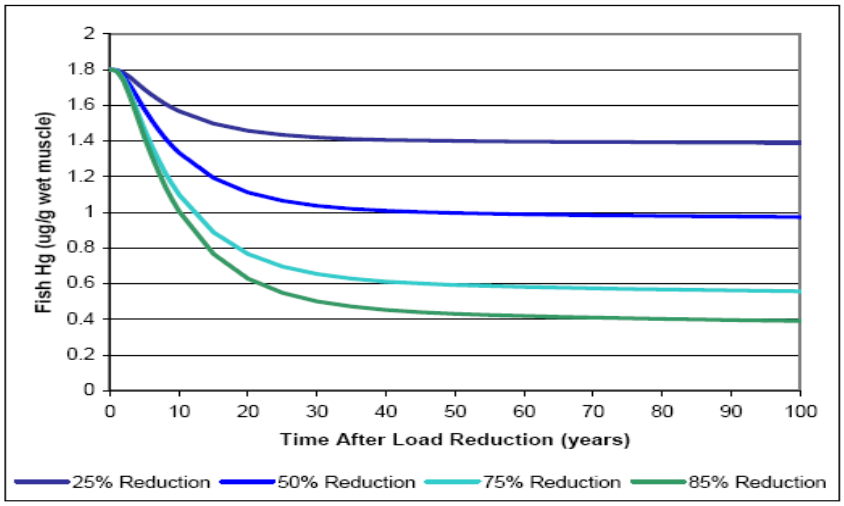
FIGURE VI-4
THREE YEAR OLD LARGEMOUTH BASS PREDICTED MERCURY CONCENTRATIONS (AS A FUNCTION OF DIFFERENT ATMOSPHERIC MERCURY DEPOSITION ANNUAL RATES)



Atmospheric Inorganic mercury deposition (wet and dry, ug/m2/yr)
Fish mercury (ug/g wet muscle)

It is unknown at this time if the results of this study are applicable in North Carolina as a predictive tool. South Florida's metrological experience is very different from that found in this State. There are also major differences in mercury sources, topography, soil structure, and exposure to pollution affects across state borders.

FIGURE VI-5
PREDICTED DYNAMIC RESPONSE OF MERCURY CONCENTRATIONS IN LARGEMOUTH BASS IN WCA 3A-15 FOLLOWING DIFFERENT REDUCTIONS IN RGM DEPOSITION.

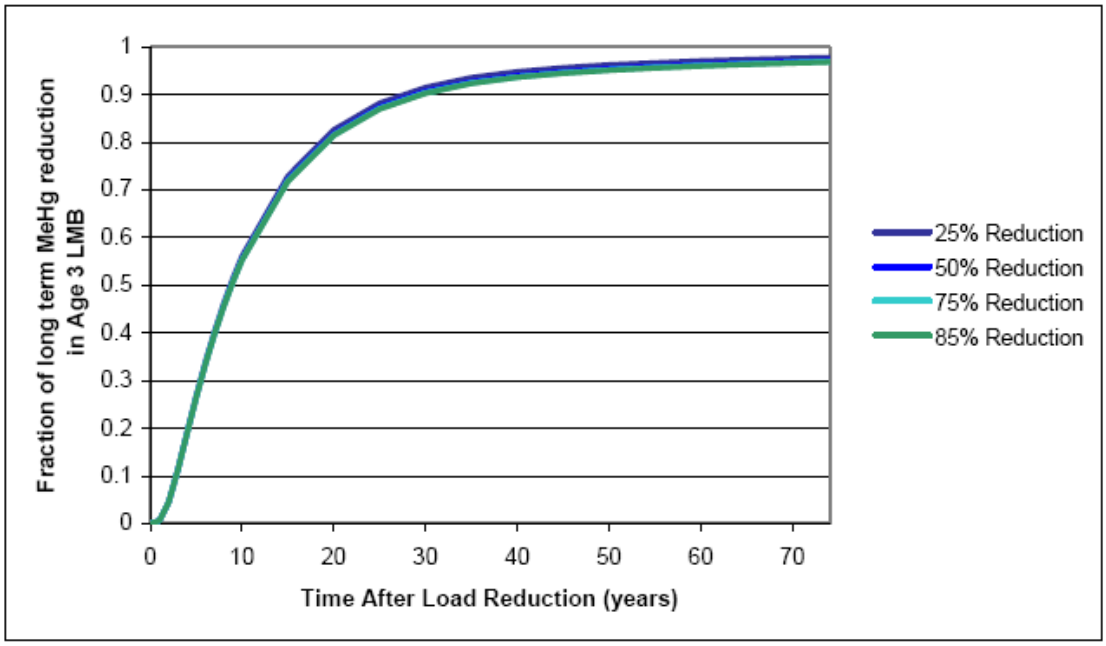


Predictions are based on calibration to current loading of 35 µg/m2/yr.

Figure VI-6 shows that the number of years required for the system to approach a new steady state is effectively independent of the actual magnitude of the change. Two phases are illustrated by the curve: the first is a period of comparatively rapid response driven by the decline of inorganic mercury loading and the hydraulic residence time of the system; the second phase is far slower, and is governed by the turnover rate of labile inorganic mercury in the sediments supporting methylation. Because the simulated concentrations of mercury in largemouth bass ultimately reflect net methylation rates in the sediments, the response of largemouth bass is prolonged. For example, the time required to achieve 50 percent of the ultimate response in fish tissue mercury concentrations is approximately 10 years for all load reduction scenarios tested with the base calibration with atmospheric inorganic mercury deposition at 35 µg/m2/yr. Within 30 years, approximately 90 percent of the ultimate predicted response is projected to occur.

Figure VI-6

Comparison Of The Rate At Which Age 3 Largemouth Bass Concentrations Approach Steady State Following Different Reductions In Inorganic Mercury Deposition



Simulations all based on calibration with current Inorganic mercury deposition = 35 µg/m2/yr.).

The report discusses uncertainties in some detail. Causes of uncertainty are listed to encourage the reader to understand that this report, excellent as it is, may or may not represent the true relationship of atmospheric mercury deposition to methylmercury contamination in fish:

- No simple relationship links mercury concentrations in water and mercury concentrations in fish; the relationship is site specific.

- The average annual precipitation for the study year was 156 cm. The normal precipitation range at the site is 125-140 cm.

- The model indicates a significant seasonal trend in total mercury wet deposition to the area, predicting that over 80 percent of the wet deposition would occur from May through October.

- The program used measured wet deposition (23.1 $\mu g/m^2$/year) and modeled estimate of dry deposition (12.2 $\mu g/m^2$/year). For a total of 35 $\mu g/m^2$/year.

- Assumption that two limiting factors govern methylation and demethylation rates: the supply of available mercury and the rate of activity of the methylating and demethylating microbes.

- Assumption that microbial methylation and demethylation rates were limited only by their respective mercury substrates.

- Assumption that RGM and methylmercury concentrations in inflows would respond linearly to changes in atmospheric deposition.

- Several attempts have been made at construction of global mercury models but all lack key information on the atmospheric reactions of mercury and their rates.

- The understanding of the biogeochemical cycle of mercury has advanced greatly in the past decade but a number of features of that cycle remain obscure. The program was calibrated to a single site in this study.

- Unable to compare model predictions to observations in terms of the effects of different site conditions such as pH, DOC, fish growth rates, sulfate and sulfide levels, and other site conditions that vary systematically across the Everglades.

THE FLORIDA MERCURY REPORT – PUTTING IT IN PERSPECTIVE[47]

EPRI Comments on "Integrating Atmospheric Mercury Deposition With Aquatic Cycling in South Florida"

Recent news coverage of the Florida Mercury Report published on November 6 indicates that the installation of mercury emission control technology on waste incinerators in the early1990s has resulted in a 60-70% decrease in mercury concentrations in fish and birds in the Everglades. Does this mean that placing mercury emission controls on power plants throughout the United States would have a similar effect?

The mercury emissions released by municipal and medical waste incinerators are

[47] *The Florida Mercury Report – Putting it in Perspective,* EPRI • askepri@epri.com • www.epri.com

different from those released by power plants.

- There are two major forms of mercury in emissions – oxidized (or ionic), which is water-soluble, and elemental, which is not water-soluble.

- Most incinerator mercury is in the water-soluble form whereas the form of mercury released from power plants depends upon many factors, such as the type of coal being burned. Recent research has shown that most of the mercury released by utilities (at least 60 percent) is the non-water soluble elemental form, and that a significant amount of the remainder converts to this non-soluble form shortly after leaving the stack.

- The form of mercury emitted is critical as oxidized mercury can be washed into local rivers, lakes, and streams by rainfall whereas elemental mercury is carried away by wind and enters the global mercury cycle.

- Power plant chimneys are typically higher than incinerator chimneys and therefore disperse emissions over a larger area, resulting in less local impact.

The Florida Everglades represents a unique ecological system not typical of, and in fact, strikingly different from other US waterways. Thus, the results from this study are not necessarily applicable to other areas.

- The Everglades are in a tropical zone (no seasons), the water is shallow, and the bottom sediments are much different from those in other water bodies throughout the U.S. Other waterways also have different levels of acidity, biological activity, dissolved oxygen, and turbidity. These differences can dramatically affect mercury cycling and uptake by biological organisms. Thus, it is unlikely that the changes in mercury, both amount and rate of decline, observed in fish would be observed in other US waters.

The claim that changes in mercury emissions result in rapid changes in fish mercury content is not supported by the data or findings.

- The Florida report assumes that mercury deposition in the Everglades originates from local sources (primarily incinerators and power plants). However, while such patterns might be expected, data measurements and long-range transport modeling indicate otherwise.

- In fact, despite decreases in mercury emissions from incinerators, the amount of mercury being deposited in the Everglades overall has not changed significantly.

- Indeed, both EPA and EPRI have modeled mercury transport and concluded that over 60 percent of mercury deposited in Florida originates outside the State.

- Since fish mercury content has apparently fallen, other factors must be involved. Several theories have been suggested involving changing nutrient levels and water flows in the Everglades. Further research is needed to understand this situation.

- An April 2004 researchers' review of the Florida mercury findings concluded that the observed fish mercury trends could not be explained solely by estimated changes in mercury emissions, but needed data on other atmospheric components that might be required to drive such trends.

The atmospheric transport model used by the State of Florida to estimate mercury deposition has limitations.

- The model does not incorporate chemical reactions in the atmosphere. It also does not include global sources of mercury, only local emissions. Thus, it cannot effectively simulate the actual mercury deposition.

EPRI's recent research findings indicate that power plant mercury controls would not significantly change the amount of mercury contained in fish, or the human exposure to it.

- In early 2003, EPRI completed a comprehensive study of US power plant mercury emissions, potential mercury controls, and responses of fish to changes in mercury in their habitat waters. The results showed that reducing mercury emissions from power plants by approximately 50 percent would result in a reduction of mercury in fish of about 1½ percent . This study, combining atmospheric data and models, fish consumption information from US government studies, and an economic model of the US utility industry, relies on more recent information than the two-year-old Florida study report released on November 6.

THE ISSUE OF MERCURY "HOT SPOTS"

MERCURY DEBATE CONCENTRATES ON HOT SPOTS[48]

There's no argument that mercury is a noxious pollutant yet there is widespread disagreement over how or whether to control it. Now the attention is on potential "hot spots," whereby individual power plants could end up not cutting mercury-related emissions under a free market approach espoused by the Bush administration and others. The issue has come to light because of the trading system proposed by the Bush team—the same kind used successfully to help control sulfur dioxide emissions. Simply put, power plants that run afoul of the caps can buy credits from those that exceed their targets. That's the cap-and-trade part of it. The other aspect is that the plan sets a limit of 34 tons of mercury deposits by 2010, or a reduction of 30 percent from today's levels—a number that the Energy Information Administration predicts would be more like 40 percent because of the addition of the trading approach.

[48] http://www.rppi.org/mercurydebate.shtml

But, many environmental groups oppose such tactics, noting that while national mercury levels may drop, specific places will suffer from hot spots unless maximum allowable levels are set by individual plants. A cap-and-trade program raises the possibility that any utility could choose to buy credits rather than implement modern pollution controls. Individual communities could therefore suffer harm.

ENVIRONMENTAL DEFENSE REPORT NAMES TOP 10 U.S. MERCURY 'HOT SPOTS'[49]

"Mercury hot spots sound the alarm for strong national limits on dangerous mercury pollution," said Michael Shore, Environmental Defense senior air policy analyst. "EPA's weak stance on mercury ignores the agency's own scientific assessment and puts profits of the utility industry ahead of children's health. Affordable technology exists to protect our children from toxic mercury pollution and it is the government's legal and moral responsibility to put those tools to work now."

According to the report, the top 10 states for mercury hot spots (ranked by the most severe hot spot in each state) are Indiana, Michigan, Maryland, Florida, Illinois, South Carolina, North Carolina, Pennsylvania, Texas and Tennessee**.**

"America's children can't afford for the EPA to get a failing grade on the cleanup of toxic mercury emissions from coal-fired power plants. Other polluters have already been required to reduce their mercury emissions by 90 percent, and coal-fired power plants should not be let off the hook. States with mercury hot spots should vigorously pursue strong standards to protect water quality, ensure fish are fit to eat, and prevent brain damage in children," said Shore.

Somewhere north of Fort Wayne lies an area of nearly 500 square miles considered to be the most mercury-contaminated spot in the country, according to figures from the U.S. Environmental Protection Agency. Environmental Defense, a private non-profit organization, released the figures compiled earlier by the EPA, but never published, in December, listing the 484-square-mile "hot spot" as leading the country in mercury deposits.

Using data from 1998, the Environmental Defense report is based on a complicated computer model that analyzed weather patterns, mercury emissions from area coal-fired power plants and other information, said Michael Shore, a senior policy analyst for Environmental Defense.

The report from Environmental Defense, a national organization of 400,000 members founded in 1967, does not give a source for the contamination. Nor does it specifically define the hot-spot area by county lines or municipal boundaries. Instead, the report used mapping done by the EPA that divided the country into 22-mile-by-22-mile square grids. The checkerboard square with the most mercury deposits was a grid ambiguously described as being north of Fort Wayne, Shore said. "It's not a precise spot," he said.

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[49] http://www.fortwayne.com/mld/fortwayne/news/local/7685703.htm Laura Johnston / Ft. Wayne Journal Gazette 11 Jan 2004

"When you look at the specific sites, when you look at the states in the Midwest and the East, there are hot spots all over. The places where mercury deposition is highest, local sources dominate." Shore blamed the coal-fired power plants in Indiana, as well as plants in northeast Illinois and western Ohio, for the contamination.

The Indiana Department of Environmental Management is aware of the mercury issue, which it considers a national problem, spokeswoman Laura Pippenger said. The agency is working with the EPA to find out how it gathered and interpreted the data that indicated the northeast Indiana hot spot. "This sort of modeling can have discrepancies that can indicate a hot spot like this," Pippenger said. But the Environmental Defense study shows that mercury pollution is caused by power plants nearby, Shore said. "It travels to some extent, but communities that live around the power plants are most at risk to mercury pollutants," said Jones, of the Indiana Public Interest Group. Shore and Jones hope that information will convince the Bush administration to enact tough regulations on power plants. "If we're going to clean up pollution, we need to reduce mercury from local sources," Shore said.

"HOT SPOTS"—MERCURY EMISSIONS AND DEPOSITION PATTERNS[50]

There are concerns about potential mercury "hot spots" in the United States, particularly those that might be associated with power plant emissions and might not diminish, but actually become more numerous or severe, following proposed power plant regulations. EPRI has addressed this issue using computer modeling and data analyses, and concludes that mercury emissions from power plants will not create or intensify any hot spots under regulations proposed by EPA. Indeed, power plants contribute little to the areas of highest deposition in the United States, either currently or in future regulated scenarios.

In its December 2003 proposals to regulate mercury emissions from power plants, the EPA defined mercury "hot spots" as locations where deposition contributed by power plants alone is enough to raise mercury in fish tissue above the level EPA deems safe to consume. This is also the highest permissible level for waterways not to be classified as mercury impaired. In general, mercury hot spots are areas of excessively high mercury deposition compared to national or regional averages. Widely scattered measurements of the amount of mercury depositing in rainfall and other precipitation show no strong gradient from the Midwest to the East that might reflect the greater number of mercury sources in the eastern United States. However, simulations done with some computer models have led to speculation that some unmeasured U.S. locations may experience elevated mercury deposition compared with nearby areas, meeting the general definition of hot spots. There are concerns that a cap-and-trade regulatory approach, one of the alternatives proposed by EPA, will allow some electric utility sources to increase the amount of mercury they emit—or will not require them to reduce emissions as much as a Maximum Achievable Control Technology (MACT) approach would. Thus, there has been speculation that the cap-and-trade approach may have the potential to create or exacerbate mercury hot spots.

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[50] http://www.epri.com/corporate/discover_epri/news/HotTopics/env_HotSpots.pdf. June 2004

EPRI has applied state-of-the-art modeling to evaluate the potential for hot spots under alternative approaches to regulating utility mercury proposed by EPA.
Because it is impractical to look for "hot spots" by measuring mercury deposition at every location in the country, EPRI has run sophisticated, state-of-the-art computer models to simulate deposition of the mercury released from power plants and other emission sources. EPRI's analysis considered the amount and chemical forms of mercury emitted from every coal-fired power plant in the United States under three scenarios: a 2004 Base Case, for current conditions; and EPA's two proposed regulatory approaches, the MACT rule and the Cap & Trade rule. The model simulations of regulatory scenarios are for year 2020, when all emission reduction measures mandated by either rule will be fully implemented. The Base Case simulates mercury emissions from power plants and all other mercury sources, such as municipal and medical waste incinerators. The two regulatory scenarios lower power plant emissions according to requirements of the proposed MACT or Cap & Trade rules, but keep emissions from other sources constant. Holding emissions from other sources constant while varying emissions only from power plants allows researchers to estimate the impacts of EPA's proposed approaches to regulating utility mercury.

To perform the simulations, EPRI used a national economic model to evaluate the amount and chemical forms of mercury emitted from U.S. power plants under each scenario. These emission results were fed into a fine-scale model of mercury chemistry and physics in the atmosphere, which was used to calculate amounts and patterns of deposition throughout the United States under current conditions, the MACT rule, and the Cap & Trade rule.

EPRI's results show that the highest values of modeled deposition in the United States are produced by mercury emitted from sources other than power plants.
According to EPRI's computer simulations, after regulation, the areas of highest mercury deposition in the United States will continue to be those locations chiefly affected by emissions from sources other than power plants. Even with a liberal definition of utility-influenced deposition locations (i.e., where utility-emitted mercury makes up roughly 30 percent or more of the total deposition), only about 2.5 percent of US surface area falls into this category following MACT or Cap and Trade. The leading non-utility mercury deposition locations receive most of their mercury from municipal and medical waste incinerators. Locations affected by these incinerators would continue as the leading areas of mercury deposition in the mid-Atlantic and southern New England states, even after power plants have fully reduced their emissions. This result holds for either the MACT rule or the Cap & Trade rule. While distant non-U.S. mercury sources are the dominant contributors to deposition in much of the United States, non-utility U.S. sources emit mercury at rates and in forms that dominate deposition in their regions. Even after power plant sources are controlled, incinerators will continue to dominate the mercury contributing to deposition in high-deposition areas. Both regulatory approaches proposed by EPA would play an important role in reducing deposition in locations that have substantial deposits from utility sources in 2004. Power plant dominated locations would subsequently fall below the top 55 locations of highest human-caused deposition under

either regulatory approach. However, the Cap & Trade approach would produce markedly lower deposition at utility-dominated locations than would the MACT approach.

Neither proposed regulatory approach would increase deposition in high-deposition areas or create new high-deposition areas compared to current levels. The Cap & Trade rule produces greater mercury deposition reductions than does the MACT rule.

Modeling results for 2020 show that all states in the country will experience overall reductions in deposition due to the proposed mercury rules. But the reduction in mercury deposition is greater under the Cap & Trade rule (an average drop of 7 percent) than under the MACT rule (an average drop of 5 percent). Reductions in deposition vary somewhat by location, with greater reductions occurring in the mid-Atlantic and Southeastern states. This is because the proposed rules incorporate greater incentives for power plants in these regions to pursue mercury controls. Those power plants tend to burn bituminous coal, which emits a relatively higher proportion of divalent mercury, the chemical form most easily captured by currently available NOx and SOx emission control devices, as well as by mercury specific control devices currently under development. Since it is more cost-effective to reduce mercury emissions at these plants, they are more likely to install controls and therefore will have a greater relative impact on reducing mercury emissions and deposition. Finally, neither the Cap & Trade rule nor the MACT rule substantially lowers the highest deposition values that occur at locations in the Middle Atlantic and southern New England states, because the values at those locations are primarily influenced by emissions from municipal and medical waste incinerators.

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CHAPTER VII NORTH CAROLINA'S TOTAL AND SPECIATED MERCURY EMISSION ESTIMATES

NC UTILITY BOILER CHARACTERISTICS

North Carolina is one of the leading electricity producing states with 46 coal-fired utility boilers with a total capacity of 13,300 megawatts (MW). Duke Energy and Progress Energy companies own and operate a combined total of 46 boilers at 14 power stations, accounting for 97 percent of NC's electrical generating capacity. In addition, there are eight coal-fired cogeneration boilers at four stations producing nearly 500 MW that are not covered under the CSA, but would be subject to proposed federal EPA requirements.

All the Duke Energy and Progress Energy boilers burn pulverized eastern bituminous coal and currently employ electrostatic precipitators (ESPs) as their only particulate matter (PM) controls. Most of these boilers were built before 1977 and are not subject to EPA New Source Performance Standards. As is typical in other states, there are a wide variety of boiler vintages (1950's to 1980s), boiler manufacturers (Combustion Engineering, Babcock & Wilcox, Riley), boiler design types (tangential-fired, wall-fired), and boiler sizes (40 to 1250 MW). Likewise, the existing ESPs reflect a wide variety of vintages (1950's to 1980s), manufacturers (Research Cottrell, Western Precipitation, Buell, and Environmental Elements), design types (cold- and hot-sides), sizes (sectionalization) from 3 to 6 fields; collection plate areas from 80,000 to 980,000 square feet), and some with, and others without, resistivity conditioning systems (sulfur trioxide or ammonia injection) on cold-side ESPs.

The state's two main electrical utility companies are mandated to significantly reduce NO_x and SO_2 emissions to the caps and schedule stipulated in the NC CSA. Each of the two major utility companies submitted their plans identifying the boilers being retrofitted with NO_x and SO_2 control technologies and the corresponding retrofit schedules. In contrast to the definitive CSA provisions with corresponding NO_x and SO_2 technology plans already made by the utilities, the new State law does not mandate any specific requirements or technology choices for mercury emission reductions. Instead, considerable mercury emission reductions from utility boilers are expected as co-benefits from to the specific reductions of NO_x and SO_2 emissions.

Table VII-1 presents a summary-level profile of the current and planned emission control characteristics of the NC coal-fired boiler population. One change in planned emission control occurred since last year: Progress Energy is not planning to install a FGD scrubber on the Lee Unit 3 boiler as previously intended. The characterization highlights include:

- 99 percent with advanced NOx combustion controls based on generating capacity,
- 79 percent with SO_2 scrubbers based on generating capacity; 87 percent with SO_2 scrubbers based on the amount of coal fired in Btu/yr,

- 68 percent with cold-side ESPs based on generating capacity, and
- 32 percent with hot-side ESPs based on generating capacity.

TABLE VII-1.
GENERATING CAPACITY STATISTICS FOR NO_X AND SO_2 CONTROLS ON NC COAL FIRED ELECTRIC UTILITIES

Utility	Advanced NO_x Control [1]	Generating Capacity and Percent Capacity with NO_x Control	SO_2 Control	Generating Capacity and Percent Capacity with SO_2 Control
Duke Energy (28 boilers with 8,192 MW total)	Total MW with Advanced Control	8,192 MW	Total MW with Scrubbers	6,217 MW
	Percent MW with Advanced Control	100 %	Percent MW with Scrubbers	76 % by capacity (87 % by use factor, trillion Btu/yr coal fired)
Progress Energy (18 boilers with 5,111 MW total)	Total MW with Advanced Control	5,013 MW	Total MW with Scrubbers	4,325 MW
	Percent MW with Advanced Control	98 %	Percent MW with Scrubbers	85 % (88 % by use factor, trillion Btu/yr coal fired)
Statewide (45 boilers with 13,303 MW total)	Total MW with Advanced Control	12,756 MW	Total MW with Scrubbers	10,542 MW
	Percent MW with Advanced Control	99 %	Percent MW with Scrubbers	79 % (87 % by use factor, trillion Btu/yr coal fired)

1. Technologies considered as advanced NOx controls include SCR, SNCR, NH_3 injection, or combustion modification.

Table VII-2 summarizes the NOx and SO_2 control technologies and operational schedules selected for each of the 14 power stations by the two utility companies to comply with the CSA requirements. A few rather minor changes in FGD installation schedules were made. Also included in Table VII-2 are the stations' generating capacity and general type of ESP. To the extent possible, the table reflects the tendency in installing:

- SCRs on some of the largest boilers early in the schedule (2002-2004) and SNCRs on the medium sized boilers later in the schedule (2003-2009), and
- FGD wet and dry scrubbers on the medium and large boilers (200-1250 MW) across the schedule (2005-2012).

These trends tend to maximize cost-effectiveness and accelerate air quality improvement for the affected period (2002-2012).

TABLE VII-2.
NC CLEAN SMOKESTACK COMPLIANCE PLAN WITH SCHEDULE [1]

Facility	Rating (MW)	Existing ESP type[2]	Post-combustion NOx Controls		FGD SO_2 Scrubber Controls	
			Technology[2]	Operation Year	Technology[2]	Operation Year
DUKE POWER						
Allen	1160	Cold (1-5)	SNCR (1-5)	2003-07	Wet (1-5)	2011-12
Belews Creek	2490	Cold (1, 2)	SCR (1, 2)	2003-04	Wet (1, 2)	2008
Buck	370	Hot (3-6)	SNCR (3-6)	2006-09	None	
Cliffside	780	Hot (1- 4) Cold (5)	SNCR (1-4) SCR (5)	2002-09	Wet (5)	2009
Dan River	470	Cold (3) Hot (1, 2)	SNCR (1-3)	2007-09	None	
Marshall	2000	Cold (1- 4)	SNCR (1- 4)	2005-08	Wet (1- 4)	2006-07
Riverbend	970	Hot (4-7)	SNCR (4-7)	2007-08	None	
Subtotal	8,240			2002-09		2006-12
PROGRESS ENERGY						
Asheville	390	Cold (1, 2)	SCR (1, 2)	2009	Wet (1, 2)	2005-06
Cape Fear	320	Cold (5, 6)	ROFA /NH_3 (5, 6)		Wet (5, 6)	2011-12
Lee	410	Cold (1,3) Hot (2)	ROFA (2) SCR (3)	2007, 2010	None	
Mayo	750	Hot (1)	SCR (1)		Wet (1)	2008
Roxboro	2460	Cold (1-3) Hot (4)	SCR (1- 4)		Wet (1- 4)	2007, 2009
Sutton	610	Cold (3) Hot (1, 2)	ROFA (2, 3) NH_3 (3)	2006	Wet (No. 3 only)	2012
Weatherspoon	180	Cold (1-3)	None		None	
Subtotal	5,120					2005-2012

1. Data presented in Duke Power and Progress Energy Compliance Plan 2004 Annual Updates.
2. Number in parenthesis identifies boiler unit(s) equipped with corresponding emission control technology.

PRELIMINARY ESTIMATE OF TOTAL MERCURY EMISSIONS FROM NC UTILITY BOILERS

In 1999, the U.S. EPA conducted the Electric Utility Steam Generating Unit Mercury Information Collection Request (EU/ICR) to gather comprehensive information about mercury emissions from the coal-fired electric utility industry**.** This effort included collection of speciated Hg (elemental, oxidized, and particle-bound Hg species) emission control tests using the Ontario Hydro measurement method on 80 utility boilers. Recently validated by EPA and the utility industry, the Ontario Hydro method has become the

official method for measuring speciated Hg emissions from coal-fired utilities. The tests measured Hg rates in the coal feed to the boiler, and speciated Hg concentrations in the gas streams entering and exiting the emission control device. In addition, it also collected data on each of the roughly 1100 boilers in the United States of the important coal characteristics affecting Hg emission control. The coal data involved type, quantity burned, heating value, Hg, chlorine, sulfur, ash, and moisture content for the entire year of 1999. DAQ utilized each of the following tools to estimate Hg emissions from the existing and future planned emission control technology configurations for the NC coal-fired power plants.

EPA HG EMISSION ESTIMATING TOOL

DAQ staff utilized appropriate data to calculate the estimated emissions for each boiler for the corresponding categories of NC utility boilers (see Appendix C). For the case of existing boiler configurations, two categories were utilized: cold-side ESP and hot-side ESP, each with bituminous coal, conventional dry-bottom pulverized boilers (Bins 1 and 4, respectively). For the case of future planned configurations, two additional categories were utilized: cold-side ESP with wet scrubber and hot-side ESP with wet scrubber, likewise each with bituminous coal, conventional pulverized boilers (Bins 10 and 11, respectively). The amount of Hg fed to each boiler was calculated from the 1999 EU/ICR data as the product of the amount of coal burned and the Hg coal content. Then the Hg emission level from each boiler was then calculated as the combined product of the following three factors:

- Amount of Hg fed to each boiler,
- Total Hg collection efficiency, and
- Relative percentage of each Hg species (elemental, oxidized, and PM-bound) in the emissions.

EPRI HG EMISSION ESTIMATING TOOL

A similar engineering tool to develop *preliminary estimates* of speciated mercury emissions using site-specific information from electric utility boilers is available from the Electric Power Research Institute (EPRI).[51] While similar, the EPRI tool has three primary distinctions relative to the EPA tool.

- First, the EPRI tool sub-divides the 80-boiler EU/ICR emission database into only 11 categories. The data sets were grouped largely by emission control technology configurations, not by coal and boiler types.
- Second, EPRI's analysts concluded that the coal chlorine level was the dominant predictor of total and speciated Hg emission collection performance for all but one emission control technology (see third

[51] Electric Power Research Institute, "An Assessment of Mercury Emissions from U.S. Coal-Fired Power Plants," Final Report 1000608, October 2000.

distinction below). Given this correlation, they used regression analysis techniques to describe the relationship between coal chlorine level and Hg collection performance for 10 of the 11 categories of emission control technologies. This relationship predicts higher Hg emission control performance for increasing coal chlorine content. Coal chlorine is expressed in parts per million (ppm).

- Third, additional analysis indicated that for one emission control technology, namely cold-side ESPs, another chlorine-related factor, coal chlorine-to-SO_2 ratio, provided a better correlation with Hg collection performance than just coal chlorine. This relationship predicts higher Hg emission control performance for increasing coal chlorine/SO2 ratio. In this case SO_2 is expressed in lb/million Btu. [Limited copies of the report containing the EPRI tool are available to borrow from DAQ.]

In summary, EPA and EPRI used sound scientific principles in evaluating the EU/ICR database and in developing their respective engineering tools. DAQ considers both the EPA tool and the EPRI tool as viable means to estimate Hg emissions from the existing and future planned emission control technology configurations for the NC coal-fired power plants. Accordingly, DAQ has applied both tools to gain insight and understanding on the relative performance and emissions of existing and future planned emission controls on NC utility boilers.

NC COAL COMPOSITION

Both engineering tools recognize the importance of coal characteristics and emission control technology on the extent and control of mercury emissions. EPA divided up the EU/ICR data into coal types, and accounted for the amount of coal mercury. EPRI took another direction by accounting and correlating mercury control performance on coal chlorine composition or coal chlorine/SO_2 ratio. Table VII-3 presents coal composition data to show the favorable characteristics of the coal burned in NC electric utilities, including:

- Coal mercury content is slightly lower than the national average,
- Coal chlorine content is twice than the national average, and
- Coal chlorine/ SO_2 ratio is over three times more than the national average.

TABLE VII-3.
COMPARISON OF AVERAGE COAL BURNED IN NC AND USA ELECTRIC UTILITIES

Area	Coal Composition		
	Mercury, [1] lb/TBtu	Chlorine, [2] ppm	Cl/SO_2 Ratio [3]
NC	6.5	1400	1000
USA	7.0	700	300

1. Mercury content expressed as pounds of Hg per trillion Btu.
2. Chlorine content expressed as parts per million (ppm).
3. Chlorine to SO_2 ratio expressed as chlorine ppm per SO_2 ppm.

EMISSION ESTIMATES USING THE EPA AND EPRI TOOLS

Based on using input data from the 1999 EU/ICR, DAQ staff calculated the estimated emissions for each boiler for the corresponding categories of NC utility boilers using Excel spreadsheets. Table VII-4 compares the total Hg collection efficiencies delineated by emission control technology produced separately by the EPA and EPRI engineering tools. In three of the four emission control categories for existing and planned configurations, the EPRI tool predicts higher total Hg collection efficiencies than the EPA tool. Only in the case of Cold-side ESP followed by a FGD scrubber did the EPA tool predict a higher total Hg collection efficiency than the EPRI tool. Given the EPA predictions are based on a category average for each coal type, one performance number within a given coal/boiler/emission control type is developed, independent of coal chlorine content. The EPRI predictions are based on coal chlorine content or coal chlorine/SO_2 ratio. Consequently, there is a range of performance numbers developed, depending on the corresponding range of values of these two coal composition factors for the coals combusted in NC. Given that the EPA and EPRI tool developers took different directions in analyzing the available database, it is not surprising that performance levels for comparable control technologies did not turn out exactly the same.

TABLE VII-4.
MERCURY EMISSION CONTROL PERFORMANCE FOR EPA AND EPRI TOOLS

Emission Control Technology	EPA Tool [1]	EPRI Tool [2]
	Percent Total Mercury Removal, percent	
ESP Cold-side	29	40-48
ESP Hot-side	11	22-27
ESP Cold-side / FGD	78	65-70
ESP Hot-side / FGD	40	65

1. EPA prediction based on a category average for each coal type; one performance number within a given coal type is used independent of coal chlorine content.
2. EPRI prediction based on coal chlorine content or coal chlorine/SO2 ratio; a range of performance numbers is used depending on the corresponding values of these two coal composition factors.

Table VII-5 and Figure VII-1 present the results of the statewide mercury emission estimates for the current and future planned emission control configurations produced by using the EPA and EPRI tools. These two graphics show that:

- Nearly the same level of coal mercury feed levels as input to the boiler for both the EPA and EPRI tools of roughly 4,100 lb/yr.

- Modest emission reductions for the current set of emission controls; the EPA tool predicts nearly 3,000 lb/yr Hg emissions and 25 percent emission control, which are considerably higher than the EPRI tool predicting roughly 2,400 lb/yr Hg emissions and 42 percent emission control.

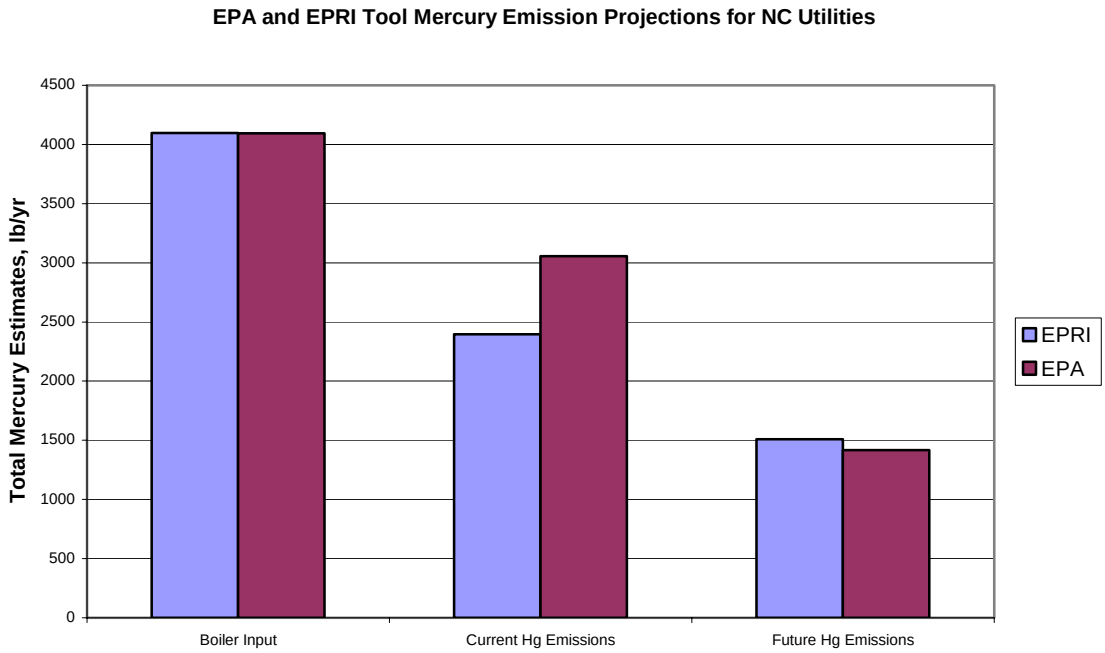
- Significant emission reductions for the future planned set of emission controls; the EPA tool predicts approximately 1,400 lb/yr Hg emissions and 65 percent emission control, comparable to the EPRI tool predictions of approximately 1,500 lb/yr Hg emissions and 64 percent emission control.

TABLE VII-5.
MERCURY EMISSION ESTIMATE PROJECTIONS
USING EPA AND EPRI TOOLS FOR NC ELECTRIC UTILITY BOILERS [1,2]

Tool	Total Mercury Levels				
	Boiler input, lb/yr	Emissions, lb/yr		Removal, %	
		Current	Future	Current	Future
EPA	4094	3057	1417	25	65
EPRI	4096	2397	1487	42	64
Average	4095	2727	1452	34	64

1. Projections assume the same coal supply and electric generation levels as 1999.
2. Estimate reflects average of EPA and EPRI tools.

FIGURE VII-1.
TOTAL MERCURY EMISSION PROJECTIONS FOR NC ELECTRIC UTILITIES USING EPA AND EPRI TOOLS

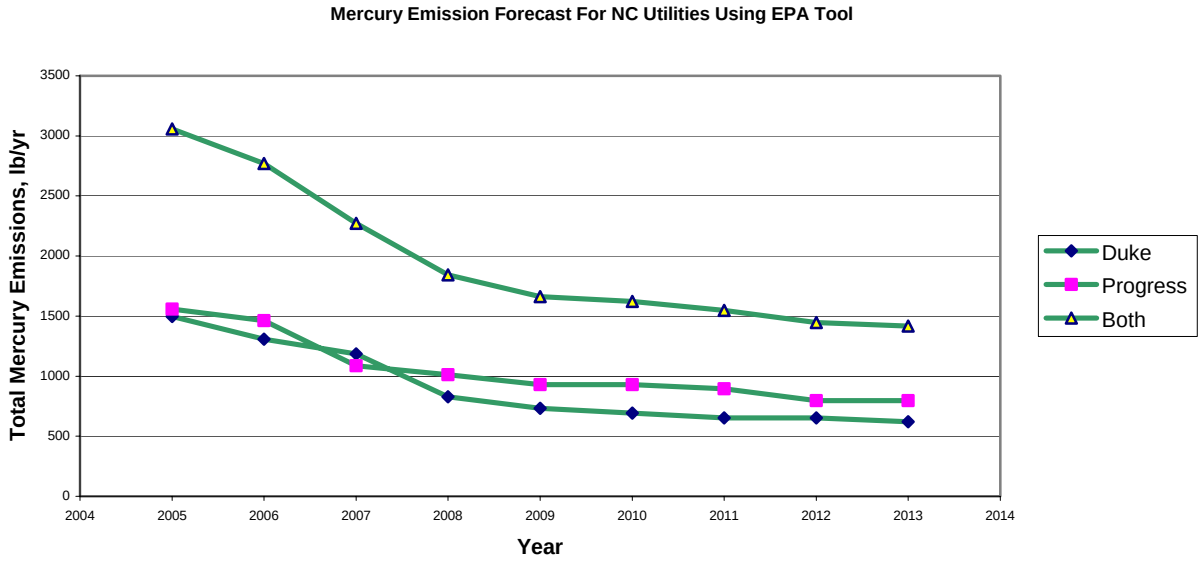


TOTAL MERCURY EMISSION FORECAST

The mercury emission estimate results from utilizing the EPA tool were applied with the SO_2 scrubber operational plans presented in Table VII-2 for forecasting emission reductions from 2005 – 2013. For the purpose of these future projections, it was assumed that the emission reductions from installing scrubbers would be fully effective during the year the utility company planned to install the equipment. This assumption was based on the general prediction that, on balance, the scrubber would become operational near mid-year and the boiler would be non-operational with no emissions for approximately a two-month period during equipment tie-in.

Figure VII-2 shows three graphs illustrating the estimated total mercury emissions for Duke Energy, Progress Energy, and the sum of both utilities. Note there are more emission reductions (reflected by the relatively steeper slope of the emission graphs) during the first half of the period (2005-2009) than in the second half (2009-2013) for all three graphs. Similar to the SO_2 case, this is due to the fact that each utility tends to install scrubbers on their largest units first, thereby achieving the largest emission reductions in the first half of the SO_2 / NOx compliance period.

FIGURE VII-2.
MERCURY EMISSION REDUCTION SCHEDULE FOR
NC ELECTRIC UTILITIES USING EPA TOOL



PRELIMINARY ESTIMATE OF SPECIATED MERCURY EMISSIONS FROM NC UTILITY BOILERS

For the past several years, advancements in the study of mercury have evolved to include examining the three chemical forms or species in which it is released into ambient air. The three species include elemental, oxidized, and particle-bound Hg. Total mercury is the sum of the three species. The term *speciation* is used to denote the relative amounts of these chemical forms of mercury. A related term – *partitioning* -- is similarly used in describing the relative behavior or outcome of the sub-division of these three parts of mercury species. Each mercury species has its unique set of chemical and physical properties leading to distinctive traits in terms of reactivity, toxicity, and collectability in emission controls.

To begin understanding the complex behavior of mercury in and from coal-fired exhaust gas, it is now standard practice to measure the individual mercury species. Given the capture of mercury by emission control equipment is dependent on mercury speciation, virtually all mercury studies for the past 5 years recognize the fundamental importance of focusing on particular mercury species. Research programs now provide information, methods, models, and data to address the key questions dealing with Hg speciation. Studies characterizing collection performance of various emission control technologies, behavior and transport of plumes, and plume deposition entails mercury species. For example, in terms of their contrasting properties and behavior, recent studies show that:

- Bituminous coal produces more oxidized Hg than other coal types;
- Most conventional and emerging control technologies capture oxidized Hg and particle-bound Hg much more effectively than elemental Hg;

- Elemental Hg is relatively stable, stays suspended for long time periods and is the dominant of the three species in ambient airs sheds; whereas

- Oxidized Hg emissions are fairly reactive, become attached to particles or other gases, and tend to be deposited within 25-50 miles of release. Of the three species, it can be argued that oxidized mercury represents the most important species to control from a state perspective because of its tendency to be deposited within a relatively short distance of release.

Given this basic and profound significance, DAQ utilized the available tools to quantify not only total mercury, but also speciated mercury emissions. The additional effort proved worthwhile, as interesting and encouraging information was produced regarding speciated mercury emissions.

Table VII-6 shows average results from the EPA and EPRI tools for the current and future situations delineating total and speciated mercury emission estimates from the NC utility boilers. It depicts the relative collection performance of ESPs in the current case of emission controls. The data in the table confirms that ESPs do not collect any elemental mercury, only collect a small fraction of oxidized mercury, but collect the majority of particle-bound mercury. Similarly, it depicts the relative collection performance of adding wet scrubbers to the majority of the boilers (80 percent by capacity, 87 percent on Btu heat input basis) in the future case of emission controls. The data in the table reflects that scrubbers do not collect any elemental mercury, collect a very high fraction of oxidized mercury, and likewise collect the majority of particle-bound mercury. It also suggests that some of the oxidized mercury collected in the scrubber is converted over to elemental mercury in the scrubber water, and is re-emitted out the stack.

The top half of Table VII-6 reflects a mass balance. For the current case of emission controls, it shows that the:

- Amount of mercury in the coal fed to the boilers is 4,100 lb/yr;

- Total mercury emissions are 2700 lb/yr;

- Oxidized mercury emissions are 1800 lb/yr, comprising most of the total mercury;

- Elemental emissions are 800 lb/yr; and

- Particle-bound emissions are 100 lb/yr.

(In rounded numbers to the nearest 100 for readability purpose and to reflect the nature of estimated numbers)

For the future case of emission controls, it shows some similar and contrasting facts, including:

- The same amount of mercury in the coal fed to the boilers would be 4,100 lb/yr;
- Total mercury emissions would be reduced to 1500 lb/yr;
- Oxidixed mercury emissions would drop to 400 lb/yr;
- Elemental emissions would be expected to *increase* to 1100 lb/yr, accounting for the majority of mercury emissions; and
- Particle-bound emissions would be reduced to 20 lb/yr.

The bottom half of Table VII-6 describes the data in terms of the relative percentage of mercury species for the two time cases. This helps to show how the mercury species are partitioned. In the current case:

- (All percentages presented below are relative to the mercury fed to the boilers):
- Emission controls (ESPs) collect 33 percent of the mercury fed to the boilers;
- The remainding 67 percent are released as emissions:
- Elemental emissions being 20 percent;
- Oxidized emissions being 44 percent, accounting for the majority of mercury emissions and
- Particle-bound emissions account for only 3 percent.

TABLE VII-6.
MERCURY MASS BALANCE AND PARTITIONING FORECAST FOR NC ELECTRIC UTILITY BOILERS [1,2]

Mercury Mass Balance							
Time	Coal Hg, lb/yr		Mercury Emissions, lb/yr				Total
			Total		Elemental	Oxidized	PM	
Current	4095		2727		813	1808	106	
Future	4095		1462		1061	384	17	
Mercury Partitioning [3]							
	Coal Hg, %		Removed in Emission Controls, %		Distribution of Mercury Emissions, %			
					Elemental	Oxidized	PM	
Current	100		33		20	44	3	100
Future	100		64		26	9	0.4	100

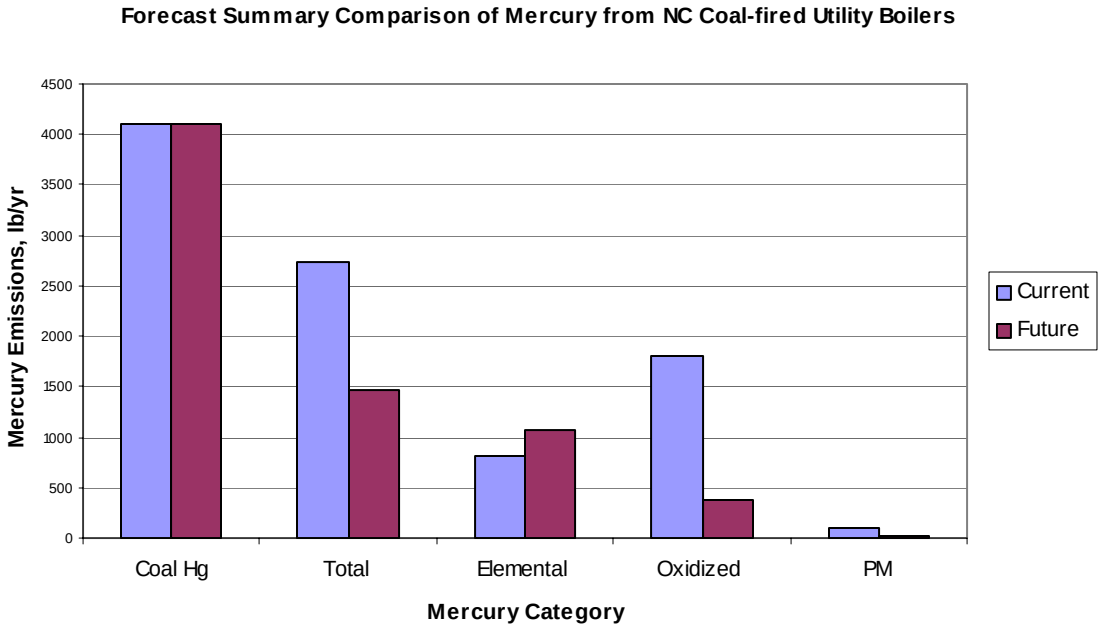
1. Projections assume the same coal supply and electric generation levels as 1999.
2. Estimate reflects average of EPA and EPRI tools.
3. Percentages presented are relative to the mercury fed to the boilers.

For the future case of emission controls, it likewise shows some similar and contrasting facts, including:

- Emission controls (ESPs and scrubbers) collect 64 percent of the mercury fed to the boilers;
- The remaining 36 percent are released as emissions:
- Elemental emissions would be expected to *increase* to 26 percent, accounting for most mercury emissions;
- Oxidixed emissions would drop to only 9 percent, and
- Particle-bound emissions would account for less than 1 percent.
  (All percentages presented above are relative to the mercury fed to the boilers)

Figure VII-3 graphically illustrates the same data as in Table VII-6 and can show the relative trends in total and speciated mercury emissions discussed above more readily for some readers.

FIGURE VII-3.
FORECAST SUMMARY OF TOTAL AND SPECIATED MERCURY EMISSION ESTIMATES FROM NC UTILITY BOILERS (REPRESENTS AVERAGE FROM EPA AND EPRI TOOLS)



Summary

Speciated data adds a new layer of valuable information regarding mercury emissions. Adding SO_2 scrubbers to most of the boiler capacity significantly deceases the amount of total mercury emissions from over 2700 to less than 1500 lb/yr. Of equal or possibly more importance, the addition of scrubbers reduces the amount of *oxidized* mercury emissions from over 1800 to less than 400 lb/yr. This means that only 9 percent of the 4100 lb/yr of mercury fed to the boilers (representing potential *oxidized* mercury emissions) is expected to be emitted in the future, a huge improvement over the current case of nearly 45 percent of boiler-fed mercury being emitted as *oxidized* mercury.

This significant reduction in *oxidized* mercury emissions suggests the possibility of considerable reductions in mercury deposition across NC. The exact amount of reduction in mercury deposition is unknown and considered controversial. The relative contribution of global versus statewide/local mercury emissions to atmospheric mercury deposition is poorly understood and remains an area of scientific debate. In general, there are two conflicting hypotheses:

- Hypothesis A. On one hand, roughly 90% of global mercury emissions come from abroad. Results of simulated modeling indicate that half of the mercury deposited in NC comes from abroad. This would suggest that even if NC could completely eliminate all its mercury emissions, there would only be a 50 percent drop in mercury deposition.

- Hypothesis B. On the other hand, data from the ongoing Florida study indicate a linear relationship between local emission reduction and deposition. This data suggests that any reduction in mercury emissions, especially *oxidized* mercury, will proportionally decrease local deposition and result in local environmental benefits within a few years. Accordingly, there could only be a nearly 2-fold or nearly 5-fold percent drop in mercury deposition, depending on whether the relationship is largely driven by total mercury or *oxidized* mercury.

Given that both engineering tools indicate similar performance levels, there is reasonable level of confidence in the expected emission reductions from adding scrubbers. These tools project emission reductions over current levels by nearly 2-fold for total mercury and nearly 5-fold for *oxidized* mercury. What is uncertain is whether Hypothesis A, B, or something in between applies in NC, and whether the relationship between emission reduction and environmental benefit is largely driven by total mercury or *oxidized* mercury.

CHAPTER VIII MERCURY CONTROL OPTIONS BEYOND CSA

OPTIONS UNDER THE CLEAN SMOKESTACK ACT ON THE DEVELOPMENT AND IMPLEMENTATION OF MERCURY STANDARDS AND PLANS

This report section is in response to Section 12 of the Clean Smokestacks Act (CSA) directing DAQ to study mercury issues. This Second Interim Report section includes a description of options that might be available in terms of standards and plans.

OPTIONS

This chapter discusses the rationale and plans to further study the complex and evolving science on mercury controls and effects. Included are three options with approximate dates for completion. We solicit the input of any and all interested persons concerning these or any other options.

- Option 1. Further study,
- Option 2. Set standards similar to those adopted or being considered by other states, or
- Option 3. Further study and then set standards, or
- Other sugested options.

OPTION 1. FURTHER STUDY; DEFER ANY RULEMAKING ACTION UNTIL A LATER TIME.

RATIONALE FOR FURTHER STUDY

First, as was the case when the CSA was signed in 2002, essentially all scientific information dealing with the benefits and costs of alternative strategies is still evolving, and is expected to continue evolving in the near-term. The federal government, electric power industry, and pollution control industry are advancing the technology and state-of-the-science on the measurement, control, fate, and health effects of mercury emissions.

Second, EPA is scheduled to finalize similar federal standards for controlling mercury emissions from coal-fired power plants in March 2005. The format of the federal requirements may add to the significant mercury emission reductions to be realized from the NC CSA.

Third, the relative impact of mercury deposition from local emission sources versus nearby states and the global "pool" is not fully understood; some data indicate that local sources have a profound effect, while other data suggest that emissions from abroad drive deposition. The different data makes it difficult to accurately predict mercury emission reductions and corresponding deposition from in-state power plants resulting from co-benefits of the NOx and SO_2 control device installations that will result from the CSA. It is also difficult to predict the effects from out-of-state areas from new EPA standards and/or NC's Section 126 petition urging emission reductions in 13 nearby states. In summary, it can be argued that it is too early and untimely at this point in time to

mandate any additional requirements beyond the CSA and the pending EPA standards for controlling mercury emissions from NC coal-fired power plants.

And fourth, NC appears to be the leading, or at least one of the leading, states in reducing mercury emissions from coal-fired power plants. This claim is based on our preliminary conservative projections that total and oxidized mercury emissions will be reduced by 65 percent and 90 percent, respectively, by 2013. These relatively high levels are consistent with the CSA, which stated that "[t]he General Assembly anticipates … significant reductions in the emissions of mercury."

SCOPE FOR STUDY

There are no "hard" data available that clearly and unambiguously establish the relationship between Hg emission reductions from scrubbed coal-fired power plant and the local Hg deposition impact. Given this data gap and the state's apparent mercury-sensitive environmental properties, a comprehensive study is being planned to determine this relationship. DAQ has the experience for such a study, including speciated Hg ambient air monitoring, meteorological monitoring, wet mercury deposition monitoring, and dispersion modeling. Coincidentally, two NC coal-fired utility boiler stations have started constructing FGD scrubbers for operation in 2005-2007, providing opportunity to collect the above- mentioned set of Hg data before and after scrubber operation. The plants are Duke Power's Marshall Station and Progress Energy's Asheville Station. DAQ will collaborate with the stakeholders in preparing a study plan in the summer/fall of 2004.

Concurrently, it would be beneficial for the NC utilities to collect new, or share any already collected, total and speciated mercury emission data from some of the power plants. This would help better establish their current emission levels and provide sets of data to compare and validate the EPA and EPRI emission estimating tools data. It would also provide additional opportunity to evaluate an evolving list of emission control technology options.

Currently three technology options are considered possibly viable for NC utility boilers:

- Wet FGD scrubbers on boilers only equipped with cold-side or hot-side ESPs. Studies show that FGDs following cold-side ESPs have much higher performance and, therefore are more cost-effective, in mercury removal than those following hot-side ESPs.

- Carbon injection on units equipped with cold-side or hot-side ESPs. Currently, conventional activated carbon injection is considered only applicable on cold-side ESPs, even though carbon injection with fabric filters produce much higher performance than cold-side ESPs. Specially-treated carbons, such as brominated carbon, are the only sorbents currently viable on hot-side ESPs. Duke Power conducted a 1-week long brominated-carbon injection feasibility test at its Cliffside station in 2003;

results were encouraging enough that a 1-month long test is scheduled in 2004 at Duke's Buck Station with the same technology.

- Carbon injection with a fabric filter on units equipped with cold-side or hot-side ESPs. A full-scale continuous demonstration with activated carbon injection and fabric filter treating flue gas from a bituminous-fired boiler with hot-side ESP has shown the capabilities and limitations of the technology since July 2003. Mercury capture results show performance in the 70 – 90 percent range.

Several other mercury and multi-pollutant control technologies offer potential, but the promise of their performance has not yet undergone enough performance and reliability testing.

SCHEDULE

A comprehensive study could be completed in 2007 or 2008 by DAQ, pending resource availability.

OPTION 2. SET STANDARDS LIKE OTHER STATES

Option 2. Set standards like other states requiring mercury emission reductions on a percent basis (such as 40, 80, or 90 percent as in CT, IN, and WI), a thermal release basis (such as 0.6 lb/million Btu as in CT, IN, and MA), or a energy production basis (such as 0.0066 lb/MWhr as in NJ).

RATIONALE FOR RULEMAKING

Five states (CT, IN, MA, NJ, and WI) have mercury emission reduction standards in place or are already planning to propose mercury emission reduction standards. These states take the position that, while the science and technology are not fully developed, they are adequately developed to initiate rulemaking requirements. Federal mercury emission standards have been in effect on waste incinerators using carbon injection (the same control technology being successfully demonstrated at power plants) for several years. [For example, the municipal waste incinerator near Wilmington, NC has been using carbon injection for 3 years.] States with mercury standards believe that, since rulemaking has a history of forcing cost-effective technological developments, rulemaking will again be the engine for development. Rulemaking bodies in these states are convinced they have mercury problems with corresponding health effects. To them, common sense dictates that they must reduce mercury emissions from their largest sources. Lacking federal rules, these states have exercised or are planning to exercise their independence while setting an example for other states to follow.

SCHEDULE

DAQ projects that rulemaking in response to directions from the General Assembly could commence as early as 2006, with implementation occurring at least two or more years thereafter.

OPTION 3. STUDY FURTHER AND THEN SET STANDARDS.

Upon completion of the comprehensive study outlined in Option 1, DAQ would initiate a rulemaking development effort, similar to that described in Option 2.

RATIONALE FOR STUDY FOLLOWED BY RULEMAKING

Some argue that it is simply too premature and untimely to mandate additional requirements beyond the CSA now, based on the nature and extent of complex, evolving science, technology, and pending federal regulations. DAQ's conservative estimates indicate that significant mercury emission reductions are already expected as a co-benefit under the CSA. Further study as outlined in Option 1 is expected to improve understanding of the issues, along with results from many ongoing studies by federal agencies and the industry. It could be beneficial for all stakeholders to wait until additional information is available for additional future mercury control than to propose standards soon that may need to be revised (up or down) later.

SCHEDULE

DAQ anticipates that the studies could be completed in 2007 or 2008, allowing rulemaking to occur in 2008 or 2009, with implementation at least two years thereafter.

REFERENCES

1. U.S. EPA, Mercury Compounds (www.epa.gov/ttn/atw/hlthef/mercury).

2. U.S. EPA, Mercury Research Strategy (www.epa.gov/ORD/NRMRL/ mercury).

3. U.S. EPA, Mercury Study Report To Congress, Volume 1, EPA-452/R-97-003, December 1997.

4. Dr. Gary Gill, Texas A&M University, Galveston, Chemistry of Mercury to Methylmercury, paper presented at Mercury Forum Meeting, May 2002.

5. U.S. EPA, Water Quality Criterion for the Protection of Human Health: Methylmercury (Final), EPA-823-R-01-001, January 2001.

6. U.S. EPA, Study of Hazardous Air Pollutants from Electric Utility Steam Generating Units Final Report to Congress, Volume 1, EPA-453/R-98-004a, February 1998.

7. U.S. EPA, Emissions of Mercury by Plant (www.epa.gov/ttnatw01/combust/ utiltox/pitxplt3.pdf).

8. Jeffrey Cole, RTI, Draft Memorandum, Statistical Analysis of Mercury Test Data Variability in Support of a Determination of the MACT Floor for the Regulation of Mercury Air Emissions from Coal-Fired Electric Utility Plants, August 28, 2002.

9. Carl Richardson, *et al*., Effect of NO_x Control Process on Mercury Speciation in Utility Flue Gas, Journal of the Air & Waste Management Association, Volume 52, August 2002.

10. Tests Indicates Mercury Removal Technology Effective But Costly, Power Engineering, November 2001.

11. Stephen Niksa, *et al*., A Mechanism for Mercury Oxidation in Coal-Derived Exhausts, Journal of the Air & Waste Management Association, Volume 52, August 2002.

12. C. Jean Bustard, *et al*., Full Scale Evaluation of Mercury Control with Sorbent Injection and COHPAC at Alabama Power E. C. Gaston, Journal of the Air & Waste Management Association, Volume 52, August 2002.

13. Ruud Meij, *et al*., The Fate and Behavior of Mercury in Coal-Fired Power Plants, Journal of the Air & Waste Management Association, Volume 52, August 2002.

14. Loreal V. Heebink and David J. Hassett, Release of Mercury Vapor from Coal Combustion Ash, Journal of the Air & Waste Management Association, Volume 52, August 2002.

15. Carl Richardson, *et al*., Effect of NO_x Control Process on Mercury Speciation in Utility Flue Gas, Journal of the Air & Waste Management Association, Volume 52, August 2002.

16. U.S. EPA, Mercury Emissions and Electric Utilities: Fact Sheet (www.epa.gov/ttn/oarpg/t3/fact_sheet/hg17th.pdf)

17. Draft memorandum dated August 28, 2002, from Mr. Jeffery Cole, RTI, to William Maxwell, EPA/OAQPS/ESD/CG, "Statistical Analysis of Mercury Test Data Variability in Support of a Determination of the MACT Floor for the Regulation of Mercury Air Emissions from Coal-Fired Electric Utility Plants."

18. EPRI Journal Online (www.epri.com/journal/details.asp?id=376).

19. Kirk-Othmer, *Concise Encyclopedia of Chemical Technology*, A Wiley-Interscience Publication, (New York 1985), John Wiley and Sons, Inc.

20. EPA Website www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html.

APPENDIX A
SCHEDULE OF PRESENTATIONS

Due to size of electronic files, these presentations are not included in the printed version of this report, but may be seen at DAQ's website: http://daq.state.nc.us/news/leg/2004-04-hg-co2-agenda.pdf

Monday, April 19

Introduction and Welcome
Keith Overcash, Director, NC Division of Air Quality, DENR

Background and Significance of Clean Smokestacks Act
Brock Nicholson, Deputy Director, NC Division of Air Quality, DENR

Purpose and Charge for this Workshop, Logistics, etc.
Jim Southerland, Environmental Engineer, NC Division of Air Quality, Planning Section

Basis for Issues to be Discussed: CO_2 and Mercury
Moderator, Sheila Holman, Planning Chief, NC Division of Air Quality

Review of the Science and Concerns for Climate Change in North Carolina
Ryan Boyles, Associate State Climatologist, State Climate Office of NC at NCSU

History and Transitions of the Global Warming Program and Policies in the US
Wiley Barbour, Environmental Resources Trust

Development, Components and Status of the NC State Energy Plan
Larry Shirley, Director, NC State Energy Office, NC Department of Administration

Health Effects of Methylmercury and North Carolina's Advice on Eating Fish
Dr. Luanne Williams, Toxicologist, NC Department of Health and Human Services

Recent NC Water Quality Mercury Monitoring Results
Michelle Woolfork, Water Quality Engineer, NC Division of Water Quality

Update on DAQ's Air Quality Measurements and Mercury Studies
Steve Schliesser and Todd Crawford, Toxic Protection Branch, NC Division of Air Quality

Lunch Speaker - Importance and Impacts of CSA Sections 12 and 13 and Your Input for the Future of North Carolina
Secretary William (Bill) Ross, NC Department of Environmental and Natural Resources

General Mercury Topics and Issues Session (Hg-1)
Moderator, Michael Abraczinskas, Environmental Engineer/Meteorologist, NC Division of Air Quality

Voluntary Mercury Reductions: NC Champions
Norma Murphy, NC Division of Pollution Prevention (P2), DENR

State of Science/Ability to Measure Mercury in Smokestack Environments
Barrett Parker, USEPA

Developing a Tool for Estimating Mercury Emissions and Reductions from Coal-Fired Utilities
Jeff Cole and C. Clark Allen, RTI International

` **Atmospheric Modeling and Deposition of Mercury from Stack to Sounds and other Water Bodies**

O. Russell Bullock, Jr., Meteorologist, NOAA Air Resources Laboratory (on assignment to the EPA Office of Research and Development)

Historical Scientific Examination of Mercury Deposition to the Florida Everglades over the Past 100 Years or Atmospheric Mercury; Pandora's Box Revisited
Dr. Thomas D. Atkeson, FI DEP, Tallassee, FL, Robert K. Stevens, FL DEP (at US EPA, RTP, NC), and Matthew S. Landis, US EPA, RTP, NC

Tuesday, April 20

NC Specific Mercury Topics and Issues – Session 2 – (Hg-2)
Moderator, Steve Schliesser, Senior Environmental Engineer, NC Division of Air Quality

USEPA's Proposed Mercury MACT and Alternate Proposals for Mercury Reduction Trading Options
A Summary of Options and Schedule for Comments and Final Regulations
Bill Maxwell and Dr. Bob Wayland, USEPA

Performance and Costs of Mercury Control Technology for Bituminous Coals
Dr. Michael Durham, President, ADA Environmental Solutions

Achieving CSA System-wide Reductions in (NOx &SO_2) Emissions at Duke Energy Facilities and Reactions to Achieving EPA's MACT/Trading Proposals for Mercury (Including limited comments on options for new technologies, etc.)
Robert A. McMurry, Duke Energy

Achieving CSA System-wide Reductions in (NOx & SO_2) Emissions at Progress Energy Facilities and Reactions to Achieving EPA's MACT/Trading Proposals for Mercury
Ben White, Progress Energy

Estimated Emission Reductions in NC from Co-control as a Result of CSA, Using EPA Tool to Estimate NC Coal-Fired Power Plant Mercury Emissions
Steve Schliesser & Paul Grable, Environmental Engineers, NC Division of Air Quality

Developing Policy Options That Can Result in Integration of CO_2 and Mercury Reductions and State Implementation Plan Credits
Alden Hathaway, Environmental Resources Trust, Inc., Washington, DC

Lunch Speakers – Mercury and CO_2 Emissions from the Power Generation Sector
***Dr.** C.V. Mathai, Manager for Environmental Policy, Arizona Public Service Company, Phoenix, AZ*

Insights from Economic Analyses of the Impacts to the Utility Industry from Mercury and CO_2 Controls, *Dr. Anne E. Smith, Vice President, Charles River Associates, Washington, DC*

Mercury Reduction Programs in Other States
Martha Keating, Air Toxics Scientist, Clean Air Task Force

General CO_2 Topics and Issues (CO_2)
Moderator, Phil Besesi, Project Manager, NC State Energy Office

Potential Impacts for the NC State Energy Plan on Emissions of CO_2 with Technical Procedures and Assumptions Upon Which These Plans Were Developed
Jeff Tiller, Appalachian State University

Technology, Energy Efficiency, and Renewable Energy for Emission Reduction
Ward Lenz, Director, Energy Programs and John Morrison, Vice President, Advanced Energy

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The People, the Planet, and the Pocketbook: How a Green Builder Program Can Avoid Emissions Using Solar Energy
Dona Stankus, AIA, NC Solar Center

Potential in NC for Extraction of Wind Energy
Dr. Dennis Scanlin, Professor, Technology Department, Appalachian State University

Past, Present and Projected Participation in Climate Wise by North Carolina Companies
James Haven, Global Warming Initiatives, Inc.

Wednesday, April 21

NC Specific CO_2 Topics and Issues – Session (CO_2-2)
Moderator, Phyllis D. Jones, NC Division of Air Quality

Review of Real/Practical and Projected Options fro CO_2 at a Coal-Fired Generating Unit
Kevin Johnson, URS

Integrated Gasification Combined Cycle (IGCC) Technology; Carbon Sequestration and Cost Implications
Joe Chaisson, (Harpswell, ME), Clean Air Task Force (Boston, MA)

Forestry and Agriculture as Real Options to Increase Carbon Sequestration in Vegetation and Soils
Dr. William H. Schlesinger, Dean, The Nicholas School of the Environment & Earth Sciences, Duke University.

NC Animal Waste as a Potential Resource for Reducing CO_2 and Methane Emissions
Kurt Creamer P.E., Animal and Poultry Waste Management Center, *NC State University*

Industry Experience in Reducing CO2 and GHG Emissions – A Case Study of International Proportions
Bill Bailey, DuPont, Charlotte, NC

What Other States Are Doing or Considering Regarding Reductions of CO2 From Coal-Fired Utilities – With an Update from Milan and Introduction to STAPPA/ALAPCO's Software
Amy Royden, STAPPA/ALAPCO

Lunch speaker – Herding Sheep: The Commons and the Marketplace
Michael Shore, Environmental Defense

Overview of the Southeast Regional Carbon Sequestration Partnership
Gerald R. Hill, Ph.D, Senior Technical Advisor, Southeastern Regional Carbon Sequestration Partnership

Rate Implications Due to Mercury Reductions
Elise Cox, Assistant Director, Public Staff, NC Utilities Commission

Closing Comments by Keith Overcash, Director, NC DAQ

APPENDIX B

LETTERS ADDRESSING PERCEIVED FLAWS IN PROPOSED STANDARDS OF PERFORMANCE FOR NEW AND EXISTING STATIONARY SOURCES: ELECTRIC UTILITY STEAM GENERATING UNITS

STAPPA/ALAPCO Letter

Concerning the "National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units: Proposed Rule,"

June 29, 2004

Docket ID No. OAR-2002-0056
EPA Docket Center (Air Docket)
U.S. Environmental Protection Agency
West (6102T), Room B-108
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Dear Sir or Madam:

On behalf of the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO), thank you for this opportunity to comment on the "National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units: Proposed Rule," which was published in the *Federal Register* on January 30, 2004 (69 *Federal Register* 4652) and the "Supplemental Notice for the Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units," which was published in the *Federal Register* on March 16, 2004 (69 *Federal Register 1*2398).

It is well known that mercury is a powerful neurotoxin that accumulates in the food chain and can cause damage to the brain and nervous system when ingested. In fact, because of methylmercury contamination, the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration, 45 states throughout the country and other organizations, such as Health Canada, have issued fish consumption advisories to the public due to elevated concentrations of mercury. In January 2003, the Centers for Disease Control and Prevention estimated that nearly 8 percent of women of childbearing age are exposed to mercury levels that are above those considered safe for a developing fetus. More recently, EPA researchers have indicated that, based on examinations of umbilical cord blood, the estimate is closer to 15 percent.

In view of the dangers associated with exposure to mercury and other hazardous air pollutants, STAPPA and ALAPCO believe it is extremely important that EPA take swift and aggressive steps to reduce emissions of these pollutants from utilities and other source categories.

Unfortunately, for the reasons that will be described in these comments, STAPPA and ALAPCO are extremely dismayed with EPA's proposals to regulate hazardous air pollutants from electric utilities. We do not believe the rule will adequately protect public health and the environment, a concern that is shared by many others. For example, the Children's Health Protection Advisory Committee (CHPAC), a panel of experts that EPA formed to advise the agency on issues related to the protection of children's health, has expressed deep concerns with EPA's proposed rule. Specifically, CHPAC stated, "[f]rom our understanding, the unique vulnerabilities of children, infants, and women of child-bearing age were not adequately considered in the development of the EPA's proposed rule." Additionally, CHPAC indicated that the current proposal does not go as far as feasibly possible and "[t]o protect children from mercury exposure, EPA needs to go beyond the minimum required by statute (i.e., the proposed MACT floor)."

In view of our deep concerns and the objections other groups have expressed regarding the proposal, STAPPA and ALAPCO strongly urge the agency to abandon its proposed strategy and, instead, develop final Maximum Achievable Control Technology (MACT) standards, with stringent emission limits and expeditious deadlines, as required by Section 112(d) of the Clean Air Act. We have several major concerns with EPA's proposals, which we will articulate in this comment letter.

Flawed Emission Limits Under Sections 111 and 112

EPA has included several options for addressing emissions of hazardous air pollution from electric utilities, including proposals under Section 111, Section 112(d), and Section 112(n) of the Clean Air Act. We oppose all three options for a variety of reasons; most importantly, each is extremely weak and not sufficiently protective of public health and welfare.

We believe the Clean Air Act clearly calls for emissions of hazardous air pollution from electric utilities to be regulated under Section 112. Therefore, EPA's proposal to regulate those sources under Section 111, instead, is totally inappropriate. Furthermore, the limits contained in the Section 111 proposal are not nearly stringent enough. The proposal calls for an interim emissions cap – expected to be 34 tons per year – to be achieved by 2010 that, in fact, does not require *any* additional control of mercury beyond the co-benefits expected from other programs aimed at reducing emissions of sulfur dioxide and nitrogen oxide, such as the Interstate Air Quality Rule (IAQR). It appears, then, that the interim cap for mercury is wholly dependent upon the IAQR, rather than on any measures specifically designed to address hazardous air pollutant emissions. What would happen if, for some reason, the IAQR does not become final? Would the 2010 cap remain enforceable? Moreover, while EPA specifies a 15-ton final cap to be achieved in 2018, the agency acknowledges in its proposal that mercury

emissions could reach 22 tons (or only a 54-percent reduction from the 48 tons determined in 1999) in 2020, when banking and trading are utilized. Thus, EPA's stated 15-ton cap will not truly be achieved. We believe this does not adequately reflect what is technologically feasible and falls far short of what is needed to provide appropriate public health and environmental protection.

While we support regulating hazardous air pollution emissions from utilities under Section 112, as Congress intended, we believe EPA's proposals under Section 112(d) and 112(n) are seriously flawed. The EPA proposal sets MACT levels that would result in national emissions of 34 tons per year, which is clearly not consistent with the legislative mandate for calculating MACT under Section 112. Astonishingly, these levels are even less stringent than the recommendations made by industry representatives during an EPA-sponsored utility MACT development stakeholder process.

STAPPA and ALAPCO are extremely troubled by the statistical analysis regarding the variability of mercury content that EPA used in developing the proposed MACT standard. We believe the Clean Air Act is clear that EPA should base MACT for existing sources on the average of the top 12 percent of sources. We also believe variability in coal mercury content is adequately addressed in the annual averaging time of the standard. EPA's method for accounting for the variability of mercury content in coal is an inappropriate manipulation of the data. It resulted in emission limits that are far more relaxed than they should have been, based on the appropriate use of available data on well-controlled sources. Several state and local air agencies have conducted a thorough review of EPA's variability analysis and are providing the agency with specific comments regarding its inadequacies. We urge EPA to review those comments carefully. In light of our concern about the inappropriateness of EPA's variability analysis, we strongly urge EPA to develop the final MACT standard *without* the faulty statistical analysis the agency incorporated into the development of the proposal.

In addition to using a flawed variability analysis to develop the MACT standards, EPA failed to consider all available technologies. For example, activated carbon injection is commercially available and is widely recognized as a viable control technology for mercury. It has been demonstrated with pilot and full-scale demonstration projects on coal and has been used for over 10 years on other large combustion sources. Also, states are now requiring that activated carbon injection be installed on new coal-fired units for the control of mercury. In failing to consider available technologies like activated carbon injection, EPA has veered significantly from its past approach for developing mercury emission limits for combustion sources and has provided no justification for this dramatic change in the development of emission limits.

In previous MACT standards, EPA has not required technologies to be in long-term use to be considered "commercially available" and to be evaluated as a potential control method. Specifically, at the time EPA proposed the new source performance standards and emission guidelines for municipal waste combustors, activated carbon injection had been tested at only two facilities in the United States. Nonetheless, EPA justified the proposal to use activated carbon injection to set emission limits for mercury

"beyond the floor" because the tests showed lower mercury emissions to be achievable, and because the incremental costs to control mercury beyond the floor were low (59 *Federal Register* 48198 and 48228). EPA did not indicate that its deliberation was limited to control strategies the agency determined to be in long-term use when developing emission limits. Further, EPA continued to evaluate the applicability and efficacy of activated carbon injection when developing mercury emission limits at hazardous waste and medical waste combustors, even when this technology was rarely used at facilities.

EPA has not provided justification for considering coal-fired power plants in a different light. In fact, EPA has likely significantly frustrated the rapid and wide deployment of mercury control technologies by not considering their use for utility boilers, since the very act of EPA evaluating a technology as a means of developing an emissions limit drives the further development and installation of technologies.

EPA is undoubtedly well aware from its research that sorbent injection technologies, such as activated carbon injection, have been demonstrated to achieve significant mercury emission reductions at coal-fired power plants, regardless of coal-type. For example, a recent study by the Northeast States for Coordinated Air Use Management (*Mercury Emissions from Coal-Fired Power Plants* – October 2003) concludes, based on full-scale demonstration of activated carbon injection technology, that mercury control efficiency of above 90 percent is feasible (at costs similar to those of nitrogen oxide removal).

State and local permitting authorities have been relying on results from these studies to establish mercury emission limits in permits issued for the construction of coal-fired boilers. For example, Wisconsin is preparing to permit a coal-fired electric utility plant, using subbituminous coal, at 83-percent control efficiency.[52] Also, Iowa has issued a permit for a facility that will operate with subbituminous coal. That permit sets a limit of 1.7 lb Hg/TBtu, which is equivalent to an 83-percent reduction for operation with coal from the source with the highest average mercury content.[53]

Clearly, since a coal-fired power boiler operator holding a permit with mercury limits that rely on sorbent injection has commenced construction of a facility under that permit, the technology is clearly in commercial use, and thus must be considered in the development of mercury emission limits.

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[52] Wisconsin Public Service Corporation Weston Unit 4 – 500 MW supercritical pulverized subbituminous coal-fired boiler; 1.7 lb. of Hg./TBtu controlled; 10.0 lb. of Hg./TBtu uncontrolled; 83% mercury control efficiency; sorbent injection/baghouse/dry FGD; sorbent not identified.

[53] MidAmerican Energy Company CBEC (Council Bluffs Energy Center) Unit 4 - 790 MW (estimated net) 7,675 MMBtu/hr heat input supercritical pulverized subbituminous coal-fired boiler; 1.7 lb. of Hg/TBtu (controlled); 10 lb. of Hg/TBtu (uncontrolled); expected control efficiency of 83% on coal with highest average mercury content; activated carbon injection with a minimum feed rate of 10 pounds per million cubic feet of exhaust gas. An optimization study required in which facility is to optimize control and can try other sorbents. Other controls - baghouse/selective catalytic reduction (SCR)/dry flue gas desulfurization (FGD).

Finally, EPA's proposal also includes an alternative MACT scheme that would allow for a cap-and-trade program similar to the proposal under Section 111. The preamble indicates that EPA would institute such a program under the provisions of Section 112(n) of the Clean Air Act. Section 112(n) calls for EPA to conduct a study for Congress describing the public health hazards resulting from utility emissions and describing control alternatives. Section 112(n) also states that "[t]he Administrator shall regulate electric utility steam generating units under this *section…,"* (i.e., Section 112) (emphasis added). It does not indicate that the regulations should be established under that *subsection* (i.e., subsection 112[n]). Sections 112(d), 112(f) and 112(h) of the Clean Air Act are the only subsections of Section 112 under which EPA is authorized to establish National Emission Standards for Hazardous Air Pollutants (see 40 CFR 63.2). Therefore, EPA is not authorized to establish emission standards under Section 112(n).

Recommended MACT Standard

As the Clean Air Act requires, EPA should establish a MACT standard that reflects *at least* "the average emission limitation achieved by the best performing 12 percent of the existing sources" or "the emission control that is achieved in practice by the best controlled similar source." Rather than recommending a specific technology, STAPPA and ALAPCO suggest a performance standard. Also, we prefer a common standard for bituminous and subbituminous coal, but different percent limits can be considered for the coal types, as long as the limits provide for very good controls of mercury emissions and do not promote fuel switching or blending to avoid controls (see discussion below). Accordingly, STAPPA and ALAPCO believe it is reasonable to consider 90-percent control for sources using bituminous coal and 80-percent control for units firing subbituminous coal. These limits would result in a national emission reduction between 85-90 percent, which is much more stringent than the decreases expected from EPA's proposal.

In summary, we do not believe EPA's proposal is appropriate or consistent with the requirements of the Clean Air Act. As we have recommended, the agency should calculate and establish a more stringent MACT level, in accordance with a proper reading of Section 112.

Coal Blending and Switching

We are concerned about the effects of fuel switching and blending under EPA's proposal. The proposed limits for subbituminous coal are so lax – in fact, they are tantamount to no control – that facilities may switch from bituminous to subbituminous coal or blend their fuels simply to obtain a higher allowable limit and escape stricter controls. The result would be higher emission limits and greater emissions of mercury. We recommend that the final rule address this problem by requiring a stricter emission limit for subbituminous coal (i.e., 80 percent). Additionally, EPA should require facilities that blend fuels to meet the most stringent emission limit that applies to whatever types of coal it uses.

Deadlines

We are very concerned that the deadlines in the Section 111 proposal are extremely protracted. While the settlement agreement under which EPA is operating calls for the agency to issue final utility standards for hazardous air pollutants by March 2005 (formerly December 2004), with compliance by December 2007, EPA's proposal postpones final compliance until 2018 and, as mentioned, would allow compliance to be delayed even further, perhaps for many years, due to banking and trading. We believe this extraordinary delay in compliance is inappropriate and counter to the mandate of the Clean Air Act and the settlement agreement.

The Clean Air Act requires that MACT be determined first and be no less stringent than the average of the best 12 percent of sources. The timing of compliance is to be a separate consideration. If, after the MACT determination is complete, it becomes evident that more than three years is required for all facilities to comply, additional time is available under Sections 112(i)(3) and 112(i)(4) of the Clean Air Act. If Congress had intended for EPA to always limit a MACT determination to what could be achieved in three years, it would not have provided these special extensions.

We recognize that the adoption of facility-by-facility controls with the effectiveness we are recommending represents a significant commitment on the part of many sources and may require more time than the traditional three-year compliance time period for MACT sources. Therefore, if needed, EPA can provide the extensions of time for compliance that are already available within the Clean Air Act.

Trading

STAPPA and ALAPCO are extremely concerned that EPA is proposing on a national basis to allow trading of mercury emissions between utilities. Not only do we question the legality of mercury trading, we are also very concerned that trading could lead to serious "hotspot" problems around the country.

While mercury emissions can travel great distances, some of the pollutant can also be deposited near its source. In fact, there is recent evidence that sources of mercury can have significant local impacts. In November 2003, the state of Florida published a study entitled, *Integrating Atmospheric Mercury Deposition with Aquatic Cycling in South Florida*, which estimated how quickly fish tissue levels respond to decreased regional mercury emissions. According to state officials, drastic reductions in the mercury concentrations in fish and wading birds in the Everglades "…are directly linked to the installation of technology that reduced mercury in emissions from industries in South Florida by a 100-fold during the last two decades." Additionally, according to a report of the New Jersey Mercury Task Force, which examined local emissions, models, and other studies, "it is likely that approximately half of the mercury that is deposited in New Jersey comes from relatively nearby sources." Thus, the concern about local sources causing local mercury hotspots must not be dismissed.

In the proposal, EPA has likened the mercury trading proposal to the acid rain trading program that is in place. Such a comparison is not appropriate because of the nature of the pollutants in question. While the acid rain program focused primarily on emissions contributing to welfare effects, the utility proposal focuses on mercury, which is a neurotoxin with serious health impacts. The two programs are not comparable.

EPA has proposed that any hot spots could be addressed through the adoption of more stringent state or local standards. While the adoption of more stringent standards by state and local agencies is a fundamental right that the Clean Air Act provides for almost all of its programs, the reality is not so clear-cut. Implementing more protective air quality measures is often unrealistic, if not impossible, for many areas. According to a survey that STAPPA and ALAPCO conducted, approximately one-half of state air pollution control agencies have restrictions on their ability to adopt programs that are more stringent than those of the federal government. Therefore, there is the very real possibility that EPA's proposal would result in hot spots that would remain unaddressed, endangering the population living in that area and the surrounding environment.

We have reviewed the trading program EPA outlined in both the proposal published in the *Federal Register* on January 30, 2004 and the supplemental notice on March 16, 2004, In light of the concerns we have raised regarding trading of mercury emissions between utilities, we recommend that EPA abandon this approach.

Additional Deficiencies of Proposed Use of Section 111

As stated earlier, STAPPA and ALAPCO believe EPA's choice of Section 111 as the vehicle for regulating emissions of hazardous air pollutants from electric utilities is highly inappropriate. By using Section 111 of the Clean Air Act to regulate mercury and nickel emissions from utilities, EPA has ignored other important statutory obligations under Section 112 of the Clean Air Act. For instance, EPA is disregarding the mandate to examine other hazardous air pollutants including, but not limited to, arsenic, chromium, cadmium, dioxins and hydrogen chloride. We strongly urge EPA to address emissions of other hazardous air pollutants in addition to mercury and nickel and to do so under Section 112.

Furthermore, while Section 112 requires EPA to evaluate and address the risks that remain eight years after a MACT standard is issued, Section 111 circumvents those requirements and does not mandate a future evaluation of residual risk. The Residual Risk program contained in Section 112(f) is a critical element of the Clean Air Act's efforts to protect public health against the dangers of exposure to toxic air pollution and should be applied to utilities, as it is to other sources of hazardous air pollutants.

STAPPA and ALAPCO strongly believe there is no justification for EPA to take such a huge legal risk by regulating mercury under Section 111 of the Clean Air Act when Congress clearly intended that mercury, like other hazardous air pollutants, be regulated under Section 112. Adoption of a Section 111 rule will undoubtedly be the

subject of protracted legal battles, which will further delay the protection of public health and the environment.

Finally, we are concerned that the use of Section 111, rather than Section 112, will result in a process similar to the State Implementation Plan (SIP) system currently used for Criteria Pollutants. That is, each state or local agency will be required to develop a plan, submit it to EPA, and await approval. Rather than a uniform national approach to regulating HAP emissions from utilities, which Section 112 would provide, the result of a Section 111 regulation would be a time-consuming process, a duplication of effort by each state and many local agencies, and an inconsistent set of state-by-state programs.

Process for Developing the Proposals

We feel compelled to comment on the process EPA used to develop these proposed standards. STAPPA and ALAPCO representatives were involved in the formal, one-and-a-half year Federal Advisory Committee Act (FACA) stakeholder process that EPA sponsored to develop the utility MACT. The FACA workgroup consisted of federal, state, local, industry and environmental group representatives, including six members representing state, local and tribal agencies; eight members representing environmental organizations; 14 members representing industry; one member representing control equipment vendors; and two members representing coal interests, producers and unions. This group met 14 times over a period of 18 months and thoroughly analyzed all issues related to the regulation of toxic air pollution from utilities.

In its January 30, 2004, proposal, EPA completely disregarded the stakeholder group's deliberations. For example, during the stakeholder process, the group never considered the possibility of substituting Section 111 for Section 112. In addition, the FACA workgroup dismissed the possibility of trading mercury emissions between utilities. Furthermore, upon completing the process, the workgroup requested that EPA complete integrated planning modeling based on the workgroup's final recommendations. EPA has failed to do this. It is unacceptable that EPA would abandon the efforts of the agency's FACA workgroup and propose a rule that represents such a marked departure from what the stakeholders considered and recommended. In addition to rejecting the expert advice the agency needed, EPA's action undermines and devalues the entire FACA process.

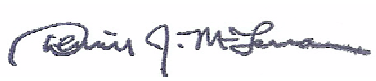
While we were extremely disappointed that the recommendations of the FACA workgroup were ignored, we were absolutely astonished to learn that the proposals EPA issued contained evidence of excessive reliance on industry input. For example, we noted that portions of documents supplied by an industry group and a law firm representing industry clients appeared verbatim or in nearly identical form in the proposals. This does not reflect an open process that takes into account the recommendations of the other stakeholders.

Conclusion

In light of all of these serious concerns with EPA's proposed regulations for limiting hazardous air pollutant emissions from utilities, STAPPA and ALAPCO strongly urge EPA to abandon its proposed strategy, and, instead, develop final MACT standards with stringent limits as required by Section 112(d) of the Clean Air Act. We continue to believe that the adoption of MACT standards for utilities is necessary and appropriate to protect public health and the environment.

Please do not hesitate to contact us if you need additional information.

Sincerely,



James A. Joy, III
President of STAPPA

Dennis J. McLerran
President of ALAPCO

North Carolina Division of Air Quality Letter

June 29, 2004

EPA Docket Center (Air Docket)
U.S. EPA West (6102T)
Room B-108
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460
Attention Docket ID No. OAR-2002-0056

To Whom It May Concern:

On behalf of the North Carolina Division of Air Quality (DAQ), I would like to offer comments on the U.S. Environmental Protection Agency's (EPA's) proposed and supplemental proposed rules addressing national emission standards for hazardous air pollutants (NESHAP) for mercury and nickel which were published in the Federal Register January 30, 2004 and March 16, 2004.

My comments focus on three areas: the health effects of mercury in North Carolina, a comparison of the EPA proposal with existing measures in North Carolina, and a discussion on the relationship between the EPA proposal and future steps required to be taken by North Carolina.

Health Effects of Mercury in North Carolina

Methylmercury levels in fish from eastern North Carolina continue to be elevated above all of the existing toxicological benchmarks provided by the federal government, including benchmarks by the Food and Drug Administration and the Environmental Protection Agency. The North Carolina Department of Health and Human Services has issued fish consumption advisories for three species of freshwater fish that may be caught from waters south and east of Interstate-85; this constitutes more than one half of the state. The Department of Health and Human Services has advised women of childbearing age and small children not to consume these three species of fish when caught from surface waters south and east of Interstate-85. Reduced consumption rates are recommended for the general public. This is a tremendous loss of use of surface waters and natural resources. What makes this all the more important is that the area of greatest concern with respect to methylmercury levels in fish tissue is also the area with the most economic difficulty. Much of eastern North Carolina is economically depressed due to the loss of jobs and many families have resorted to providing their own sustenance through increased fishing and/or hunting.

Studies conducted by the Division of Water Quality suggest that mercury and methylmercury levels in surface waters, and therefore in fish, will not reach benchmark levels without realizing mercury reductions in the atmosphere. Total mercury concentrations in rainwater are at or above levels that water quality agencies would seek

in order to restore the ability to eat locally caught fish without an increased risk of neurological effects. Water quality agencies would typically seek pollutant reductions from wastewater and stormwater when a loss of use occurs. In this case, most municipal wastewater facilities have already installed equipment that would reach the current level of best available technology for mercury removal. This is in spite of the fact that most municipal wastewater facilities also receive and treat rainwater prior to discharging back to surface waters. Clearly this is not a situation to which traditional Clean Water Act controls would apply.

Therefore significant reduction in mercury emissions to the atmosphere is necessary for public health protection. Also, the reduction in a national program must assure that all local problem areas with identified mercury issues benefit from the program.

Comparison of the EPA Proposal with Existing Measures in North Carolina

Recognizing these health concerns, North Carolina is moving forward to control mercury emissions. In 2002, North Carolina passed the Clean Smokestacks Act (CSA), which substantially cuts the state's coal-fired power plants emissions of multiple air pollutants that cause smog, haze and other pollution problems. Under the CSA, North Carolina's 14 coal-fired power plants will reduce their emissions of key pollutants. In particular, the CSA requires power plants to reduce:

> Nitrogen oxide (NOx) emissions from 245,000 tons in 1998 to 56,000 tons by 2009 (78 percent).
>
> Sulfur dioxide (SO2) emissions from 489,000 tons in 1998 to 250,000 tons by 2009 (49 percent) and 130,000 tons by 2013 (74 percent).

The pollution controls required under the CSA are projected, as a co-benefit, to reduce mercury emissions in North Carolina by more than 50 percent by 2012. The EPA proposals will not yield comparable reductions. Under the proposed MACT, the reductions projected are 29 percent until 2018 nationally. In addition, there is no guarantee of site-specific reductions due to EPA's proposed Cap-and-Trade system.

Relationship Between the EPA Proposal and the Future Steps Required to be taken by North Carolina

In addition, the CSA requires the DAQ to conduct a study of mercury emissions in the state, including "the development and implementation of standards and plans to implement programs to control emissions of mercury from coal-fired generating units." Attached to these comments is a copy of the first interim report, "Mercury Emissions and Mercury Controls for Coal-Fired Electrical Utility Boilers", dated September 1, 2003. DAQ's final findings and recommendations are due to the NC legislature no later than September 1, 2005.

We would encourage EPA to consider in its final rule the process North Carolina already has in motion for evaluating the health needs and available technologies for achieving additional mercury reductions. Given the significant early reductions from implementation of the CSA, North Carolina hopes EPA will pass regulations that require similar reductions in other States. Regional reductions in mercury are required to ensure speedy return to safe consumption of local fish by populations at risk.

To summarize my comments: (1) mercury is a significant health problem in North Carolina, (2) the speed and amount of reduction of EPA's proposal are less than those for North Carolina's own requirements, and (3) the EPA rule needs to offer explicit right and authority for States to deal with residual local issues and to avoid preempting State programs.

Thank you for the opportunity to comment and for your consideration of these comments in the development of the final rule. Should you have any questions on the comments, please contact Sheila Holman of my staff at (919) 715-0971.

Sincerely,

B. Keith Overcash, P.E.

Attachment

cc: Secretary Bill Ross
Alan Klimek, P.E.

Appendix C
Electrical Generating Boiler
Mercury Emission Estimates
EPA Emission Estimating Tool Estimates

DUKE POWER	US EPA Mercury Emission Estimating Tool Data			Hg In Combusted Coal	Existing Hg Emissions		Clean Stacks Hg Emissions		Project
Plant	Unit	Plant	Location	Lbs/year	Percent Reduced	Lbs/year	Percent Reduced	Lbs/year	Completion Date
Allen	1	Allen	Belmont	43	29	31	69	10	2011
Allen	2	Allen	Belmont	20	29	14	69	4	2011
Allen	3	Allen	Belmont	80	29	56	69	18	2011
Allen	4	Allen	Belmont	82	29	58	69	18	2012
Allen	5	Allen	Belmont	82	29	58	69	18	2012
			TOTAL	**308**		**218**		**69**	
Belews Creek	1	Belews Creek	Walnut Cove	420	29	298	69	94	2008
Belews Creek	2	Belews Creek	Walnut Cove	314	29	222	69	70	2008
			TOTAL	**734**		**520**		**163**	
Buck	5	Buck	Salisbury	6	11	5	0	5	None
Buck	6	Buck	Salisbury	6	11	5	0	5	None
Buck	7	Buck	Salisbury	7	11	6	0	6	None
Buck	8	Buck	Salisbury	43	11	38	0	38	None
Buck	9	Buck	Salisbury	43	11	39	0	39	None
			TOTAL	**104**		**93**		**93**	
Cliffside	1	Cliffside	Cliffside	3	11	3	0	3	None
Cliffside	2	Cliffside	Cliffside	3	11	3	0	3	None
Cliffside	3	Cliffside	Cliffside	7	11	6	0	6	None
Cliffside	4	Cliffside	Cliffside	7	11	6	0	6	None
Cliffside	5	Cliffside	Cliffside	121	29	86	69	27	2009
			TOTAL	**141**		**104**		**45**	
Dan River	1	Dan River	Eden	9	11	8	0	8	None
Dan River	2	Dan River	Eden	9	11	8	0	8	None
Dan River	3	Dan River	Eden	22	29	16	0	16	None
			TOTAL	**41**		**32**		**32**	
Marshall	1	Marshall	Terrell	119	29	84	69	26	2007
Marshall	2	Marshall	Terrell	132	29	93	69	29	2007
Marshall	3	Marshall	Terrell	172	29	122	69	38	2006
Marshall	4	Marshall	Terrell	219	29	155	69	49	2006
			TOTAL	**642**		**455**		**143**	
Riverbend	4	Riverbend	Mount Holly	32	11	28	0	28	None
Riverbend	5	Riverbend	Mount Holly	11	11	10	0	10	None
Riverbend	6	Riverbend	Mount Holly	11	11	10	0	10	None
Riverbend	7	Riverbend	Mount Holly	30	11	27	0	27	None
			TOTAL	**84**		**75**		**75**	
		Duke Energy	**Total**	**2054**		**1498**		**621**	
		NC State	**Total**	**4,094**		**3,056**		**1,416**	

Appendix C
Electrical Generating Boiler
Mercury Emission Estimates

PROGRESS ENERGY	US EPA Mercury Emission Estimating Tool Data		Hg In Combusted Coal	Existing Hg Emissions		Clean Stacks Hg Emissions		Project
Plant	Unit	Location	Lbs/year	Percent Reduced	Lbs/year	Percent Reduced	Lbs/year	Completion Date
Ashville	2	Arden	105	29	74	69	23	2006
		TOTAL	**196**		**139**		**44**	
Cape Fear	5	Moncure	53	29	38	69	12	2012
Cape Fear	6	Moncure	73	29	51	69	16	2011
		TOTAL	**126**		**89**		**28**	
Lee	1	Goldsboro	25	29	18	0	18	None
Lee	2	Goldsboro	24	11	21	0	21	None
Lee	3	Goldsboro	89	29	63	0	63	None
		TOTAL	**138**		**102**		**102**	
Mayo	1A	Roxboro	128	11	115	32	78	2008
Mayo	1B	Roxboro	128	11	115	32	78	2008
		TOTAL	**257**		**229**		**156**	
Roxborro	1	Semora	171	29	121	69	38	2009
Roxborro	2	Semora	296	29	210	69	66	2007
Roxborro	3A	Semora	163	29	115	69	36	2007
Roxborro	3B	Semora	163	29	115	69	36	2007
Roxborro	4A	Semora	132	11	118	32	80	2007
Roxborro	4B	Semora	132	11	118	32	80	2007
		TOTAL	**1056**		**797**		**337**	
L V Sutton	1	Wilmington	33	11	30	11	30	None
L V Sutton	2	Wilmington	31	11	28	11	28	None
L V Sutton	3	Wilmington	152	29	108	69	34	2012
		TOTAL	**216**		**165**		**91**	
Wspn	1	Lumberton	15	29	11	0	11	None
Wspn	2	Lumberton	15	29	11	0	11	None
Wspn	3	Lumberton	23	29	16	0	16	None
		TOTAL	**53**		**37**		**37**	
		State Totals lbs/year	**4,094**		**3,056**		**1,416**	

Appendix C
Electrical Generating Boiler
Mercury Emission Estimates
Speciated Mercury Emissions Using EPA Mercury Emission Tool

EPA Mercury Emission Estimating Tool Data													
		Hg in Coal	Existing						Clean Stacks				
			Total Hg		Hg Species Emissions				Total Hg		Hg Species Emissions		
Plant	Unit	Lbs/year	Percent Reduced	Emission Lbs/year	Elemental Lbs/year	PM	Oxidized		Percent Reduced	Emission Lbs/year	Elemental Lbs/year	PM	Oxidized
Duke Power **(North Carolina)**													
Allen	1	43.42	29.10	30.77	7.91	1.88	20.99		77.70	9.68	8.91	0.02	0.75
Allen	2	20.01	29.10	14.18	3.65	0.87	9.67		77.70	4.46	4.11	0.01	0.35
Allen	3	79.64	29.10	56.44	14.51	3.45	38.51		77.70	17.76	16.34	0.04	1.38
Allen	4	82.42	29.10	58.41	15.02	3.57	39.85		77.70	18.38	16.91	0.04	1.43
Allen	5	82.16	29.10	58.22	14.97	3.56	39.72		77.70	18.32	16.86	0.04	1.43
Subtotal		307.65		218.02	56.06	13.32	148.75			68.61	63.12	0.15	5.34
Belews Cre	1	419.95	29.10	297.60	76.52	18.18	203.05		77.70	93.65	86.16	0.20	7.28
Belews Cre	2	313.66	29.10	222.28	57.15	13.58	151.66		77.70	69.95	64.35	0.15	5.44
Subtotal		733.61		519.88	133.67	31.76	354.70			163.59	150.51	0.36	12.73
Buck	5	5.68	10.70	5.23	1.89	0.25	2.93		10.70	5.07	1.89	0.25	2.93
Buck	6	5.68	10.70	5.23	1.89	0.25	2.93		10.70	5.07	1.89	0.25	2.93
Buck	7	7.06	10.70	6.31	2.35	0.31	3.65		10.70	6.30	2.35	0.31	3.65
Buck	8	42.54	10.70	38.01	14.15	1.86	21.97		10.70	37.99	14.15	1.86	21.97
Buck	9	43.28	10.70	38.67	14.40	1.89	22.35		10.70	38.65	14.40	1.89	22.35
Subtotal		104.24		93.45	34.68	4.56	53.84			93.09	34.68	4.56	53.84
Cliffside	1	3.22	10.70	2.88	1.07	0.14	1.66		10.70	2.88	1.07	0.14	1.66
Cliffside	2	3.40	10.70	3.04	1.13	0.15	1.76		10.70	3.04	1.13	0.15	1.76
Cliffside	3	6.52	10.70	5.83	2.17	0.29	3.37		10.70	5.82	2.17	0.29	3.37
Cliffside	4	7.24	10.70	6.47	2.41	0.32	3.74		10.70	6.47	2.41	0.32	3.74
Cliffside	5	120.91	29.10	85.69	22.03	5.23	58.46		77.70	26.96	24.81	0.06	2.10
Subtotal		141.29		103.91	28.81	6.13	68.99			45.16	31.59	0.95	12.62
Dan River	1	9.12	10.70	8.15	3.03	0.40	4.71		10.70	8.14	3.03	0.40	4.71
Dan River	2	9.44	10.70	8.43	3.14	0.41	4.88		10.70	8.43	3.14	0.41	4.88
Dan River	3	22.38	29.10	15.86	4.08	0.97	10.82		29.10	15.87	4.08	0.97	10.82
Subtotal		40.94		32.44	10.25	1.78	20.41			32.44	10.25	1.78	20.41
Marshall	1	118.65	29.10	84.08	21.62	5.14	57.37		77.70	26.46	24.34	0.06	2.06
Marshall	2	131.65	29.10	93.29	23.99	5.70	63.65		77.70	29.36	27.01	0.06	2.28
Marshall	3	172.41	29.10	122.18	31.41	7.46	83.36		77.70	38.45	35.37	0.08	2.99
Marshall	4	219.02	29.10	155.21	39.91	9.48	105.90		77.70	48.84	44.94	0.11	3.80
Subtotal		641.73		454.76	116.93	27.78	310.28			143.10	131.66	0.31	11.13
Riverbend	4	31.66	10.70	28.29	10.53	1.39	16.35		10.70	28.27	10.53	1.39	16.35
Riverbend	5	11.04	10.70	9.87	3.67	0.48	5.70		10.70	9.86	3.67	0.48	5.70
Riverbend	6	11.36	10.70	10.15	3.78	0.50	5.87		10.70	10.14	3.78	0.50	5.87
Riverbend	7	30.29	10.70	27.07	10.08	1.33	15.65		10.70	27.05	10.08	1.33	15.65
Subtotal		84.35		75.38	28.07	3.69	43.57			75.32	28.07	3.69	43.57
Duke Energy		2050.01	26.94	1497.84	408.46	89.02	1000.53		69.69	621.32	449.88	11.80	159.64
Progress Energy (North Carolina)													
Asheville	1	91.27	29.10	64.71	16.63	3.95	44.13		77.70	20.35	18.73	0.04	1.58
Asheville	2	104.52	29.10	74.10	19.04	4.52	50.54		77.70	23.31	21.44	0.05	1.81
Subtotal		195.79		138.82	35.67	8.48	94.66			43.66	40.17	0.10	3.40
Cape Fear	5	53.24	29.10	37.75	9.70	2.30	25.74		77.70	11.87	10.92	0.03	0.92
Cape Fear	6	72.51	29.10	51.41	13.21	3.14	35.06		77.70	16.17	14.88	0.04	1.26
Subtotal		125.75		89.16	22.91	5.44	60.80			28.04	25.80	0.06	2.18
Lee	1	25.27	29.10	17.92	4.60	1.09	12.22		29.10	17.92	4.60	1.09	12.22
Lee	2	23.66	11.00	21.13	7.87	1.04	12.22		11.00	21.13	7.87	1.04	12.22
Lee	3	88.67	29.10	62.87	16.16	3.84	42.87		29.10	62.87	16.16	3.84	42.87
Subtotal		137.60		101.91	28.63	5.97	67.31			101.91	28.63	5.97	67.31
Mayo	1A	128.31	11.00	114.58	42.69	5.62	66.27		39.20	78.01	61.39	0.49	16.13
Mayo	1B	128.31	11.00	114.58	42.69	5.62	66.27		39.20	78.01	61.39	0.49	16.13
Subtotal		256.62		229.16	85.38	11.23	132.55			156.02	122.79	0.98	32.26
Roxboro	1	171.03	29.10	121.26	31.16	7.40	82.69		77.70	38.14	35.09	0.08	2.97
Roxboro	2	295.73	29.10	209.67	53.88	12.80	142.99		77.70	65.95	60.67	0.14	5.13
Roxboro	3A	162.62	29.10	115.30	29.63	7.04	78.63		77.70	36.26	33.36	0.08	2.82
Roxboro	3B	162.62	29.10	115.30	29.63	7.04	78.63		77.70	36.26	33.36	0.08	2.82
Roxboro	4A	131.90	11.00	117.79	43.89	5.77	68.13		39.20	80.20	63.11	0.50	16.58
Roxboro	4B	131.90	11.00	117.79	43.89	5.77	68.13		39.20	80.20	63.11	0.50	16.58
Subtotal		1055.80		797.10	232.08	45.83	519.19			337.01	288.71	1.39	46.90
L V Sutton	1	33.08	11.00	29.54	11.01	1.45	17.09		11.00	29.54	11.01	1.45	17.09
L V Sutton	2	30.98	11.00	27.67	10.31	1.36	16.00		11.00	27.67	10.31	1.36	16.00
L V Sutton	3	152.08	29.10	107.82	27.71	6.58	73.53		77.70	33.91	31.20	0.07	2.64
Subtotal		216.14		165.03	49.02	9.39	106.62			91.12	52.52	2.88	35.73
Weather spo	1	15.07	29.10	10.68	2.75	0.65	7.29		29.10	10.68	2.75	0.65	7.29
Weather spo	2	15.29	29.10	10.84	2.79	0.66	7.39		29.10	10.84	2.79	0.66	7.39
Weather spo	3	22.53	29.10	15.97	4.11	0.98	10.89		29.10	15.97	4.11	0.98	10.89
Subtotal		52.89		37.50	9.64	2.29	25.57			37.50	9.64	2.29	25.57
Progress Energy		2040.59		1558.68	463.34	88.63	1006.70			795.27	568.26	13.66	213.35
State Totals		4094.40	25.34	3056.69	871.81	177.65	2007.24		65.40	1416.58	1018.14	25.46	372.98

Appendix C
Electrical Generating Boiler
Mercury Emission Estimates
Speciated Mercury Emissions Using EPRI Mercury Emission Tool
Duke Power

		Hg in Coal	Cl in Coal	Cl/SO2 Ratio	Existing						Clean Stacks				
EPRI Mercury Emission Estimating Tool Data					Total Hg		Hg Species Emissions				Total Hg		Hg Species Emissions		
		Lbs/year	ppm		Percent Reduced	Emission Lbs/year	Elemental	PM	Oxidized		Percent Reduced	Emission Lbs/year	Elemental	PM	Oxidized
							Lbs/year						Lbs/year		
Allen	1	43	1153	904	45	23	8	0	16		67	14	12	0	2
Allen	2	18	1153	904	45	10	3	0	7		67	6	5	0	1
Allen	3	78	1153	904	45	43	14	1	28		67	26	21	0	4
Allen	4	78	1153	904	45	43	14	1	29		67	26	21	0	4
Allen	5	78	1153	904	45	43	14	1	29		67	26	21	0	4
Subtotal		295				162	52	2	108			97	81	0	16
Belews Creek	1	424	1197	965	46	230	73	3	154		68	137	114	1	23
Belews Creek	2	309	1197	965	46	167	53	3	112		68	100	83	0	17
Subtotal		734				397	125	6	266			237	197	1	39
Buck	5	6	823	599	22	4	2	0	2		22	4	2	0	2
Buck	6	6	823	599	22	4	2	0	2		22	4	2	0	2
Buck	7	7	823	599	22	5	2	0	3		22	5	2	0	3
Buck	8	45	823	599	22	35	16	0	19		22	35	16	0	19
Buck	9	46	823	599	22	36	16	0	19		22	36	16	0	19
Subtotal		109				85	38	1	46			85	38	1	46
Cliffside	1	3	1479	1103	27	2	1	0	1		27	2	1	0	1
Cliffside	2	3	1479	1103	27	3	1	0	2		27	3	1	0	2
Cliffside	3	7	1479	1103	27	5	2	0	3		27	5	2	0	3
Cliffside	4	8	1479	1103	27	6	2	0	4		27	6	2	0	4
Cliffside	5	122	1479	1103	48	64	18	1	45		70	37	30	0	6
Subtotal		143				79	24	1	54			52	35	0	16
Dan River	1	11	1183	922	25	8	3	0	5		25	8	3	0	5
Dan River	2	12	1183	922	25	9	3	0	5		25	9	3	0	5
Dan River	3	29	1183	922	45	16	5	0	10		45	16	5	0	10
Subtotal		52				33	12	0	21			33	12	0	21
Marshall	1	119	1062	810	44	67	22	1	44		66	40	34	0	6
Marshall	2	132	1062	810	44	74	25	1	48		66	44	37	0	7
Marshall	3	165	1062	810	44	93	31	1	61		66	56	47	0	9
Marshall	4	218	1062	810	44	123	41	2	80		66	74	62	0	12
Subtotal		634				357	118	5	233			214	179	1	34
Riverbend	4	11	924	626	23	8	4	0	5		23	8	4	0	5
Riverbend	5	11	924	626	23	8	4	0	5		23	8	4	0	5
Riverbend	6	30	924	626	23	23	10	0	13		23	23	10	0	13
Riverbend	7	31	924	626	23	24	10	0	13		23	24	10	0	13
Subtotal		83				64	28	1	36			64	28	1	36
Duke Energy		2050			43	1177	397	17	763		62	782	570	5	208
State Totals		4096			41	2397	29	1	69		63.2	1508	1105	9	394

Appendix C
Electrical Generating Boiler
Mercury Emission Estimates

Speciated Mercury Emissions Using EPRI Mercury Emission Tool

Progress Energy

EPRI Mercury Emission Estimating Tool Data		Hg in Coal	Cl in Coal	Cl/SO2 Ratio	Existing					Clean Stacks				
					Total Hg		Hg Species Emissions			Total Hg		Hg Species Emissions		
		Lbs/year	ppm		Percent Reduced	Emission Lbs/year	Elemental	PM	Oxidized	Percent Reduced	Emission Lbs/year	Elemental	PM	Oxidized
							Lbs/year					Lbs/year		
Asheville	1	91	970	612	40	54	19	1	35	65	32	27	0	5
Asheville	2	106	970	612	40	63	22	1	41	65	37	31	0	6
Subtotal		197				118	40	2	75		69	57	0	11
Cape Fear	5	53	1776	1108	48	28	7	0	20	70	16	13	0	3
Cape Fear	6	73	1776	1108	48	38	10	1	28	70	22	18	0	4
Subtotal		126				66	18	1	48		38	31	0	7
Lee	1	25	1468	954	46	14	4	0	10	46	14	4	0	10
Lee	2	24	1468	954	27	17	6	0	11	27	17	6	0	11
Lee	3	88	1468	954	46	48	14	1	33	46	48	39	0	8
Subtotal		137				79	24	1	54		79	49	1	29
Mayo	1A	127	2186	2124	27	93	27	1	65	65	44	32	0	12
Mayo	1B	127	2186	2124	27	93	27	1	65	65	44	32	0	12
Subtotal		254				185	54	2	129		89	65	1	24
Roxboro	1	171	1482	1022	47	92	26	1	64	70	51	42	0	9
Roxboro	2	297	1482	1022	47	159	46	2	110	70	89	73	0	15
Roxboro	3A	165	1482	1022	47	88	25	1	61	70	49	41	0	9
Roxboro	3B	164	1482	1022	47	88	25	1	61	70	49	40	0	9
Roxboro	4A	134	1482	1022	27	97	28	1	68	65	47	38	0	8
Roxboro	4B	134	1482	1022	27	97	28	1	68	65	47	38	0	8
Subtotal		1064				621	179	9	432		333	273	1	58
L V Sutton	1	33	1818	1240	27	24	8	0	16	27	24	8	0	16
L V Sutton	2	30	1818	1240	27	22	7	0	15	27	22	7	0	15
L V Sutton	3	152	1818	1240	49	78	20	1	56	70	46	37	0	8
Subtotal		215				124	35	2	87		92	52	1	39
Weather spoon	1	15	1717	1105	48	8	2	0	6	48	8	2	0	6
Weather spoon	2	15	1717	1105	48	8	2	0	6	48	8	2	0	6
Weather spoon	3	23	1717	1105	48	12	3	0	8	48	12	3	0	8
Subtotal		53				28	8	0	20		28	8	0	20
Progress Energy		2046			40	1220	357	18	845	65	726	535	4	187
State Totals		4096			41	2397	29	1	69	63.2	1508	1105	9	394

APPENDIX D

2002 REPORTED NC MERCURY EMISSIONS

Location Name	Pounds/Year	Percent
Duke Energy Corp - Belews Creek Steam Station	**730.5448**	**14.04**
Nucor Steel	679.0190	13.05
CP&L - Roxboro Steam Electric Plant	**666.2140**	**12.80**
Duke Energy Corporation - Marshall Steam Station	**620.9031**	**11.93**
PCS Phosphate Company Inc. - Aurora	267.6866	5.14
CP&L - Mayo Facility	**258.0166**	**4.96**
Duke Energy Corporation - Allen Steam Station	**237.6020**	**4.57**
New Hanover County WASTEC	172.2500	3.31
Duke Energy Corporation - Cliffside Steam Station	**136.6129**	**2.62**
L V Sutton Steam Electric Plant	**132.0304**	**2.54**
Duke Energy Corporation - Riverbend Steam Station	**110.6019**	**2.13**
Progress Energy - F Lee Plant	**109.2136**	**2.10**
Duke Energy Corporation - Buck Steam Station	**88.9013**	**1.71**
Progress Energy Carolinas - Cape Fear Plant	**78.7800**	**1.51**
Cleveland Regional Medical Center	61.0000	1.17
University of North Carolina at Chapel Hill	45.4924	0.87
Blue Ridge Paper Products - Canton Mill	45.0843	0.87
DAK Monomers LLC	42.5850	0.82
Progress Energy Carolinas, Inc., W.H. Weatherspoon Plant	**38.0100**	**0.73**
Weyerhaeuser Company - Plymouth	36.5900	0.70
Ecusta Business Development Center LLC	34.2000	0.66
Cogentrix of Rocky Mount	33.2009	0.64
Stericycle Inc	27.7725	0.53
Duke Energy Corp - Dan River Steam Station	**27.7024**	**0.53**
Duracell Global Business Management Group	27.0000	0.52
Invista, Incorporated	24.7900	0.48
Duke University	24.5000	0.47
Marine Corps Air Station	19.5416	0.38
Miller Brewing Company - Eden Plant	19.5000	0.37
Cogentrix of North Carolina Inc - Southport	17.7602	0.34
Union Mem Regl Medcenterinc **inactive**	16.7000	0.32
Carolina Stalite Company	16.2728	0.31
Forest City Tool	16.0000	0.31
Frye Regional Medical Center	15.6720	0.30
International Paper	14.1332	0.27
Elementis Chromium	14.1200	0.27
Leesona Co John Brown Div**inactive**	12.0000	0.23
Cargill Inc - Fayetteville	11.3664	0.22
Tyson Foods Inc Harmony	10.5470	0.20
Cape Fear Valley Med Center	10.2000	0.20
Onslow Memorial Hospital	8.0120	0.15
Cogentrix of North Carolina Inc	7.0902	0.14
Craven County Wood Energy	6.9100	0.13
Total Mercury Emissions in Pounds Per Year	4972.1291	

* List is truncated from original