COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
Fax (804) 698-4500 TDD (804) 698-4021
www.deq.virginia.gov

L. Preston Bryant, Jr.
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

To: The Honorable Timothy M. Kaine

The Honorable M. Kirkland Cox, Chair
House Committee on Agriculture, Chesapeake and Natural Resources

The Honorable Charles R. Hawkins, Chair
Senate Committee on Agriculture, Conservation and Natural Resources

From: David K. Paylor

Date: October 15, 2007

Subject: Report on the Status of the Virginia Mercury Study

I am pleased to provide you with a copy of "Status of the Virginia Mercury Study." This report has been prepared pursuant to Chapter 867 of the 2006 Acts of Assembly (House Bill 1055) and sets forth the status of DEQ's efforts to assess mercury deposition in Virginia.

DEQ has begun to assess mercury deposition in Virginia and will provide a final report of its assessment by October 15, 2008. The final report will include: "(i) an evaluation of the state of mercury control technology for coal-fired boilers, including the technical and economic feasibility of such technology and (ii) an assessment of the mercury reductions and benefits expected to be achieved by the implementation of the CAIR and CAMR regulations."

This report is being made available at www.deq.virginia.gov/regulations/reports/html. If you have any questions concerning this report or if you would like a hard copy of this report, please contact Angela Jenkins, Assistant Director of Legislative and Legal Affairs at (804) 698-4268.

STATUS OF THE VIRGINIA MERCURY STUDY

A Report to the Honorable Timothy M. Kaine, Governor and the House Committee on Agriculture, Chesapeake and Natural Resources and the Senate Committee on Agriculture, Conservation and Natural Resources

Virginia Department of Environmental Quality

October 2007

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I. EXECUTIVE SUMMARY

This report is prepared pursuant to the requirements of Chapter 867 of the 2006 Acts of Assembly (House Bill 1055). The Act directs the Department of Environmental Quality (DEQ) to conduct a detailed assessment of mercury deposition in Virginia in order to determine whether particular circumstances exist that justify, from a health and cost and benefit perspective, requiring additional steps to be taken to control mercury emissions within Virginia. The assessment must include (i) an evaluation of the state of mercury control technology for coal-fired boilers, including the technical and economic feasibility of such technology and (ii) an assessment of the mercury reductions and benefits expected to be achieved by the implementation of the CAIR and CAMR regulations. This report is a preliminary assessment of DEQ's efforts and findings. A final assessment will be provided by October 15, 2008.

DEQ identified the largest emitters of mercury in the Commonwealth and in August 2006 sent letters to 75 industrial facilities in Virginia requesting estimated mercury emissions for calendar years 2002 and 2005. The facilities chosen for this request are the largest known mercury emitters in Virginia. Information received from each of the facilities will be used to estimate future-year emissions. The future-year estimates will be used in the air quality modeling and deposition analysis.

In order to assess the mercury reductions and benefits expected to be achieved by the implementation of the Clean Air Interstate Rule (CAIR) and the Clean Air Mercury Rule (CAMR) regulations, DEQ staff issued a Request for Proposal (RFP) on September 25, 2006 for a detailed assessment of mercury deposition in Virginia. The scope of the RFP included an analysis of mercury air emissions data, an assessment of mercury deposition modeling, as well as the development of information on the human health risks from consuming methylmercury-contaminated fish.

In February 2007, two contracts were awarded for the assessment. One contract was awarded to ICF Resources, LLC (ICF) for work on the mercury emissions data analysis and deposition modeling portions of the study. Specifically, ICF will conduct mercury deposition model simulations that can be used by DEQ to examine:

1. Air deposition as a contributor of mercury to Virginia's impaired water bodies and other mercury sensitive waters;

2. Impacts of emissions from Virginia's electric generating units (EGUs) on mercury deposition in Virginia, including an evaluation of the benefits of CAMR and other federal and state programs which may impact or reduce mercury emissions;

3. Contributions of Virginia's non-EGUs to mercury deposition in Virginia; and

4. The individual impact of a selected number of Virginia facilities to local and regional scale mercury deposition.

DEQ also awarded a contract to the Center for Environmental Studies at the Virginia Commonwealth University (VCU) to assess the human health risks from consuming methylmercury-contaminated fish. The study will focus on understanding the risks of

consuming methylmercury through ingestion of freshwater fish by sensitive sub-populations (such as children and pregnant women) in Virginia. This study will use DEQ's fish tissue database and on-site fish consumption data to estimate risks to human health. These estimates of risks to human health will then be monetized by DEQ to arrive at potential economic benefits and costs of current levels of mercury and potential future reductions. The mercury uptake and human health risk portions of the study are dependent on the findings in the mercury deposition portion of the study. Final results from the modeling deposition portion of the study are scheduled to be completed by mid-February 2008. Therefore, the main focus of this interim report is the work completed to date on ICF's emissions data analysis.

DEQ was unable to fund an analysis of the mercury deposition impact on fish tissue concentrations resulting from Virginia sources because the only vendor who met the requirements of the RFP was cost prohibitive. Therefore DEQ staff will consult available literature sources, review experiences in other states, and interact with researchers to derive a default value or range of values to estimate the effects that changes of deposition rates of mercury to watersheds could have on local fish tissue contamination levels.

DEQ is in the initial stages of performing the mercury control technology cost assessment task. The project team is collecting data from internal and external sources on control technologies used at all of Virginia's coal-fired power plants in order to understand expected mercury removal rates and costs of controls. The team expects to develop estimates later this year that distinguish the portion of such control costs that can be ascribed to mercury from the co-benefits of controlling other pollutants. The team then will analyze the costs associated with mercury-specific control technologies for coal-fired power plants.

Information regarding the Virginia Mercury Study can be found on the DEQ website at http://www.deq.virginia.gov/air/vamercury/vamercurystudy.html. Additionally, the State Air Pollution Control Board and DEQ are hosting a symposium about mercury on November 28-29, 2007 in Newport News, Virginia. Interim results of the DEQ mercury study will be presented at the symposium. Outside experts and stakeholders have been invited to provide information and perspectives on mercury emissions; transport, deposition, and biotransformation; prevention and control technologies; and human health and environmental impacts.

II. BACKGROUND

Human exposure to mercury is most commonly associated with the consumption of contaminated fish. Due to measured high levels of mercury in fish, at least 44 states have, in recent years, issued fish consumption advisories. These advisories may suggest limits on the consumption of certain types of fish or they may recommend limiting or not eating fish from certain bodies of water due to unsafe levels of mercury. States have identified more than 6,000 individual bodies of water as mercury impaired and have issued mercury fish advisories for more than 2,000 individual bodies of water.

Prior to 2002, significant mercury impairment of Virginia surface waters was known to affect only three rivers (the North Fork of the Holston River, the South River, and the South Fork of the Shenandoah River) with historic industrial releases. Since that time, however, state monitoring has identified impairment of a number of surface waters without readily identifiable sources of mercury releases.

Virginia expanded its mercury monitoring in 2002 based on an increasing scientific understanding of mercury's environmental chemistry and discoveries in other states (e.g., Florida and Maryland) of mercury pollution in water bodies without direct source releases. The 2002 monitoring effort focused on rivers of the coastal plain, mostly to the east of I-95. As a result of this effort, Virginia found elevated mercury levels in some fish in the Blackwater River, the Great Dismal Swamp Canal, the Dragon Run Swamp, and the Piankatank River. Consistent with findings from Florida and elsewhere, these water bodies in Virginia possess characteristics favorable to the formation of methylmercury, the highly bio-accumulative form of mercury. These characteristics include low dissolved oxygen, high organic matter, and low pH, and are most prevalent in "backwaters" of the southeastern portion of the Commonwealth.

The primary source of mercury to these water bodies is suspected to be atmospheric deposition. Historically, there were three Mercury Deposition Network (MDN)[1] sites in Virginia located in: the Shenandoah National Park, Culpeper[2], and Harcum. Data from these sites have contributed to DEQ's understanding of the regional characterization of mercury transport and deposition throughout the state. Additional monitoring at the Harcum site in 2005 revealed that dry deposition of reactive gaseous (divalent) mercury along the Piankatank River (near the Chesapeake Bay) and in upstream areas is an important contributor to the high mercury levels observed in the water and fish in the area.

Global, regional, and local sources of mercury emissions contribute to the deposition; therefore, understanding these contributions is an important step toward identifying measures that will effectively reduce mercury deposition and environmental mercury levels.

III. OBJECTIVES

The second enactment clause of HB 1055 (2006) provides:

> That the Department of Environmental Quality shall conduct a detailed assessment of mercury deposition in Virginia in order to determine whether particular circumstances exist that justify, from a health and cost and benefit perspective, requiring additional steps to be taken to control mercury emissions within Virginia. The assessment shall also include (i) an evaluation of the state of mercury control technology for coal-fired boilers, including the technical and economic feasibility of such technology and (ii) an assessment of the mercury reductions and benefits expected to be achieved by the implementation of the CAIR and CAMR regulations. The Department shall complete its preliminary assessment as soon as practicable, but not later than October 15, 2007, and shall report the final findings and recommendations made as a result of the assessment to the Chairmen of the House Committee on Agriculture, Chesapeake and Natural Resources and the Senate Committee on Agriculture, Conservation and Natural Resources as soon as practicable, but no later than October 15, 2008.

[1] The Mercury Deposition Network (MDN) is the mercury wet-deposition monitoring arm of the National Atmospheric Deposition Program (NADP). The NADP is a cooperative monitoring program comprised of federal and state agencies, academic institutions, Native American tribal governments, and private organizations.

[2] The Culpeper site, which had been funded by the United States Geological Survey, was shut down at the end of 2006 due to lack of funding.

In response to this mandate, this study includes a detailed analysis of mercury emissions inventory data, as well as a comprehensive mercury deposition modeling analysis. Both the data analysis and modeling components are intended to examine and quantify the contribution of regional and local emissions sources to mercury deposition throughout the Commonwealth, and to provide information to support further analysis of the impact of mercury deposition on the environment.

For each of the bodies of water listed as impaired by Virginia, the Clean Water Act calls for the calculation of a Total Maximum Daily Load (TMDL). TMDLs identify the pollutant reductions or limits that are needed in order to achieve water quality standards. TMDLs must also allocate the reductions to the different sources of pollution, including air sources. Thus, another key objective of the data and modeling analyses is to provide information that will enable DEQ to conduct TMDL studies.

Finally, the results of this study also will be used to support DEQ's evaluation of available measures to reduce mercury emissions in Virginia. Specifically, the data analyses and modeling will allow DEQ to evaluate the effectiveness of selected control measures and support the development of management strategies for meeting water quality criteria and protecting human health.

The reliability of the mercury deposition assessments, including the modeling, will depend on the quality and completeness of the emission inventory data. Thus, a key objective of the emissions data analysis component of the study will be to assess and improve, as needed, the reliability of the mercury emissions data. The data analysis focuses on the review and refinement of the mercury emissions data from a variety of source categories, including coal-fired utilities, medical waste incinerators, and municipal waste incinerators. The emissions data analysis also requires the reliable projection of these data to three future years (2010, 2015 and 2018), taking into account implementation of federal and state laws impacting emissions of mercury.

The modeling analysis includes development of a conceptual description of mercury deposition, which will improve the overall understanding of mercury impacts and the relationships between meteorology and mercury deposition. The modeling results will provide a basis for quantifying the contribution of emissions sources to mercury deposition and examining the fate of mercury emissions from selected sources. For environmental planning purposes, modeling will be used to examine the effectiveness of control measures in reducing mercury concentrations in contaminated bodies of water and improving or maintaining water quality within the designated areas of interest in Virginia. By quantifying deposition, the modeling results also will provide a link between the analysis of mercury emissions and the assessment of the impacts of airborne mercury on fish tissue and human health.

IV. INITIAL STEPS AND PRELIMINARY INFORMATION

DEQ solicited candidates to conduct the detailed assessment of mercury deposition in Virginia through a RFP. The RFP scope included mercury air emissions data analysis, mercury deposition modeling assessment, and an analysis of the mercury deposition impact on fish tissue concentrations resulting from Virginia sources, as well as information on the human health risks from consuming methylmercury contaminated fish.

In February 2007, two contracts were awarded for the assessment. One contract was awarded to ICF Resources, LLS (ICF) for the emissions data analysis and mercury deposition modeling portions of the study. Specifically, ICF will conduct mercury deposition model simulations that can be used by DEQ to examine:

1. Air deposition as a contributor of mercury to Virginia's "impaired" water bodies and other mercury sensitive waters;

2. Impacts of emissions from Virginia's EGUs on mercury deposition in Virginia, including an evaluation of the benefits of CAMR and other applicable federal and state programs that may impact or reduce mercury emissions;

3. Contributions of Virginia's non-EGUs to mercury deposition in Virginia; and

4. The individual impact of a selected number of Virginia facilities to local and regional scale mercury deposition.

A second contract was awarded to the Center for Environmental Studies at VCU to assess the human health risks from consuming methylmercury contaminated fish. The study will focus on understanding the risks of consuming methylmercury through seafood by sensitive sub-populations of Virginia. This study will use DEQ's fish tissue database and on-site fish consumption data to estimate risks to human health. These estimates of risks to human health will then be monetized by DEQ to arrive at potential economic benefits and costs from current levels of mercury and potential future reductions.

V. EMISSION DATA ANALYSIS AND MERCURY DEPOSITION MODELING

Following are summaries of the work ICF has completed. To keep the project on schedule and to address issues as they arose, DEQ staff held teleconference calls with ICF every other week. ICF also is required to provide monthly progress reports to DEQ staff.

V.A. Mercury Emissions Data Analysis

The objectives of this portion of the Virginia Mercury Study are to: 1) conduct a review and analysis of recently updated mercury point source information for sources located in Virginia that will subsequently be used in the air deposition analysis, 2) estimate future-year emissions for 2010, 2015, and 2018 for these sources, and 3) conduct a literature search of recently completed mercury studies related to air deposition, emissions/controls, and air quality modeling and modify the planned approach to the modeling analysis, if warranted, to take advantage of the latest science related to mercury deposition modeling. The first two objectives ensure that the best available mercury emissions inventory is used for the base and future-year modeling analyses. The third objective ensures that the air deposition modeling analysis will be conducted using the latest available modeling tools and approaches.

V.A.1 Literature Review

A literature review was conducted of recent research into atmospheric chemistry and reactivity, mercury deposition mechanisms, and physical and chemical characteristics of mercury. Reports addressing mercury emissions issues, deposition modeling, and modeling studies were reviewed to compile estimated global background values of mercury. Estimates of global background vary widely in the current literature and outputs from various global models have been used in recent modeling studies as input for continental-scale mercury modeling studies. These findings are summarized and incorporated into the mercury emissions data analysis report included as Attachment A.

V.A.2 Virginia Point Source Mercury Inventory

DEQ solicited the 75 largest known point sources of mercury for updated mercury emission estimates for 2002 and 2005. Of those that provided updated information, some sources prepared emissions estimates based on measurements (stack tests), while others based their estimates on standard process-based emission factors for various source types (e.g., AP-42). Still others may have estimated emissions using alternative methods. For each facility a thorough technical review of the emissions estimates was conducted, taking into account the important factors that affect mercury emissions such as process-type, boiler type, fuel type, equipment type, and stack parameters (e.g., flow rate, exit temperature, exit velocity, etc.). For each facility the accuracy of the emission estimates and all of the facility specific information including location, stack parameters, hours of operation, maintenance schedules, and estimated daily operating profiles were reviewed for accuracy. An investigation also was conducted to determine whether any emission control or other equipment was installed or replaced between 2002 and 2005 and whether there were plans to change/update equipment in the near future. Any new control or other equipment expected to be installed beyond 2005 will be accounted for in the future year emission estimates.

V.A.3 Other Inventories

In addition to the Virginia point source inventory, the United States Environmental Protection Agency (EPA) compiles and maintains the National Emission Inventory (NEI) of mercury emissions. As part of this analysis, the latest version (Version 3) of the NEI mercury inventory was obtained from EPA. This inventory contains information for point sources and "non-point" sources, also referred to as area sources. These include various other types of fuel combustion sources. The NEI inventory will be used in the modeling deposition portion of the study to account for other influences, such as mobile sources and landfills, affecting mercury deposition in Virginia.

V.A.4 Report

ICF submitted a report to DEQ in September 2007 titled "The Virginia Mercury Study: Review and Assessment of Virginia Mercury Emissions Data and Recent Mercury Studies." This report summarizes ICF's review and analysis of the sources of atmospheric mercury emissions located within the Commonwealth of Virginia and surrounding areas. This report also includes a summary of recent mercury studies that were reviewed as part of the literature review. A copy of the report is included as Attachment A.

V.B. Mercury Deposition Modeling

Atmospheric modeling provides an analytic method for quantifying the contributions from sources of airborne mercury to mercury deposition. Regional-scale modeling is especially well suited to quantifying the global, national, and regional contributions to mercury deposition in a given area. At the local scale, other methods such as high-resolution modeling or Gaussian modeling may be needed to quantify the impacts of local sources on a given body of water or hydrologic zone.

For the regional-scale modeling, the Community Multi-scale Air Quality (CMAQ) model and, in particular, the CMAQ Particle and Precursor Tagging Methodology (PPTM) will be used to quantify source contributions and guide the control strategy assessment. PPTM allows the modeler to track or tag mercury emissions from selected sources, and quantify the sources' contribution to mercury deposition throughout a modeling domain and simulation period.

There are several steps that need to be completed prior to performing the model simulations. These include the development of the conceptual model and modeling protocol, performing a model sensitivity analysis and evaluating model performance. A brief description of each of these tasks is provided.

V.B.1 Conceptual Model

The conceptual model is developed to help the modeler understand the overall picture. It includes the extent of data availability, determination of the confidence in the data, and examination of processes that contribute to mercury deposition. For this study, the description is based on observed mercury deposition data, meteorological data, emissions inventory information, and some recent existing mercury deposition modeling results.

The conceptual model provides insight into some key questions regarding the nature of mercury deposition.

Is mercury deposition primarily a local issue, or are regional, national, and global factors important?

Based on a review of the available data and prior modeling results, it is expected that global, national, regional, and local factors contribute to mercury deposition in Virginia. The primary source of mercury to impaired water bodies is believed to be atmospheric deposition, which is comprised of both natural and anthropogenic emissions. These emissions can be directly emitted or re-emitted to the atmosphere after being deposited at another location. Various atmospheric processes influence the transport and deposition of mercury and these involve a variety of scales ranging from global to local. Specifically:

- Mercury may be transported globally by atmospheric circulation systems and prior mercury deposition modeling results indicate that global background may comprise 60 to 70 percent of the contribution to mercury deposition at the Virginia MDN sites.
- Mercury also may be subject to regional-scale transport. Prior modeling indicates that emissions contributing to the simulated deposition are from Virginia, the neighboring states, and other states within the United States. Similarities in observed mercury wet

deposition among monitoring sites in Virginia and several neighboring states support the conclusion that mercury deposition is, at least in part, a regional-scale issue.
- Finally, prior modeling reveals local source-specific contributions to mercury deposition at the three monitoring sites.

Does mercury deposition vary with time?

Annual mercury wet deposition amounts vary by year for monitoring sites in Virginia and the surrounding states. In addition, within each calendar year, there are variations in deposition by week, month, and quarter, primarily in accordance with variations in rainfall amount. Mercury deposition (and rainfall amount) appears to have an annual cycle, with higher deposition amounts during the second and third calendar quarters (April through June and July through September, respectively).

Does mercury deposition vary from location to location?

Measurements of wet mercury deposition data indicate that deposition varies from location to location. For the period 2003-2005, annual mercury deposition for the Virginia MDN sites is about the same as the deposition for nearby sites in southern Pennsylvania and lower than the deposition for nearby sites in North Carolina and Tennessee. In some cases, deposition characteristics are similar for geographically similar sites within the mid-Atlantic region. For each of the Virginia MDN sites, it is possible to identify a longer term monitoring site (from a neighboring state) that has similar deposition characteristics.

Prior modeling performed by EPA also indicates that mercury deposition varies from location to location and more specifically that annual mercury deposition is related to the distribution of emission sources, especially within the eastern United States.

How does meteorology influence mercury deposition in Virginia?

A number of different meteorological factors influence mercury deposition in Virginia; key factors include precipitation, temperature, wind speed, and the potential for recirculation. The relative importance of each of these factors varies among the three monitoring sites. In addition, there are different types of meteorological conditions and combinations of parameters that lead to high deposition.

Although there is a high correlation between mercury wet deposition and precipitation, rainfall amount does not fully explain the observed variations in deposition. For all three MDN sites, there is a positive correlation between rainfall, temperature, and relative humidity such that the greater the values of these parameters, the greater the deposition. Higher deposition is associated with lower wind speeds and a well mixed atmosphere. The conditions are representative of summertime conditions and consistent with the timing of the higher observed deposition amounts.

Wind directions, both near the surface and at upper levels, may influence the regional and local transport of mercury emissions from source regions or individual sources for subsequent deposition at the monitoring sites (and to bodies of water) in Virginia. For all three MDN sites, wind directions are slightly different during high deposition periods compared to all periods and indicate possible regional or local transport of mercury emissions from the east or northeast for Culpeper and Shenandoah, and from the south or southwest for Harcum.

Finally, dry deposition of mercury is influenced by several meteorological factors including the temperature characteristics of the atmosphere and the wind speed.

Are there discernable trends in mercury deposition and have recent changes in deposition been accompanied by changes in emissions or primarily driven by meteorological variability?

Variations in meteorology contribute to observed variations in quarterly and annual mercury wet deposition.

Annual deposition amounts that have been adjusted to account for these variations in meteorology exhibit much less variation among the years. For the Virginia sites, the meteorologically adjusted deposition values for 2003-2005 are consistent with changes in the emissions for Virginia. For the Culpeper and Shenandoah sites, the adjusted deposition values indicate a slight downward trend.

For sites in Pennsylvania and North Carolina, the meteorologically adjusted deposition trends for 2000-2005 are consistent with changes in the U.S. emissions. For 2003 to 2005 the trend is slightly upward, in contrast to that for the Virginia sites.

What is the relative importance of wet versus dry deposition, and the various mercury species?

Prior modeling results suggest that for all three Virginia sites, dry deposition is a significant contributing factor to total mercury deposition. Overall, the simulated dry deposition represents about 40 percent or more of the total deposition. Prior modeling also indicates that both wet and dry deposition are predominantly reactive gaseous mercury, and that dry deposition includes about 10 percent particulate mercury.

These results are consistent with monitoring data. The National Oceanic and Atmospheric Administration Air Resources Laboratory conducted a monitoring study during the summer of 2005 at the Harcum site and found that dry deposition was significant and was dominated by reactive gaseous mercury.

V.B.2 Modeling Protocol

The purpose of a modeling protocol is to document in detail how a modeling analysis will be performed and how the results will be presented. ICF submitted a modeling protocol to DEQ in April 2007. This protocol document outlines the methods and procedures to be followed in conducting mercury deposition modeling for the study. The protocol is intended to provide a basis for study participants to review and comment on all aspects of the modeling analysis including the modeling tools and databases, modeling domain and simulation period, modeling procedures, quality assurance procedures, schedule, and communication structures.

The protocol will be used to guide the progress of the modeling analysis and any decisions that need to be made as the work is progressing. Although there are no current EPA guidelines for mercury deposition modeling, the modeling protocol and the modeling practices are designed to

be consistent, wherever applicable, with current EPA guidelines for ozone and fine particulate modeling.

V.B.3 Model Sensitivity Analysis

A sensitivity analysis is the process of varying model input parameters over a reasonable range (range of uncertainty in values of model parameters) and observing the relative change in model response.

Mercury is a complex pollutant to simulate because of the characteristics associated with mercury transport and the chemistry of mercury formation. Transport of mercury in the atmosphere involves many different scales. At the global scale, mercury is known to reside in the atmosphere for long periods of time and is transported around the globe in its elemental form. At the regional and local scales, divalent forms of mercury emitted from sources can have impacts downwind, in some cases immediately downwind, of those sources. Thus modeling of mercury deposition must account for the global, regional, and local components.

The chemistry of mercury formation also contributes to the complexity required of mercury deposition modeling. Mercury exists in the atmosphere in an elemental form and in a number of different compounds. These various forms of mercury react with other species in the atmosphere resulting in a cycling of the airborne mercury among the different forms.

The proposed approach for mercury deposition modeling accounts for the different scales and chemical interactions.

V.B.4 Model Performance Evaluation

A model performance evaluation is performed by running the model using existing emissions data and comparing the results with the observed results in order to evaluate the predictive capabilities of the model. ICF will follow EPA guidance for evaluating model performance to examine whether each model is able to replicate observed and estimated mercury deposition data (when no actual data is available) and whether the response of the model to changes in mercury emissions is reasonable.

V.B.5 Modeling Simulations

ICF will use both the CMAQ and AERMOD models to examine the contributions of a variety of sources to mercury deposition to Virginia's impaired water bodies.

ICF will conduct mercury deposition model simulations that can be utilized by DEQ to examine the following:

1. The contribution of air emissions to mercury deposition for the list of Virginia's impaired water bodies and other mercury sensitive waters. The evaluation will include a breakdown of the contribution of Virginia's air emissions versus regional, national and global emissions sources;

2. The impact of mercury emissions from Virginia EGUs on mercury deposition in Virginia, including an evaluation of the benefits of CAMR and other federal and state programs which may impact or reduce mercury emissions;

3. The impact of mercury emissions from Virginia's non-EGUs on mercury deposition in Virginia; and

4. The individual impact of a selected number of Virginia facilities (up to a maximum of 100 facilities) to local and regional scale mercury deposition.

Modeling simulations for each of the four scenarios outlined above also will be conducted for the baseline year (2002) as well as three future projection years (2010, 2015 and 2018). Future year modeling inventories will take into account the impacts of federal and state laws to reduce emissions.

Results of the modeling simulations will be used as inputs into the other portions of the study.

V.B.6 Mercury Deposition Modeling Report

The final results of the mercury deposition modeling will be detailed in the mercury deposition modeling report. This report is slated to be complete by February 2008.

VI. ANALYSIS OF MERCURY DEPOSITION IMPACT ON FISH TISSUE CONCENTRATIONS

A significant issue is to understand the impact of reducing air deposition of mercury into watersheds on methylmercury concentrations in fish. DEQ was unable to fund this portion of the study because the only vendor that satisfied the requirements of the RFP was cost prohibitive. As a result, DEQ staff will consult the scientific literature, researchers, and those with experience in other states to see if it is feasible to estimate a default value or range of values for relating changes of deposition rates of mercury to watersheds to local fish tissue contamination levels.

VII. PERFORMANCE AND COST ASSESSMENT OF CONTROL TECHNOLOGIES FOR COAL-FIRED POWER PLANTS

DEQ also is evaluating the state of mercury control technology and assessing the technical and economic feasibility of such technology. DEQ staff is reviewing studies by EPA, the Department of Energy (DOE), the European Union, and others to identify available control technologies for EGUs and will develop a list of such technologies by December 2007. The cost-effectiveness of selected control technologies pertinent to Virginia EGUS will then be assessed. This assessment will include:

- Economic cost assessment of existing control technologies so as to isolate the co-benefits associated with multi-pollutant controls on mercury reductions; and

- Economic cost analyses of potential mercury-specific control technologies that could be adopted by Virginia coal-fired power plants. For those facilities that choose not to adopt dedicated mercury control technologies, the analyses will identify the costs as investments that facilities could elect but choose not to undertake.

DEQ staff is gathering control technology performance and cost data, including capital and operating costs, from EPA, DOE, the Electric Power Research Institute (EPRI), technology vendors, utilities, and other sources. Such data, however, are frequently limited, incomplete, and imprecise. Thus some degree of engineering estimate and expert opinion also will be applied. Upon completion of the data collection, performance and cost indicators will be entered into a DOE-approved simulation modeling tool--Integrated Environmental Control Model (IECM)--that can evaluate Virginia source-specific control technologies. Simulation runs, to be completed by the Spring of 2008, will provide estimated net removal costs associated with adoption of dedicated mercury control technologies.

VIII. HUMAN HEALTH RISKS ASSESSMENT

Human exposure to methylmercury can result in adverse health effects on the cardiovascular, digestive, and nervous systems. The primary source of chronic, low dose exposure to methylmercury in the United States is through the consumption of contaminated fish. The human health risk assessment study is a component of the overall DEQ mercury assessment study. Some of the most significant documented effects of methylmercury are on the developing nervous system; therefore sensitive subpopulations include women of childbearing age and children. Frequent consumers of fish, such as those who depend on fishing as a food source, including some minority ethnic populations in certain areas are also considered a sensitive subpopulation.

VCU will assess the human health risks associated with consumption of methylmercury-contaminated recreationally caught freshwater fish by sensitive sub-populations in Virginia.

VIII.A. Survey

The VCU assessment will include a survey to obtain fish consumption information for recreationally-caught freshwater fish across two significant sets of Virginian populations: freshwater anglers that fish in Virginia's coastal plain and Native American tribes that live in Virginia's coastal plain. Results from the primary data based survey will be used to create fish consumption distributions for the target populations and related sub-populations. Consumption patterns across the above mentioned sub-populations will then be analyzed for exposure to methylmercury contaminated freshwater fish.

VIII.B. Sample Design and Analysis Plan

VIII.B.1 Target populations and sampling strategy

- The target populations for this survey are recreational freshwater anglers (including their household members) who fish in Virginia's coastal plain and Native Americans who live in Virginia's coastal plain.

- Boat ramps and key road crossings in the region of interest were visited multiple times on randomly selected days and at randomly selected times of day over a four month period (June – September of 2007).

- Native American tribes will be asked to participate in this survey. If the tribes agree to participate, VCU plans to conduct a census of all adult members of the tribe (both recreational fish consumers and non-recreational fish consumers will be asked to participate).

- Because of the different sampling methods (random sample vs. census), VCU will analyze the distributions of the two target populations separately.

VIII.B.2 Specific data to be gained from the survey

- Fishing behavior information (frequency of fishing, average distance traveled to fish and years of fishing on that water body)

- Consumption habits with regard to caught fish (e.g. consumption of catch, frequency, meal size)

- Primary purpose for fishing (e.g. for food)

- Household make-up and number of people in each category that consume recreationally caught fish

- Consumption habits with regard to store bought fish consumed by anglers (including canned tuna)

- Demographic information (zip code, age, race, education level, income level)

Existing levels of methylmercury in fish tissue (from DEQ's fish tissue database) will be combined with information derived from this survey to produce baseline estimates of human health effects to sensitive sub-populations. Thereafter, modeled reductions in mercury deposition across Virginia will be used to estimate the proportion of the subpopulations that are at risk. These estimates of risks to human health will be monetized by DEQ to arrive at potential economic benefits and costs due to current levels of mercury emissions versus potential future reductions.

IX. FINAL REPORT

As outlined above and required by Chapter 867 of the 2006 Acts of Assembly (House Bill 1055), DEQ has begun to conduct a detailed assessment of mercury deposition in Virginia, including "(i) an evaluation of the state of mercury control technology for coal-fired boilers, including the technical and economic feasibility of such technology and (ii) an assessment of the mercury reductions and benefits expected to be achieved by the implementation of the CAIR and CAMR regulations." DEQ will provide its final report on mercury deposition by October 15, 2008.

Virginia Department of Environmental Quality (VDEQ)

The Virginia Mercury Study: Review and Assessment of Virginia Mercury Emissions Data and Recent Mercury Studies

Mercury Modeling Study Contract № 13360 Report

September 2007

07-045

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Virginia Department of Environmental Quality (VDEQ)

The Virginia Mercury Study: Review and Assessment of Virginia Mercury Emissions Data and Recent Mercury Studies

Mercury Modeling Study Contract № 13360 Report

September 2007

Prepared for
Michael Kiss
Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23219
(804) 698-4061

Prepared by:
Jay Haney, YiHua Wei, Sharon Douglas, Tom Myers
ICF International
101 Lucas Valley Road, Suite 260
San Rafael, CA 94903
(415) 507-7164

Tim Lavallee
LPES, Inc.
14053 Lawns Creek Road
Smithfield, VA 23430

Diane Shotynski
Thruput LLC
7261 Sleigh Hill Drive
Saltville, VA 24370

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1. Introduction

This report summarizes a review and analysis of the sources of atmospheric mercury emissions located within the Commonwealth of Virginia and surrounding areas. This review was conducted as part of the Virginia Mercury Study, which includes an air quality modeling analysis focusing on mercury air deposition to waterways.

1.1. Background

Mercury in the atmosphere can be attributed to both natural and anthropogenic sources. Natural sources of mercury include soils, rocks, volcanoes, and the oceans. Within the U.S., most natural mercury emissions are associated with land types found in the western part of the continent. Prescribed burning and wild fires, which occur in many different areas throughout the U.S., can cause re-emission of natural and previously deposited emissions into the atmosphere.

Anthropogenic sources of mercury include coal-fired power plants and other industrial coal-burning facilities, municipal, medical, industrial and hazardous waste incinerators, chlor-alkali and other chemical manufacturing plants, taconite and other metallurgical processing facilities, pulp and paper manufacturing facilities, mining operations, cement plants, mobile sources, and a wide variety of other industrial and residential sources (EPA, 2005a).

Recent national control legislation promulgated by EPA in the Clean Air Interstate Rule (CAIR) will serve to reduce emissions of NO_x, SO_2, and mercury from coal-fired power plants. The Clean Air Mercury Rule (CAMR) will build on CAIR and provide for additional future mercury emission reductions from these sources. Although controls have been mandated for a number of Virginia coal-fired power plant sources, an air quality modeling analysis will be conducted to quantify the effects of these controls on future-year mercury concentrations and deposition to waterways in the Commonwealth and to determine if more controls are needed.

Recently, the Virginia Department of Environmental Quality (VDEQ) updated the statewide mercury point source emission inventory and developed inventories for 2002 and 2005. These inventories were updated using information received from 75 facilities based on a survey. The information received from each of the facilities was reviewed in this analysis and will be used to estimate future-year emissions. The future-year estimates will be used in the air quality modeling and deposition analysis.

1.2. Objectives

The objectives of this portion of the Virginia Mercury Study are to: 1) conduct a review and analysis of recently updated mercury point source information for sources located in Virginia that will subsequently be used in the air deposition analysis, 2) estimate future-year emissions for 2010, 2015, and 2018 for these sources, and 3) conduct a literature search of recently completed mercury studies related to air deposition, emissions/controls, and air quality modeling and modify the planned approach to the modeling analysis, if warranted, to take advantage of the latest science related to mercury deposition modeling. The first two objectives ensure that the best available mercury emissions inventory is used for the base and future-year modeling analyses, while the third objective ensures that the air deposition modeling analysis will be conducted using the latest available modeling tools and approaches.

1.3. Atmospheric Mercury

Airborne mercury (Hg), emitted from various manmade and natural sources, is comprised of three forms: elemental mercury (Hg(0)), reactive gaseous mercury (RGM), and particulate mercury (Hg(p)). RGM is known to be comprised almost entirely of divalent mercury (Hg^{2+} or Hg(II)), since mercury compounds at other valence states tend to be chemically unstable in the atmosphere (Bullock et al., 2007). Hg(p) is also primarily comprised of divalent mercury, but may also include elemental mercury.

Elemental mercury is the dominant atmospheric species and comprises about 99 percent of the total mercury in the atmosphere. Hg(0) is characterized by low reactivity and low solubility in water. The dry deposition velocity is believed to be relatively low. Hg(0) has a long atmospheric lifetime (perhaps on the order of months to years) and is therefore dispersed and transported/circulated globally.

RGM represents less than one percent of atmospheric mercury. It is highly reactive and highly soluble. It can be actively removed from the atmosphere through both wet and dry deposition processes. As a result, the atmospheric lifetime of RGM is expected to be on the order of one day to one week. Based on these properties, RGM likely contributes to mercury deposition near the source location (locally or regionally).

Hg(p) also represents less than one percent of atmospheric mercury. It is moderately reactive and highly soluble in water. It is likely removed from the atmosphere primarily through wet deposition, since the dry deposition velocity of Hg(p) is expected to be low (based on that for similar fine particles). The atmospheric lifetime of Hg(p) is estimated to be on the order of one day to one week, or longer in the absence of precipitation. Based on these properties, Hg(p) also likely contributes to mercury deposition near the source location (locally or regionally).

1.4. Report Outline

Section 2 of this report summarizes the review of the Virginia point source inventory and Section 3 summarizes the base- and future-year estimates that will be used for the modeling analysis. Section 4 presents a summary of recent mercury studies that were reviewed as part of the literature search task. Finally, a comprehensive bibliography of recently completed reports and presentations is provided in the Appendix.

2. Overview of the Virginia Point Source Inventory

2.1. Review of 2002 Point Source Inventory

This section provides an overview of the process followed in reviewing and updating the mercury point source emissions inventory. As part of this study, point source inventories for 2002 and 2005 were obtained from VDEQ. These inventories were recently compiled based on responses to an information survey conducted by VDEQ to obtain the latest available emission inventory data for mercury point sources located in Virginia. Information regarding process type, emission totals, and mercury speciation was solicited and obtained. For those sources that did not have any speciation information based on recent stack testing, VDEQ instructed them to specify the default speciation profiles that were used in EPA's CAMR modeling analysis.

The intent of this review was to evaluate the information and identify missing data that, if updated, would improve the overall quality of the emission inventory. As noted, the 2002 emission inventory will be used in the base-year air quality modeling analysis and will be the basis for development of the future-year mercury emission inventories, so it is important to review the information and make any changes necessary to ensure that the latest and best information be made available for the modeling analysis.

In February 2007, a CD was received from VDEQ containing emission inventory files for seventy-five Virginia point sources. Of the facilities included, thirty-four supplied complete information and forty-one facilities had some missing or questionable information. Below, we summarize the findings of the initial review of the inventory.

The following table outlines the completeness of the initial responses to the DEQ data request.

	Number of Facilities
VDEQ potential source list	75
Supplied complete information	34
No information was supplied	5
Emissions rates incomplete	6
Speciation data incomplete	15
Stack parameter information incomplete	15
General source information incomplete	10

Detailed information for each category of missing data/information is provided below. Updates received from VDEQ for each of these categories are italicized in each of the sections.

No Information Provided

Information for five facilities on VDEQ's original list of potential mercury facilities was not included in the emission inventory. The facilities, along with the Virginia registration number, include:

1.	UVA Medical Center	40359
2.	Tangier Town	40714
3.	Perdue Farms–Soybean Oil Processing	60277
4.	Norman M Cole Jr Pollution Control Plant	70714
5.	Merck & Co	80524

Upon review by VDEQ, the UVA Medical Center and the Merck & Co. sources were removed from the list of potential mercury emitters. The Tangier Town and Norman M Cole Jr Pollution Control Plant sources were deemed insignificant sources of mercury. New emissions for the Perdue Farms source were provided by VDEQ.

Incomplete Emissions Information

Mercury emission rates were missing or questionable for six of the facilities. The equations and approach to determining the emission rates varied appreciably – approaches included AP-42, mass balance, stack test data, SW-486 and NCASI. In many cases, no supporting calculations are provided. Facilities with missing mercury emission rate information include:

1.	RES dba Steel Dynamics	20131	*Provided total Hg emissions for plant*
2.	Rock Tenn Co Mill	30188	*No updates provided*
3.	Dominion–Mecklenburg Power Station	30861	*Added new Hg emissions*
4.	Philip Morris USA Inc–Park 500	50722	*No updates provided*
5.	Burlington Industries LLC Hurt Fin	30379	*Added new Hg emissions*
6.	Stone Container Enterprises (Smurfit)	40126	*Confirmed that three stacks in facility have no Hg emissions*

Specific updates, as noted in the list above, were provided by VDEQ for these sources.

Speciation Information

Speciation information was missing for fifteen of the facilities. Facilities with speciation information missing included:

1.	MeadWestvaco Packaging Resources	20328
2.	RES dba Steel Dynamics	20131
3.	Philip Morris USA Mfg Center	50076
4.	Hopewell WWTP	50735
5.	James River Cogeneration Company	50950

6.	Spruance Genco LLC	51033
7.	Cogentrix Virginia Leasing Corp	61049
8.	H L Mooney Water Reclamation Facility	71751
9.	Georgia Pacific Corp Big Island Plt	30389
10.	Honeywell Nylon LLC–Hopewell	50232
11.	Philip Morris USA Inc.–Blended Leaf	50080
12.	Philip Morris USA Inc.–Leaf Processing	50082
13.	Burlington Industries LLC Hurt Fin	30379
14.	Griffin Pipe Products Company	30397
15.	Stone Container Enterprises (Smurfit)	40126

New information on mercury speciation profiles was obtained from VDEQ for all of these sources.

Incomplete Stack Parameter Information

Stack parameter information for fifteen facilities was initially incomplete or questionable. The deficient information ranged from missing geographic location, questionable entries, and missing physical stack parameters. Facilities with stack parameter information missing include:

1.	MeadWestvaco Packaging Resources	20328
2.	Dominion–Mecklenburg Power Station	30861
3.	Dominion–Clover Power Station	30867
4.	Birchwood Power Partners, L.P.	40809
5.	Honeywell Nylon LLC–Hopewell	50232
6.	Stone Container Corporation–Hopewell	50370
7.	Philip Morris USA Inc–Park 500	50722
8.	City of Harrisonburg– Resource Recovery	81016
9.	Dan River Incorporated Schoolfield	30240
10.	University of Virginia	40200
11.	US Navy Little Creek Amphibious Base	60033
12.	Burlington Industries LLC Hurt Fin	30379
13.	Griffin Pipe Products Company	30397
14.	Stone Container Enterprises (Smurfit)	40126
15.	Hopewell Cogeneration Ltd Partnership	50967

New stack information was obtained from VDEQ for all of these sources.

Incomplete General Information

General emission unit information for ten facilities was incomplete or questionable. Primarily this included SCC and MACT codes. In many cases, it was not clear whether the sources met the requirements for MACT. It was not possible to tell if all emission sources for the individual facilities were included in the preliminary inventory. Facilities with incomplete general emission unit information included:

1. Virginia Tech 20124
2. MeadWestvaco Virginia Specialty 20329
3. Internet Foundry Archer Creek 30121
4. Solite LLC/Giant Resource Recovery 30200
5. Burlington Industries LLC Hurt Fin 30379
6. Georgia Pacific Corp Big Island Plt 30389
7. Griffin Pipe Products Company 30397
8. Stone Container Enterprises (Smurfit) 40126
9. Hopewell Cogeneration Ltd Partnership 50967
10. Mohawk Industries Inc-Lees Carpet 80269

New information was obtained from VDEQ for all of these sources.

Specific Information Requested for Updating the Virginia Point Source Inventory

In addition to the general missing information related to emissions and stack parameters identified above, efforts were made to obtain the following information:

1. SCC codes for the following facilities.
    a. Chemical Lime Company 20225
    b. Celanese/Cinergy Solutions (21418) 20304
    c. Commonwealth Chesapeake Power 40898
    d. James River Cogeneration Company 50950
    e. Spruance Genco LLC 51033
    f. Cogentrix Virginia Leasing Corp 61049

New SCC code information was obtained from VDEQ for all of these sources.

2. Verify that the mercury speciation profiles for the following electric generating units (EGUs), which were specified as default 20/30/50 (hgp/hg2/hg0), are the latest available (or obtain updated profiles, if available).
    a. Dominion–Altavista Power Station 30859
    b. Dominion–Clover Power Station 30867
    c. Dominion–Bremo 40199

d. Dominion–Gordonsville Power Station 40808
e. Dominion–Chesterfield Power Station 50396
f. Dominion–Yorktown Power Station 60137
g. Dominion–Chesapeake Energy Center 60163
h. Dominion–Southampton Power Station 61093
i. Dominion–Elizabeth River CT Station 61108
j. Dominion–Possum Point Power Station 70225
k. Covanta Alexandria/Arlington, Inc. 71895
l. Covanta Fairfax, Inc. 71920

No new facility-specific speciation profile information was available for any of these sources.

2.2. Updated 2002 Point Source Inventory

Based on the initial review of the inventory as summarized in the previous section, updated information was received from VDEQ. Table 2-1 presents the final 2002 Virginia mercury point source inventory, summarized by facility. The table includes speciated emissions for EGU's and non-EGU's (other industrial sources) and the sources are listed in descending order by total facility mercury emissions. As noted above, for those sources that did not obtain any speciation information based on recent stack testing, they were instructed by VDEQ to specify the default speciation profiles that were used in EPA's CAMR modeling analysis (EPA, 2005a).

Table 2-1 VDEQ 2002 Point Source Mercury Emissions Inventory—Ranked by Facility Total Emissions

	Facility Name	County	Source Type	HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	*Total (lb/yr)*
1	Dominion–Chesterfield Power Station	Chesterfield	EGU	179.42	107.65	71.77	*358.83*
2	Jewel Coke Company LLP	Buchanan	non-EGU	271.67	33.96	33.96	*339.59*
3	Chaparral Steel	Dinwiddie	non-EGU	233.75	29.29	29.26	*292.30*
4	Dominion–Bremo	Fluvanna	EGU	83.86	50.32	33.55	*167.73*
5	American Electric Power- Clinch River	Russell	EGU	38.21	121.00	0.00	*159.21*
6	Dominion–Chesapeake Energy Center	Chesapeake	EGU	78.69	47.22	31.48	*157.38*
7	Potomac River Generating Station	Alexandria	EGU	11.83	106.43	0.00	*118.26*
8	Dominion–Yorktown Power Station	York	EGU	53.82	32.29	21.53	*107.64*
9	Dominion-Possum Point Power Station	Prince William	EGU	50.09	30.06	20.04	*100.19*
10	Stone Container Enterprises (Smurfit)	King William	non-EGU	46.81	27.22	3.73	*77.76*
11	Stone Container Corporation -Hopewell	Hopewell	non-EGU	34.84	20.91	13.94	*69.69*
12	American Electric Power	Giles	EGU	26.06	39.08	0.00	*65.14*
13	Intermet Foundry Archer Creek	Campbell	non-EGU	51.97	6.53	6.51	*65.01*
14	RES dba Steel Dynamics	Roanoke	non-EGU	48.64	6.08	6.08	*60.80*
15	Spruance Genco LLC	Richmond	EGU	27.75	16.65	11.10	*55.50*
16	Mead Westvaco Packaging Resources	Covington	non-EGU	12.96	4.88	9.07	*26.91*
17	Covanta Fairfax, Inc.	Fairfax	EGU	12.87	7.72	5.15	*25.73*
18	James River Cogeneration Company	Hopewell	EGU	12.65	7.59	5.06	*25.30*
19	Celanese/Cinergy Solutions (21418)	Giles	non-EGU	9.20	5.52	3.68	*18.40*
20	Dominion–Clover Power Station	Halifax	EGU	8.34	5.00	3.34	*16.68*
21	Giant Yorktown Refinery	York	non-EGU	12.74	1.59	1.59	*15.93*
22	SPSA Refuse Derived Fuel Plant	Portsmouth	non-EGU	3.43	9.05	3.12	*15.61*
23	H L Mooney Water Reclamation Facility	Prince William	non-EGU	3.21	8.47	2.92	*14.61*
24	Hopewell WWTP	Hopewell	non-EGU	2.93	7.71	2.66	*13.30*
25	HRSD Chesapeake-Elizabeth Sewage	Virginia Beach	non-EGU	2.87	7.56	2.61	*13.04*
26	Cogentrix Virginia Leasing Corp	Portsmouth	EGU	5.85	3.51	2.34	*11.70*
27	Chemical Lime Company	Giles	non-EGU	9.20	1.15	1.15	*11.50*
28	Burlington Industries LLC Hurt Fin	Pittsylvania	non-EGU	5.53	3.32	2.21	*11.05*
29	HRSD Boat Harbor Sewage Treatment Plt	Newport News	non-EGU	2.11	5.56	1.92	*9.59*
30	Roanoke Cement Company	Botetourt	non-EGU	6.96	1.21	1.11	*9.28*
31	Alliant Ammunition & Powder Co.	Montgomery	non-EGU	4.57	2.74	1.83	*9.14*
32	Philip Morris USA Inc–Park 500	Chesterfield	non-EGU	4.35	2.61	1.74	*8.69*
33	Georgia Pacific Corp Big Island Plt	Bedford	non-EGU	3.84	2.30	1.53	*7.67*
34	Mohawk Industries Inc-Lees Carpet	Rockbridge	non-EGU	3.76	2.26	1.50	*7.52*
35	HRSD Virginia Initiative Plant	Norfolk	non-EGU	1.45	3.81	1.31	*6.57*
36	HRSD Army Base Sewage Treatment Plt	Norfolk	non-EGU	1.41	3.71	1.28	*6.40*
37	Intermet Corporation Radford	Radford	non-EGU	4.90	0.61	0.61	*6.12*
38	Bear Island Paper Company LLC	Hanover	non-EGU	2.96	1.77	1.18	*5.91*
39	US Navy Little Creek Amphibious Base	Virginia Beach	non-EGU	2.93	1.76	1.17	*5.87*
40	HRSD Williamsburg	James City	non-EGU	0.99	2.62	0.90	*4.51*
41	Georgia-Pacific/Emporia Plywood	Greensville	non-EGU	2.06	1.24	0.82	*4.12*

	Facility Name	County	Source Type	HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	*Total (lb/yr)*
42	Covanta Alexandria/Arlington, Inc.	Alexandria	EGU	1.96	1.17	0.78	*3.92*
43	Dan River Incorporated Schoolfield	Danville	non-EGU	1.86	1.11	0.74	*3.71*
44	International Paper Company	Isle Of Wight	non-EGU	1.82	1.09	0.73	*3.63*
45	Honeywell Nylon LLC–Hopewell	Hopewell	non-EGU	1.81	1.09	0.72	*3.62*
46	Birchwood Power Partners, L.P.	King George	EGU	1.41	2.05	0.13	*3.59*
47	Solite LLC/Giant Resource Recovery	Buckingham	non-EGU	1.45	0.50	0.55	*2.50*
48	University of Virginia	Charlottesville	non-EGU	1.25	0.75	0.50	*2.49*
49	Philip Morris USA Mfg Center	Richmond	non-EGU	1.24	0.74	0.50	*2.48*
50	Dominion-Southampton Power Station	Southampton	EGU	1.10	0.66	0.44	*2.19*
51	Dominion–Altavista Power Station	Campbell	EGU	1.09	0.65	0.44	*2.18*
52	O-N Minerals (Chemstone) Strasburg	Shenandoah	non-EGU	1.74	0.22	0.22	*2.17*
53	Rock Tenn Co Mill	Lynchburg	non-EGU	0.94	0.56	0.37	*1.87*
54	Virginia Tech	Montgomery	non-EGU	0.75	0.45	0.30	*1.49*
55	Martinsville Thermal, LLC	Henry	non-EGU	0.71	0.42	0.28	*1.41*
56	Commonwealth Chesapeake Power	Accomack	EGU	0.67	0.40	0.27	*1.34*
57	Dominion–Mecklenburg Power Station	Mecklenburg	EGU	0.84	0.25	0.03	*1.11*
58	Hopewell Cogeneration Ltd Partnership	Hopewell	non-EGU	0.53	0.32	0.21	*1.05*
59	INVISTA S.a.r.l. -Waynesboro	Waynesboro	non-EGU	0.52	0.31	0.21	*1.04*
60	Dominion–Gordonsville Power Station	Louisa	EGU	0.41	0.25	0.16	*0.82*
61	Griffin Pipe Products Company	Lynchburg	non-EGU	0.57	0.07	0.07	*0.71*
62	O-N Minerals (Chemstone) Clearbrook	Frederick	non-EGU	0.32	0.04	0.04	*0.40*
63	Hampton/NASA Steam Plant	Hampton	non-EGU	0.07	0.17	0.06	*0.30*
64	Perdue Farms–Soybean Oil Processing	Chesapeake	non-EGU	0.13	0.08	0.05	*0.26*
65	Philip Morris USA Inc.–Leaf Processing	Richmond	non-EGU	0.10	0.06	0.04	*0.20*
66	Mead Westvaco Virginia Specialty	Covington	non-EGU	0.07	0.01	0.01	*0.09*
67	Blacksburg Sanitation Authority	Montgomery	non-EGU	0.01	0.03	0.01	*0.06*
68	Philip Morris USA Inc.–Blended Leaf	Richmond	non-EGU	0.03	0.02	0.01	*0.05*
	Total			*1,404.81*	*793.43*	*352.62*	*2,550.86*

2.3. Comparison of 2002 Virginia Inventory with the NEI

The EPA compiles and maintains a national inventory of mercury emissions as contained in the National Emission Inventory (NEI). As part of this task, the latest version (Version 3) of the 2002 NEI mercury inventory was obtained from EPA. This inventory contains information for point sources and "non-point" sources, also referred to as area sources. These include various other types of fuel combustion sources that emit mercury. The NEI inventory obtained from EPA contains mercury emissions information for 379 distinct Virginia facilities. The top 25 of these sources represent 97 percent of total point source mercury emissions, so there are a number of facilities in this inventory with very small mercury emissions, the majority of which are landfills that emit less than 1 lb of mercury per year. The 2002 Virginia DEQ mercury point source inventory contains information for 68 facilities. The top 25 of these sources represent 93 percent of total point source mercury emissions. A number of the smaller facilities emit less than 5 lbs of mercury per year.

Table 2-2 presents a comparison of emissions for the 68 point sources contained in the updated Virginia inventory with those same sources contained in the NEI inventory. The table includes speciated emissions for elemental, divalent, and particulate mercury based on total mercury, and the assumed speciation profile for each source. The table shows some similarities in emissions totals but also major differences in emissions for a number of the top mercury point source emitters in Virginia. In addition, there are some differences in the assumed speciation profile for a number of sources. It is not evident why the emissions for some of the sources are different or why there are differences in assumed speciation profiles. It is assumed that the updated Virginia inventory includes the latest and most accurate information for these sources. The table also shows that some of the top mercury point sources in Virginia are not included in the current national inventory. Conversely, there are a number of moderate-sized sources listed in the NEI that are not included in the Virginia inventory and it was found that some of the sources in the NEI were closed prior to 2002. It is not clear why certain sources are missing from the NEI or why a few of the closed sources are still included, however, it is expected that emissions for Virginia's updated mercury point source inventory will be submitted to EPA, along with changes/corrections/shutdowns to any other Virginia source in the existing NEI, for inclusion in the next version of the NEI.

Table 2-2. Comparison of Mercury Emitters in the 2002 VDEQ Point Source Inventory with those same sources in the 2002 NEI Version 3 Inventory

	Facility Name	County	Source Type	Updated VDEQ Inventory							EPA 2002 NEI Version 3 Inventory						
				2002 Emissions				Speciation			2002 Emissions				Speciation		
				HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	Total (lb/yr)	HG0	HG2	HGP	HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	Total (lb/yr)	HG0	HG2	HGP
1	Dominion - Chesterfield Power Station	Chesterfield	EGU	179.42	107.65	71.77	358.83	50%	30%	20%	114.42	303.62	27.19	445.23	26%	68%	6%
2	Jewel Coke Company LLP	Buchanan	non-EGU	271.67	33.96	33.96	339.59	80%	10%	10%	271.67	33.96	33.96	339.59	80%	10%	10%
3	Chaparral Steel	Dinwiddie	non-EGU	233.75	29.29	29.26	292.30	80%	10%	10%	312.79	39.10	39.10	390.98	80%	10%	10%
4	Dominion - Bremo Power Station	Fluvanna	EGU	83.86	50.32	33.55	167.73	50%	30%	20%	59.72	92.67	7.87	160.26	37%	58%	5%
5	American Electric Power- Clinch River	Russell	EGU	38.21	121.00	0.00	159.21	24%	76%	0%	41.74	110.76	9.92	162.42	26%	68%	6%
6	Dominion - Chesapeake Energy Center	Chesapeake	EGU	78.69	47.22	31.48	157.38	50%	30%	20%	46.98	124.65	11.16	182.79	26%	68%	6%
7	Potomac River Generating Station	Alexandria	EGU	11.83	106.43	0.00	118.26	10%	90%	0%	18.62	49.40	4.42	72.45	26%	68%	6%
8	Dominion - Yorktown Power Station	York	EGU	53.82	32.29	21.53	107.64	50%	30%	20%	40.07	87.88	10.98	138.93	29%	63%	8%
9	Dominion-Possum Point Power Station	Prince William	EGU	50.09	30.06	20.04	100.19	50%	30%	20%	36.88	89.43	9.43	135.74	27%	66%	7%
10	Stone Container Enterprises (Smurfit)	King William	non-EGU	46.81	27.22	3.73	77.76	60%	35%	5%	0.03	0.02	0.01	0.06	50%	30%	20%
11	Stone Container Corporation - Hopewell	Hopewell	non-EGU	34.84	20.91	13.94	69.69	50%	30%	20%	33.70	20.22	13.48	67.39	50%	30%	20%
12	American Electric Power - Glen Lyn	Giles	EGU	26.06	39.08	0.00	65.14	40%	60%	0%	19.59	51.98	4.65	76.22	26%	68%	6%
13	Intermet Foundry Archer Creek	Campbell	non-EGU	51.97	6.53	6.51	65.01	80%	10%	10%	0.80	0.10	0.10	1.00	80%	10%	10%
14	RES dba Steel Dynamics	Roanoke	non-EGU	48.64	6.08	6.08	60.80	80%	10%	10%	185.07	23.13	23.13	231.33	80%	10%	10%
15	Spruance Genco LLC	Richmond	EGU	27.75	16.65	11.10	55.50	50%	30%	20%	3.77	1.09	1.21	6.08	62%	18%	20%
16	Mead Westvaco Packaging Resources	Covington	non-EGU	12.96	4.88	9.07	26.91	48%	18%	34%	0.45	0.27	0.18	0.89	50%	30%	20%
17	Covanta Fairfax, Inc.	Fairfax	EGU	12.87	7.72	5.15	25.73	50%	30%	20%	2.98	7.85	2.71	13.54	22%	58%	20%
18	James River Cogeneration Company	Hopewell	EGU	12.65	7.59	5.06	25.30	50%	30%	20%							
19	Celanese/Cinergy Solutions (21418)	Giles	non-EGU	9.20	5.52	3.68	18.40	50%	30%	20%	0.12	0.07	0.05	0.23	50%	30%	20%
20	Dominion - Clover Power Station	Halifax	EGU	8.34	5.00	3.34	16.68	50%	30%	20%	7.34	4.01	0.81	12.17	60%	33%	7%
21	Giant Yorktown Refinery	York	non-EGU	12.74	1.59	1.59	15.93	80%	10%	10%	10.56	1.32	1.32	13.20	50%	30%	20%
22	SPSA Refuse Derived Fuel Plant	Portsmouth	non-EGU	3.43	9.05	3.12	15.61	22%	58%	20%	3.35	8.83	3.04	15.22	22%	58%	20%
23	H L Mooney Water Reclamation Facility	Prince William	non-EGU	3.21	8.47	2.92	14.61	22%	58%	20%							
24	Hopewell WWTP	Hopewell	non-EGU	2.93	7.71	2.66	13.30	22%	58%	20%							
25	HRSD Chesapeake-Elizabeth Sewage	Virginia Beach	non-EGU	2.87	7.56	2.61	13.04	22%	58%	20%							
26	Cogentrix Virginia Leasing Corp	Portsmouth	EGU	5.85	3.51	2.34	11.70	50%	30%	20%							
27	Chemical Lime Company	Giles	non-EGU	9.20	1.15	1.15	11.50	80%	10%	10%	3.92	0.49	0.49	4.90	80%	10%	10%
28	Burlington Industries LLC Hurt Fin	Pittsylvania	non-EGU	5.53	3.32	2.21	11.05	50%	30%	20%							
29	HRSD Boat Harbor Sewage Treatment Plt	Newport News	non-EGU	2.11	5.56	1.92	9.59	22%	58%	20%							
30	Roanoke Cement Company	Botetourt	non-EGU	6.96	1.21	1.11	9.28	75%	13%	12%	4.73	0.82	0.76	6.30	75%	13%	12%
31	Alliant Ammunition & Powder Co.	Montgomery	non-EGU	4.57	2.74	1.83	9.14	50%	30%	20%	0.05	0.02	0.02	0.08	58%	20%	22%
32	Philip Morris USA Inc - Park 500	Chesterfield	non-EGU	4.35	2.61	1.74	8.69	50%	30%	20%							
33	Georgia Pacific Corp Big Island Plt	Bedford	non-EGU	3.84	2.30	1.53	7.67	50%	30%	20%							
34	Mohawk Industries Inc-Lees Carpet	Rockbridge	non-EGU	3.76	2.26	1.50	7.52	50%	30%	20%							

	Facility Name	County	Source Type	Updated VDEQ Inventory							EPA 2002 NEI Version 3 Inventory						
				2002 Emissions				Speciation			2002 Emissions				Speciation		
				HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	Total (lb/yr)	HG0	HG2	HGP	HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	Total (lb/yr)	HG0	HG2	HGP
35	HRSD Virginia Initiative Plant	Norfolk	non-EGU	1.45	3.81	1.31	6.57	22%	58%	20%							
36	HRSD Army Base Sewage Treatment Plt	Norfolk	non-EGU	1.41	3.71	1.28	6.40	22%	58%	20%							
37	Intermet Corporation Radford	Radford	non-EGU	4.90	0.61	0.61	6.12	80%	10%	10%	0.18	0.02	0.02	0.23	80%	10%	10%
38	Bear Island Paper Company LLC	Hanover	non-EGU	2.96	1.77	1.18	5.91	50%	30%	20%							
39	US Navy Little Creek Amphibious Base	Virginia Beach	non-EGU	2.93	1.76	1.17	5.87	50%	30%	20%							
40	HRSD Williamsburg	James City	non-EGU	0.99	2.62	0.90	4.51	22%	58%	20%							
41	Georgia-Pacific/Emporia Plywood	Greensville	non-EGU	2.06	1.24	0.82	4.12	50%	30%	20%	2.06	1.24	0.82	4.12	50%	30%	20%
42	Covanta Alexandria/Arlington, Inc.	Alexandria	EGU	1.96	1.17	0.78	3.92	50%	30%	20%	1.41	3.72	1.28	6.41	22%	58%	20%
43	Dan River Incorporated Schoolfield	Danville	non-EGU	1.86	1.11	0.74	3.71	50%	30%	20%	0.00	0.00	0.00	0.00	80%	10%	10%
44	International Paper Company	Isle Of Wight	non-EGU	1.82	1.09	0.73	3.63	50%	30%	20%							
45	Honeywell Nylon LLC - Hopewell	Hopewell	non-EGU	1.81	1.09	0.72	3.62	50%	30%	20%	0.53	0.32	0.21	1.06	50%	30%	20%
46	Birchwood Power Partners, L.P.	King George	EGU	1.41	2.05	0.13	3.59	39%	57%	4%	2.16	1.17	0.24	3.56	61%	33%	7%
47	Solite LLC/Giant Resource Recovery	Buckingham	non-EGU	1.45	0.50	0.55	2.50	58%	20%	22%	55.73	19.22	21.14	96.08	58%	20%	22%
48	University of Virginia	Charlottesville	non-EGU	1.25	0.75	0.50	2.49	50%	30%	20%							
49	Philip Morris USA Mfg Center	Richmond	non-EGU	1.24	0.74	0.50	2.48	50%	30%	20%	1.31	0.79	0.53	2.63	50%	30%	20%
50	Dominion-Southampton Power Station	Southampton	EGU	1.10	0.66	0.44	2.19	50%	30%	20%	0.94	0.29	0.31	1.54	61%	19%	20%
51	Dominion - Altavista Power Station	Campbell	EGU	1.09	0.65	0.44	2.18	50%	30%	20%	0.89	0.26	0.29	1.44	62%	18%	20%
52	O-N Minerals (Chemstone) Strasburg	Shenandoah	non-EGU	1.74	0.22	0.22	2.17	80%	10%	10%	1.76	0.22	0.22	2.20	80%	10%	10%
53	Rock Tenn Co Mill	Lynchburg	non-EGU	0.94	0.56	0.37	1.87	50%	30%	20%							
54	Virginia Tech	Montgomery	non-EGU	0.75	0.45	0.30	1.49	50%	30%	20%							
55	Martinsville Thermal, LLC	Henry	non-EGU	0.71	0.42	0.28	1.41	50%	30%	20%	0.13	0.08	0.05	0.25	50%	30%	20%
56	Commonwealth Chesapeake Power	Accomack	EGU	0.67	0.40	0.27	1.34	50%	30%	20%							
57	Dominion - Mecklenburg Power Station	Mecklenburg	EGU	0.84	0.25	0.03	1.11	75%	22%	2%	0.34	0.25	0.07	0.65	52%	38%	10%
58	Hopewell Cogenertion Ltd Partnership	Hopewell	non-EGU	0.53	0.32	0.21	1.05	50%	30%	20%	0.30	0.18	0.12	0.60	50%	30%	20%
59	INVISTA S.a.r.l. -Waynesboro	Waynesboro	non-EGU	0.52	0.31	0.21	1.04	50%	30%	20%							
60	Dominion - Gordonsville Power Station	Louisa	EGU	0.41	0.25	0.16	0.82	50%	30%	20%							
61	Griffin Pipe Products Company	Lynchburg	non-EGU	0.57	0.07	0.07	0.71	80%	10%	10%							
62	O-N Minerals (Chemstone) Clearbrook	Frederick	non-EGU	0.32	0.04	0.04	0.40	80%	10%	10%	0.32	0.04	0.04	0.40	80%	10%	10%
63	Hampton/NASA Steam Plant	Hampton	non-EGU	0.07	0.17	0.06	0.30	22%	58%	20%	64.92	171.16	59.02	295.11	22%	58%	20%
64	Perdue Farms - Soybean Oil Processing	Chesapeake	non-EGU	0.13	0.08	0.05	0.26	50%	30%	20%	0.98	0.59	0.39	1.95	50%	30%	20%
65	Philip Morris USA Inc. - Leaf Processing	Richmond	non-EGU	0.10	0.06	0.04	0.20	50%	30%	20%	0.03	0.02	0.01	0.07	50%	30%	20%
66	Mead Westvaco Virginia Specialty	Covington	non-EGU	0.07	0.01	0.01	0.09	80%	10%	10%							
67	Blacksburg Sanitation Authority	Montgomery	non-EGU	0.01	0.03	0.01	0.06	22%	58%	20%							
68	Philip Morris USA Inc. - Blended Leaf	Richmond	non-EGU	0.03	0.02	0.01	0.05	50%	30%	20%	2.25	1.35	0.90	4.51	50%	30%	20%

Figure 2-1 presents a comparison of total emissions for the 68 Virginia mercury point sources with emissions from those same sources contained in the NEI. A comparison of totals shows the NEI inventory with 12 percent higher emissions. As noted above, this is due to the fact that a few large emitters listed in the NEI have been closed in recent years or that this version of the NEI contains outdated and/or erroneous emission estimates for certain sources. For example, source #63 in Table 2-2 shows a total of 0.3 lbs/yr total mercury emissions in the updated Virginia inventory and 295 lbs/yr total mercury in the NEI inventory, which is obviously wrong based on the updated survey information.

For the mercury deposition modeling analysis, the updated Virginia point source inventory will be combined with emissions from point and non-point sources contained in the NEI. The emissions for the 68 facilities will be combined with emissions from other Virginia sources contained in the NEI inventory, but not included in the list of 68. The emissions for these other NEI sources were also reviewed by VDEQ as part of this work, and some of these sources were eliminated because they were either closed or were not regarded as "air" sources by VDEQ. Although the emissions from the remaining valid NEI sources are very small, they will be accounted for in the deposition modeling analysis. As noted above, it is expected that emissions for Virginia's updated mercury point source inventory will be submitted to EPA, along with changes/corrections/shutdowns to any other Virginia source in the existing NEI, for inclusion in the next version of the NEI.

Figure 2-1. Mercury Emissions for Virginia Point Sources: 2002 VDEQ vs. 2002 NEI V3

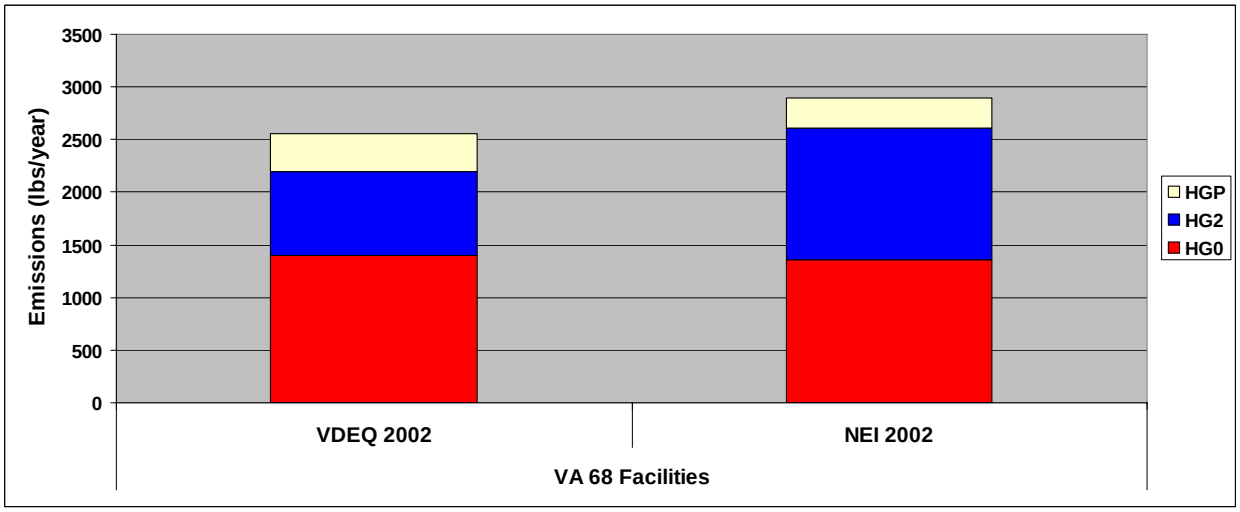
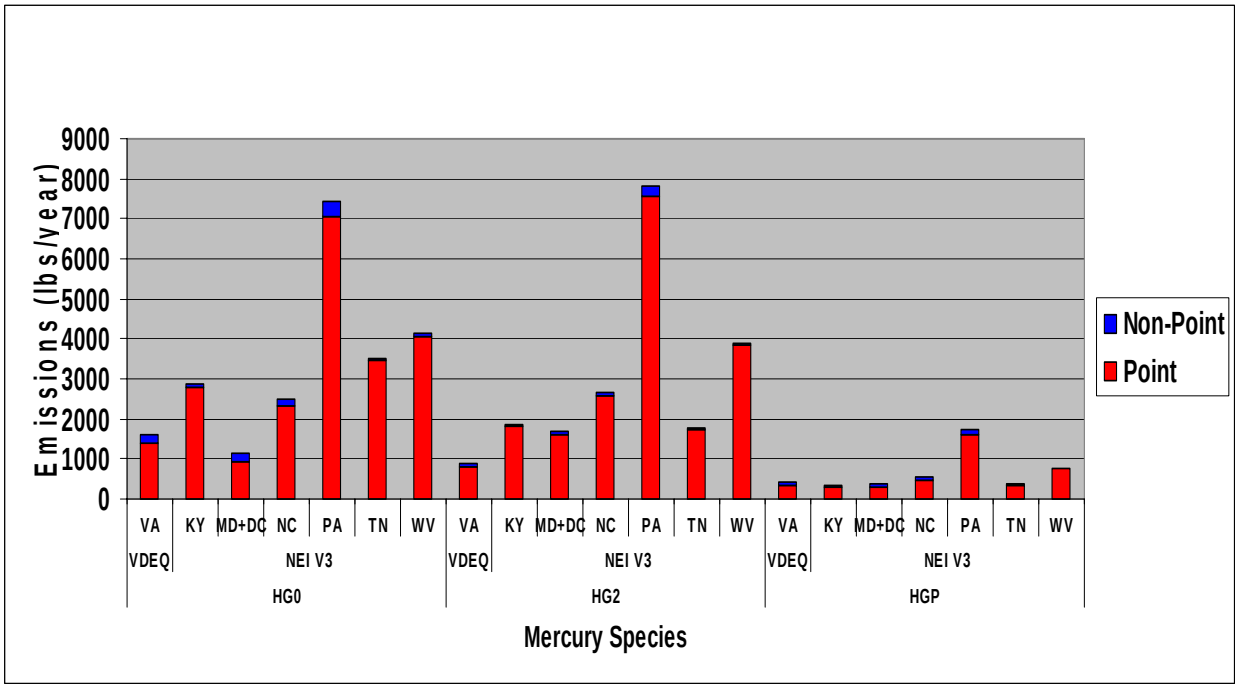


Figure 2-2 presents a comparison of the 2002 Virginia mercury emissions with those contained in the NEI for the neighboring states of Kentucky, Maryland/D.C., North Carolina, Pennsylvania, Tennessee, and West Virginia. These emissions and emissions from all other states in the modeling domain obtained from the NEI inventory will be used in the mercury air deposition modeling. Of the seven states, Virginia's emissions are comparable to the combined Maryland/D.C. emissions totals. The neighboring states have the potential to influence mercury deposition in Virginia watersheds and emissions from these states will be fully accounted for in the modeling analysis.

Figure 2-2. Comparison of the 2002 VDEQ Speciated Mercury Emissions Inventory with the 2002 NEI Version 3 Inventory for Selected Neighboring States

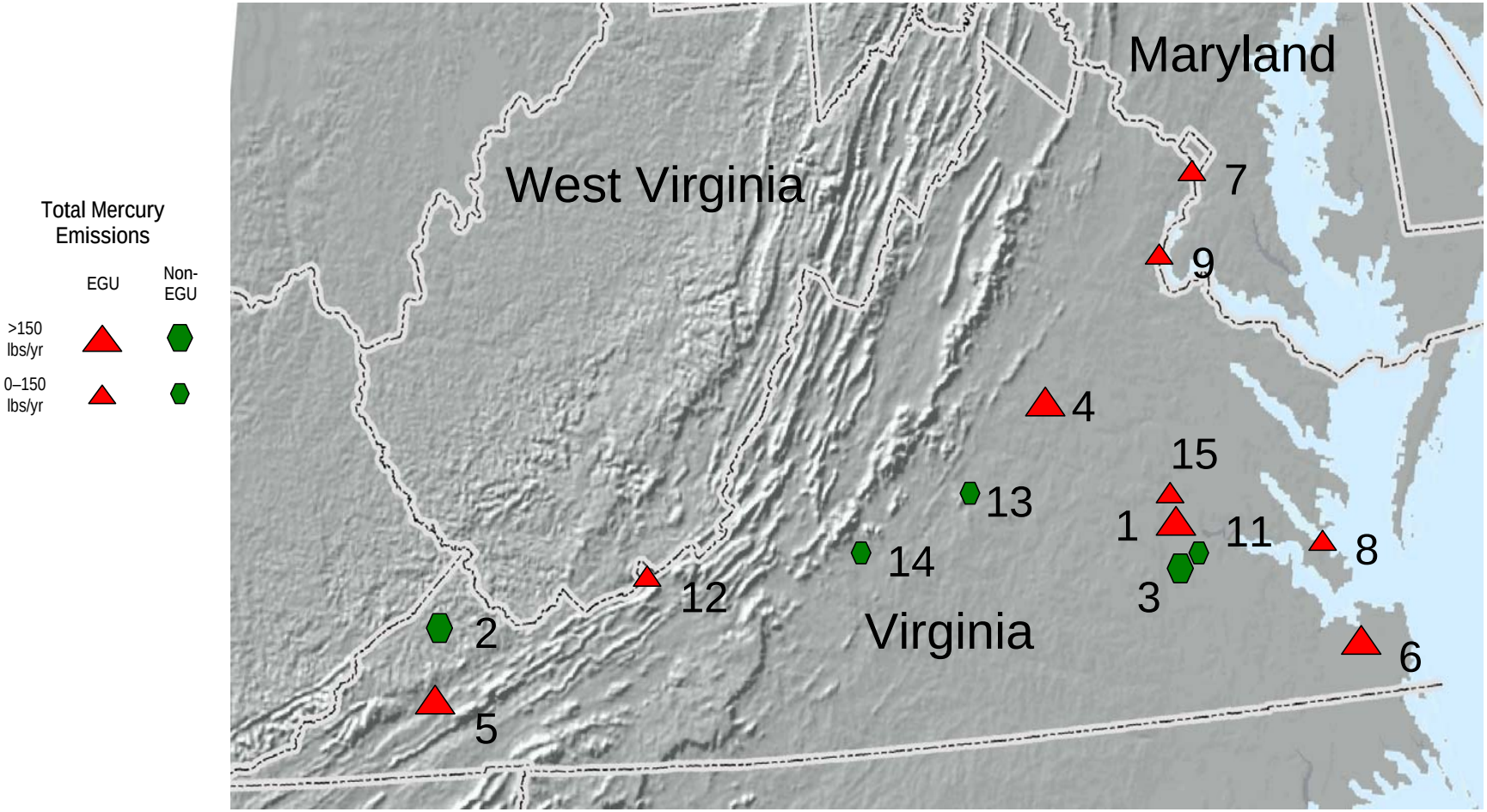


3. Summary of Virginia Mercury Inventory

3.1. Base-Year Emission Inventory for Modeling

The 2002 Virginia mercury point source inventory, as listed in Table 2-1, will be processed and used with the CMAQ air quality modeling system to estimate mercury deposition affecting Virginia waterways. To provide an example of the point-source emissions as they will be input to the model, Figure 3-1 presents the location and magnitude of the top 15 mercury point sources in Virginia for 2002 as contained in Table 2-1. These 15 EGU and non-EGU point sources represent 86 percent of total mercury point source emissions for Virginia in 2002. The figure presents information for total annual mercury emissions from these sources in two ranges: 0 – 150 lbs/yr and > 150 lbs/yr.

Figure 3-1. Location and Magnitude of the Top 15 Virginia Mercury EGU and Non-EGU Point Sources for 2002 (Hg-Total Mercury)



	Facility Name	County	Source Type		Facility Name	County	Source Type
1	Dominion–Chesterfield Power Station	Chesterfield	EGU	9	Dominion-Possum Point Power Station	Prince William	EGU
2	Jewel Coke Company LLP	Buchanan	non-EGU	10	Stone Container Enterprises (Smurfit)	King William	non-EGU
3	Chaparral Steel	Dinwiddie	non-EGU	11	Stone Container Corporation -Hopewell	Hopewell	non-EGU
4	Dominion–Bremo	Fluvanna	EGU	12	American Electric Power	Giles	EGU
5	American Electric Power- Clinch River	Russell	EGU	13	Intermet Foundry Archer Creek	Campbell	non-EGU
6	Dominion–Chesapeake Energy Center	Chesapeake	EGU	14	RES dba Steel Dynamics	Roanoke	non-EGU
7	Potomac River Generating Station	Alexandria	EGU	15	Spruance Genco LLC	Richmond	EGU
8	Dominion–Yorktown Power Station	York	EGU				

3.2. Future-Year Emission Inventory Estimates for Virginia Sources

For this study, mercury air deposition will be assessed in the modeling analysis for 2002 and three future years: 2010, 2015, and 2018. As noted above, recent national control legislation promulgated by EPA in the Clean Air Interstate Rule (CAIR) will reduce emissions of NO_x, SO_2, and mercury from coal-fired power plants in the eastern US. Phase 1 controls for NOx are due in place by January 2009, while phase 1 controls for SO_2 are due by January 2010. Phase 2 controls for NO_x and SO_2 are both due by January 2015. Mercury emissions reduction benefits will be realized from the NO_x and SO_2 controls in place by January 2010. The Clean Air Mercury Rule (CAMR) will build on CAIR and provide for additional future mercury emission reductions from these sources. Mercury controls are mandated to be in place by January 2018 for those coal-fired power plants subject to the rule.

Presently, a number of Virginia sources have existing pollution control equipment installed and running, while others are planning on installing future controls. Table 3-1 presents a summary of control equipment currently being utilized or planned to be installed by Virginia coal-fired boilers. Most of the new control equipment is expected to be installed by 2010.

Table 3-1. Summary of Existing and Planned Emission Controls for Virginia Coal Fired Boilers

Facility Name	MW (NOx SIP Call)	MW Calculated	Control Equipment[1]	Projected Control Equipment	Projected Year To Install
Dominion - Chesterfield Power Station (1)					
3	113	110.0	OFA/LNB/ESP	FGD	2011
4	188	167.7	SCR/ESP/Staged combustion	FGD	2011
5	359	343.2	SCR/ESP/Staged combustion	FGD	2011
6	694	633.3	SCR/ESP/Staged combustion	FGD/FF	2008
Dominion - Bremo Power Station (4)					
3	69	86.9	ESP (hot sided)/BOOS		
4	185	161.8	ROFA/ESP (hot sided)		
American Electric Power - Clinch River (5)					
1	235	200.0	staged combustion/ESP		
2	235	200.0	staged combustion/ESP		
3	235	200.0	staged combustion/ESP		
Dominion - Chesapeake Energy Center[2] (6)					
1	113	123.8	OFA /ROFA/ESP	SA Coal 50% CE for Hg and 40% for S	2007
2	113	123.8	OFA/ROFA/ESP	SA Coal 50% CE for Hg and 40% for S	2007
3	185	158.4	LNB/SCR/ESP	SA Coal 50% CE for Hg and 40% for S	2007
4	239	223.4	LNB/SCR/ESP (all cold sided)	SA Coal 50% CE for Hg and 40% for S	2007
Potomac River Power Generating Station[3] (7)					
1	93	92.4	LNB/ESP		
2	93	92.4	LNB/ESP		
3	108	91.5	LNB/SOFA/ESP		
4	108	91.5	LNB/SOFA/ESP		
5	108	91.5	LNB/SOFA/ESP		
Dominion - Yorktown Power Station (8)					
1	188	161.6	LNB/OFA/SNCR/ESP	FGD	2015
2	188	166.2	LNB/OFA/SNCR/ESP	FGD	2015
Stone Container Corp., West Point Mill[4](10)					
2			Concentric firing/LNB/ESP	SO2 Scrubber	2008
Stone Container Corp., Hopewell (11)					
1		80.6	ESP		
American Electric Power - Glen Lyn (12)					
51	100	54.5	staged combustion/ESP		
52	100	54.5	staged combustion/ESP		
6	238	194.3	staged combustion/ESP		
Spruance Genco LLC (15)					
BLR01A		35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR01B	115	35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR02A		35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR02B	115	35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR03A		35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR03B	115	35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR04A		35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
BLR04B	115	35.7	SNCR/FGR/OFA/Meth/FF/D FGD		
James River Cogeneration (18)					
BLR01A		19.0	FGR/OFA/FF	SDA	2010
BLR01B		19.0	FGR/OFA/FF	SDA	2010
BLR01C	108.5	19.0	FGR/OFA/FF	SDA	2010
BLR02A		19.0	FGR/OFA/FF	SDA	2010
BLR02B		19.0	FGR/OFA/FF	SDA	2010
BLR02C	108.5	19.0	FGR/OFA/FF	SDA	2010
Dominion - Clover Power Station (20)					
1	424	389.0	LNB/SNCR/FF/Wet FGD		
2	424	389.0	LNB/SNCR/FF/Wet FGD		

Summary of Virginia Mercury Inventory

Facility Name		MW (NOx SIP Call)	MW Calculated	Control Equipment[1]	Projected Control Equipment	Projected Year To Install
Cogentrix Virginia Leasing-Portsmouth (26)						
	BLR01A		19.0	FGR/OFA/FF	SDA	2010
	BLR01B		19.0	FGR/OFA/FF	SDA	2010
	BLR01C	108.5	19.0	FGR/OFA/FF	SDA	2010
	BLR02A		19.0	FGR/OFA/FF	SDA	2010
	BLR02B		19.0	FGR/OFA/FF	SDA	2010
	BLR02C	108.5	19.0	FGR/OFA/FF	SDA	2010
Georgia-Pacific - Big Island Plant (33)						
	4		27.0	ESP		
	6		27.1	LNB/FGR (not coal fired)		
Dan River Inc—Schoolfield Complex (43)						
			24.0	ESP		
International Paper Co. - Franklin Mill (44)						
	3		47.2	ESP		
	17			shutdown		
	29			LNB/SCR		
Birchwood Power Partners Facility (46)						
	1	240	219.0	SCR/FF/DLS		
Dominion - Southampton Power Station (50)						
	1	71.1	38.1	OFA/DFGD/FF/Staged combustion		
62.7 MW total	2	71.1	38.1	OFA/DFGD/FF/Staged combustion		
Dominion - Altavista Power Station (51)						
	1	71.1	36.4	SNCR/LNB/DLS/FF		
	2	71.1	36.4	SNCR/LNB/DLS/FF		
Dominion - Mecklenburg Cogeneration Facility (57)						
	1		79.4	LNB/OFA/FF/FGD		
	2	139.9	79.4	LNB/OFA/FF/FGD		
Mead Westvaco Virginia Specialty, Covington (66)						
	1		52.4	LNB/ESP/FGD		
	2		41.9	FGR /ESP/FGD		
	3		55.2	FGR/ESP/FGD		
	4		76.9	LNB/ESP/FGD		
	5					
	11			LNB/FGR		

[1] Control equipment includes the following: selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), low-NOx burners (LNB), electrostatic precipitators (ESP), dry lime scrubbing (DLS), fabric filters (FF), over-fired air (OFA), flue-gas desulfurization (FGD), flue-gas recirculation (FGR), rotating opposed-fired air (ROFA), and burners out of service (BOOS).

[2] Chesapeake Energy Center was originally slated to be controlled by SDA. However, a Dominion update of the control plan notes these installations are indefinitely delayed, and South American coal with about half of the Hg content and about 40% lower sulfur content is currently being used at the facility.

[3] Potomac River is currently using Trona injection on 3, 4, and 5. They are also subject to the CAIR cap without trading provisions due to their location in a nonattainment area. They will be capped for both NOx and SO2.

[4] Installation of the SO2 scrubber by 2008 is the result of a federal consent decree and enforcement action.

For those EGU sources subject to EPA's CAMR reductions, future year emissions budgets have been established based on the CAMR provisions as well as Virginia-specific emissions rules. According to VDEQ, proposed mercury allowance allocations to coal fired electric steam generating units in Virginia, for the control period 2010 – 2017, were made according to State Air Pollution Control Board Regulation for Emission Trading Programs. A total of 95 percent of the allocated state budget of 1184 lbs (0.592 tons, excluding 4% set-aside for the new and 1%

for energy efficient units) are distributed to the existing units in proportion to their baseline heat input in million Btu. The baseline heat input for this purpose is the average of three highest amounts of the unit's control period heat input for the years 2000 through 2004.

Table 3-2 presents the estimated future-year budgets for those Virginia EGU's subject to CAMR for 2014, 2015-17, and 2018. The number in the table corresponds to the number in the 2002 inventory table (Table 2-2) above. Because many of the EGU sources listed have (or will have) controls in place to reduce mercury emissions below these budgets, the actual future year emissions to be used in the mercury deposition modeling analysis may be different than those listed in the table.

Table 3-2. Future Year Mercury Emissions Budgets for Virginia EGU's Subject to CAMR

#	Facility Name	County	Source Type	2002				2014	2015–2017	2018
				HG0 (lb/yr)	HG2 (lb/yr)	HGP (lb/yr)	Total (lb/yr)	Total (lb/yr)	Total (lb/yr)	Total (lb/yr)
1	Dominion - Chesterfield Power Station	Chesterfield	EGU	179.42	107.65	71.77	358.83	230.39	94.00	94.00
4	Dominion – Bremo Power Station	Fluvanna	EGU	83.86	50.32	33.55	167.73	44.45	18.14	18.14
5	American Electric Power- Clinch River	Russell	EGU	38.21	121.00	0.00	159.21	113.40	113.40	46.27
6	Dominion - Chesapeake Energy Center	Chesapeake	EGU	78.69	47.22	31.48	157.38	122.04	49.79	49.79
7	Potomac River Generating Station	Alexandria	EGU	11.83	106.43	0.00	118.26	72.96	72.96	29.77
8	Dominion - Yorktown Power Station	York	EGU	53.82	32.29	21.53	107.64	58.08	23.70	23.70
9	Dominion-Possum Point Power Station	Prince William	EGU	50.09	30.06	20.04	100.19	56.93	23.23	23.23
12	American Electric Power – Glen Lyn	Giles	EGU	26.06	39.08	0.00	65.14	47.69	47.69	19.46
15	Spruance Genco LLC	Richmond	EGU	27.75	16.65	11.10	55.50	55.50	55.50	22.64
18	James River Cogeneration Company	Hopewell	EGU	12.65	7.59	5.06	25.30	24.54	24.54	10.01
20	Dominion - Clover Power Station	Halifax	EGU	8.34	5.00	3.34	16.68	190.08	77.55	77.55
26	Cogentrix Virginia Leasing Corp	Portsmouth	EGU	5.85	3.51	2.34	11.70	19.19	19.19	7.83
46	Birchwood Power Partners, L.P.	King George	EGU	1.41	2.05	0.13	3.59	38.57	38.57	15.74
51	Dominion - Altavista Power Station	Campbell	EGU	1.09	0.65	0.44	2.18	11.07	4.52	4.52
57	Dominion - Mecklenburg Power Station	Mecklenburg	EGU	0.84	0.25	0.03	1.11	25.74	15.56	10.50

4. Summary of Recent Mercury Studies

This section summarizes information that may be relevant to the current study from recent papers and presentations on data collection and analysis, modeling, and emissions and controls studies of mercury deposition. Note that all of the references given in this section can be found in the bibliography provided in the appendix. They are also available on the Virginia DEQ Mercury Study web page: http://www.deq.virginia.gov/air/vamercury/vamercurystudy.html

4.1. General Mercury Deposition and Data Analysis Studies

Numerous reports and papers discuss the state-of-the science of mercury deposition, with emphasis on the sources of airborne mercury, mercury chemistry, global and regional transport, mercury deposition mechanisms, and mercury effects on aquatic ecosystems. Several studies focus on the analysis of collected mercury deposition data for specific locations. A few recent studies examine the relationships between meteorology and mercury deposition.

General Studies

Nearly all of the papers and reports examined discussed the **sources of mercury** in the atmosphere. It is widely understood that mercury is emitted to the atmosphere from both natural and anthropogenic sources.

Certain soils, rocks, and other geologic structures naturally contain mercury and therefore represent natural or geogenic sources of mercury emissions. Volcanic activity is thought to be an important but variable source of naturally occurring airborne mercury (Niagru and Becker, 2003). Within North America, most natural mercury emissions are associated with land types found in the western part of the continent. In addition to the land masses, the oceans are also a source of natural mercury emissions. Emissions fluxes from the ocean are thought to be greatest near the equator and to decrease toward the poles (Seigneur et al., 2003; Kim and Fitzgerald, 1986).

Anthropogenic sources of mercury include coal-fired power plants and other industrial coal-burning facilities, municipal, medical, industrial and hazardous waste incinerators, chlor-alkali and other chemical manufacturing plants, taconite and other metallurgical processing facilities, pulp and paper manufacturing facilities, mining operations, cement plants, mobile sources, and a wide variety of other industrial and residential sources (EPA, 2005).

It is also widely understood that re-emission of both natural and anthropogenic emissions from both land and water areas is an important part of the global mercury budget. Over land, prescribed burning and wild fires can increase the rate of re-emission.

Driscoll et al. (2007) estimates that approximately one-third of the emissions are direct anthropogenic emissions. Valente et al. (2007) summarizes the results of numerous studies in estimating that global mercury emissions are equally apportioned among natural emissions, direct anthropogenic emissions, and re-emission of previously deposited natural and anthropogenic emissions.

Understanding the **mercury chemistry** is an active area of research. Bullock et al. (2007) summarizes the three forms of airborne mercury (Hg) as follows: elemental mercury (Hg(0)), reactive gaseous mercury (RGM), and particulate mercury (Hg(p)). RGM is known to be comprised almost entirely of divalent mercury (Hg^{2+} or Hg(II)), since mercury compounds at other valence states tend to be chemically unstable in the atmosphere. Hg(p) is also primarily comprised of divalent mercury, but may also include elemental mercury.

Valente et al. (2007) and others offer that elemental mercury is the dominant atmospheric species and comprises about 99 percent of the total mercury in the atmosphere. Hg(0) is characterized by low reactivity and low solubility in water and has a long atmospheric lifetime. RGM represents less than one percent of atmospheric mercury. It is highly reactive and highly soluble and can be actively removed from the atmosphere through both wet and dry deposition processes. Hg(p) also represents less than one percent of atmospheric mercury. It is moderately reactive and highly soluble in water. It is removed from the atmosphere primarily through wet deposition

Seigneur et al. (2003) discuss the chemical transformations that transfer mercury mass from one of these states to another. Several gas phase and aqueous phase reactions and equilibrium processes are expected to be important.

The **global and regional transport** of mercury is the topic of much discussion in the current literature, especially in explaining deposition observed at remote locations and in the context of mercury deposition modeling. With an atmospheric lifetime that may be on the order of months to years, Hg(0) is dispersed and transported globally by atmospheric circulation systems and regionally by large-scale weather systems. Similarly, with atmospheric lifetimes on the order of a week, RGM and Hg(p) may also be subject to regional-scale transport.

With regard to **deposition mechanisms**, a key area of interest is the re-emission of mercury from both land and water surfaces (e.g., Sofiev and Galperin (2000)). Prescribed burning and wild fires may account for some of the re-emissions. Other natural processes, including microbial activity, may also account for some of the re-emission (Syrakov, 1998). Re-emission of mercury is mainly in the form of Hg(0) (Schluter, 2000).

Of primary interest for states and EPA is the **impact of mercury deposition on aquatic ecosystems**. In the U.S., more than 8,500 individual bodies of water have been identified as mercury impaired and the primary source of mercury to these water bodies is believed to be atmospheric deposition. For example, the South Florida Mercury Science Program found that atmospheric deposition of mercury accounts for more than 95 percent of the new mercury entering the Everglades each year (Fink et al., 1998).

Based on the network of mercury deposition measurements for the Northeast, Driscoll et al. (2007) concludes that mercury can be directly deposited onto surface waters or deposited in forest and wetland areas and then transported through the watershed to accumulate in the surface waters.

In certain bodies of water such as those with low dissolved oxygen, high organic matter content, and low acidity, mercury deposition can lead to the formation and build up of the highly bio-accumulative form of mercury (methyl mercury, CH_3Hg^+ or $MeHg^+$). Human exposure to mercury is linked with the consumption of contaminated fish from such water bodies.

Analysis of Mercury Deposition Data for Specific Locations

Numerous analyses of mercury deposition data (e.g., Seigneur et al. (2003) indicate that there are spatial patterns in the data and that these can vary from year to year. While the patterns are clearly related to rainfall amount, some studies (for example, Keeler et al. (2006)) suggest that there are spatial patterns in the wet deposition data that are not fully accounted for by the rainfall patterns. This suggests the potential for impact from local and regional sources.

An analysis of wet mercury deposition for two rural, coastal sites in North Carolina (Haywood et al., 2000 and others) revealed both a spatial pattern as well as a seasonal pattern of wet

mercury deposition when the data are separated into summer (April – September) and winter (October–March) months.

While most monitoring of mercury is of wet deposition, several studies have also examined mercury air concentrations and dry deposition.

Haywood et al. (2000) also found that both mercury concentration and wet deposition rates are consistently higher at Lake Waccamaw than Pettigrew State Park (both located in coastal North Carolina) and surmised that the pattern could be a result of local source influences.

The National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory (NOAA, 2007) conducted a monitoring study during the summer of 2005 at the Harcum site in coastal Virginia which revealed that dry deposition was significant and was dominated by RGM.

Relationships between Meteorology and Mercury Deposition

It is recognized that in addition to the location of sources and the chemical species of mercury emitted, climate and meteorology are key factors in mercury deposition. The relationship between precipitation and deposition is well established. Scavenging by wet deposition is an important mechanism for wet deposition. Few studies, however, address the potentially more complex relationships between meteorology and mercury deposition. EPA (1997) reported that, in general, humid locations have higher deposition rates than arid locations. Keeler et al. (2006) found the annual amount of precipitation to be related to annual mercury deposition. They also found that individual precipitation events can contribute significantly to the annual mercury deposition totals.

4.2. Mercury Air Modeling Studies

Current literature focuses on the development of mercury capabilities in air quality modeling and some national- and regional-scale applications.

Bullock and Brehme (2006) present a description of the methodology for modeling mercury using CMAQ Version 4.5.1. This paper provides a description of the mercury treatment in the CMAQ model that will be used in this study (although the version that will be used for this study is 4.6, the mercury treatment is effectively unchanged). Note that the Particle and Precursor Tagging Methodology (PPTM) has been added to version 4.6.

Several areas of potential uncertainty that may be useful in designing and conducting sensitivity analysis with CMAQ are pointed out in this paper. These include:

- Rates of chemical reactions.
- Deposition of elemental mercury.
- Natural emission and re-emission of mercury.

The presentation of Vijayaraghavan et al. (2005) provides a potential reference/comparison for model performance for the VDEQ study. The authors add the following to the list of potential sources of uncertainty for CMAQ:

- Global emissions.
- Input meteorology, specifically rainfall.
- Dispersion of plumes.

- Chemistry in plumes.

The authors also suggest that the lifetime of mercury in the atmosphere as 1.2 years.

Lin et al. (2004) suggest that the lifetime of mercury in the atmosphere is 0.5 to 2 years and also present some potential implementation issues regarding simulation of mercury with CMAQ. These include:

- Specific uncertainties in gas phase chemistry and in deposition
- Potential for much more rapid oxidation of Hg(0) by halogens in coastal areas

Areas of potential improvement in CMAQ are presented by Lin et al. (2005). Of interest here is the sensitivity to possible improvements in CMAQ algorithms. Some of these improvements have been addressed in Version 4.6 of CMAQ. These include natural emissions and dry deposition of elemental mercury. Additional improvements noted by Lin et al. may be considered during the selection of sensitivity simulations.

Pongprueksa and Lin (2006) conducted sensitivity simulations for mercury using CMAQ. They specifically explored the sensitivity of the simulation results to additional Hg(II) reduction reactions.

Several related papers present information on natural emissions and sensitivity to the CMAQ system to changes in emissions (Wen, 2006; Gbor et al., 2006; Gbor et al., 2004). Topics addressed in these papers include:

- A methodology for estimating natural emissions.
- Deposition vs. evasion of Hg.
- Sensitivity of simulation results to changes in emissions of Hg, NOx, VOC, etc.

To the extent possible, we may qualitatively compare the results of these sensitivity tests to the VDEQ modeling results.

A comparison of model-based and observation-based estimates of dry deposition is made in Marsik et al. (2007). The authors compare the direct measurement of dry deposition to estimates from a resistance model, such as that employed by CMAQ. This gives us some insight into the quality of the CMAQ dry deposition estimates.

A presentation by Braverman (2005) provides some information on EPA's regulatory modeling related to mercury. This presentation gives some background on the Clean Air Mercury Rule (CAMR) modeling and a summary of CMAQ model performance in CAMR. Again, this provides a potential source of comparison for model performance for the VDEQ study.

Discussions of plume models vs. grid model treatments for mercury are discussed in Karamchandani et al. (2006) and Seigneur et al. (2006). The authors present some expected benefits of a plume-in-grid treatment for point sources, with an emphasis on power plant plumes. Comparisons of Hg deposition estimates from grid models and a Gaussian model are provided. Of interest for the VDEQ modeling study is a description of a methodology for estimating deposition using a Gaussian model.

Regional modeling with the SARMAP Air Quality Model (SAQM) studies mercury concentrations in Connecticut (Xu et al., 2000a; Xu et al., 2000b). This study is limited to a small section of the

northeastern U.S. around Connecticut and uses the SAQM model with simple and probably outdated Hg chemistry. The authors include estimates of natural emissions and re-emissions, which may be of some interest for the VDEQ study.

A project update by Walcek (2005) provides information on a modeling study in New York State. It is possible that the estimates of in-state vs. out-of-state contributions to deposition in New York from this study could provide a check on the estimates obtained from the VDEQ study.

A brief project update by Seigneur (2005) summarizes estimates of global and regional contributions to mercury deposition in New York State. This work includes a modeling sensitivity analysis and estimates of deposition contributions to New York State for various emissions sectors. A key finding is that the greatest contributor is U.S. emissions sources (non-New York emissions).

Several reports present the results of national- and regional-scale mercury deposition modeling conducted for the EPA Office of Water (OW), as well as background on and results from the Particle and Precursor Tagging Methodology (PPTM). Modeling of mercury deposition in Wisconsin is reported by Myers et al. (2006a). This report was intended as a peer-reviewed prototype for mercury tagging using the REMSAD model and includes:

- PPTM results for Wisconsin sources with deposition estimates for mercury.
- An estimate of potential year-to-year variability in Hg deposition for several sites in Wisconsin.

Similar modeling in support of the Maryland TMDL is reported by Myers et al. (2004a). This study included:

- Hg tagging simulations using REMSAD for Maryland and surroundings to estimate deposition of Hg.
- An estimate of potential year-to-year variability in Hg deposition for several sites in Maryland.

Additional modeling in support of a Louisiana TMDL is reported by Myers et al. (2004b). This study included:

- Hg tagging simulations for Louisiana and surroundings using REMSAD.
- Estimates of mercury deposition loading from tagged Louisiana sources for Louisiana estuaries.

Simulation results for the entire U.S. are reported by Myers et al. (2006b). In this study, PPTM was applied for approximately 300 sources located throughout the U.S. The study results include estimates of mercury deposition contributions for some Virginia sources. These results may provide a check on similar estimates obtained from the VDEQ study.

Attribution of global emissions to mercury deposition is treated by Seigneur et al. (2004). This paper provides

- Global simulation results using the Chemical Transport Model (CTM).
- Estimates of contributions of various regions of the world to deposition in U.S.

The potential influence of Asian mercury emissions on the U.S. is examined by Lin et al. (2006). Direct deposition of Asian emissions to Virginia should be small, but their contribution to global background may be important.

As an alternative to grid-based modeling, use of the HYSPLIT model is discussed in Cohen et al. (2004) and in Cohen (2004). The authors estimate contributors to mercury deposition to Great Lakes and the Chesapeake Bay using HYSPLIT model. The results tend to differ from other modeling estimates in that very distant sources may contribute to deposition loading. The use of trajectory modeling over long periods of time adds considerable uncertainty to the HYSLPIT modeling approach.

A combination of statistical and modeling techniques is used by Michaels et al. to examine the possible link between local power plant emissions and impaired bodies of water in Virginia. This study relied on HYSPLIT trajectory modeling of Virginia power plants. The authors were not able to establish a statistical link between elevated Hg in fish tissue with power plant emissions.

4.3. Mercury Emissions and Control Studies

As noted above, mercury in the atmosphere originates from a wide variety of anthropogenic, biogenic, and geogenic sources. As mercury deposition and contamination issues have become more important in many areas of the country in the last decade, efforts have been made to prepare more accurate estimates of emissions from mercury sources. Like the criteria pollutant inventories maintained by each state, the mercury emissions inventories are used by EPA and states to assess long term trends in emissions and for rule compliance. In addition, these inventories are used in air quality modeling studies to assess deposition for a base year and as a means of evaluating changes in mercury deposition in a future year. As part of its ongoing development work with the CMAQ modeling system, EPA has developed a methodology to estimate mercury emissions from biogenic sources (Lin, et al., 2004). This methodology will be evaluated for potential use in the Virginia mercury modeling analysis. Other researchers have investigated mercury emissions from soils as a contributor to atmospheric loading. Schluter (2000) found that mercury evaporation rates from non-contaminated soils are small, but do contribute to overall emissions of both elemental and methyl mercury.

Controlling anthropogenic sources of mercury has been the focus of a number of studies conducted in recent years by EPA, the Department of Energy (DOE), and a number of state agencies, with research in control technology ranging from those placed on large industrial combustion sources (e.g., EGU's) to ensuring the proper recycling and disposal of fluorescent light bulbs. The DOE conducted a study evaluating the control efficiencies and effects of selective catalytic reduction (SCR) and fluidized gas desulfurization (FGD) on mercury speciation and removal (Withum, et al, 2006). The study found that the combination of the SCR with FGD removed a substantial amount of mercury from the flue gas. A similar study by Lee, et al. (2004) investigated the effects of SCR on mercury speciation using three different types of coal, and concluded that the effects of SCR in promoting elemental mercury oxidation and removal is highly dependent on the sulfur and chlorine content of the coal.

A number of state agencies have evaluated a list of potential mercury control technologies, including North Carolina (2005), Minnesota (2005), and NESCAUM (2004). The North Carolina and NESCAUM studies primarily focus on controls for EGU's and include various updates of control technology information, cost/benefit information, and recommendations for reducing emissions from such sources. The Minnesota report provides the 2005 annual summary for the Minnesota Legislature of efforts underway to meet the state standards. The report indicates that much of the reduction in mercury air emissions in Minnesota since 1990 has been the result of significant changes in "product use and disposal" category, which includes such items as the elimination of mercury as a preservative in paint products, the use of mercury in electric

switches, and the use of mercury in batteries. These studies provide good references for activities and controls other states have evaluated and undertaken to reduce mercury air emissions from a variety of source sectors.

4.4. Summary of Findings and Implications for Mercury Modeling Analysis

The tools and methods that will be applied for the Virginia mercury deposition modeling represent the current state-of-the-science in regulatory mercury deposition modeling. Similar approaches were used by EPA in the Clean Air Mercury Rule (CAMR) modeling. Ongoing research in the areas of mercury data collection and analysis, deposition modeling, and control technology assessment offers some possibilities for enhancing the VDEQ modeling effort, especially with regard to designing and conducting modeling sensitivity analyses, evaluating model performance, and assessing the effectiveness of local controls. Specific implications and action items for the VDEQ modeling study include:

- Qualitatively compare the modeled results for mercury concentration, wet deposition, and dry deposition with the findings from monitoring studies in North Carolina and Virginia (Harcum) regarding the observed spatial and temporal distributions and relationships among these parameters and with other modeling studies.
- As time and budget allow, conduct model-based sensitivity tests to examine the following key issues:
  - Sensitivity of the modeling results to meteorological inputs, and specifically precipitation amounts.
  - Uncertainties in the mercury chemistry and deposition algorithms.
  - Role of natural emissions.
- Ensure that future-year emissions controls are consistent with recent studies regarding effects on speciation of emissions and the overall effectiveness of control measures.
- To the extent possible, obtain and utilize future-year national emission inventories that reflect planned mercury control technologies/measures prepared by other states.

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Washington, *Washington's Mercury Chemical Action Plan*:
http://www.ecy.wa.gov/programs/eap/pbt/mercuryplan.html

North Carolina, *North Carolina's Mercury Information Page*:
http://www.p2pays.org/mercury/general.asp#ncgen

National Energy Technology Laboratory

This list server is produced by the National Energy Technology Laboratory (NETL) to provide monthly updates on recent events, publications, presentations, and technical reports related to mercury. For further information, please visit the Environmental & Water Resource (E&WR) website at http://www.netl.doe.gov/technologies/coalpower/ewr/index.html.

The following are new mercury project reports that have been recently added to the E&WR website. Each link will take you directly to the report.

- A report, "The Economics of Powder River Basin Coalbed Methane Development," prepared by Advanced Resources International, Inc., January 2006, has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/pubs/netl%20Cost%20of%20Produced%20Water%20Treatment%200106.pdf.

- A quarterly progress report, "Field Testing of Activated Carbon Injection Options for Mercury Control at TXU's Big Brown Station," prepared by University of North Dakota Energy & Environmental Research Center for the period of October 1–December 31, 2005, has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/JP-ACI%20at%20BB-42305-Dec05.pdf.

- A quarterly progress report, "Evaluation of MerCAP™ for Power Plant Mercury Control," prepared by URS Group, Inc. for the period of October 1–December 31, 2005, has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/41993_Q123105.PDF.

- A quarterly progress report, "Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems," prepared by URS Corporation for the period of October–1 December 31, 2005, has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/GRE-CPS123105.pdf.

- A quarterly progress report, "Pilot Testing of Mercury Oxidation Catalysts for Upstream of Wet FGD Systems," prepared by URS Corporation for the period of October 1–December 31, 2005, has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/TXU-Duke-SCC123105.pdf.

- A final site report for testing conducted at the Laramie River Station for the project entitled "Evaluation of Sorbent Injection for Mercury Control," prepared by ADA-ES, Inc., for the period of October 1, 2003 through December 31, 2005 has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/toprpt_laramie_river_station.pdf.

- Two quarterly progress reports for the project entitled "Field Test Program for Long-Term Operation of a COHPAC® System for Removing Mercury from Coal-Fired Flue Gas," prepared by ADA-ES, Inc., have been posted:

  1. Quarterly period of July 1–September 30, 2005: http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/41591%20Q093005.pdf.

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- Three quarterly progress reports for the project entitled "Low-Cost Options for Moderate Levels of Mercury Control," prepared by ADA-ES, Inc., have been posted:

  1. Quarterly period of April 1–June 30, 2005: http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/42307%20Q063005.pdf.

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- A quarterly progress report, "Amended Silicates for Mercury Control," prepared by Amended Silicates, LLC for the period of July 1–September 30, 2005 has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/41988%20Q093005.pdf.

- A quarterly progress report, "Large-Scale Mercury Control Technology Testing For Lignite-Fired Utilities Oxidation Systems for Wet FGD," prepared by University of North Dakota Energy & Environmental Research Center for the period of July 1–September 30, 2005, has been posted at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/control-tech/pubs/41991%20Q093005.pdf.

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- For additional information on NETL mercury related activities, please visit the Environmental & Water Resources' Mercury site located at http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/index.html.