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September 30, 2002

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
State Capitol
600 East Boulevard Avenue, Dept. 405
Bismarck, ND 58505-0840

Dear Ms. Fine:

Subject: EERC Proposal No. 2002-0076

Enclosed please find an original and 6 copies of the proposal titled "Mercury and Air Toxic Element Impacts of Coal Combustion Byproduct Disposal and Utilization." Also enclosed is a check for $100.

As noted in the proposal, the Energy & Environmental Research Center requests that North Dakota Industrial Commission (NDIC) match funds already committed by Great River Energy for this effort. The U.S. Department of Energy National Energy Technology Laboratory and several additional industrial sponsors have also committed to funding this project. If NDIC approves funding for this effort, the project will go forward as detailed in the enclosed proposal. A project start date is anticipated during the last quarter of 2002.

If you have any questions or comments, please feel free to contact me by telephone at (701) 777-5261 or by e-mail at dphassett@undeerc.org. I appreciate your consideration of the enclosed proposal.

Sincerely,

Debra F. Pflughoeft-Hassett
Research Manager

DPH/kmd

Enclosures

Energy & Environmental Research Center

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF COAL COMBUSTION BYPRODUCT DISPOSAL AND UTILIZATION

EERC Proposal No. 2002-0076

Submitted to:

Ms. Karlene Fine

Executive Director
North Dakota Industrial Commission
State Capitol
600 East Boulevard Avenue, Dept. 405
Bismarck, ND 58505-0840

Amount of request: $37,500

Submitted by:

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John R. Gallagher
Loreal V. Heebink
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Office of Research and Program Development

September 2002

TABLE OF CONTENTS

Continued. . .

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF COAL COMBUSTION BYPRODUCT DISPOSAL AND UTILIZATION

ABSTRACT

The goal of the proposed effort is to evaluate the impact of mercury and other air toxic elements on the management of coal combustion byproducts (CCBs). Supporting objectives are to 1) determine the release potential of selected air toxic elements, including mercury and arsenic, from CCBs under specific environmental conditions; 2) increase the database of information on mercury and other air toxic element releases for CCBs; 3) develop comparative laboratory and field data; and 4) develop appropriate laboratory and field protocols.

The anticipated results will support continued environmentally responsible management of CCBs and appropriate federal regulation of CCBs. Results will indicate appropriate utilization guidelines and disposal requirements. If the environmental performance of CCBs from conventional and advanced emission control systems is similar, it will facilitate the maintenance of current CCB markets and minimize the potential for an additional barrier to utilization of CCBs. If the environmental performance varies among emission control systems, the proposed project will facilitate an understanding of appropriate management options and provide direction for any future regulatory assessment of CCBs.

The total cost for this three-year effort is $1,500,000. The U.S. Department of Energy National Energy Technology Laboratory has indicated it will provide $1,200,000. The remaining $300,000 will be provided by four industrial sponsors: Great River Energy, Utility Solid Waste Activities Group, Center for Air Toxic Metals (CATM) Affiliates, and Cinergy. Great River Energy has agreed to provide $12,500 per year, and this proposal requests that the North Dakota Industrial Commission (NDIC) Lignite Research Council provide a matching $12,500 per year for a total of $37,500 over the duration of the 3-year effort.

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF COAL COMBUSTION BYPRODUCT DISPOSAL AND UTILIZATION

PROJECT SUMMARY

The Energy & Environmental Research Center (EERC) is proposing a project to develop data on the environmental acceptability of coal combustion byproducts (CCBs) produced in systems with conventional and advanced emission controls. Data are lacking on the effects of advanced emission control systems on CCBs but must be obtained and identified so that the appropriate safeguards are in place for typical disposal and utilization scenarios.

The overall project goal is to evaluate the impact of mercury and other air toxic elements on the management of CCBs. Supporting objectives are.

1. Determining the release potential of selected air toxic elements, including mercury and arsenic, from CCBs under specific environmental conditions.
2. Increasing the database of information on mercury and other air toxic element releases for CCBs.
3. Developing comparative laboratory and field data.
4. Developing appropriate laboratory and field protocols.

Development of reliable methods to determine the release of air toxic elements from CCBs will provide a means of evaluating the environmental risk associated with CCB management. Using appropriate methods to develop a data set of currently produced CCBs and CCBs produced under experimental/simulated conditions will provide a baseline for the CCB industry and regulatory agencies to understand the impact of various emission control technologies. In particular, the project will evaluate the impact of Hg and other air toxics, including As, Se, Cd, Pb, Ni, and Cr on the disposal and/or utilization of CCBs. Also, CCBs from pilot- or full-scale systems with improved emission controls for sulfur dioxide, nitrogen oxide, particulate matter, acid gases,

and Hg will be analyzed to determine if any chemical or physical characteristics of the CCBs have changed, which may indicate a change in environmental performance. If environmental performance changes, possible impacts on the environment and water resources must be addressed.

PROJECT DESCRIPTION

Objectives

The goal of the proposed effort is to evaluate the impact of mercury and other air toxic elements on the management of CCBs. Supporting objectives are to 1) determine the release potential of selected air toxic elements, including mercury and arsenic, from CCBs under specific environmental conditions; 2) increase the database of information on mercury and other air toxic element releases for CCBs; 3) develop comparative laboratory and field data; and 4) develop appropriate laboratory and field protocols.

The specific mechanisms of air toxic element releases to be evaluated will be leaching releases, vapor releases to the atmosphere, and biologically induced leaching and vapor releases.

Methodology

As emission control technologies change, it is anticipated that mercury and air toxic elements will have a greater potential to be associated with and/or concentrated on solid byproducts. The proposed EERC project is designed to determine the stability and levels of selected air toxic elements released to the environment from CCBs under typical management scenarios. The existing data on this topic are limited and need to be supplemented to address specific questions related to the release of air toxics, including mercury, from CCBs. A focused effort is required to select and validate methodologies, determine the levels of releases, determine release mechanisms, and determine the impact of mercury and other air toxic elements on the management of CCBs. The proposed 3-year effort includes laboratory and field tasks and regular review and assessment of accumulated information to refine the proposed experimental tasks over the duration of the effort.

Task 1.0 – Literature Search

The existing EERC database of documentation on the subjects of mercury and other air toxic elements on CCBs, the mobility of those elements from CCBs, and new control technologies will be augmented by a focused literature search during the initiation of this effort. The majority of this task will be completed in Year 1, but literature monitoring as well as contact with the U.S. Department of Energy, the U.S. Environmental Protection Agency, and other groups involved in research and regulatory activities related to this effort will continue throughout the project. An annotated bibliography of references will be assembled and updated over the duration of the project.

Task 2.0 – Analytical Methods Selection

As noted in several forums in recent years, the methodologies used to evaluate CCBs must be relevant to the material and the management of CCBs where possible. Under this task, EERC researchers will continue to participate in discussions and efforts to identify appropriate methodology. EERC researchers will review methods currently being used at the EERC and elsewhere to determine the best possible methods for this effort. It is anticipated that discussions on methodology will continue, but method selection for this effort will be completed as soon as is practical by utilizing input from other efforts, as reasonable, and maintaining scientific validity for the selected protocols. The appropriateness of individual leaching procedures is frequently debated, and the selection of leaching procedures for this effort will be a key activity under this task. EPA Office of Research and Development (ORD) has indicated a strong interest in developing a standard leaching protocol for research related to mercury release from CCBs. EERC researchers are participants in discussions coordinated by EPA ORD, and information drawn from these discussions will be used to facilitate this task. A recommendation on methodologies for evaluations planned for this study will be made during Year 1 of the proposed project.

Task 3.0 – Sample Identification and Selection

Samples for use in this project will be identified through government, industry, and marketing contacts. The objective of this task is to select CCBs from systems with conventional and advanced emission control technologies. Examples of samples from conventional technologies are wet and dry flue gas desulfurization (FGD) materials, ammoniated ash from systems using selective catalytic reduction (SCR) and selective noncatalytic reduction (SNCR), and "high"-mercury fly ash. The high-mercury fly ash samples are expected to come from systems producing fly ash with higher-than-average carbon content or, in some cases, those from fabric filter collection systems. Samples from systems with advanced emission controls will most likely be collected from system technologies in the research, development, and demonstration phases under DOE and other programs focused on emission control technologies. Fly ash samples containing activated carbon injected for mercury sorption will be included in the samples. Selected samples will represent bituminous, subbituminous, and lignite fuels. It is anticipated that the samples will include 1) currently produced fly ash from a variety of coal sources and system configurations; 2) wet and dry FGD materials, focusing on processes with a higher probability for future installation; and 3) CCBs from pilot-scale or experimental emission control technologies with a high potential to be implemented under existing or expected regulations.

Review of previous work, the EPA report on the management of CCBs, Information Collection Request (ICR) data, and input from industrial partners will facilitate sample identification and selection. EERC researchers, DOE, EPA, and industrial partners will be asked to aid in the selection and collection of CCBs from advanced emission control technologies. In order to maintain the project schedule, samples and field sites will be identified as early as possible in the project.

It is anticipated that the EERC will include a limited number of samples from parallel investigations. One example of a parallel study planned by EPRI is to evaluate arsenic and selenium releases through leaching from CCBs in field settings. With the agreement of the project sponsors, the EERC and EPRI would share samples, and the EERC would incorporate these samples into the laboratory phases of the EERC effort. The EERC and EPRI would share results from these evaluations and work together on interpretation of the results. Please note that EPA and EPRI are not providing cost share toward this project. The EERC will seek other synergistic opportunities through DOE projects, EPA, and industrial sponsors.

Task 4.0 – Chemical and Physical Characterization

Characterization of selected samples will include determination of the bulk chemical composition of major, minor, and trace constituents. Samples will also be evaluated for particle size, morphology, pH, and general reactivity based on heat of hydration and cementation. The characterization data will be assembled into an existing database at the EERC and made available to DOE and industrial sponsors. This task will provide information to facilitate prioritization of the air toxic elements for the laboratory and field efforts.

Task 5.0 – Laboratory Evaluation of Air Toxic Element Releases

Assembled samples will be used in laboratory experiments focusing on specific release mechanisms of mercury and other air toxic elements. Primary release mechanisms are leaching, vaporization, and biologically stimulated leaching and vaporization. Air toxic elements, including mercury, arsenic, and selenium, will be evaluated for release through leaching. Vapor release experiments, based on previous work and a fundamental understanding of mercury chemistry, will focus on mercury. The chemical characterization, industry input, and environmental and regulatory concerns will be used to develop a prioritized list of air toxic elements to focus on for this effort. A preliminary list developed for this proposal includes mercury, arsenic, selenium, cadmium, lead, nickel, and chromium.

Subtask 5.1 – Leaching

A wide variety of leaching protocols have been used to evaluate CCBs for leaching potential and profiles, including batch and column leaching procedures. Leaching procedures to be used in this task will be selected based on a critical review of existing procedures and regulatory requirements as noted in Task 2.

Since mercury and other air toxic elements in CCBs have been shown to be released and transported through leaching, the full suite of elements will be determined in leachates. The oxidation state of select elements, including chromium, will be determined in some leachates.

In addition to leachates of as-received CCB samples, selected biologically activated CCBs generated from other laboratory experiments will be leached.

Subtask 5.2 – Vapor Transport

The vapor transport experiments will focus on mercury. The release of mercury from CCB samples will be investigated at ambient and near-ambient temperatures to simulate disposal and many utilization options for CCBs. Long-term ambient and near-ambient temperature desorption will be quantified. Air or another suitable gas will flow through pressurized containers containing up to 150 grams of CCBs. As the gas flows through the CCB, any mercury released from the CCBs will be collected on gold-coated quartz traps. After 30 days, the gold-coated quartz traps will be desorbed at 500°C, analyzed using atomic fluorescence, and reattached to the apparatus. In this manner, a long-term, integrated picture of mercury release can be obtained.

A similar effort will be undertaken for elevated temperatures to simulate some manufacturing scenarios for CCB utilization. Thermal devolatilization of mercury and mercury compounds will be investigated at temperatures between ambient and 600°C. A small CCB sample will be placed in a tube furnace and heated at a linear ramp from ambient to 600°C. Mercury release will be measured in real time. The experimental protocol for doing this has been described elsewhere in more detail (1).

Subtask 5.3 – Microbiological Release

Tests for biological mobilization of metals will be performed using a select group of CCBs and mixtures of CCBs with topsoil. The methodology under development at the EERC requires the CCB or CCB–soil mixture to be buffered to near neutral with phosphate buffer. The sample will then be dosed with glucose, as a carbon and energy source, and other salts to stimulate microbial growth and inoculated with a source of microbes. The inoculated sample is sparged with element-free gas and monitored for the release of elements from the mixture. Freshly collected sediment from a local brackish wetland will be used as the inoculum. This inoculum will contain a variety of microbes including both aerobic and anaerobic bacteria.

During the experiments, mixtures will be mechanically agitated at room temperature and sparged with clean gas. Aerobic and anaerobic conditions will be used in this task. Under aerobic conditions, the electron acceptor will be oxygen. Under the anaerobic conditions, the electron acceptor will be the appropriate salts present in the CCB (e.g., iron and sulfate). Mercury released from the sample will be trapped on two outlet gas traps, a gold-coated quartz trap, and a carbon trap.

These samples will generally be incubated for 30 days; it is expected that 30 days will be sufficient to consume the glucose added; significant additional activity is not expected after that time. At the termination of incubation, the traps will be analyzed for Hg, as in the vapor transport task, and the CCBs or CCB–soil mixtures will be subjected to leaching procedures to determine if the aqueous mobility of the metals has been affected.

Task 6.0 – Field Investigations

This task will focus on developing information to determine how laboratory results can be used effectively to determine potential releases of air toxic elements from CCBs in real-world management settings. Field investigations will be initiated in Year 2 of the project. EERC researchers will work with industry to identify field opportunities for this effort. No actual management activities will be performed under this effort; however, CCBs from field activities will be collected, and associated field sites will be evaluated for potential field sample collection. Field sampling will include air samples to determine mercury vaporization from CCBs, groundwater and surface water, and solids including CCBs and sediments, depending on the management activity. Examples of CCB management practices to be included in field investigations are 1) wet/dry disposal sites (with leachate collection, if possible); 2) mine placement; 3) soil amendments; and 4) manufacturing, such as FGD gypsum wallboard, aggregate, and building products. Industrial partners will facilitate the selection of field applications and aid in identifying field sites. One application (and a site in North Dakota) already identified by Great River Energy is the "paste" technology for mine placement and/or disposal of fly ash.

As noted in the sample selection task, a parallel field effort is planned by EPRI to evaluate leaching releases of arsenic and selenium. If the EPRI effort goes forward, the EERC will have access to the EPRI field data in exchange for EERC laboratory data. As a result, the EERC field effort could focus on air toxic elements such as mercury.

Task 7.0 – Data Reduction and Interpretation

All data collected will be compiled into a database and interpreted together with past EERC data and similar data from other studies. Results will be used to determine if mercury and other air toxic element releases from CCBs, both as currently produced and with mercury and other emission controls in place, are realistic environmental issues.

Anticipated Results

The results of this work will support continued environmentally responsible management of CCBs and appropriate federal regulation of CCBs. Results will provide an indication of appropriate utilization guidelines and disposal requirements. If the environmental performance of CCBs from conventional and advanced emission control systems is similar, it will facilitate the maintenance of current CCB markets and minimize the potential for an additional barrier to utilization of CCBs. If the environmental performance changes with added emission controls, the proposed project will facilitate an understanding of appropriate management options and provide direction for any future regulatory assessment of CCBs.

Facilities, Resources, Techniques, and Capabilities

More than 250 scientists, engineers, technicians and support staff are available at the EERC to address current problems and assess future needs. The multidisciplined engineering and scientific research staff is equipped with state-of-the-art analytical and engineering facilities to respond to a wide variety of energy and environmental needs faced by industry and government. The main EERC facilities, with 169,000 square feet of laboratory, technology demonstration facility, and office space, are dedicated to energy and environmental research, development, demonstration, and commercialization. The EERC has a wide range of analytical capabilities that have been tailored to fuels, ash, and other materials associated with energy and environmental issues; these techniques include a full range of organic, inorganic, surface, mineralogical, thermal, and physical analysis. Analytical techniques are now available to determine the distribution of phases in fuels, fly ashes, deposits, slags, ash utilization materials, soils, and other materials. Analytical methods development is an ongoing research activity at the EERC. Thus the EERC can provide a total-systems assessment of a wide variety of energy, environmental, and mineral resource research topics.

Facilities of particular importance to the proposed project are the following. The Analytical Research Laboratory (ARL) is equipped for routine and specialized analysis of inorganic and organic constituents. Equipment capabilities of the ARL include various ion chromatography techniques, atomic absorption, and atomic fluorescence. The Environmental Microbiology Laboratory houses equipment and facilities available for general and physiological microbiological research, including a sterilizer, water baths, shakers, incubators, ovens, an aerobic glove box, and an apparatus for macro- and microoxygen uptake assays. Other facilities and equipment available to researchers in this project include x-ray fluorescence, x-ray diffraction, specialized computer-controlled scanning electron microscopy, and several mercury analyzers. For additional information, see http://www.undeerc.org/facilities/listoffacilities.htm.

Environmental and Economic Impacts While Project Is under Way

Over the 3-year duration of this project, the environmental and economic impacts will be limited. The project is designed to include both laboratory and field experiments. These experiments will involve the submission of CCB samples from project sponsors and others involved in mercury emission control technology development and testing. Field investigations will focus on applications and sites where CCBs are currently being disposed of utilized. No new disposal or utilization sites will be developed under this project. The laboratory work will be done exclusively at the EERC facilities. Field sites will be selected with input from industrial sponsors and DOE.

Ultimate Technological and Economic Impacts

The proposed effort will evaluate the release of air toxic elements from CCB samples under controlled laboratory conditions and in select utilization and disposal field settings. The information collected will be evaluated and interpreted together with past EERC data and similar data from other studies. Results will be used to determine if mercury and other air toxic element releases from CCBs, both as currently produced and produced with advanced emission controls in place, are environmental concerns. The proposed work will result in improvements to existing technologies by 1) providing comparative information on CCBs from systems with various emission controls, which will aid utilities in selecting emission control technologies consistent with existing CCB management plans; 2) developing scientifically sound experimental protocols for determining air toxic releases from CCBs based on CCB properties and management scenarios; and 3) providing information to the state and federal agencies that regulate disposal and utilization options.

Why This Project Is Needed

This project is needed because anticipated changes in emission regulations may impact the elements and concentrations of elements incorporated into or sorbed onto CCBs, and it is important to understand the fundamental behavior of these elements in CCBs in order to manage them in an environmentally sound manner. Data also need to be developed on byproducts from advanced emission control technologies, such as those under development for Hg emission control.

Mercury and other air toxic elements can be present in fly ash, bottom ash, boiler slag, and FGD material. Emission control technologies have a significant potential to impact the Hg and other air toxic element concentrations present in fly ash and FGD materials. Significant changes in the chemical composition, physical properties, and morphology of byproducts may occur as a result of the application of new emission controls.

The presence of Hg, As, and other air toxic elements in CCBs poses a potential environmental problem depending on their stability under disposal and utilization conditions, a concern raised by state regulatory agencies (2) and citizen groups (3).

Laboratory tasks will address three areas: 1) direct leachability of air toxic constituents from CCBs, 2) vapor release of mercury from CCBs at ambient and elevated temperatures, and 3) biologically induced leachability and vapor release of Hg and other air toxic elements from CCBs. These tasks address fundamental issues critical to determining the release of these constituents over the life cycle of CCBs in a variety of management scenarios.

In assessing the behavior of Hg and other air toxic elements associated with CCBs, it is important to evaluate samples from real-world management scenarios. Field investigations will determine actual releases through leaching and vapor transport when various CCBs are disposed or utilized. Laboratory and field data will be interpreted together, and results will be used to assess appropriate management options.

STANDARDS OF SUCCESS

The standards of success for this project will be completion of several deliverables. In addition to periodic, topical, and final reports, the following deliverables will result from the proposed effort: 1) a written recommendation on laboratory methodology for evaluation of CCBs; 2) an annotated bibliography of references assembled and updated throughout the duration of the project; 3) a comprehensive database of characterization data at the EERC and from other programs, as available; 4) a monthly management summary of technical progress over the duration of the project and conference calls, as necessary, with DOE and industrial sponsors to discuss key issues and project direction; 5) annual reports and meetings detailing results of each year and offering an opportunity for project sponsors to provide input; 6) a comprehensive final report; 7) written and oral input to EPA ORD activities; and 8) one or more peer-reviewed journal articles and presentations at key conferences and workshops, as determined by DOE and industrial sponsors.

The EERC is committed to delivering consistent and high-quality research that meets our clients' needs and expectations. An organizationwide quality management system is in effect that governs all programs within the organization. This project is required to be in compliance with the Quality Manual and any project-specific quality assurance procedures, thus assuring that any requirements relating to quality and compliance with applicable regulations, codes, and protocols are adequately fulfilled. The EERC Quality Assurance Manager implements and oversees all aspects of quality assurance/quality control for all research, development, and demonstration projects and will review the QA/QC components of this project. The EERC maintains a wide range of analytical and testing laboratories that follow nationally recognized or approved standards and methods put forth by EPA, the American Society for Testing and Materials, the National Institute of Standards and Technology, and other agencies.

BACKGROUND

Mercury and other air toxic elements can be present in fly ash, bottom ash, boiler slag, and FGD material. Emission control technologies have a significant potential to impact the Hg and other air toxic element concentrations present in fly ash and FGD materials. Coming changes in regulations for emissions from coal-fired power plants have the potential to change the chemical composition, physical properties, and morphology of CCBs. The presence of Hg, As, and other air toxic elements in CCBs poses a potential environmental problem depending on their stability under disposal and utilization conditions, a concern raised by state regulatory agencies (2) and citizen groups (3).

It is important to understand the fundamental behavior of these elements in CCBs in order to manage them in an environmentally sound manner. Data also need to be developed on byproducts from advanced emission control technologies, such as those under development for Hg emission control.

The EERC is currently performing limited investigations of leaching, ambient and near-ambient temperature Hg release from CCBs, thermal release of Hg from CCBs at temperatures from ambient to 600°C, and the effects of microbial action on release of Hg and organomercury compounds from CCBs (4, 5). Although, the EERC has been conducting leaching studies on CCBs and other materials for over 20 years (6–8), the information on mercury release is limited because previous mercury analysis techniques were not as sensitive as current methods. While ambient, near-ambient, and thermal release of Hg studies have been ongoing for approximately 3 years, work to date has focused on developing appropriate, reliable laboratory methods and limited data on fly ash currently being generated. Studies to evaluate the impact of biological activity on leaching and vapor transport have also recently been initiated at the EERC (5), again focusing on methods development and evaluation of limited fly ash samples.

Leaching is the most likely mechanism of transport of constituents from disposed or utilized CCBs contacted by water. Leaching is typically performed on CCBs to characterize them for management purposes. Several issues have been raised by EPA's ORD and Office of Solid Waste (OSW) related to the best means of evaluating the leaching potential of CCBs. In the proposed project, leaching methodologies will be reviewed, and recommendations based on the appropriateness of existing methodologies will be made and coordinated with EPA. The existing leaching data set is not representative of the broad cross section of fly ash and FGD material currently produced in the United States.

Thermal release, particularly of Hg, is important from the perspective of long-term use, storage, or disposal of CCBs. Although the concentration of Hg in CCBs is relatively low, the large volumes of CCBs produced annually cause concern about potential mercury releases. Ambient, near-ambient, and elevated-temperature studies of Hg release resulted in the development of an apparatus to determine mercury release in real time from CCBs.

Previous EERC experiments (5) indicate that Hg is released from CCBs at ambient and near-ambient temperatures. These preliminary laboratory data warrant further investigation. Vapor transport experiments will evaluate Hg release from a bed of CCBs at ambient and near-ambient temperatures and constant airflow through the bed. The design of these experiments is critical to give laboratory results that can be compared to field experiments at CCB management sites.

The wide distribution and variety of microorganisms in the environment indicate that microbiological release of Hg and other air toxic elements needs to be investigated. A wide variety of specific microbe interactions can affect key elements associated with CCBs, including oxidation/reduction and alkylation/dealkylation reactions. The microbial cycling of other air toxic metals follows a similar pattern to that seen with mercury. In order for microbes to be metabolically active, a few constraints must be satisfied. In some CCB management options, these criteria are unlikely to be met, but for options where they can be met, laboratory experiments will simulate appropriate scenarios.

If CCBs from systems with existing and advanced emission control systems in place are found to be environmentally appropriate for existing management options, a continued rise is expected in CCB utilization. Therefore, an important part of this effort is in the area of selecting, developing, and validating scientific procedures for evaluating CCBs for environmental performance. By documenting the procedures selected and working closely with EPA to refine and validate those procedures, the proposed work will result in a definitive approach that can be effectively used in federal regulatory efforts and by state agencies.

QUALIFICATIONS

Debra F. Pflughoeft-Hassett will serve as the project manager. Ms. Pflughoeft-Hassett has extensive experience managing technical projects related to the management of CCBs. Many of these projects have been accomplished using the team research concept and industrial consortium sponsorship proposed for this effort. Ms. Pflughoeft-Hassett has extensive contacts in the CCB industry and has been involved with key personnel in EPA efforts to regulate CCBs and evaluate the impacts of mercury controls on CCBs. Ms. Pflughoeft-Hassett will work with David J. Hassett, John R. Gallagher, and Loreal V. Heebink, the principal investigators, to direct all phases of this effort. The project manager and principal investigators will direct the laboratory work and field efforts performed by professional EERC staff. Mr. Hassett has been involved in investigations of environmental issues related to CCB management since 1977. Mr. Gallagher has frequently teamed with the EERC CCB research team and has familiarity with CCBs and a variety of CCB management scenarios. Ms. Heebink is an environmental chemist whose work has primarily involved investigations related to CCBs. Dennis L. Laudal and John H. Pavlish will advise the project research team. Mr. Laudal and Mr. Pavlish have been involved in numerous projects related to mercury and other emission control technologies and will advise the project manager and technical staff on issues related to emissions and emission controls. Mr. Pavlish is the Director of Center for Air Toxic Materials (CATM), which is funded by EPA. The project team has worked together in past efforts on mercury release from CCBs funded through CATM. Resumes of all involved research staff are included in "resume.doc." EERC professional staff will support this project in field sampling activities, reporting, accounting, contracting, and associated tasks.

EERC key personnel have specific experience in the successful execution of projects similar to the proposed program. The EERC has conducted extensive CCB research in the areas of characterization, environmental and engineering performance, product testing and development, and management since the mid-1970s. Key personnel have participated in government and industry forums to address environmental and regulatory issues related to CCB management.

The EERC has performed numerous research projects related to mercury and trace elements from fossil fuel conversions and CCBs. Several related projects performed under CATM include "Development of Mercury Control Technologies," "Mercury and Volatile Organic Contaminants Control Using Fiber-Based Bioreactors," "Economic Evaluation of Mercury Control Options," and "Mercury Stability in Solid Materials." Other efforts related to environmental aspects of CCB management include "Environmental Evaluation for Utilization of Ash in Soil Stabilization," jointly funded by DOE and EPRI, and "Demonstration of Coal Ash for Feedlot Surfaces," funded by a consortium of industrial sponsors, state entities, and DOE (see http://www.undeerc.org/ catm/catm_home.html and http://www.undeerc.org/carrc/index.html). Table 1 shows a partial list of EERC projects involving mercury measurement and control.

VALUE TO NORTH DAKOTA

The value to North Dakota is to develop a better understanding of the impacts of new emission control technologies for mercury on CCBs generated and the potential impact on management options for North Dakota utilities. One management scenario to be evaluated is the "paste" technology for placement of fly ash in mine settings or disposal settings. The information developed will allow Great River Energy to assess the applicability of this technology to potentially altered fly ash, and this information can be shared with the North Dakota Department of Health to facilitate appropriate state regulatory actions for this CCB management option. North Dakota will also benefit from the broad approach to evaluating CCBs from existing and improved emission control technologies because all North Dakota utilities will be able to assess the impacts of various mercury emission control technologies on CCBs and CCB management. It is anticipated that the information developed in this project will allow EPA to make more

Table 1. Listing of Related Projects

Project Title	Funding Sources/ End Date
Center for Air Toxic Metals – The EERC has been designated a center of excellence for air toxic measurement and control. This is an ongoing cooperative agreement with EPA that has funded a wide variety of mercury projects at the EERC.	EPA and Industrial Affliates/2002
Formal Evaluation of Mercury Measurement Methods	EPRI–DOE/1998
Characterization and Modeling of Mercury	EPRI–DOE/2000
Mercury Emissions from North Dakota Lignite-Fired Power Plants on the Bioavailability of Mercury to Humans	DOE–NDIC–Industry/1999
Evaluate the Fate and Distribution of Trace Elements in Integrated Gasification Systems	DOE–NETL/1998
Evaluation of Mercury Standard Gases	Spectra Gases/1998
Fine Particulate ($PM_{2.5}$) Characterization and Source Apportionment	DOE/1999
Hot-Gas Filter Testing	DOE/1998
Determination of Particulate Deposition Parameters Using a Novel Duel-Tracer Method: Phase I	EPA/2000
Effects of Fly Ash on Mercury Oxidation During Postcombustion Conditions	Iowa State University/2001
Bench-Scale Tests in Support of the Characterization and Modeling of the Forms of Mercury from Coal-Fired Power Plants Project	DOE–EPRI/2000
Value-Added Sorbent Development for Mercury Control	DOE/1998
Determine the Potential to Control Mercury from Coal-Fired Boilers by Using Sorbents	DOE/1998
Advanced Hybrid Particulate Collector, A New Concept for Air Toxics and Fine-Particulate Control	DOE–Gore/2001

informed decisions on the appropriate management of CCBs from emerging mercury control technologies, and this will be useful to the North Dakota Department of Health and North Dakota utilities.

MANAGEMENT

Debra F. Pflughoeft-Hassett will serve as the project manager. David J. Hassett, John R. Gallagher, and Loreal V. Heebink will serve as the principal investigators. Other research scientists and/or engineers involved in the project will include Dennis L. Laudal and John H. Pavlish. Resumes of all involved research staff are included in Appendix A. EERC professional staff will support this project in field sampling activities, reporting, and associated tasks. Figure 1 shows the project organizational chart.

TIMETABLE

Table 2 reflects the project schedule and milestones for this project.

As illustrated in Figure 1 below, an industrial advisory board comprising representatives of industry sponsors will provide input to the project team. Commitment letters from four industrial sponsors, Great River Energy, Utility Solid Waste Activities Group, CATM Affiliates, and Cinergy are included.

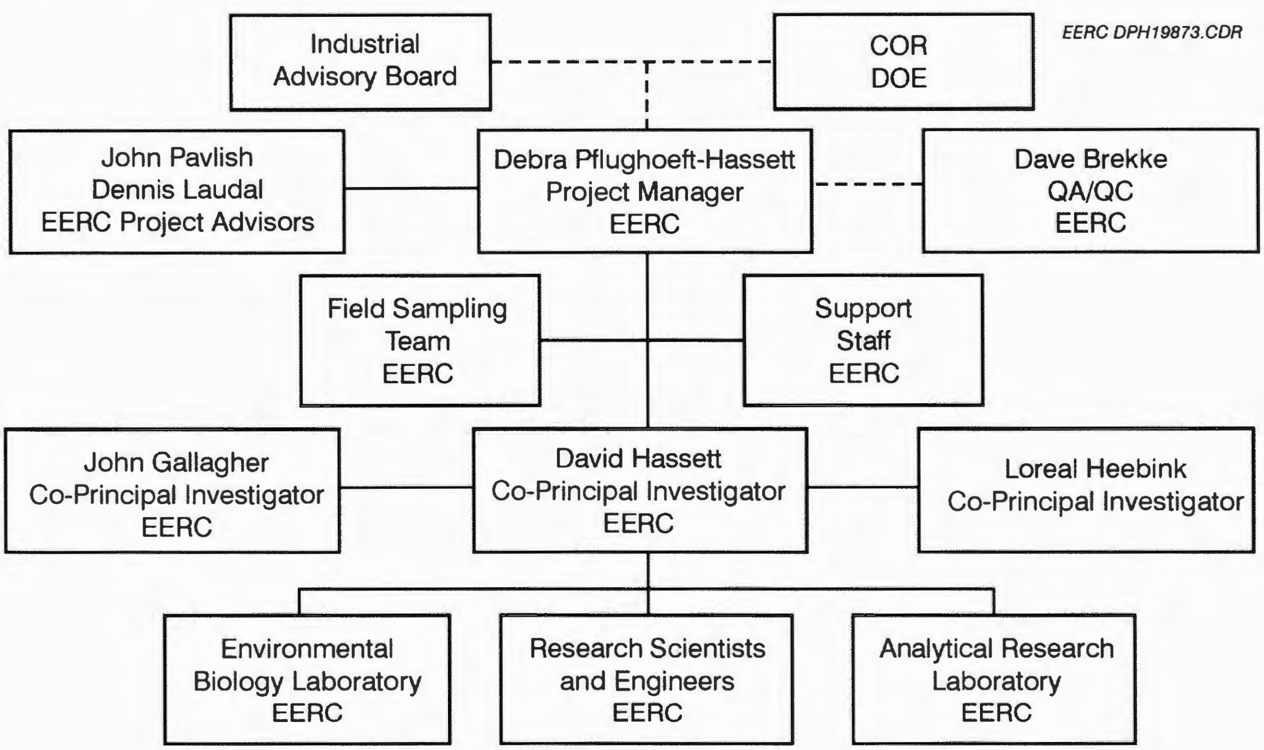
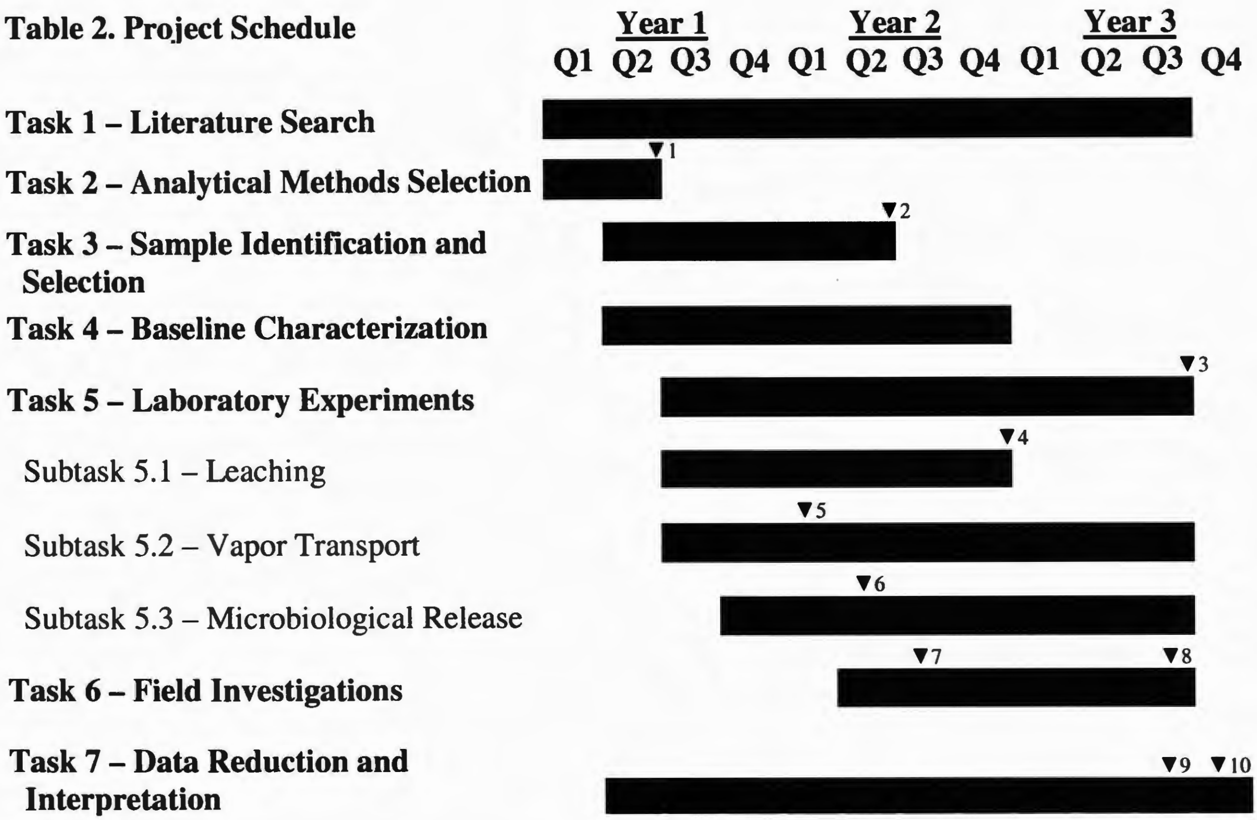


Figure 1. Project organizational chart.

Table 2. Project Schedule



1 Report detailing methods and selection, criteria and process.
2 Final selection of existing and experimental materials.
3 Laboratory experiments completed.
4 Laboratory leaching procedures completed and data assembled.
5 Vapor transport techniques related to specific real-world management applications initiated.
6 Microbial tests on real-world application initiated.
7 Field sites selected.
8 Field sampling/testing completed.
9 Data assembly completed.
10 Data interpretation completed.

BUDGET

The budget includes all costs associated with accomplishment of the proposed effort including laboratory and field investigations, research and support staff time, equipment, travel, and other direct costs. A detailed budget and budget notes are included.

MATCHING FUNDS

The total cost for this 3-year effort is $1,500,000. DOE's National Energy Technology Laboratory has indicated it will provide $1,200,000. The remaining $300,000 will be provided by industry. The four industrial sponsors include Great River Energy (GRE), Utility Solid Waste Activities Group, CATM Affiliates, and Cinergy. Each industrial sponsor has agreed to provide $25,000 per year for each of the three project years. GRE intends to meet its obligation by providing $12,500 per year with matching funds of $12,500 per year ($37,500 for the 3-year project) from the North Dakota Industrial Commission. This proposal requests that the North Dakota Industrial Commission (NDIC) Lignite Research Council provide the matching funds to GRE's contribution.

Letters of award and support are included in Appendix B.

TAX LIABLITY

The EERC—a research organization within UND, which is an institution of higher education within the state of North Dakota—is not a taxable entity.

CONFIDENTIAL INFORMATION

No confidential information is included in this proposal.

REFERENCES

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Publication 99-EERC-09-03; Energy & Environmental Research Center: Grand Forks, ND, Sept 1999.

2. Hassett, D.J.; Heebink, L.V. *Environmental Evaluation for Utilization of Ash in Soil Stabilization*; Final Report for U.S. Department of Energy, in press.

3. Keating, M.H.; Chaisson, J.M. The Fate of Mercury on Coal-Fired Power Plants and Combustion Wastes. In *Mercury in the Environment, Proceedings of a Specialty Conference;* Air & Waste Management Association, Minneapolis, MN, Sept 15–17, 1999; 494–499.

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6. Hassett, D.J.; Henke, K.E.; McCarthy, G.J. Characterization of a Lignite Ash from the METC Gasifier: III. Leaching Behavior. In *Proceedings of Fly Ash and Coal Conversion By-Products: Characterization, Utilization and Disposal I.* Materials Research Society, 1985; 44, 188–194.

7. Hassett, D.J. A Comprehensive Chemical Characterization to Predict Environmental Impact form Leachate Generation (abs.). In *Proceedings of Achieving Land Use Potential Through Reclamation, 9th Annual Meeting of the American Society for Surface Mining and Reclamation*; Duluth, MN, 1992; 548.

8. Pflughoeft-Hassett, D.F.; Dockter, B.A.; Eylands, K.E.; Hassett, D.J.; Pavlish, J.H. Impact of Mercury Emission Control Technologies on Conventional Coal Combustion By-Product

Management. Presented at the Air & Waste Management Association 89th Annual Meeting and Exhibition, Nashville, TN, June 23–28, 1996.

SUMMARY BUDGET - ALL YEARS

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
DOE NETL
PROPOSED START DATE: 11/01/02
EERC PROPOSAL #2002-0076

	TOTAL		NON-FEDERAL SHARE		DOE NETL SHARE	
CATEGORY	**HRS**	**$COST**	**HRS**	**$COST**	**HRS**	**$COST**
TOTAL DIRECT LABOR	19,970	$ 521,314	3,928	$ 101,595	16,042	$ 419,719
FRINGE BENEFITS - % OF DIRECT LABOR		$ 275,119		$ 53,858		$ 221,261
TOTAL LABOR		$ 796,433		$ 155,453		$ 640,980
OTHER DIRECT COSTS						
TRAVEL		$ 54,702		$ 6,885		$ 47,817
COMMUNICATION - PHONES & POSTAGE		$ 4,180		$ 494		$ 3,686
OFFICE (PROJECT SPECIFIC SUPPLIES)		$ 5,632		$ 938		$ 4,694
SUPPLIES		$ 24,000		$ 3,508		$ 20,492
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)		$ 15,563		$ 400		$ 15,163
EQUIPMENT > $5000		$ 34,000		$ 25,000		$ 9,000
FEES		$ 91,525		$ 8,603		$ 82,922
TOTAL OTHER DIRECT COST		$ 229,602		$ 45,828		$ 183,774
TOTAL DIRECT COST		$ 1,026,035		$ 201,281		$ 824,754
FACILITIES & ADMIN. RATE - % OF MTDC	VAR	$ 473,965	56%	$ 98,719	46%	$ 375,246
TOTAL COST		$ 1,500,000		$ 300,000		$ 1,200,000

NOTE: Due to limitations within the University's accounting system, the system does not provide for accumulating and reporting expenses at the Detailed Budget level. The Summary Budget is presented for the purpose of how we propose, account, and report expenses. The Detailed Budget is presented to assist in the evaluation of the proposal.

DETAILED BUDGET - ALL YEARS

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
DOE NETL
PROPOSED START DATE: 11/01/02
EERC PROPOSAL #2002-0076

LABOR	LABOR CATEGORY	HOURLY RATE	YEAR ONE TOTAL HRS	YEAR ONE TOTAL $COST	YEAR TWO TOTAL HRS	YEAR TWO TOTAL $COST	YEAR THREE TOTAL HRS	YEAR THREE TOTAL $COST	TOTAL HRS	TOTAL $COST	NON-FEDERAL COST SHARE HRS	NON-FEDERAL COST SHARE $COST	DOE NETL SHARE HRS	DOE NETL SHARE $COST
PFLUGHOEFT-HASSETT, D.	PROJECT MANAGER	$ 29.33	850	$ 24,931	850	$ 24,931	850	$ 24,931	2,550	$ 74,793	382	$ 11,204	2,168	$ 63,589
HASSETT, D.	PRINCIPAL INVESTIGATOR	$ 31.05	1,025	$ 31,826	1,040	$ 32,292	935	$ 29,032	3,000	$ 93,150	368	$ 11,427	2,632	$ 81,723
GALLAGHER, J.	PRINCIPAL INVESTIGATOR	$ 26.19	250	$ 6,548	250	$ 6,548	720	$ 18,857	1,220	$ 31,953	224	$ 5,867	996	$ 26,086
HEEBINK, L.	PRINCIPAL INVESTIGATOR	$ 18.48	1,287	$ 23,784	1,000	$ 18,480	1,600	$ 29,568	3,887	$ 71,832	871	$ 16,096	3,016	$ 55,736
LAUDAL, D.	RESEARCH SCIENTIST/ENGINEER	$ 40.24	174	$ 7,002	174	$ 7,002	174	$ 7,002	522	$ 21,006	96	$ 3,863	426	$ 17,143
PAVLISH, J.	RESEARCH SCIENTIST/ENGINEER	$ 41.56	174	$ 7,231	174	$ 7,231	174	$ 7,231	522	$ 21,693	96	$ 3,989	426	$ 17,704
--------------	SENIOR MANAGEMENT	$ 44.82	173	$ 7,754	173	$ 7,754	173	$ 7,754	519	$ 23,262	126	$ 5,646	393	$ 17,616
--------------	QUALITY CONTROL MANAGER	$ 23.99	64	$ 1,535	64	$ 1,535	64	$ 1,535	192	$ 4,605	36	$ 864	156	$ 3,741
--------------	RESEARCH SCIENTIST/ENGINEER	$ 25.68	1,297	$ 33,307	965	$ 24,781	998	$ 25,629	3,260	$ 83,717	927	$ 23,805	2,333	$ 59,912
--------------	RESEARCH TECHNICIAN	$ 16.73	296	$ 4,952	296	$ 4,952	296	$ 4,952	888	$ 14,856	213	$ 3,564	675	$ 11,292
--------------	UNDERGRAD-RES.	$ 7.45	870	$ 6,482	870	$ 6,482	870	$ 6,482	2,610	$ 19,446	452	$ 3,367	2,158	$ 16,079
--------------	TECHNICAL SUPPORT SERVICES	$ 13.86	250	$ 3,465	250	$ 3,465	300	$ 4,158	800	$ 11,088	137	$ 1,898	663	$ 9,190
			6,710	$ 158,817	6,106	$ 145,453	7,154	$ 167,131	19,970	$ 471,401	3,928	$ 91,590	16,042	$ 379,811
ESCALATION ABOVE CURRENT BASE		VAR		$ 8,735		$ 15,273		$ 25,905		$ 49,913		$ 10,005		$ 39,908
TOTAL DIRECT LABOR				$ 167,552		$ 160,726		$ 193,036		$ 521,314		$ 101,595		$ 419,719
FRINGE BENEFITS - % OF DIRECT LABOR		55%		$ 88,392		$ 84,460		$ 102,052		$ 274,904		$ 53,821		$ 221,083
FRINGE BENEFITS - % OF STUDENT LABOR		1%		$ 68		$ 72		$ 75		$ 215		$ 37		$ 178
TOTAL FRINGE BENEFITS				$ 88,460		$ 84,532		$ 102,127		$ 275,119		$ 53,858		$ 221,261
TOTAL LABOR				$ 256,012		$ 245,258		$ 295,163		$ 796,433		$ 155,453		$ 640,980
OTHER DIRECT COSTS														
TRAVEL				$ 10,574		$ 22,612		$ 21,516		$ 54,702		$ 6,885		$ 47,817
COMMUNICATION - PHONES & POSTAGE				$ 1,500		$ 1,444		$ 1,236		$ 4,180		$ 494		$ 3,686
OFFICE (PROJECT SPECIFIC SUPPLIES)				$ 2,292		$ 2,500		$ 840		$ 5,632		$ 938		$ 4,694
SUPPLIES				$ 15,000		$ 7,500		$ 1,500		$ 24,000		$ 3,508		$ 20,492
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)				$ 4,376		$ 4,167		$ 7,020		$ 15,563		$ 400		$ 15,163
EQUIPMENT > $5000				$ 34,000		$ -		$ -		$ 34,000		$ 25,000		$ 9,000
NATURAL MAT. ANALYTICAL RES. LAB.				$ 2,827		$ 7,404		$ 3,095		$ 13,326		$ 619		$ 12,707
FUELS & MATERIALS RESEARCH LAB				$ 1,583		$ 3,868		$ -		$ 5,451		$ 743		$ 4,708
ANALYTICAL RESEARCH LAB.				$ 12,818		$ 39,233		$ 3,430		$ 55,481		$ 2,686		$ 52,795
GRAPHICS SUPPORT				$ 3,904		$ 4,089		$ 4,274		$ 12,267		$ 855		$ 11,412
OUTSIDE LABS				$ 5,000		$ -		$ -		$ 5,000		$ 3,700		$ 1,300
TOTAL OTHER DIRECT COST				$ 93,874		$ 92,817		$ 42,911		$ 229,602		$ 45,828		$ 183,774
TOTAL DIRECT COST				$ 349,886		$ 338,075		$ 338,074		$ 1,026,035		$ 201,281		$ 824,754
FACILITIES & ADMIN. RATE - % OF MTDC			VAR	$ 150,114	VAR	$ 161,925	VAR	$ 161,926	VAR	$ 473,965	56%	$ 98,719	46%	$ 375,246
TOTAL PROJECT COST				$ 500,000		$ 500,000		$ 500,000		$ 1,500,000		$ 300,000		$ 1,200,000

DETAILED BUDGET - YEAR ONE

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
DOE NETL
PROPOSED START DATE: 11/01/02
EERC PROPOSAL #2002-0076

LABOR	LABOR CATEGORY	HOURLY RATE	TOTAL HRS	TOTAL $COST	NON-FEDERAL COST SHARE HRS	NON-FEDERAL COST SHARE $COST	DOE NETL SHARE HRS	DOE NETL SHARE $COST
PFLUGHOEFT-HASSETT, D.	PROJECT MANAGER	$ 29.33	850	$ 24,931	120	$ 3,520	730	$ 21,411
HASSETT, D.	PRINCIPAL INVESTIGATOR	$ 31.05	1,025	$ 31,826	120	$ 3,726	905	$ 28,100
GALLAGHER, J.	PRINCIPAL INVESTIGATOR	$ 26.19	250	$ 6,548	45	$ 1,179	205	$ 5,369
HEEBINK, L.	PRINCIPAL INVESTIGATOR	$ 18.48	1,287	$ 23,784	60	$ 1,109	1,227	$ 22,675
LAUDAL, D.	RESEARCH SCIENTIST/ENGINEER	$ 40.24	174	$ 7,002	30	$ 1,207	144	$ 5,795
PAVLISH, J.	RESEARCH SCIENTIST/ENGINEER	$ 41.56	174	$ 7,231	30	$ 1,247	144	$ 5,984
--------------	SENIOR MANAGEMENT	$ 44.82	173	$ 7,754	42	$ 1,882	131	$ 5,872
--------------	QUALITY CONTROL MANAGER	$ 23.99	64	$ 1,535	12	$ 288	52	$ 1,247
--------------	RESEARCH SCIENTIST/ENGINEER	$ 25.68	1,297	$ 33,307	354	$ 9,091	943	$ 24,216
--------------	RESEARCH TECHNICIAN	$ 16.73	296	$ 4,952	71	$ 1,188	225	$ 3,764
--------------	UNDERGRAD-RES.	$ 7.45	870	$ 6,482	120	$ 894	750	$ 5,588
--------------	TECHNICAL SUPPORT SERVICES	$ 13.86	250	$ 3,465	40	$ 554	210	$ 2,911
			6,710	$158,817	1,044	$ 25,885	5,666	$ 132,932
ESCALATION ABOVE CURRENT BASE		5.5%		$ 8,735		$ 1,424		$ 7,311
TOTAL DIRECT LABOR				$167,552		$ 27,309		$ 140,243
FRINGE BENEFITS - % OF DIRECT LABOR		55%		$ 88,392		$ 14,501		$ 73,891
FRINGE BENEFITS - % OF STUDENT LABOR		1%		$ 68		$ 9		$ 59
TOTAL FRINGE BENEFITS				$ 88,460		$ 14,510		$ 73,950
TOTAL LABOR				$256,012		$ 41,819		$ 214,193
OTHER DIRECT COSTS								
TRAVEL				$ 10,574		$ -		$ 10,574
COMMUNICATION - PHONES & POSTAGE				$ 1,500		$ 255		$ 1,245
OFFICE (PROJECT SPECIFIC SUPPLIES)				$ 2,292		$ 427		$ 1,865
SUPPLIES				$ 15,000		$ 1,500		$ 13,500
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)				$ 4,376		$ 376		$ 4,000
EQUIPMENT > $5000				$ 34,000		$ 25,000		$ 9,000
NATURAL MAT. ANALYTICAL RES. LAB.				$ 2,827		$ -		$ 2,827
FUELS & MATERIALS RESEARCH LAB				$ 1,583		$ -		$ 1,583
ANALYTICAL RESEARCH LAB.				$ 12,818		$ -		$ 12,818
GRAPHICS SUPPORT				$ 3,904		$ -		$ 3,904
OUTSIDE LABS				$ 5,000		$ 3,700		$ 1,300
TOTAL OTHER DIRECT COST				$ 93,874		$ 31,258		$ 62,616
TOTAL DIRECT COST				$349,886		$ 73,077		$ 276,809
FACILITIES & ADMIN. RATE - % OF MTDC			VAR	$150,114	56%	$ 26,923	46%	$ 123,191
TOTAL COST				$500,000		$ 100,000		$ 400,000

DETAILED BUDGET - YEAR TWO

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
DOE NETL
PROPOSED START DATE: 11/01/02
EERC PROPOSAL #2002-0076

LABOR	LABOR CATEGORY	HOURLY RATE	TOTAL HRS	TOTAL $COST	NON-FEDERAL COST SHARE HRS	NON-FEDERAL COST SHARE $COST	DOE NETL SHARE HRS	DOE NETL SHARE $COST
PFLUGHOEFT-HASSETT, D.	PROJECT MANAGER	$ 29.33	850	$ 24,931	100	$ 2,933	750	$ 21,998
HASSETT, D.	PRINCIPAL INVESTIGATOR	$ 31.05	1,040	$ 32,292	70	$ 2,174	970	$ 30,118
GALLAGHER, J.	PRINCIPAL INVESTIGATOR	$ 26.19	250	$ 6,548	42	$ 1,100	208	$ 5,448
HEEBINK, L.	PRINCIPAL INVESTIGATOR	$ 18.48	1,000	$ 18,480	611	$ 11,291	389	$ 7,189
LAUDAL, D.	RESEARCH SCIENTIST/ENGINEER	$ 40.24	174	$ 7,002	33	$ 1,328	141	$ 5,674
PAVLISH, J.	RESEARCH SCIENTIST/ENGINEER	$ 41.56	174	$ 7,231	33	$ 1,371	141	$ 5,860
--------------	SENIOR MANAGEMENT	$ 44.82	173	$ 7,754	42	$ 1,882	131	$ 5,872
--------------	QUALITY CONTROL MANAGER	$ 23.99	64	$ 1,535	12	$ 288	52	$ 1,247
--------------	RESEARCH SCIENTIST/ENGINEER	$ 25.68	965	$ 24,781	262	$ 6,728	703	$ 18,053
--------------	RESEARCH TECHNICIAN	$ 16.73	296	$ 4,952	71	$ 1,188	225	$ 3,764
--------------	UNDERGRAD-RES.	$ 7.45	870	$ 6,482	167	$ 1,244	703	$ 5,238
--------------	TECHNICAL SUPPORT SERVICES	$ 13.86	250	$ 3,465	40	$ 554	210	$ 2,911
			6,106	$145,453	1,483	32,081	4,623	$ 113,372
ESCALATION ABOVE CURRENT BASE		10.5%		$ 15,273		$ 3,369		$ 11,904
TOTAL DIRECT LABOR				$160,726		$ 35,450		$ 125,276
FRINGE BENEFITS - % OF DIRECT LABOR		55%		$ 84,460		$ 18,741		$ 65,719
FRINGE BENEFITS - % OF STUDENT LABOR		1%		$ 72		$ 14		$ 58
TOTAL FRINGE BENEFITS				$ 84,532		$ 18,755		$ 65,777
TOTAL LABOR				$245,258		$ 54,205		$ 191,053
OTHER DIRECT COSTS								
TRAVEL				$ 22,612		$ 4,750		$ 17,862
COMMUNICATION - PHONES & POSTAGE				$ 1,444		$ 192		$ 1,252
OFFICE (PROJECT SPECIFIC SUPPLIES)				$ 2,500		$ 500		$ 2,000
SUPPLIES				$ 7,500		$ 1,708		$ 5,792
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)				$ 4,167		$ 4		$ 4,163
NATURAL MAT. ANALYTICAL RES. LAB.				$ 7,404		$ -		$ 7,404
FUELS & MATERIALS RESEARCH LAB				$ 3,868		$ 743		$ 3,125
ANALYTICAL RESEARCH LAB.				$ 39,233		$ 2,000		$ 37,233
GRAPHICS SUPPORT				$ 4,089		$ -		$ 4,089
TOTAL OTHER DIRECT COST				$ 92,817		$ 9,897		$ 82,920
TOTAL DIRECT COST				$338,075		$ 64,102		$ 273,973
FACILITIES & ADMIN. RATE - % OF MTDC			VAR	$161,925	56%	$ 35,898	46%	$ 126,027
TOTAL COST				$500,000		$ 100,000		$ 400,000

DETAILED BUDGET - YEAR THREE

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
DOE NETL
PROPOSED START DATE: 11/01/02
EERC PROPOSAL #2002-0076

LABOR	LABOR CATEGORY	HOURLY RATE	TOTAL HRS	TOTAL $COST	NON-FEDERAL COST SHARE HRS	NON-FEDERAL COST SHARE $COST	DOE NETL SHARE HRS	DOE NETL SHARE $COST
PFLUGHOEFT-HASSETT, D.	PROJECT MANAGER	$ 29.33	850	$ 24,931	162	$ 4,751	688	$ 20,180
HASSETT, D.	PRINCIPAL INVESTIGATOR	$ 31.05	935	$ 29,032	178	$ 5,527	757	$ 23,505
GALLAGHER, J.	PRINCIPAL INVESTIGATOR	$ 26.19	720	$ 18,857	137	$ 3,588	583	$ 15,269
HEEBINK, L.	PRINCIPAL INVESTIGATOR	$ 18.48	1,600	$ 29,568	200	$ 3,696	1,400	$ 25,872
LAUDAL, D.	RESEARCH SCIENTIST/ENGINEER	$ 40.24	174	$ 7,002	33	$ 1,328	141	$ 5,674
PAVLISH, J.	RESEARCH SCIENTIST/ENGINEER	$ 41.56	174	$ 7,231	33	$ 1,371	141	$ 5,860
--------------	SENIOR MANAGEMENT	$ 44.82	173	$ 7,754	42	$ 1,882	131	$ 5,872
--------------	QUALITY CONTROL MANAGER	$ 23.99	64	$ 1,535	12	$ 288	52	$ 1,247
--------------	RESEARCH SCIENTIST/ENGINEER	$ 25.68	998	$ 25,629	311	$ 7,986	687	$ 17,643
--------------	RESEARCH TECHNICIAN	$ 16.73	296	$ 4,952	71	$ 1,188	225	$ 3,764
--------------	UNDERGRAD-RES.	$ 7.45	870	$ 6,482	165	$ 1,229	705	$ 5,253
--------------	TECHNICAL SUPPORT SERVICES	$ 13.86	300	$ 4,158	57	$ 790	243	$ 3,368
			7,154	$167,131	1,401	$ 33,624	5,753	$ 133,507
ESCALATION ABOVE CURRENT BASE		15.5%		$ 25,905		$ 5,212		$ 20,693
TOTAL DIRECT LABOR				$193,036		$ 38,836		$ 154,200
FRINGE BENEFITS - % OF DIRECT LABOR		55%		$102,052		$ 20,579		$ 81,473
FRINGE BENEFITS - % OF STUDENT LABOR		1%		$ 75		$ 14		$ 61
TOTAL FRINGE BENEFITS				$102,127		$ 20,593		$ 81,534
TOTAL LABOR				$295,163		$ 59,429		$ 235,734
OTHER DIRECT COSTS								
TRAVEL				$ 21,516		$ 2,135		$ 19,381
COMMUNICATION - PHONES & POSTAGE				$ 1,236		$ 47		$ 1,189
OFFICE (PROJECT SPECIFIC SUPPLIES)				$ 840		$ 11		$ 829
SUPPLIES				$ 1,500		$ 300		$ 1,200
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)				$ 7,020		$ 20		$ 7,000
NATURAL MAT. ANALYTICAL RES. LAB.				$ 3,095		$ 619		$ 2,476
ANALYTICAL RESEARCH LAB.				$ 3,430		$ 686		$ 2,744
GRAPHICS SUPPORT				$ 4,274		$ 855		$ 3,419
TOTAL OTHER DIRECT COST				$ 42,911		$ 4,673		$ 38,238
TOTAL DIRECT COST				$338,074		$ 64,102		$ 273,972
FACILITIES & ADMIN. RATE - % OF MTDC			VAR	$161,926	56%	$ 35,898	46%	$ 126,028
TOTAL COST				$500,000		$ 100,000		$ 400,000

DETAILED BUDGET - TRAVEL

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
EERC PROPOSAL #2002-0076

RATES USED TO CALCULATE ESTIMATED TRAVEL EXPENSES

DESTINATION	AIRFARE	LODGING	PER DIEM	CAR RENTAL	REGIST.
Unspecified Destination (USA)	$ 1,524	$ 125	$ 46	$ 50	$ 400
Pittsburgh, PA	$ 1,060	$ 83	$ 46	$ 50	$ -

PURPOSE/DESTINATION	NUMBER OF TRIPS	NUMBER OF PEOPLE	NUMBER OF DAYS	AIRFARE	LODGING	PER DIEM	CAR RENTAL	MISC.	REGIST.	TOTAL
AWMA Conference/Unspecified Dest. (USA)	1	1	5	$ 1,524	$ 500	$ 230	$ 250	$ 100	$ 400	$ 3,004
DOE Briefing/Pittsburgh, PA	2	2	3	$ 4,240	$ 664	$ 552	$ 300	$ 240	$ -	$ 5,996
Annual Contractor's Review Mtg.	1	1	3	$ 1,060	$ 166	$ 138	$ 150	$ 60	$ -	$ 1,574
TOTAL ESTIMATED TRAVEL -YEAR ONE										$10,574
AWMA Conference/Unspecified Dest. (USA)	1	2	5	$ 3,048	$ 1,000	$ 460	$ 250	$ 200	$ 800	$ 5,758
DOE Briefing/Pittsburgh, PA	1	2	3	$ 2,120	$ 332	$ 276	$ 150	$ 120	$ -	$ 2,998
Annual Contractor's Review Mtg./Pittsburgh, PA	1	1	3	$ 1,060	$ 166	$ 138	$ 150	$ 60	$ -	$ 1,574
Field Sampling/Site Visit/Unspecified Dest. (USA)	3	2	3	$ 9,144	$ 1,500	$ 828	$ 450	$ 360	$ -	$12,282
TOTAL ESTIMATED TRAVEL -YEAR TWO										$22,612
AWMA Conference/Unspecified Dest. (USA)	1	2	5	$ 3,048	$ 1,000	$ 460	$ 250	$ 200	$ 800	$ 5,758
DOE Briefing & Contractor Review Mtgs./Pittsburgh, PA	2	2	3	$ 4,240	$ 664	$ 552	$ 300	$ 240	$ -	$ 5,996
Annual Contractor's Review Mtg./Pittsburgh, PA	1	1	3	$ 1,060	$ 166	$ 138	$ 150	$ 60	$ -	$ 1,574
Field Sampling/Site Visit/Unspecified Dest. (USA)	2	2	3	$ 6,096	$ 1,000	$ 552	$ 300	$ 240	$ -	$ 8,188
TOTAL ESTIMATED TRAVEL -YEAR THREE										$21,516
TOTAL ESTIMATED TRAVEL - ALL YEARS										$54,702

DETAILED BUDGET - EQUIPMENT

DESCRIPTION	$COST
Atomic Absorption Spectrometer	$ 21,000
Atomic Fluorescence Detector upgrade	$ 7,000
Mercury Vapor Calibration Unit	$ 6,000
TOTAL ESTIMATED EQUIPMENT	$ 34,000

DETAILED BUDGET - FEES

MERCURY AND AIR TOXIC ELEMENT IMPACTS OF CCB DISPOSAL AND UTILIZATION
EERC PROPOSAL #2002-0076

		YEAR ONE		YEAR TWO		YEAR THREE		ALL YEARS	
NATURAL MAT. ANALYTICAL RES. LAB.	**RATE**	#	$COST	#	$COST	#	$COST	#	$COST
XRD	$134	20	$ 2,680	50	$ 6,700	20	$ 2,680	90	$ 12,060
SUBTOTAL			$ 2,680		$ 6,700		$ 2,680		$ 12,060
ESCALATION		5.5%	$ 147	10.5%	$ 704	15.5%	$ 415	VAR	$ 1,266
TOTAL NATURAL MAT. ANALYTICAL RES. LAB.			$ 2,827		$ 7,404		$ 3,095		$ 13,326

FUELS & MATERIALS RESEARCH LAB.	**RATE**	#	$COST	#	$COST	#	$COST	#	$COST
MALVERN PART. SIZE	$50	30	$ 1,500	70	$ 3,500	-	$ -	100	$ 5,000
SUBTOTAL			$ 1,500		$ 3,500		$ -		$ 5,000
ESCALATION		5.5%	$ 83	10.5%	$ 368	15.5%	$ -	VAR	$ 451
TOTAL FUELS & MATERIALS RESEARCH LAB.			$ 1,583		$ 3,868		$ -		$ 5,451

ANALYTICAL RESEARCH LAB.	**RATE**	#	$COST	#	$COST	#	$COST	#	$COST
CVGAA	$27	100	$ 2,700	175	$ 4,725	25	$ 675	300	$ 8,100
GFAA	$30	200	$ 6,000	650	$ 19,500	50	$ 1,500	900	$ 27,000
ICP	$21	100	$ 2,100	325	$ 6,825	25	$ 525	450	$ 9,450
MIXED ACID DIGESTION	$27	50	$ 1,350	165	$ 4,455	10	$ 270	225	$ 6,075
SUBTOTAL			$ 12,150		$ 35,505		$ 2,970		$ 50,625
ESCALATION		5.5%	$ 668	10.5%	$ 3,728	15.5%	$ 460	VAR	$ 4,856
TOTAL ANALYTICAL RESEARCH LAB.			$ 12,818		$ 39,233		$ 3,430		$ 55,481

GRAPHICS SUPPORT	**RATE**	#	$COST	#	$COST	#	$COST	#	$COST
GRAPHICS (HOURLY)	$37	100	$ 3,700	100	$ 3,700	100	$ 3,700	300	$ 11,100
SUBTOTAL			$ 3,700		$ 3,700		$ 3,700		$ 11,100
ESCALATION		5.5%	$ 204	10.5%	$ 389	15.5%	$ 574	VAR	$ 1,167
TOTAL GRAPHICS SUPPORT			$ 3,904		$ 4,089		$ 4,274		$ 12,267

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

Background

The EERC is an independently organized multidisciplinary research center within the University of North Dakota (UND). The EERC receives no appropriated funding from the state of North Dakota and is funded through federal and nonfederal grants, contracts, or other agreements. Although the EERC is not affiliated with any one academic department, university academic faculty may participate in a project, depending on the scope of work and expertise required to perform the project.

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, subcontracts) is for planning purposes only. The principal investigator may, as dictated by the needs of the work, reallocate the budget among approved items or use the funds for other items directly related to the project, subject only to staying within the total dollars authorized for the overall program. The budget prepared for this proposal is based on a specific start date; this start date is indicated at the top of the EERC budget or identified in the body of the proposal. Please be aware that any delay in the start of this project may result in an increase in the budget. Financial reporting will be at the total project level.

Salaries and Fringe Benefits

As an interdisciplinary, multiprogram, and multiproject research center, the EERC employs an administrative staff to provide required services for various direct and indirect support functions. Direct project salary estimates are based on the scope of work and prior experience on projects of similar scope. Technical and administrative salary charges are based on direct hourly effort on the project. The labor rate used for specifically identified personnel is the current hourly rate for that individual. The labor category rate is the current average rate of a personnel group with a similar job description. For faculty, if the effort occurs during the academic year and crosses departmental lines, the salary will be in addition to the normal base salary. University policy allows faculty who perform work in addition to their academic contract to receive no more than 20% over the base salary. Costs for general support services such as grants and contracts administration, accounting, personnel, and purchasing and receiving, as well as clerical support of these functions, are included in the EERC facilities and administrative cost.

Fringe benefits are estimated on the basis of historical data. The fringe benefits actually charged consist of two components. The first component covers average vacation, holiday, and sick leave (VSL) for the EERC. This component is approved by the UND cognizant audit agency and charged as a percentage of direct labor for permanent staff employees eligible for VSL benefits. The second component covers actual expenses for items such as health, life, and unemployment insurance; social security matching; worker's compensation; and UND retirement contributions.

Travel

Travel is estimated on the basis of UND travel policies, which include estimated General Services Administration (GSA) daily meal rates. Travel includes scheduled meetings and conference participation as indicated in the scope of work.

Communications (phones and postage)

Monthly telephone services and fax telephone lines are generally included in the facilities and administrative cost. Direct project cost includes line charges at remote locations, long-distance telephone, including fax-related long-distance calls; postage for regular, air, and express mail; and other data or document transportation costs.

Office (project-specific supplies)

General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are provided through a central storeroom at no cost to individual projects. Budgeted project office supplies include items specifically related to the project; this includes duplicating and printing.

Data Processing

Data processing includes items such as site licenses and computer software.

Supplies

Supplies in this category include scientific supply items such as chemicals, gases, glassware, and/or other project items such as nuts, bolts, and piping necessary for pilot plant operations. Other items also included are supplies such as computer disks, computer paper, memory chips, toner cartridges, maps, and other organizational materials required to complete the project.

Instructional/Research

This category includes subscriptions, books, and reference materials necessary to the project.

Fees

Laboratory and analytical fees are established and approved at the beginning of each fiscal year, and charges are based on a per sample or hourly rate depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the University when necessary.

Graphics services fees are based on an established per hour rate for overall graphics production such as report figures, posters for poster sessions, standard word or table slides, simple maps, schematic slides, desktop publishing, photographs, and printing or copying.

Shop and operation fees are for expenses directly associated with the operation of the pilot plant facility. These fees cover such items as training, safety (protective eye glasses, boots, gloves), and physicals for pilot plant and shop personnel.

General

Freight expenditures generally occur for outgoing items and field sample shipments.

Membership fees (if included) are for memberships in technical areas directly related to work on this project. Technical journals and newsletters received as a result of a membership are used throughout development and execution of the project as well as by the research team directly involved in project activity.

General expenditures for project meetings, workshops, and conferences where the primary purpose is dissemination of technical information may include costs of food (some of which may exceed the institutional limit), transportation, rental of facilities, and other items incidental to such meetings or conferences.

Facilities and Administrative Cost

The facilities and administrative rate (indirect cost rate) included in this proposal is the rate that became effective July 1, 2001. Facilities and administrative cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of $5000 and subcontracts/subgrants in excess of the first $25,000 of each award.