EERC
Energy & Environmental Research Center

UNIVERSITY OF NORTH DAKOTA
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Web Site: www.undeerc.org

September 30, 2010

Ms. Karlene Fine
Executive Director
North Dakota Industrial Commission
600 East Boulevard Avenue
State Capitol, 10th Floor
Bismarck, ND 58505-0310

Dear Ms. Fine:

Subject: EERC Proposal No. 2011-0072, "Center for Air Toxic Metals® Affiliates Program – 3-year Continuation of Membership"

Enclosed please find an original and one copy of the subject proposal along with a check for $100. This proposal is a request from the Energy & Environmental Research Center (EERC) for $45,000 to extend the existing membership by 3 years for the North Dakota Industrial Commission (NDIC) under the Center for Air Toxic Metals® (CATM®) Affiliates Program. Unlike most projects, the CATM Program is intended to be an ongoing project. Organizations joining through the Affiliates Program may join year-to-year but are strongly encouraged to commit to a 3-year agreement in order to conduct research that is more far-reaching in its scope.

Research staff at the EERC are very appreciative of the ongoing support that the NDIC has provided as we seek to find solutions to energy and environmental issues facing our state and our nation. Through CATM, we continue to investigate emerging issues that are most relevant to industry. In doing so, we are able to perform cutting-edge research that provides answers to industry when needed. Recent examples of this would be the mercury-related work we performed that provided answers well in advance of regulations.

We appreciate the ongoing, long-term support that NDIC has provided to our state through its support of projects at the EERC and for past participation in the CATM Affiliates Program. We are appreciative of NDIC's ongoing support, feedback, and participation in this research to promote environmental quality and efficient use of energy resources. I look forward to your continued participation.

This transmittal letter represents a binding commitment by the EERC to complete the project described in this proposal. If you have any questions related to CATM or the Affiliates Program, please contact me by telephone at (701) 777-5268, by fax at (701) 777-5181, or by e-mail at jpavlish@undeerc.org.

Sincerely,

John H. Pavlish
Senior Research Advisor

Approved by:

Dr. Gerald H. Groenewold, Director
Energy & Environmental Research Center

JHP/kal
Enclosures

CENTER FOR AIR TOXIC METALS® (CATM®) AFFILIATES MEMBERSHIP

EERC Proposal No. 2011-0072

Submitted to:

Karlene Fine

Attn: Lignite Research Program
North Dakota Industrial Commission
State Capitol – Fourteenth Floor
600 East Boulevard Avenue
Bismarck, ND 58505

Amount of Request for Membership: $45,000, 3-year Term
Alternative $18,000, 1-year Term

Submitted by:

John H. Pavlish
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John H. Pavlish, Project Manager

FOR Dr. Gerald H. Groenewold, Director
Energy & Environmental Research Center

September 2010

TABLE OF CONTENTS

Continued . . .

TABLE OF CONTENTS (continued)

LIST OF FIGURES

CENTER FOR AIR TOXIC METALS® (CATM®) AFFILIATES MEMBERSHIP

ABSTRACT

Energy and chemical production and chemical-related environmental issues—especially as they pertain to toxic trace metals—have gained worldwide attention. Since 1992, the Center for Air Toxic Metals® (CATM®) Program has focused on critical air toxic issues, especially those sectors facing regulation—the energy sector, and in industries as diverse as cement, taconite, and chemical production. CATM, with its multifaceted "cradle-to-grave" approach to trace metal research, especially for mercury, has provided both fundamental and applied research to stakeholders—policymakers, industry leaders, researchers, conservationists, and academia—on toxic metal transformations and pathways; sampling, measurement, and analysis of toxic metal emissions; effective control technologies; and health risks related to toxic concentrations of trace metals. CATM puts sound scientific information in the hands of stakeholders through technology transfer, workshops, conferences, training material and courses, and support for general public outreach and education.

Recent work has focused on controlling trace metals in advanced energy systems and evaluating the ways that technologies, such as those for CO_2 capture, will affect trace metals.

Members of the CATM Affiliates Program, some of which are from North Dakota, are encourage to provide their perspective on air toxic metal issues, provide input into emerging issues, and assist in establishing priorities for future CATM research projects. To enable CATM to address long-term issues, members are encouraged to join for a 3-year term at a fixed-cost price of $45,000, consisting of three annual payments of $15,000. Optionally, a 1-year commitment is available for $18,000. Thus, for a very modest membership fee, industry can leverage federal funds and other matching dollars significantly.

CENTER FOR AIR TOXIC METALS® (CATM®) AFFILIATES MEMBERSHIP

PROJECT SUMMARY

Worldwide, concern is growing over emissions of trace metals considered to be air toxics. More stringent trace metal emission regulations have been promulgated for many industries and are expected to be further implemented in Europe, the United States, and elsewhere.

The research conducted by the Energy & Environmental Research Center (EERC) has been considered, used, and cited by policymakers, industry leaders, researchers, conservationists, and academia to better understand the science of trace metals and to develop means to protect the environment and public health. The EERC's research has contributed to the body of science supporting federal and state rules and guidelines, new methods for measurement and analysis of trace metals, numerous control technologies related to mercury and other trace metals, and emerging health research to better understand the toxicity of mercury. Throughout the years, the EERC has been a source of sound scientific information for the general scientific community, industry leaders, and public to answer questions and provide results germane to trace metals.

To help address issues pertaining to energy production and environmental responsibility, both domestically and internationally, the Center for Air Toxic Metals® (CATM®) Program at the EERC was established in 1992. Since then, the CATM Program has answered many critical questions related to environmental risks of toxic levels of trace metals, toxic metal transformations and pathways, sampling and measurement of toxic metal emissions, and related toxic metal control technologies. CATM has shared these results to an international audience.

Without question, the demand for a strong research program targeting critical and timely air toxic issues is greater now than ever before. Significant numbers of regulations have been proposed and/or promulgated over the course of the last year with significant impacts to the

future of energy and industrial concerns. In the energy sector and in industries as diverse as cement, taconite, and chemical production, many regulations are pending that will require changes to "business as usual." Comments received in response to these rules clearly show that many key questions remain concerning mercury, trace metals, and other elements—CATM is well poised to address these questions and build on its multifaceted expertise in trace metal research, especially for mercury, to provide both fundamental and applied research to stakeholders.

CATM work has furthered the understanding of air toxic issues and resolved many key questions put forth by affiliate sponsors. During the past 3-year period of the North Dakota Industrial Commission's (NDIC's) membership, CATM research has focused on mercury and related trace metals, particularly in advanced energy production systems, and has addressed mercury control concurrent with control of other emissions, including CO_2. The program has also focused, to a lesser degree, on industrial/commercial processes. The program will continue to address those trace metal issues identified as most critical to participating members.

Participating members in the CATM Affiliates Program typically include those from industry and commercial entities that have a research need or a vested interest in resolving air toxic issues. The CATM Affiliates Program is designed to scientifically address these issues and meet the many challenges facing industry and government and facilitate discussions with regulatory agencies to develop and implement reasonable and effective standards. Membership through CATM Affiliates Program provides immediate access to a comprehensive air toxics research program. Partnerships through CATM Affiliates Program with proactive organizations provide the necessary direction to ensure that CATM research meets both short- and long-term goals and needs. Affiliates members help to shape the future program by guiding CATM's

research goals and research priorities. Their continued input into the dialogue concerning toxic metals is valued and helps to shape the future of research conducted at the EERC and, specifically, through CATM.

To enable CATM to address long-term issues, CATM encourages a 3-year commitment for $45,000, which has not increased since the program was initiated. An optional membership is available on an annual basis for $18,000 a year. Membership provides numerous benefits including the following:

- Direct access to EERC experts who can provide technical advice on solving problems associated with air toxic metals.
- A forum for members to voice concerns and keep current on the latest government and international studies and strategies, as well as emerging issues that may not yet be regulated.
- Rapid access to state-of-the-art research on air toxic metal sampling, analysis, control, and predictive techniques.
- Research and development at a fraction of the cost available to a single organization.
- Interaction with other affiliates, regulatory agencies, and research institutions interested in air toxic metals.
- Discounted rates on CATM-sponsored workshops, educational courses, and conferences, as well as on computer software developed through CATM.
- Up-to-date information, publications, and reports.
- Representation and a voice regarding air toxic metal issues, assisting in defining the direction and scope of future research activities.

- Access to the Joint Program on Research and Development for Fossil Energy-Related Resources funding to leverage Affiliate sponsorship for appropriate projects, integrating funds from other sources such as industry groups, the Electric Power Research Institute (EPRI), multiclient consortia, and individual sponsors.

PROJECT DESCRIPTION

The CATM Affiliates Program

The CATM Affiliates Program typically funds smaller, more focused, discrete research activities that more closely target the needs of industry. Additional research is possible by leveraging public and private funding sources that require matching funds. The EERC has several established federal programs that require matching funding; this is also the case for many solicitations funded by state and private industry.

To accomplish the mission and goal of CATM, the EERC fosters partnerships through relationships with industry, academia, and government to perform multidisciplinary, multiclient research. CATM serves as the focal point or hub of these partnerships, which are key to an effective, well coordinated research and development program. As can be seen in Figure 1, the CATM Program and the CATM Affiliates Program are complementary but separate programs. Industry cost-share projects that are shown in Figure 1 are an example of the hundreds of projects that have been conducted in connection with the CATM Program.

As shown in Figure 1, to facilitate coordination and input from Affiliate members, the CATM Affiliates Program has created a Research Advisory Council which comprises the Partners Advisory Committee and the Science Advisory Committee. These two committees made up of Affiliate members serve to provide direction and priorities for research and technical

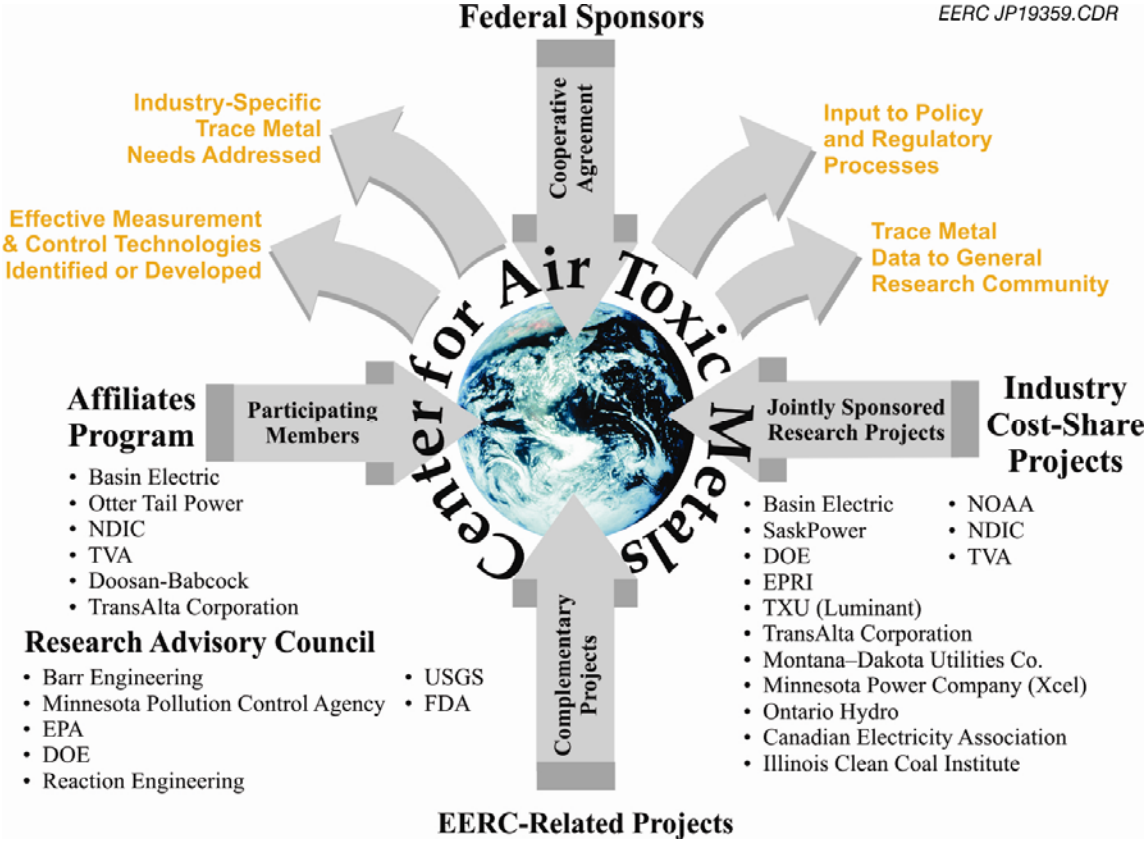

Figure 1. CATM's multiclient program is at the focal point of trace metals research.

expertise. The Partners Advisory Committee comprises members of the Affiliates Program who provide perspective, guidance, and research priority. The Science Advisory Committee comprises trace metal experts who provide a scientific and technical perspective to the CATM Program.

An important outcome of this partnership is that CATM provides a forum for scientific dialogue and debate about the needs, progress, and implications of scientific research related to trace metals. The CATM Program strives to facilitate these interactions as all Research Advisory Counsel members learn from each other, and CATM provides an opportunity for all parties to ask questions and obtain answers from different stakeholders.

CATM Research Objectives

CATM uses a cradle-to-grave approach to solve scientific and environmental issues related to the production of energy and industrial processes in an environmentally responsible manner and to assist impacted organizations to meet pending regulations and control challenges. This approach involves developing a detailed knowledge of fuel or feedstock composition and characteristics, transformation of components during conversion, effective control technologies, methods to utilize and dispose of residuals, and related health impacts of toxic metal concentrations. CATM's focus is to partner with stakeholder organizations to provide synergy to address ongoing trace metal issues, as explained below:

- Further the current understanding of the behavior of potentially toxic metals in many industries impacted by trace metals and other elements of concern.
- Develop methods to prevent or reduce air toxic metal emissions.
- Predict the fate of metals and other elements of concern.
- Evaluate and develop new control technologies to enable industries to meet regulatory standards.
- Investigate the environmental and health impacts of toxic concentrations of metals and other elements.
- Share this research to inform affiliate members, the general research community, regulatory bodies, and the public and contextualize many of the "hot topics" pertaining to trace metals and other elements.
- Keep affiliate partners informed of CATM progress and results through the CATM Web site, mailings, meetings, workshops and conferences, as well as having direct access to CATM researchers pertaining to specific questions.

Anticipated Program Outcomes

The anticipated outcomes of the CATM Program include the following:

- Elucidation of air toxic transformation mechanisms and pathways in energy production, incinerating, and industrial systems.
- Development and demonstration of emission technologies for toxic metals; various mercury control technologies are presently being developed and tested at the bench, pilot, and full scale. Control technologies for other trace metals that are likely to be regulated/controlled in the future are also covered under CATM's scope of research and will gain a more prominent role in future activities.
- Development and demonstration of environmentally sound methods to utilize and dispose of residuals.
- Development and validation of methods to sample, measure, and analyze air toxics.
- Development of predictive tools and databases.
- Evaluation of the health impacts of toxic concentrations of metals.
- Development of partnerships with industry and government.
- Development of environmental awareness and pollution prevention programs through education via university courses, workshops, conferences, seminars, and 1-day courses.
- Commercialization of results and technologies.

Work Plan

To carry out the mission of CATM to provide a nationally coordinated and practically oriented multidisciplinary research program with industry, academia, and government, CATM focuses on five integrated research program areas, as outlined below.

Program Area 1 – Trace Metal Transformation Mechanisms. This vital area focuses on determining the chemical and physical transformations of trace element emissions as a function of the association and abundance of the trace elements in fuel or feedstock and of system design and operating conditions. This area will continue to focus on 1) the development of air toxic pollution prevention strategies, 2) development of predictive and explanatory models, and 3) testing and development of control methodologies and technologies. While great strides have been made to begin to understand mercury and other trace metals in conventional combustion systems, advanced combustion systems present new challenges that must be met. Preliminary mercury and trace metal control tests performed at the EERC and other organizations show that much of what has been learned of mercury's transformations and behavior does not hold true in the advanced systems, including circulating fluidized-bed combustors, gasification systems, oxycombustion systems, and systems that use novel sorbents or additives. All of these scenarios change the chemistry and equilibrium states, requiring significant study in order to develop accurate measurement techniques and effective control technologies.

Program Area 2 – Analytical Methods Development. Research in this program area includes the development of methods to determine the abundance and association of air toxic metals in a variety of fuel resources, feedstocks, and wastes; measuring and speciating the metals in the various process streams from combustion, gasification, and industrial systems; performing in situ measurements; and providing analytical support for the other program areas. The long-term goal of this program area is to develop sufficiently versatile instrumentation methods and sampling procedures to detect and measure atomic and molecular species, solid or gaseous, which are present at a variety of locations throughout bench-, pilot-, and commercial-scale conversion systems. Developing better, more accurate, flexible, and low-cost sampling and

analytical instruments that can be applied and utilized at full-scale facilities is the ultimate goal. Advanced systems continue to push the envelope for the application of measurement techniques, and these, too, will continue to pose demanding requirements on existing measurement techniques, often requiring that they be adapted or that new methods be developed.

Program Area 3 – Control Technologies. Development of effective control technologies for industry is a high priority for CATM. Research in this key program area focuses on pursuing and identifying opportunities for minimizing and controlling trace element emissions in combustion, gasification, and industrial systems, including prevention and minimization of toxic element formation (i.e., fuel-to-energy conversion efficiency improvements and recycling); development and capture by sorbents using injection techniques (including precombustion, combustion, and postcombustion methods for energy systems) in conjunction with high-efficiency fine-particle control; and development, demonstration, and implementation of new, innovative technologies. Prevention or minimization of emissions of air toxic elements includes many factors, ranging from improvements in process operation to retrofitting or installing new high-efficiency collection equipment.

Developing low-cost control alternatives, such as sorbent technologies, will continue to be a priority. Fundamental data are needed to develop new sorbents or to extend the effectiveness of existing commercially available sorbents. Efforts will focus on determining air toxic metal sorbent interactions, the characteristics of the sorbent material, the optimal location for injection into the system, the mechanisms of formation/transformation and metal speciation, the influence of system conditions (operating and physical state), and cost-effectiveness.

Program Area 4 – Environmental Effects. Environmental issues, especially as they impact health issues tend to drive legislation and the subsequent control strategies of toxic metals.

Research in this area studies the fate of mercury in the environment, particularly in wildlife and humans. Past studies have focused on the exposure risks of metals on target tissues of the nervous, endocrine, and cardiopulmonary systems at the molecular, cellular, and tissue levels in invertebrate, animal, and human subjects. CATM is currently developing and applying innovative approaches to characterize risk and evaluate preventive and protective measures. A comprehensive approach is used to define and correlate relationships that will prove useful to those developing control strategies and legislators. Current efforts focus on trace metal (especially mercury)–selenium interactions and possible ways to partially offset toxicity of trace metals. A predictive model is being developed and demonstrated to elucidate mercury toxicity and the effect of selenium.

Studies also include characterizing trace metal releases from several sources, including possible releases from by-products of coal combustion. By-products from combustion, gasification, and industrial systems are inevitable, and although the amount of by-products produced is variable depending on the system, consideration is warranted regardless of the quantity. Coal and other fuels (e.g., biomass) produce a high volume of by-product materials in varying forms containing different metal concentrations. Developing proper management options for these materials, whether they are disposed of or utilized, is essential and is a CATM goal. Other industrial applications are likely to produce by-products that may require special handling and/or treatment processes.

Program Area 5 – Technology Commercialization and Education. The dissemination of pertinent and timely research is critical. The research conducted by the EERC has been considered, used, and cited by policymakers, industry leaders, researchers, conservationists, and academia as they seek to understand the science and develop means to protect the safety of the

general public. Research through CATM has contributed to the body of science supporting federal and state rules and guidelines, new methods for measurement and analysis of trace metals, numerous control technologies related to mercury and other trace metals, and emerging health research to better understand the toxicity of mercury. Throughout the years, the EERC has been a source for the general scientific community and public to answer questions and provide results germane to trace metals.

Current Research Priorities as Established by CATM Partners

Research activities within the five defined research areas will always evolve to address the most current challenges facing stakeholders. As such, the CATM research activities that are defined are adjusted to ensure that research funding addresses those needs that are most pressing. At this time, the most critical needs that have been communicated to CATM's researchers and that provide focus to research activities are the following:

- Additional source test data from a number of source categories.
- Additional data on the fundamental mechanisms responsible for conversion of mercury to other chemical species within combustion and gasification flue gas, as well as a better understanding of the impacts of other flue gas components on this conversion.
- Continued development of models that explain and allow prediction of key interactions between toxic metals and other compounds or elements.
- Development and validation of improved instrumentation for emission measurement and monitoring protocols and methods.
- Evaluation of sorption mechanisms that will lead to better sorbent design and provide a better understanding of why natural adsorption of mercury to some fly ashes occurs and under what conditions.

- Development, demonstration, and commercialization of more cost-effective control technologies, as well as continued evaluation of both positive and negative impacts of implementing these control strategies.
- Determination of the potential for mercury reemission from disposal of energy conversion waste by-products, with the goal of maximizing the use of these by-products in a safe manner rather than landfilling.
- Determination of the potential for mercury to impact combustion by-product utilization, as well as continued evaluation of leaching and microbial action on by-products.
- Improved modeling capabilities for predicting mercury speciation, conversion, adsorption with fly ashes and sorbents, control effectiveness, and the different forms potentially emitted. Local and regional atmospheric fate and transport models are needed, as well as evaluation of the impacts of implementing various control strategies.
- Better access for the general public to information concerning HAP emissions from power plants.
- Health information related to the impact of mercury–selenium interactions and possible ways to minimize mercury's toxic effect on scavenging selenium from essential cellular activity—an area that is still in the early stages of understanding.
- Dissemination of air toxic-related research to stakeholders through newsletters, a Web page, workshops, training sessions, conferences, forums, and other venues.

To address the needs that have been identified by stakeholders as the most critical, current research activities are focused on:

- Obtaining data related to mercury and trace metals transformations, behavior, and control in advanced power systems, especially for oxycombustion, CO_2 control systems,

and technologies likely to be used to meet future MACT (maximum achievable control technology) regulations. Under this research activity, mercury measurement techniques are being evaluated to determine if existing methods for conventional coal-fired combustion can be applied in these systems and to develop/refine them if they cannot be used.

- Bench- and pilot-scale testing are being performed to gain a better understanding of the transformations, chemistry, and control of mercury and trace metals in flue gas desulfurization systems with a focus on reemission.
- Research activities are under way to develop and test technologies, including sorbents and additives, for mercury and trace metal control in advanced combustion systems and industrial processes with CO_2 control technologies.
- Research activities are under way to improve measurement methods, in particular the use of liquid chromatography–inductively coupled plasma–mass spectroscopy (LC–ICP–MS) and atmospheric pressure chemical ionization mass spectroscopy (APCI–MS). Capillary electrophoresis (CE) is also being explored to evaluate ways to separate molecules and identify how they are bound to other trace elements using fluorescence detection methods.
- Research activities continue to study the fate of mercury and trace metals in natural environments. Currently, studies are being performed to add new data regarding mercury and selenium compounds in freshwater fish, with the goal of furthering model development of mercury–selenium interactions and health impacts of these interactions.
- Other ongoing activities focus on the transfer of critical information to interested stakeholders, including commercialization, dissemination through both domestic and

international conferences, newsletters, training sessions and workshops, the CATM Web site, and publication of peer-reviewed journals and conference papers.

STANDARDS OF SUCCESS

The EERC established and formalized a quality management system (QMS) in August 1988. As a center within the EERC, CATM adheres to this system. As part of the QMS, an EERC quality manual was developed and put into place as policy to guide research projects. Additionally, the CATM Program at the EERC has a quality assurance (QA) plan in effect that addresses trace metal emissions research at the EERC; CATM's QA and quality control (QC) plans have been reviewed and approved by the U.S. Environmental Protection Agency (EPA). In addition, EPA requires CATM to prepare QA project plans for review and acceptance prior to beginning active research. Compliance with the guidelines established by these guiding documents and procedures ensures that the EERC adequately fulfills governmental and private client requirements relating to quality and compliance with applicable regulations, codes, and protocols, resulting in research and data of the highest quality.

As stated earlier, CATM Affiliates Program is intended and structured to be an ongoing research program with the ability to address critical research issues as they arise. The success of the CATM Program can be gauged by its success over the last 17 years. The success of the program over the next 3 years can be measured by continuing to provide the following expected deliverables:

- Identification of air toxic metal pollution prevention options
- Determination of air toxic transformation mechanisms in fossil fuel, waste incineration, gasification, and industrial systems
- Development of technologies to monitor and control metals behavior and emissions

- Development of environmentally sound methods to utilize and dispose of residuals
- Development of methods to sample and analyze air toxics
- Development and evaluation of methods to assess health impacts of toxic metals
- Development of predictive tools and databases
- Development of training and educational courses
- Commercialization of results and technologies

BACKGROUND

With a staff of over 345, the EERC has been conducting timely, relevant research for nearly 60 years; these researchers cover nearly every discipline related to environmental and energy issues and are involved in CATM® research. CATM is one of 11 Centers of Excellence within the EERC and is focused on addressing ongoing issues related to air toxics. Funding for the CATM Program has come from both public and private entities, with significant funding provided by both EPA and the U.S. Department of Energy (DOE), which is not guaranteed, but is expected to be continued in the future

CATM and its Affiliates Program continue to address the most timely issues pertaining to energy-producing systems and industrial entities, helping them to operate in the most clean and efficient manner.

Over several years of trace metal research, the CATM Program has provided significant inputs to stakeholders, facilitating data and practical information sharing among diverse groups with very different perspectives. This will continue over the life of this agreement.

QUALIFICATIONS

As shown in Figure 2, the CATM Program, together with its Affiliates Program, brings together experts from several scientific areas of expertise. Within the CATM, the Program Area

Managers (PAMs) each have special expertise in their respective areas. Their resumes are shown in Appendix B. In addition, PAMs and CATM's Director have at their availability EERC researchers from an extremely wide scope of research to address the myriad issues that arise while carrying out the CATM research.

In addition, the program itself is structured to bring together experts from diverse backgrounds. The CATM Director's priorities are guided by two direct means—CATM Affiliates and the Performance/Project Monitor(s) for the federal funding agencies. Affiliate members staff the Partners Advisory Committee and the Science Advisory Committee, bringing together experts from government, industry, and academia to provide a forum to address pollution prevention, control technologies, and related environmental issues. These experts,

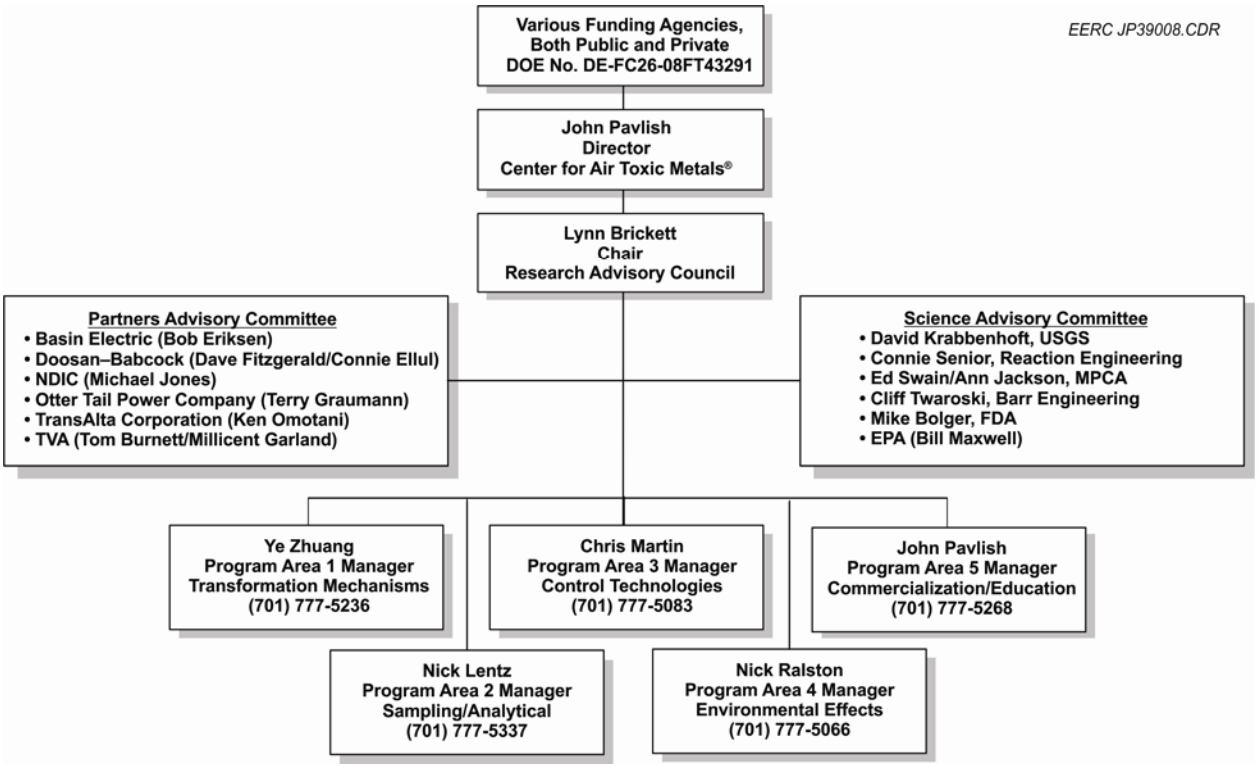

Figure 2. The structure of the CATM and CATM Affiliates Program, showing the interactive nature of the CATM funding, Affiliate partners, Science Advisory Committee, and CATM PAMs.

together with CATM and EERC researchers, provide synergy to structure research to provide valid and reliable results, being intimately aware of the needs of industry and dealing with the impacts of regulations and protecting the environment; thus their input into the direction of both the CATM and CATM Affiliates Program is invaluable. The Project or Performance Monitor for federal agencies that fund CATM research has a slightly different perspective and is also key in establishing priorities and overseeing research progress. Federal funding organizations have a seat on the Partners Advisory Committee and are voting members along with Affiliate members.

The Science Advisory Committee comprises trace metal experts from various sectors. Members of this committee provide feedback from regulatory and scientific perspectives, to share information regarding issues and research conducted by other organizations, and to provide a group of peers to provide formative critiques of the research approach and outcomes of the CATM Program. The role of the Science Advisory Committee, which consists of knowledgeable members from industry, government, and academia, is to ensure that the research activities proposed and conducted through CATM are scientifically valid, have a strong experimental plan, utilize appropriate analytical techniques, and meet overall QC guidelines. Science Advisory Committee members discuss priorities, but do not have a vote in the research that is conducted.

An important outcome of this partnership is that CATM provides a forum for scientific dialogue and debate about the needs, progress, and implications of scientific research related to trace metals. The CATM program is richer because of their interactions, all Research Advisory Council members learn from each other, and CATM provides an opportunity for all parties to ask questions and obtain answers from the different stakeholders.

VALUE TO NORTH DAKOTA

In our country and in our state, the issues pertaining to energy and industrial production systems and environmental responsibility issues are increasingly under scrutiny and have ever greater impacts on our economy, the way business is conducted, and our way of life. Increasingly stringent rules are being developed for fossil fuels, especially for coal-fired generation.

As the nation's sixth largest producer of energy, North Dakota is a key player in this arena. CATM has partnered with NDIC and other North Dakota entities to provide synergy with agencies and organizations to address these pressing issues. As an example, the EERC has worked closely with North Dakota entities to further develop and field-test several mercury control technologies that will allow North Dakota and Canadian stakeholders to meet environmental regulations. CATM continues to work to evaluate the impact of using various mercury control technologies; part of this applied research is to determine the impact of these technologies on other flue gas constitutents, especially other trace metal transformations and capture. Researchers from the EERC and the CATM Program will continue to lead in the research and development of these effective technologies, which will help enable North Dakota power plants to meet future challenges in an environmentally responsible and economical manner. CATM's research will also assist them as they evaluate and implement new technologies, such as those for carbon capture.

CATM's Affiliates Program is designed to meet the many challenges, especially those that are just emerging, facing industry and government and aids industry in interfacing with regulatory agencies and government in a constructive manner. Membership immediately and continuously provides the participant with access to a comprehensive scientific air toxics research program, including the most current research information and research professionals

who act as conduits to other research organizations, commercial entities, and stakeholders. Proactive organizations seeking to minimize risk and provide input into long- and short-term planning will benefit greatly from this program.

MANAGEMENT

The CATM Program has been funded by EPA, DOE, and many public and private entities in the past and is expected to continue to have a varied base of support.

The CATM Program and the CATM Affiliates Program are complementary, but separate, programs. To accomplish the mission and goal of CATM, the EERC fosters partnerships through relationships with industry, academia, and government to perform multidisciplinary, multiclient research. CATM is at the focal point or hub of these partnerships, which are key to effective research and development programs, as depicted in Figure 2.

The CATM Affiliates Program typically funds smaller, more focused, discrete projects that more closely meet the needs of industry; Affiliates funding allows leveraging of partner membership funds against other public and private funding sources that require matching funds. The EERC has several established federal programs that require matching funding; this is also the case for many solicitations funded by state and private industry. Affiliates memberships also provide funding for small projects to meet emerging needs throughout the year.

Overall project management and coordination of efforts for the larger CATM Program and the CATM Affiliates Program will be the responsibility of the CATM Director, Mr. John Pavlish. Mr. Pavlish has over 26 years of advanced engineering experience in the coal-fired power and industrial sectors, 16 years of which are directly related to trace metal research, especially for mercury, and has authored numerous peer-reviewed publications. He is assisted in day-to-day management functions by Ms. Lucinda Hamre, a research specialist.

To carry out the mission of CATM and the Affiliates Program, Mr. Pavlish directs and coordinates research activities with CATM Program Area Managers, each of whom is well qualified to address their specific areas of expertise. These managers operate in a synergistic manner to support each other and to draw in expertise from within the EERC, as well as outside expertise, when needed. These managers are:

- Research Area 1, Transformation Mechanisms – Dr. Ye Zhuang
- Research Area 2, Sampling and Analytical Methods – Dr. Nicholas Lentz
- Research Area 3, Control Technologies – Dr. Christopher Martin
- Research Area 4, Environmental Effects – Dr. Nicholas Ralston
- Research Area 5, Technology Commercialization, Education, and Publication – Mr. John Pavlish.

TIMETABLE

CATM has an ongoing mission that addresses both short- and long-term research needs germane to the energy and environmental needs of industry, government, and other entities. Membership fees cover projects within the five stated areas for funding periods of at least 1 year, but often extending to multiple years. CATM encourages its members to provide longer-term commitments to facilitate projects whose long-term scope requires more than 1 year to adequately research; a 3-membership is encouraged for new and renewing members.

BUDGET

CATM Affiliates Membership Cost

A detailed budget is not provided because of the ongoing nature of CATM and the nature of partnership affiliation. As stated, the EERC requests that NDIC renew its membership and fund a

3-year commitment for $45,000 on a fixed-cost basis. A 1-year membership is also available for $18,000.

Expenditures may be included as described in the budget notes, which follow.

EERC Budget Notes

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, and other agreements. Although the EERC is not affiliated with any one academic department, university faculty may participate in a project, depending on the scope of work and expertise required to perform the project.

Intellectual Property. If federal funding is proposed as part of this project, the applicable federal intellectual property (IP) regulations may govern any resulting research agreement. In addition, in the event that IP with the potential to generate revenue to which the EERC is entitled is developed under this agreement, such IP, including rights, title, interest, and obligations, may be transferred to the EERC Foundation, a separate legal entity.

Budget Information. The proposed work will be done on a fixed-price basis. The project manager may, as dictated by the needs of the work, incur costs in accordance with Office of Management and Budget (OMB) Circular A-21 found at www.whitehouse.gov/omb/circulars. If the scope of work (by task, if applicable) encompasses research activities which may be funded by one or more sponsors, then allowable project costs may be allocated at the scope of work or task level, as appropriate, to any or all of the funding sources.

Escalation of labor and EERC recharge center rates is incorporated into the budget when a project's duration extends beyond the current fiscal year. Escalation is calculated by prorating an average annual increase over the anticipated life of the project.

Salaries. The EERC employs administrative staff to provide required services for various direct and indirect support functions. Salary estimates are based on the scope of work and prior experience on projects of similar scope. 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. Salary costs incurred are based on direct hourly effort on the project. Faculty who work on this project will be paid an amount over their normal base salary, creating an overload which is subject to limitation in accordance with university policy. Costs for general support services such as contracts and intellectual property, accounting, human resources, purchasing, shipping/receiving, and clerical support of these functions are included in the EERC facilities and administrative cost rate.

Fringe Benefits. Fringe benefits consist of two components which are budgeted as a percentage of direct labor. The first component is a fixed percentage approved annually by the UND cognizant audit agency, the Department of Health and Human Services. This portion of the rate covers vacation, holiday, and sick leave (VSL) and is applied to direct labor for permanent staff eligible for VSL benefits. Only the actual approved rate will be charged to the project. The second component is estimated on the basis of historical data and is charged as actual expenses for items such as health, life, and unemployment insurance; social security; worker's compensation; and UND retirement contributions.

Travel. Travel is estimated on the basis of UND travel policies which can be found at www.und.edu/dept/accounts/policiesandprocedures.html. Estimates include General Services

Administration (GSA) daily meal rates. Travel may include site visits, field work, meetings, and conference participation.

Supplies – Professional, Information Technology, and Miscellaneous. Supply and material estimates are based on prior experience and may include chemicals, gases, glassware, nuts, bolts, and piping. Computer supplies may include data storage, paper, memory, software, and toner cartridges. Maps, sample containers, minor equipment (value less than $5000), signage, and safety supplies may be necessary as well as other organizational materials such as subscriptions, books, and reference materials. General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are included in the facilities and administrative cost (F&A).

Other Direct Costs. Communications and Postage. Telephone, cell phone, and fax line charges are generally included in the facilities and administrative cost. Direct project costs may include line charges at remote locations, long-distance telephone, postage, and other data or document transportation costs.

Printing and Duplicating. Photocopy estimates are based on prior experience with similar projects. Page rates for various photocopiers are established annually by the university's duplicating center.

Food. Food 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.

Professional Development. Fees 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 by the research team.

Operating Fees and Services – EERC Recharge Centers, Outside Labs, Freight. EERC recharge center rates for laboratory, analytical, graphics, and shop/operation fees are established and approved at the beginning of the university's fiscal year.

Laboratory and analytical fees are charged on a per sample, hourly, or daily rate, depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the university when necessary.

Graphics fees are based on an established per hour rate for production of such items as report figures, posters, and/or PowerPoint images for presentations, maps, schematics, Web site design, professional brochures, and photographs.

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

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

Facilities and Administrative Cost. F&A cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual capital expenditures, such as equipment or software costing $5000 or more with a useful life of greater than 1 year, as well as subawards in excess of the first $25,000 for each award. The F&A rate for commercial sponsors is 60%. This rate is based on costs that are not included in the federally approved rate, such as administrative costs that exceed the 26% federal cap and depreciation/use allowance on buildings and equipment purchased with federal dollars.

MATCHING FUNDS

The CATM Affiliates Program is distinct from the federal funding that was previously provided by EPA and is currently provided by DOE; thus Affiliates funding is not reported to the federal

government as formal cost share for the CATM Program. All Affiliates funding is thus eligible as formal cost share for other federal funding. Federal funding for the base CATM Program has exceeded $19 million over the past 17 years and is expected to be funded at approximately $1–$2 million a year.

Present Affiliates include Basin Electric Power Cooperative, Doosan–Babcock, NDIC, Otter Tail Power Company, Tennessee Valley Authority, and TransAlta Corporation, all of which are up for a 3-year renewal. Also, METSO Power is expected to become a new member in the next calendar year.

TAX LIABILITY

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

None.

APPENDIX A

CATM FINAL TECHNICAL REPORT – 2003–2009

Not available electronically, if you would like additional copies please contact Lucinda Hamre by phone at (701) 777-5059 or by e-mail at lhamre@undeerc.org. Thank you.

APPENDIX B

RESUMES OF KEY PERSONNEL

JOHN H. PAVLISH
Senior Research Advisor
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
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Phone: (701) 777-5268, Fax: (701) 777-5181, E-Mail: jpavlish@undeerc.org

Principal Areas of Expertise

Mr. Pavlish is a Senior Research Advisor and the Director of the multiyear, multimillion dollar Center for Air Toxic Metals® (CATM®) Program at the Energy & Environmental Research Center of the University of North Dakota. He has over 26 years of experience with advanced combustion systems to solve operational and environmental problems. His principal areas of interest and expertise include air toxic issues; hazardous air pollutants (HAPs) with special emphasis on mercury; CO_2 capture; and coal combustion process and power plant system performance, including economic and feasibility analyses. Mr. Pavlish is a registered professional engineer.

Qualifications

B.S., Mechanical Engineering, North Dakota State University, 1984.
A.A.S., Power and Machinery, University of Minnesota – Crookston, 1979.
P.E., Kansas.

Professional Experience

2000–Present: Center for Air Toxic Metals® Director, EERC, UND. Mr. Pavlish is a Senior Research Advisor and the Director of the multiyear, multimillion dollar Center for Air Toxic Metals (CATM®) Program. His responsibilities include developing and managing an array of projects involving air toxic metals (mercury), fuel impacts on energy conversion systems, emissions control technologies for power plant applications, biomass utilization, fuel cell applications, and technical and economic evaluations of various advanced emissions control and energy conversion systems.

1994–2003: Senior Research Manager, EERC, UND. Mr. Pavlish's responsibilities included managing research programs related to emissions and control of air toxic substances. In an advisory role, Mr. Pavlish provided direction, vision, and technical review of future research programs. His responsibilities also included supervising research on the effects of fuel quality on combustion and gasification system performance; laboratory, pilot, and field testing; planning and performing specific research projects; evaluating the effects of coal quality and ash on power plant performance, generation recovery, steam generator performance and reliability, formation of hazardous air pollutants, assessment of various control technologies, and flue gas-processing equipment; creating, developing, maintaining, testing, and validating innovative computer programs; identifying research opportunities and writing proposals and reports to meet client needs; and managing budgets and personnel on multiple projects.

1993–1994: Research Manager, Fuels and Materials Science, EERC, UND. Mr. Pavlish's responsibilities included supervising research on the effects of coal quality on coal combustion and gasification system performance; laboratory, pilot, and field testing; planning and performing specific research projects; evaluating the effects of coal quality and ash on power plant performance, generation recovery, steam generator performance and reliability, formation of hazardous air pollutants, assessment of various control technologies, and flue gas-processing equipment; creating, developing, maintaining, testing, and validating innovative computer programs; identifying research opportunities and writing proposals and reports to meet client needs; and managing budgets and personnel on multiple projects.

1984–1993: Unit Leader/Systems Engineer, Black & Veatch Engineers–Architects. Mr. Pavlish's responsibilities included providing engineering/technical advice; determining and managing resources; developing and monitoring budgets; developing, overseeing, and maintaining project schedules; conducting formal/informal presentations to clients and at technical conferences; writing the technical scope of work, preparing cost estimates, and providing the supervision and organization of the proposal effort; assisting in the preparation and presentation of appropriate marketing material; planning, performing, and coordinating numerous coal quality impact studies; and creating, developing, maintaining, teaching, and validating innovative computer-based programs for evaluating the impacts that coal/ash constituents have on the combustion process, power plant equipment, overall plant performance, and unit/plant/system generation costs.

1979–1981: Diesel Power Technician, Crookston Implement, Inc., Crookston, Minnesota.

Professional Memberships

U.S. Representative, Mercury Emissions from Coal International Experts Working Group on Reducing Emissions from Coal, in association with the International Energy Agency Clean Coal Centre, 2004–present
Advisory Member, BiNational Strategy Utility Mercury Reduction Committee
Advisory Member, Minnesota Pollution Control Agency Research Advisory Committee
Advisory Member, Minnesota Taconite Mercury Control Advisory Committee
Advisory Member, Advanced Emissions Control Development Program
American Society of Mechanical Engineers
Air & Waste Management Association

Patents, Publications, and Presentations

Has authored and coauthored over 200 publications and presentations and holds several patents.

LUCINDA L. HAMRE
Research Specialist
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Principal Areas of Expertise

Ms. Hamre's principal areas of interest and expertise include technical and management support for research focusing on emission control for coal-fired power systems. She has been involved in ongoing research projects for public and private entities, which have primarily focused on mercury control. For the past 6 years, Ms. Hamre has assisted with the management of the EPA-funded Center for Air Toxic Metals® (CATM®) Program, which conducts basic and applied research into the effects of potentially toxic trace metals.

Qualifications

Master's-Level Certificate, Public Administration, North Dakota State University, 2004.
B.S., Technology Assessment and Management, St. Cloud State University, 1998.
B.S., Speech Communication, St. Cloud State University, 1998.
A.A., Prenursing, Willmar Community College, 1989.

Professional Experience

2002–Present: Research Specialist, EERC, UND, Grand Forks, North Dakota. Ms. Hamre's responsibilities include project management activities, including those for the CATM Program, at the EERC and oversight of small research projects. She prepares research reports and assists with the CATM Annual Report; assists with writing peer-reviewed journal articles; develops proposals, tracks budgets and project progress; and assists with contractual and funding issues. In addition, she serves as a liaison between project managers and clients, disseminating information and otherwise keeping sponsors, subcontractors, and other EERC groups informed of project activities. She also develops presentation materials, prepares the CATM Technical Newsletter, and maintains the CATM Web site. Ms. Hamre performs sample and data collection, tracking, and submission of samples for analysis; creates, manipulates, maintains, and archives spreadsheets and databases for data reduction; assists in the development of site-specific test plans and quality assurance/quality control plans; designs graphical tools for presentation of data; and performs literature searches for project-related information; and otherwise assists CATM and researchers in accomplishing project objectives.

1998–2002: Research Information Associate, Administrative Resources, EERC, UND, Grand Forks, North Dakota. Ms. Hamre provided administrative and technical support to a Senior Research Advisor and associated team members to carry out project activities for field research projects. Ms. Hamre assisted with the preparation of proposals; writing research test plans, journal articles, and reports; and preparing presentation materials. She also assisted researchers with research sample inventory, cataloguing and inventory, data entry, spreadsheet preparation, data interpretation, and other responsibilities as needed. Project management assistance included

interaction with accountants, contract specialists, project sponsors, and other external participants as needed.

1997–1998: Executive/Administrative Clerk, Computer Department, UND Bookstore, Grand Forks, North Dakota. Ms. Hamre provided professional support for University staff and students to procure technical products. She negotiated contracts for technical products with outside vendors, processed receivables for payment, and prepared financial reports. She planned and implemented marketing campaigns, developed marketing materials, and prepared financial reports and projections.

1996–1997: Territory Representative, Devils Lake Journal, Devils Lake, North Dakota. Ms. Hamre's responsibilities included developing new business in a rural sales region for two newspapers, one weekly and one daily, and servicing accounts. She planned and carried out marketing and advertising campaigns, including advertising themes, ad design, customer proof, and layout.

1992–1994: Interim Assistant Director, Higher Education Manufacturing Process Applications Consortium, St. Cloud, Minnesota. Ms. Hamre's responsibilities included providing ongoing direction and support for a $10.6 million grant ($2.5 million federal) for manufacturing improvement by disseminating lean manufacturing engineering principles to company management through front-line employees. This joint venture project included leaders from government, higher education, and private industry. Her responsibilities included project management activities, developing and delivering training in engineering practices, advanced-level technical writing, marketing outreach, conference development, and public relations.

1984–1991: Estimator/Head of Sales Department, Print House, Willmar, Minnesota. Ms. Hamre consulted with government, nonprofits, and private industry to develop and produce marketing campaign materials and printed business materials. She was involved in contract interpretation and negotiation, consultations, and debt collection. In addition, Ms. Hamre's responsibilities included oversight of internal sales people, including training, accounting practices, and planning future staffing needs.

Publications and Presentations
Has authored or coauthored several publications.

DR. CHRISTOPHER MARTIN
Research Engineer
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
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Principal Areas of Expertise

Dr. Martin's principal areas of expertise include thermal energy conversion, utilization, and system analysis; absorption-based thermochemical cycles; adsorbent separation processes; solar energy systems; and mechanical vibrations.

Qualifications

Ph.D., Mechanical Engineering, University of Florida, Gainesville, FL, 2004.
M.S., Mechanical Engineering, University of Florida, Gainesville, FL, 2000.
B.S., Mechanical Engineering, University of North Carolina, 1998.
Engineer In Training, North Carolina State Board of Registration, June 1998.

Technical Skills/Computer Skills

Thermodynamic modeling with Aspen Plus, C++, and Matlab programming
AutoCAD
Parametric modeling and FEA experience with IDEAS
Knowledge of instrumentation requirements for various engineering measurements (e.g., force acceleration, strain, flow, etc.) and data acquisition software
Hands-on experience with a variety of manual and CNC machine tools
Trained welder with practice in all common processes

Professional Employment

2005–Present: Research Engineer, EERC, UND. Dr. Martin's responsibilities include assisting with current projects in mercury control technologies, contributing to research proposals, and developing new project areas for the EERC. Dr. Martin manages a portfolio of ongoing emission control research projects by serving as a program area manager for the EERC's Center for Air Toxic Metals® program.

2002–2005: Research Assistant, Solar Energy and Energy Conversion Laboratory, University of Florida. Dr. Martin researched the conversion of low-temperature thermal energy resources using advanced thermodynamic cycles; performed requisite tasks needed to support research work, including the design, modification, and operation of laboratory equipment; reviewed engineering literature; and prepared technical correspondence, including progress reports, presentations, and publications.

2001–2002: Teaching Assistant, Control Systems Laboratory, University of Florida. Dr. Martin taught lecture and laboratory components for an undergraduate control systems laboratory.

2000–2001: Design Engineer, Manufacturing Laboratories, Inc., Gainesville, FL. Dr. Martin aided the design, manufacture, and assembly of a precision machine tool; designed machine components; prepared production drawings; and interfaced with fabricators. He also supervised machine assembly operations.

1998–2000: Research Assistant, Machine Tool Research Center, University of Florida. Dr. Martin conducted applied research in the areas of machine tool dynamics and cutting tool testing and prepared technical progress reports for industrial sponsors.

Professional Memberships

American Society of Mechanical Engineers
International Solar Energy Society

Professional Awards

Yellott Award for research in solar energy engineering and advancing public awareness of renewable energy, given by the American Solar Energy Society to a graduate student specializing in the field of solar energy, July 2004

Pickney Award for manufacturing research and development of rotocraft components, given by the American Helicopter Society to the research partnership of the University of Florida and Bell Helicopter-Textron, May 2003

Presidential Recognition, given in recognition of outstanding achievement and contributions to the University of Florida, April 2000

Benjamin O. Hood Service Award, awarded by the University of North Carolina-Charlotte College of Engineering to one undergraduate student for outstanding service to the department, college, university, and community at large, May 1998

Publications and Presentations

Has coauthored numerous publications.

DR. YE ZHUANG
Research Manager
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Principal Areas of Expertise

Dr. Zhuang's principal areas of interest and expertise include air pollution control with an emphasis on particulate, SO_3, CO_2, and mercury emissions. Dr. Zhuang's other research interests include biomass utilization and green energy production.

Qualifications

Ph.D., Environmental Engineering and Science, University of Cincinnati, 2000.
M.S., Mechanical Engineering, Beijing Polytechnic University, 1995.
B.E., Mechanical Engineering, Beijing Polytechnic University, 1992.

Professional Experience

2010–Present: Research Manager, EERC, UND. Dr. Zhuang's responsibilities include developing and managing various research projects focused on air toxic metals, emission control technologies, biomass utilization, and technical and economic evaluation of various emission control systems.

2000–2010: Research Engineer, EERC, UND. Dr. Zhuang's responsibilities included environmental emission control, equipment design and fabrication, proposal and technical report and paper preparation, presenting research, and interacting with industry and government organizations.

1996–2000: Teaching/Research Assistant, University of Cincinnati. Dr. Zhuang's responsibilities included investigating trace heavy metal formation mechanisms in combustion, applying vapor-phase sorbent technology to emission control, characterizing and improving electrostatic precipitator performance, and performing kinetic studies on the fate of Hg in a combustion environment.

1995–1996: Research Associate, Beijing Polytechnic University, China. Dr. Zhuang's responsibilities included developing liquid jet impingement technology for microelectronic cooling, investigating enhanced heat transfer by magnetic fluid, and characterizing heat transfer and fluid mechanics in heating and ventilation systems.

1994–1995: Project Manager, National Environmental Protection Agency, China. Dr. Zhuang's responsibilities included a World Bank project to assess an innovative refrigeration technology for an ozone-depleting substance.

1993–1995: Student Assistant, Global Environmental Facility, China. Dr. Zhuang's responsibilities included assessing a control technology for greenhouse gas emission in China and stipulating energy plan incorporation of environmental consideration in China.

1992–1994: Graduate Research Assistant, Beijing Polytechnic University, China. Dr. Zhuang's responsibilities included developing a jet impingement technology for microelectronics cooling.

Professional Memberships
American Association of Aerosol Research

Publications and Presentations
Has authored or coauthored numerous publications.

DR. NICHOLAS B. LENTZ
Research Scientist
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Phone: (701) 777-5000, Fax: (701) 777-5181, E-Mail: nlentz@undeerc.org

Principal Areas of Expertise

Dr. Lentz's principal areas of expertise are the identification and development of new analytical methods for the advancement of elemental analysis in biological tissues and nonbiological samples, including coal and coal by-products; analysis for combustion flue gas, fuel oil, and biowaste; and experimental design and analysis related to control technologies to remove mercury and other elements from combustion systems.

Qualifications

Ph.D., Analytical Chemistry, Iowa State University
B.S., Chemistry, Bemidji State University, Bemidji, Minnesota.

Professional Experience

2007–Present: Research Scientist, EERC, UND. Dr. Lentz's responsibilities include identification and development of new analytical methods required for the advancement of elemental analysis in biological tissues and nonbiological samples including coal and coal by-products, as well as analysis for combustion flue gas, fuel oil, and biowaste. His work also involves experimental design and analysis related to control technologies to remove mercury and other elements from combustion systems.

2002–2007: Research Assistant, Iowa State University, Ames, Iowa. Dr. Lentz's responsibilities included performing chemical research in pursuit of graduate degree.

2005–2006: Teaching Assistant, Iowa State University. Dr. Lentz's responsibilities included teaching three physical chemistry laboratory sections, grading laboratory reports and problem sets, recording scores and helping to prepare final examinations, and maintaining three lab instruments.

2002–2003: Teaching Assistant, Iowa State University. Dr. Lentz's responsibilities included teaching general chemistry recitations and laboratory sections, proctoring exams and recording scores, grading of homework and examinations, and conducting weekly office hours at the chemistry help center.

2001–2002: Lab Assistant, Bemidji State University. Dr. Lentz's responsibilities included preparing samples and standards for general chemistry labs; performing quality control checks on undergraduate laboratories; collecting hazardous waste from laboratories and filling out necessary manifest forms; organizing and taking inventory of all chemicals used in the stockroom.

2001–2001: Undergraduate Researcher, Bemidji State University. Dr. Lentz's responsibilities included collecting water samples from Lake Bemidji and Mississippi River for ion chromatograph analysis as well as analyzing fuel samples for the Petroleum Products Research Laboratory.

Publications and Presentations
Has coauthored several professional publications.

DR. NICHOLAS V.C. RALSTON
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Principle Areas of Expertise

Dr. Ralston's areas of interest include studies of selenium physiology and molecular mechanisms mercury toxicity. His work involves analytical approaches to quantitative assessment of mercury-selenium interactions at the molecular, cellular, organism, population, and environmental levels. Program areas study the pathophysiology of toxic metal and particulate pollutant exposures as well as strategies for prevention and remediation of effects of toxicity. The roles of trace elements in human health, particularly in countering toxic agent exposures, are a further area of acute interest.

Qualifications

Ph.D., Biomedical Research Biochemistry, Mayo Medical Center, 1995.
B.S., Biology Composite, Mayville State University, 1978.

Professional Experience

2005–Present: Health Effects Research Manager, Center for Air Toxic Metals® (CATM®), EERC, UND, Grand Forks, North Dakota. Dr. Ralston is responsible for overseeing research projects of mercury exposures and the role of selenium in counteracting mercury accumulation in fish and toxicity in fish eaters.

2002: Research Scientist, EERC, UND, Grand Forks, North Dakota. Dr. Ralston was responsible for performing studies of the pathological influences of high mercury exposures on selenium physiology and developing new instrumental approaches for quantifying ligand binding affinities.

1998–2002: Research Biochemist, Grand Forks Human Nutrition Research Center (GFHNRC), U.S. Department of Agriculture (USDA), Grand Forks, North Dakota. Dr. Ralston was responsible for applying acute and chronic inflammation models to selenium studies and discovered low-molecular-weight selenomolecules are abundant in brain. This previously unknown feature of selenium metabolism has major implications in brain signaling and mercury toxicity.

1996–1998: Research Fellow, Bowman Gray Medical School, Wake Forest University, Winston-Salem, North Carolina. Dr. Ralston studied the biosynthetic pathway of sn-1-sn-1' Bis(monoacyl-glycerol) phosphate (BMP), a phospholipid with unique stereochemistry that comprises up to 50% of the lipid in active lysosome membranes and ~20% of the total phospholipid present in alveolar macrophages. BMP biochemistry may have implications in brain physiology.

1989–1995: Biomedical Research Fellow, Mayo Medical Center, Rochester, Minnesota. Dr. Ralston studied molecular mechanisms responsible for Byssinosis, a chronic pulmonary inflammatory disease caused by exposure to industrial dust particulates, and examined novel treatment options.

1979–1989: Research Technician, Chemist, Research Biologist, GFHNRC, USDA, Grand Forks, North Dakota. Dr. Ralston became head of a methods development team leading research in development of new analytical methods in health research following increasing involvement in laboratory studies of mineral nutrition in human and animal studies

Additional Responsibilities

2009–Present: Editor in Chief, *Environmental Indicators*
2005–Present: Editorial Board, *Environmental Indicators*
Coordinator and Chair, Environmental Mercury Symposium, Mercury Selenium Interactions Session at Mercury as a Global Pollutant Conference, 2nd and 3rd International Symposiums on Selenium–Mercury Interactions. Currently coordinating 4th International Symposium on Selenium–Mercury Interactions and International Environmental Indicators Meeting.
Reviewer for Scientific Journals: *Environmental Health Perspectives*, *Ecotoxicology and Environmental Safety*, *Chemosphere*, *Molecular Neurodegeneration*, *Neurotoxicology Journal*, *Lipids*, *Biological Trace Element Research*, *Science of the Total Environment*, *Cell Biology and Toxicology*

Professional Societies

Society of Environmental Toxicology and Chemistry
American Society of Limnology and Oceanography
American Association for Advancement of Science
International Society for Environmental Indicators
American Chemical Society
Society of Toxicology
Sigma Xi, President of the University of North Dakota Chapter

Publications and Presentations

Has authored or coauthored numerous publications.