Evaluation of the Emission, Transport, and Deposition of Mercury, Fine Particulate Matter, and Arsenic from Coal-Based Power Plants in the Ohio River Valley Region

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PROJECT ABSTRACT

Ohio University, in collaboration with CONSOL Energy, Advanced Technology Systems, Inc (ATS) and Atmospheric and Environmental Research, Inc. (AER) as subcontractors, is evaluating the impact of emissions from coal-fired power plants in the Ohio River Valley region as they relate to the transport and deposition of mercury, arsenic, and associated fine particulate matter. This evaluation will involve two interrelated areas of effort: ambient air monitoring and regional-scale modeling analysis.

The scope of work for the ambient air monitoring will include the deployment of a surface air monitoring (SAM) station in southeastern Ohio. The SAM station will contain sampling equipment to collect and measure mercury (including speciated forms of mercury and wet and dry deposited mercury), arsenic, particulate matter (PM) mass, PM composition, and gaseous criteria pollutants (CO, NOx, SO_2, O_3, etc.). Laboratory analysis of time-integrated samples will be used to obtain chemical speciation of ambient PM composition and mercury in precipitation. Near-real-time measurements will be used to measure the ambient concentrations of PM mass and all gaseous species including Hg^0 and RGM. Approximately 18 months of field data will be collected at the SAM site to validate the proposed regional model simulations for episodic and seasonal model runs. The ambient air quality data will also provide mercury, arsenic, and fine particulate matter data that can be used by Ohio Valley industries to assess performance on multi-pollutant control systems.

The scope of work for the modeling analysis will include (1) development of updated inventories of mercury and arsenic emissions from coal-fired power plants and other important sources in the modeled domain; (2) adapting an existing 3-D atmospheric chemical transport model to incorporate recent advancements in the understanding of mercury transformations in the atmosphere; (3) analyses of the flux of Hg0, RGM, arsenic, and fine particulate matter in the different sectors of the study region to identify key transport mechanisms; (4) comparison of cross correlations between species from the model results to observations in order to evaluate characteristics of specific air masses associated with long-range transport from a specified source region; and (5) evaluation of the sensitivity of these correlations to emissions from regions along the transport path. This will be accomplished by multiple model runs with emissions simulations switched on and off from the various source regions.

To the greatest extent possible, model results will also be compared to field data collected at other air monitoring sites in the Ohio Valley Region, operated independently of this project. These sites may include (1) the DOE National Energy Technology Laboratory's monitoring site at its suburban Pittsburgh, PA facility; (2) sites in Pittsburgh (Lawrenceville) PA and Holbrook, PA operated by ATS; (3) sites in Steubenville, OH and Pittsburgh, PA operated by U.S. EPA and/or its contractors; and (4) sites operated by State or local air regulatory agencies. Field verification of model results and predictions will provide critical information for the development of cost effective air pollution control strategies by the coal-fired power plants in the Ohio River Valley region.

EXECUTIVE SUMMARY

Ohio University is performing a Cooperative Agreement with the U.S. Department of Energy's National Energy Technology Laboratory (DOE-NETL) to conduct regional-scale modeling analysis and ambient air monitoring that will provide critical information for the development of relevant and cost effective control strategies by the coal-fired power plants in the Ohio River Valley region.

The regional modeling studies will develop a comprehensive budget of arsenic, elemental mercury (Hg^0) reactive gaseous mercury (RGM), and fine particulate matter across the Ohio Valley Region, including sources, sinks, atmospheric lifetimes, burdens, and advective fluxes. Updated emissions inventories for mercury and arsenic within the region will be developed to support the regional modeling studies. A comprehensive surface air monitoring (SAM) site is being developed and operated in southeastern Ohio to provide field data against which the model results can be compared. The SAM has the capability to monitor mercury speciation in ambient air and in precipitation, and it contains a full range of instrumentation for measuring the composition of fine particulate matter and co-pollutant gases. Short-term and seasonal simulations with the refined model will be compared to field measurements from the monitoring site, and the results will be used to develop a decision-support tool. A supplemental objective of the analysis is to evaluate the impacts of long-range transport from regions outside the Ohio Valley as well as biospheric recycling of elemental Hg on the measured and modeled reactive and total mercury concentration levels in the Ohio Valley Region.

The Cooperative Agreement began in April of 2003. A six month no cost extension to the original 27 month performance period has been requested. This would extend the project through December of 2005. The effort has been broken down into seven separate tasks as follows:

Task 1 consists of establishing and operating the SAM site in southeastern Ohio. The SAM site has been set up and routine sampling was initiated on March 1, 2004; data collection will occur over the following 18 months.

Task 2 consists of the selection and evaluation of a 3-D regional-scale chemical transport model (CTM) for an application focused on the Ohio River Valley region. The Chemical Transport Model CMAQ (Community Multiscale Air Quality) model has been set up and is operational. A one-year base-case simulation has been conducted for North America for the year 1996. Efforts are underway to conduct an additonal base-case simulation for 2004 with updated emissions.

Task 3 involves the refinement and update of emission inventories (EIs) for sources of mercury and arsenic within and upwind of the modeled domain. The Institute for Sustainable Energy and the Environment (ISEE) plans to collect and process that emissions information into the model structure throughout the modeling effort.

Task 4 consists of short-period model runs to be made for comparison with field data. The summer of 2001 will be used for initial comparisons because of the extensive field data on particulate matter, and co pollutants available from the DOE sponsored monitoring programs in the Ohio River Valley region. Short-term model runs for comparison with the speciated mercury

and arsenic data collected at the SAM for the 2004 sampling periods will follow the initial comparisons. Researchers have begun meteorological simulations for the 2004 base case simulations.

Task 5 involves seasonal-scale simulations that focus on the identification of significant sources and source regions contributing to the deposition of mercury and ambient concentrations of arsenic and fine particulate matter over periods of several months or more. The modeling will also examine the efficacy of emission reduction strategies specifically for coal-fired power plants. In addition, researchers will conduct an analysis of long-range transport from regions outside the Ohio Valley and biospheric recycling of elemental Hg on the measured and modeled reactive and total mercury in the Ohio Valley Region.

Task 6 consists of the development of Web-based model interface technologies to provide industry and government agencies with a user-friendly decision-support tool to facilitate the evaluation of source-receptor relationships and the efficacy of emission reduction strategies.

Task 7 consists of project management, data analysis, and reporting functions.

Accomplishments and tasks completed during this reporting period include (1) conducting a one-year base case simulation for the year 1996 with the 3-D chemical transport model; (2) continued to refine and update mercury and arsenic emission inventories for 2004; (3) initiating meteorological simulations for 2004 base case simulation; (4) initiating and operating a SAM station at Athens, Ohio which includes sampling equipment for collecting and measuring mercury, arsenic, $PM_{2.5}$, pollutant gases, and weather data over the project period.

I. INTRODUCTION

Ohio University is performing a Cooperative Agreement with the U.S. Department of Energy's National Energy Technology Laboratory (DOE-NETL) to conduct regional-scale modeling analysis and ambient air monitoring that will provide critical information for the development of relevant and cost effective control strategies by the coal-fired power plants in the Ohio River Valley region.

Coal flue gas contains a variety of hazardous air pollutants (HAPs), including organic and inorganic chemical compounds. Among the latter, the metals mercury and arsenic are of particular concern because of their toxicity to humans and animals. An understanding of the chemistry of these elements should be the basis of proposed legislation to regulate mercury and arsenic emissions since specific chemical species will account for differences in human toxicity, rate of transport through the ecosystem, and the design variations in possible emission control schemes. An additional layer of complexity results from the fact that these elements may or may not be associated with fine particulate matter ($PM_{2.5}$ and PM_{10}) during or after emission from a stack. In general, the less volatile species such as arsenic and oxidized mercury are likely to be associated with fine particulate matter while the more volatile moieties such as elemental or reduced mercury tend to be emitted as non-associated gases. Thus, it will be necessary to determine the chemical forms of mercury and arsenic present at the stack and at designated receptor sites, and to determine the fractions of these species bound to fine particulate matter.

Mercury, fine particulate matter, and arsenic can be transported over large distances due to their minimal rate of sedimentation. In particular, mercury transport must be considered a global problem. Elemental mercury is believed to have a half-life of approximately one year in the atmosphere, and little is known about its cyclic transport between land, water, and air. Biogenic transport and biogenic sources are even less well understood. Therefore, the ISEE will adopt a regional scale approach for adequate evaluation of source-receptor relationships for mercury, fine particulate matter, and arsenic. Our approach in evaluating the impact of arsenic and mercury emissions from coal-fired power plants and other sources is to examine the source-receptor relationship through ambient monitoring and regional scale modeling.

A. Project Goal and Objectives

The overall objective of the project is to quantitatively evaluate the emission, transport, and deposition of mercury, fine particulate matter (PM), and air toxics (arsenic) in the Ohio River Valley region. This evaluation involves two interrelated areas of effort: regional-scale modeling analysis and ambient air monitoring.

The objective of the regional modeling studies is to develop a comprehensive budget of arsenic, elemental mercury (Hg^0) and reactive gaseous mercury (RGM), and fine particulate matter including sources, sinks, atmospheric lifetimes, burdens, and advective fluxes across the Ohio Valley Region. To support this objective, project researchers will develop updated emissions inventories for mercury and arsenic within the region. The second objective is to develop an air-monitoring site in Athens, Ohio to provide the capability to monitor mercury in ambient air and in precipitation. Researchers will compare the refined model's short-term and seasonal simulations to field measurements from the monitoring site and use the results to develop a

decision-support tool. A supplemental objective of the analysis is to evaluate the impacts of long-range transport from regions outside the Ohio Valley as well as biospheric recycling of elemental Hg on the measured and modeled reactive and total mercury concentration levels in the Ohio Valley Region.

B. Project Development (Tasks)

Seven separate tasks will be completed over a proposed 33-month performance period. A six month no cost extension to the original 27 month performance period has been requested. The following project schedule is based on a start date of April 3, 2003. Table 1 on page 3 presents a progress summary for each task. Section II Experimental Design is a detailed description of each task and the progress achieved toward its completion as of April 2, 2004.

Project Schedule

- Task 1 consists of establishing and operating a SAM station in Athens, Ohio. Routine sampling was initiated on March 1, 2004. Data collection will occur over the following 18 months.

Tasks 2–6 comprise the modeling process, which will continue throughout the first 30 months of the project. Throughout Tasks 2–6, the project team will keep abreast of ongoing research and newly published literature pertaining to the atmospheric behavior of mercury. Whenever possible, new findings concerning mercury speciation and transport will be incorporated into the model algorithms.

- Task 2 consists of the selection and evaluation of a 3-D regional-scale chemical transport model (CTM) for an application focused on the Ohio River Valley region. The project team has completed the setup and development of the CTM grid system and a one-year base-case simulation for the year 1996 has been conducted for North America. It is anticipated that a 2004 base case simulation will be completed in the second year of this project.

- Task 3 involves the refinement and update of emission inventories (EIs) for sources of mercury and arsenic within and upwind of the modeled domain. It is anticipated that information on emissions will continue to be collected and processed into the model structure throughout the modeling effort.

- Task 4 consists of conducting short-period model runs for comparison with field data. The project team plans to use data collected during the summer of 2001 for initial comparisons because of the vast amount of field data on particulate matter likely to be available for the Ohio River Valley region during that period. Short-term model runs for comparison with the speciated mercury and arsenic data collected at the Athens SAM for the 2004 sampling periods will follow the initial comparisons. The team has begun meteorological simulations for the 2004 base case.

- Task 5 involves seasonal-scale simulations that focus on the identification of significant sources and source regions contributing to the deposition of mercury and ambient concentrations of arsenic and fine particulate matter over periods of several months or more.

The modeling will also examine the efficacy of emission reduction strategies specific to coal-fired power plants. In addition, researchers will analyze the long-range transport from regions outside the Ohio Valley and the biospheric recycling of elemental Hg on the measured and modeled reactive and total mercury in the Ohio Valley Region.

- Task 6 will consist of the development of Web-based model interface technologies to provide industry and government agencies with a user-friendly decision-support tool to facilitate the evaluation of source-receptor relationships and the efficacy of emission reduction strategies.

- Task 7 consists of project management, data analysis, and reporting functions.

Table 1 below is a progress summary for each task.

Table 1. Progress Summary

Task #	Description	Planned % Completed	Actual % Completed
1	SAM	44	25
2	Base Case Simulation	100	60
3	Emission Inventories	66	66
4	Model Comparison	80	20
5	Seasonal Scale Simulations	0	0
6	Development of Support Tool	0	0
7	Project Management	44	20

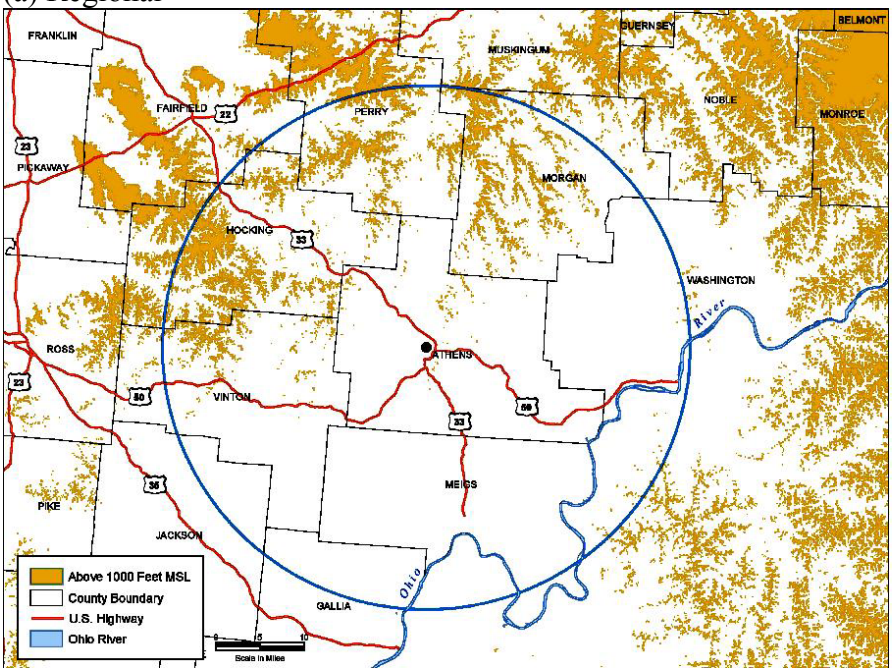
II. EXPERIMENTAL DESIGN

In this section, the description of each task is presented as it was proposed in the funding application. Following the description is a discussion of the progress made toward completing the task.

Task 1 - Establish and operate a (SAM) station in Athens, Ohio

The proposal for this project designated that the ISEE would establish a SAM station in Steubenville, Ohio. However, prior to April 3, 2003 the Environmental Protection Agency set up a SAM station in Steubenville that has the capacity to monitor for mercury. Consequently, the ISEE was able to select another site for the SAM station proposed for this project. The project staff located an optimal site south of Athens, Ohio in the heart of the Ohio River Valley region. At an elevation of 950 feet, the site is the highest point within a 100-mile radius to the east, south, and west (Figure 1, page 4). It is an excellent site from which to capture the transport of pollutants into and out of the valley. In addition, a 400-foot communication tower is adjacent to the site. ISEE staff will install a wind-speed and wind-direction sensor atop the tower that will provide critical information for evaluating transport events.

(a) Regional



(b) Local

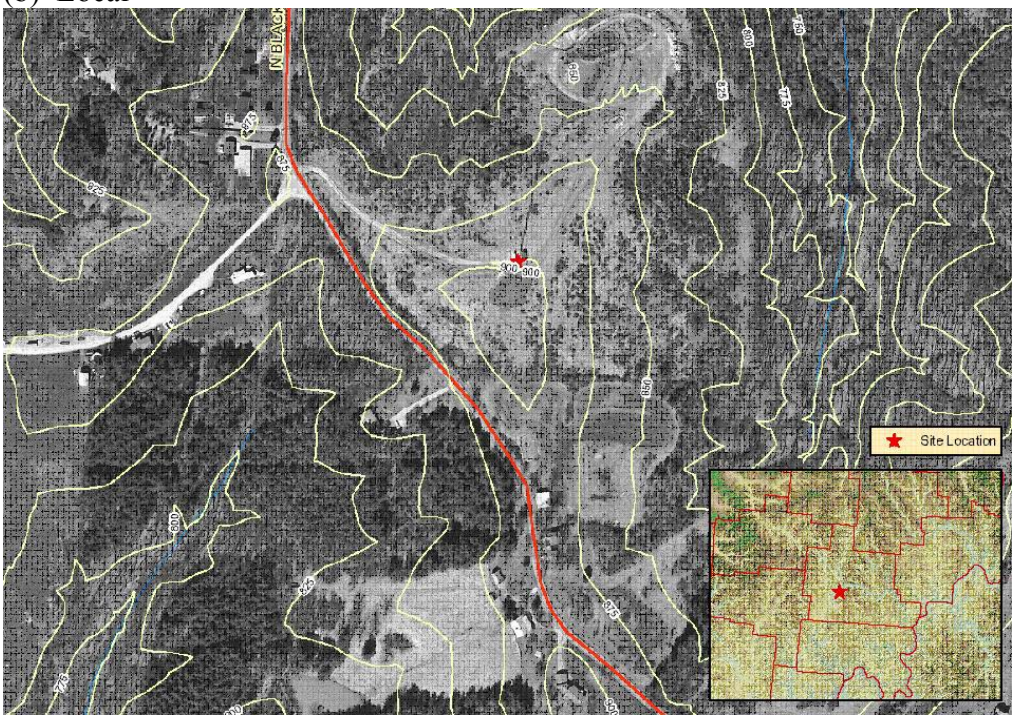


Figure 1. Topographical map of the Athens site: (a) regional and (b) local

The Athens site utilizes air-monitoring equipment from the NETL-sponsored Steubenville Comprehensive Air Monitoring Program (SCAMP) (DOE Cooperative Agreement DE-FC26-OONT40771). In addition, the site includes sampling equipment to collect and measure mercury, including total, elemental, reactive, particulate, and wet/dry deposition.

Task 1 accomplishment from October 3, 2003 to April 2, 2004:

Researchers from ISEE and Consol Energy R&D established and initiated start-up activities at the Athens SAM station. This included; training, site preparation, procuring and installing new equipment, repairing and maintaining existing sampling equipment and developing operating and data handling procedures, as outlined below:

- Researchers from Consol Energy R&D, and DOE-NETL facilitated and participated in a 2-day Tekran training seminar held at the DOE-NETL Bruceton site in November 2003. Tekran trained CONSOL Energy R&D, ISEE, and DOE-NETL personnel on the operation, maintenance and troubleshooting of the Tekran ambient mercury sampling system.

- Standard operating procedures (SOPs) were developed for the SAM station. The SOPs included sampler maintenance, troubleshooting and QA/QC.

- A building permit and site plans were prepared and approved by the Athens county code enforcement office. A 10 x 20 foot deck was installed 4 feet off the ground. A 10 x 20 foot environmentally controlled shed and the SCAMP trailer were set up in the months of November and December 2003 (Figure 2, page 6).

- The Tekran, which includes the modules for analysis of reactive gas, elemental and particulate mercury and the TEOM Series 1400a Ambient Particulate Monitor were assembled and installed. A sample equilibration system (SES) humidity unit, which enables the TEOM to operate at $30^{o}C$, was also installed.

- Start-up sampling activities were initiated in early February 2004. Calibration and startup maintenance was completed on the Federal Reference Method $PM_{2.5}$ filter-based sampler and $PM_{2.5}$ speciation sampler. Repairs and startup maintenance were completed on the SO_2, O_3, CO and NO_x ambient gas analyzers, data-logger, zero air generator and E-DAS data logging software.

- Control Analytics was also contracted, in February 2004 to assist in debugging and calibration of the gas analyzers prior to routine sampling.

- A secure wireless internet connection was installed at the site. Utilizing the wireless internet connection automated scripts on the data logging systems were developed to provide data backup from the continuous analyzers onto servers at Ohio University. In addition the data is posted hourly on a secure website which is used by research staff to audit the equipment.

Figure 2. SAM station – Athens, Ohio

- Routine sampling was initiated on March 1, 2004 for CO, SO_2, NO_x, O_3, $PM_{2.5}$, $PM_{2.5}$ speciation, elemental mercury, reactive gas mercury, particulate mercury and metrological data.

- Clyde Sweet and David Gay of the National Mercury Deposition Network (MDN) and Bob Brunette of Frontier Geosciences were contacted to finalize laboratory and sample shipping arrangements, and to clarify sampler siting requirements for the wet deposition monitor. In addition, discussions are ongoing to determine if the Athens monitoring site will be considered an official MDN site.

- The PM laboratory and weighing room were cleaned and preparations were made to begin to process filters for the PM samplers.

- The Sunset EC/OC thermal optical transmittance analyzer was tested to ensure accurate analyses. The analyzer was in idle configuration since the summer of 2003. Basic instrument maintenance was performed.

- Detection limits for anion (sulfate and nitrate) and NH_3 concentration in the particulate matter were determined on the Dionex Ion Chromatographs.

- The denuder coating station was set-up and operational in February 2004. Based on the advise from Tekran, the denuders are coating with the super saturated KCl methodology.

Task 2 - Evaluate and Select a 3-D Regional-Scale Atmospheric Chemical Transport Model (CTM) and Conduct a Base-Case Simulation

Several 3-D regional-scale CTMs with the ability to simulate tropospheric ozone, visibility, and fine particulate matter are appropriate for application to the Ohio River Valley region to evaluate total fine particulate matter mass and the arsenic component of fine particulate matter. The ISEE and Atmospheric and Environmental Research (AER) have established the 3-D modeling framework. AER is conducting the base-case simulations (1996 and 2004).

The project team chose the Community Multi-Scale Air Quality (CMAQ) model for air-pollution studies on a regional scale for this study. The EPA and its collaborators (Byun & Ching, 1999) developed the CMAQ, which uses non-hydrostatic Penn State/NCAR mesoscale model (MM5) V3-derived dynamics for transport.

Task 2 accomplishments from October 3, 2003 to April 2, 2004:

- Conducted annual simulations for 1996 using the modified CMAQ-Hg code with the MEBI chemistry solver. The modeling year was divided into four 3-month periods (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec) and 3-month simulations were conducted on different processors to speed up the overall completion of the annual simulation. A 10-day spin-up cycle was used for each 3-month simulation period. Each simulation day requires about 3 hours of CPU time.
- The seasonal boundary conditions from the global mercury chemistry transport model were applied as follows for the 3-month simulation periods:
    - Winter boundary conditions: January, February, and December
    - Spring boundary conditions: March, April, and May
    - Summer boundary conditions: June, July, and August
    - Fall boundary conditions: September, October, and November
- The version of the CMAQ-Hg code used in these simulations also included modifications to calculate and save the daily cumulative dry and wet deposition amounts and daily average concentrations of Hg (the default model only saves the hourly values).

Task 3 - Refine and Update Emission Inventories (EIs)

ATS is enhancing the mercury and arsenic emission inventories.

Task 3 accomplishments from October 3, 2003 to April 2, 2004:

- A detailed state by state comparison of the EPA National Emissions Inventory (NEI) and the AER mercury inventory was completed to identify and correct discrepancies for 14 states in and adjacent to the Ohio River Valley region.

- Updated emission data for utilities in Mexico were received from the Center for Environmental Cooperation (CEC). This data was incorporated into the emission inventory.

- Adjustments to emission inventory for over 600 power plants were made utilizing data obtained from DOE-NETL sponsored monitoring programs evaluating the efficacy of mercury removal from existing SO_2 and NO_x control systems on coal-fired power plants. After treatment technology data was obtained from the DOE Energy Information Administration (EIA) Steam Electric Plant Operation and Design Report.
- Updated mercury and arsenic emission data for Canada were obtained from the 2002 version of the National Pollutant Release Inventory. This data is currently being incorporated into the emission inventory.

Task 4 - Perform Short-Period Model Runs for Comparison with Field Data

ISEE will conduct a series of model runs to evaluate the system against field observations. First, the model will be set up along with an observational database for the Ohio Valley Region collected during the summer of 2001. The model run will correspond to the NETL-sponsored intensive sampling campaigns centered in Pittsburgh, Pennsylvania. Researchers will combine the extensive datasets collected during this campaign with other relevant datasets in this region. Meteorological input data for these simulations will be derived diagnostically using MM5 V3. The model evaluations will involve short-time-period runs for the field-intensive periods, storing hourly averaged fluxes and production-and-loss rates for ozone, hydrocarbons, arsenic, Hg^0, and RGM for direct comparison with field data. In addition, long-range transport events will be identified from the short-term CTM runs and evaluated with the observational data set.

In addition to the model evaluations conducted from field observations obtained from the 2001 NETL-sponsored sampling campaigns, the model will be set up and evaluated against the observational data sets, including the speciated mercury and arsenic data collected at the Athens SAM for the 2004 sampling period. These simulations will be vital for model verification because the Athens SAM will be one of the few sites providing measurements on individual mercury species and arsenic. The model evaluations will involve short-time-period runs for the field-intensive periods, storing hourly averaged fluxes and production-and-loss rates for ozone, hydrocarbons, arsenic, Hg^0, and RGM for direct comparison with field data. In addition, long-range transport events will be identified from the short-term CTM runs and evaluated with the observational data set. The ISEE will perform the short-term model runs for comparison with field data.

Task 4 accomplishments from October 3, 2003 to April 2, 2004:

- Work is underway to perform regional and urban modeling simulations for 36, 12, and 4 km grid resolutions for the year 2004. The 36 km grid will cover most of Eastern United States, whereas the 4 km domain will cover all the power plants in the Ohio River Valley region.

- The current parallel version of MM5 has been downloaded to the system. Observational meteorological data sets for 2004 are being acquired from the National Centers for Environmental Prediction (NCEP) to conduct 4DDA (four-dimensional data assimilation) as a part of MM5 simulations. Work is in progress to run MM5 in the nested mode for 36, 12 and 4km using 4DDA data assimilation techniques. The MM5 output will be used to prepare meteorological inputs to the photochemical model simulations.
- ISEE staff has performed a benchmark run in the Linux cluster using AER's modified CMAQ-Hg code with the 1996 EPA MM5 outputs. Efforts are underway to prepare meteorological and emission inputs for short-term photochemical model simulations for June 2001.

Task 5 - Seasonal Scale Simulations

A major focus of the modeling effort is to identify significant sources and source regions contributing to the deposition of mercury and ambient concentrations of arsenic and fine particulate matter. The modeling will also examine the efficacy of reduction strategies specifically for coal-fired power plants. In addition, researchers will conduct an analysis of the long-range transport from regions outside the Ohio Valley and the biospheric recycling of elemental Hg on the measured and modeled reactive and total mercury in the Ohio Valley Region.

Initially, researchers will set up a seasonal scale simulation for the entire North American continent on a coarse grid (36 km x 36 km), with a nested grid of 12 km over the midwestern region of the United States and 4 km over the Ohio Valley Region. They will use the NCEP-4D assimilation data set to drive the regional-scale meteorology model (MM5 V3) to develop dynamic inputs for the CTM. The model analysis will be completed for the seasonal run to establish a 'base-case' simulation or the most likely current-day simulation for the season. Uncertainty ranges will be developed for critical parameters in the model, such as emissions and deposition rates. Additional seasonal scale simulations will be performed to develop an 'uncertainty envelope' of the model-generated estimates of deposition rates and fluxes.

Task 5 accomplishments from October 3, 2003 to April 2, 2004:

- The project staff has completed a one-year base case simulation for 1996. Work is underway to analyze the model output from this simulation. Further work on this task is slated for a later phase of the project.

Task 6 - Development of a Decision-Support Tool

ISEE will conduct a series of model runs to perform a matrix analysis of the sensitivity of point sources to deposition patterns in the region. The analysis will also include selective emission reduction scenarios for these point sources. The team will couple this matrix with a GIS and the emission pre-processor to provide a detailed spatial analysis of the source–receptor relationships. In addition, this entire system will be supported by Web-based technologies to provide industry

and government agencies with a user-friendly decision-support tool that will evaluate source-receptor relationships and the efficacy of emission reduction strategies.

- The project staff has completed no work on this task, slated for a later phase of the project.

Task 7 - Project Management, Data Analysis, and Reporting

This task involves all communication between the project team members, DOE-NETL, and external collaborating parties and includes all meetings, presentations, and DOE-required reports pertaining to the project. To facilitate data analysis, the data from the SAM and the results of the model runs will be archived into a user-friendly database that will provide functionality to help calculate final mercury, arsenic, and fine particulate matter mass and composition concentrations. It will also allow the delineation of basic trends and the evaluation of variables. To the greatest extent possible, the data from the SAM site will be incorporated into the ambient air quality database being compiled for DOE-NETL by ATS and Ohio University under project DE-FC26-02NT41476. However, the primary function of the database will be to reduce data efficiently for evaluation of the proposed model simulations. At the conclusion of the project, Ohio University will submit the database containing the SAM information, results of model runs, and comparison statistics to DOE-NETL along with a comprehensive final report.

III. RESULTS AND DISCUSSION

The Cooperative Agreement began on April 3, 2003. A six month, no cost extension was requested which will extend the project through December, 2005. During the second reporting period for this project (October 3, 2003–April 2, 2004), Consol Energy R&D and ISEE set up the SAM site and initiated routine sampling on March 1, 2004. Sampling will occur over the following 18 months. Within the next several months the site will also be equipped with a wind speed/wind direction sensor located at the top of an adjacent 400 foot communication tower. In addition, the site is currently under review for consideration as an official National Mercury Deposition Network (MDN) site.

AER has completed the 1996 base case simulations using the modified CMAQ-Hg code with MEBI chemistry solver. ISEE is preparing for the regional modeling simulations to be conducted by AER on 36, 12, and 4km grid resolution for the year 2004. Observational meteorological data sets are being acquired from NCEP to conduct four dimensional data assimilation as part of the MM5 simulations and work is in progress by ISEE to run MM5 in the nested mode for 36, 12 and 4km grid resolution.

ATS is continuing to upgrade the mercury and arsenic emission inventory files. The focus of their efforts is to develop a comprehensive and accurate emission inventory utilizing current research on emissions data from coal-fired power plants. Using data obtained from DOE-NETL sponsored monitoring programs that evaluated the efficacy of mercury removal from existing SO_2 and NO_x control systems, ATS has adjusted the emission inventory for over 600 power plants. In addition, the mercury and arsenic emission inventory for Canada and Mexico have been updated based on recently released emission data by CEC and the 2002 National Pollutant Release Inventory.

IV. CONCLUSIONS

A six month, no cost extension has been requested for the first phase of this project. The request would extend the project through December of 2005. Routine sampling was initiated March 1, 2004, and will continue over the next 18 months. The 1996 base case simulation has been completed. Work is in progress on the 2001 and 2004 model simulations.

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