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## EDUCATION, PUBLICATION, COMMUNICATION, AND COMMERCIALIZATION

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### ***Project Description***

The CATM Program continues to provide scientific and technical information on trace metals to interested parties in research organizations; federal, state, and local agencies; and the energy and environmental industry. In addition, CATM encourages and supports activities that provide training and educational opportunities for both students and professionals.

Since its inception in 1993, the CATM Program has improved and provided educational courses and materials that make students and the public more aware of environmental issues and serve as reference documents to the scientific community (1–12). With respect to education, the goals of the CATM Program are consistent with EPA goals which state that “Increased information exchange between scientists, public health officials, businesses, citizens, and all levels of government will foster greater knowledge about the environment and what can be done to protect it” (13, 14). As one of the Centers of Excellence within the EERC, CATM has been instrumental in focusing attention on these issues in various public forums, both domestically and abroad.

Additionally, CATM strives to develop and demonstrate products and technologies that aid in emission measurement, prevention, and/or control. As concepts evolve, CATM works with partners to commercialize these technologies in the marketplace. To ensure that these goals, as well as the overall goals of CATM, are met, EPA has conducted on-site peer review of the CATM Program. The outcome of these reviews have been very positive, with the most recent review complimenting CATM as “one of EPA’s best centers” (15).

### ***Goal***

Specific goals are as follows:

- Prepare, publish, and present information regarding issues related to air toxic metals and CATM research at conferences and workshops and in peer-reviewed journals and conference proceedings.
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- Provide educational opportunities for students through CATM research.
- Promote technology development and commercialization.

### ***Rationale***

Because of increasing global environmental concerns, training, education, and dissemination of up-to-date information to stakeholders in government agencies (especially EPA and the U.S. Department of Energy [DOE]), research and educational institutions, and industry in a timely manner are critical. Sharing and transferring the latest research findings to industry, environmental groups, state agencies, and EPA have been instrumental in establishing scientifically based regulatory standards. CATM will continue to provide valid and timely information to those decisionmakers who must implement policy, evaluate environmental and health impacts, and determine the most judicious course of action in light of the most recent information.

### ***Approach***

Public interest has been heightened as EPA moves closer to releasing its Clean Air Mercury Rule, and stakeholders have been eager to obtain research that explains the characterization, measurement, and control of mercury emissions. As states and regions consider regulations of their own, more stakeholders are looking for scientifically sound solutions to these challenges. In addition, other pollutants are coming under closer scrutiny. Because the audience is so diverse, several vehicles of communication are necessary to ensure that this critical information reaches those who need it most. To facilitate the transfer of information to government, research organizations, academia, industry, and the general public, CATM continues to support efforts to transfer timely scientific knowledge including the following venues: 1) coordination of the CATM annual meeting in conjunction with EPA, program affiliates, and the Research Advisory Council (RAC); 2) coordination and sponsorship of the Air Quality V Conference: Mercury, Trace Elements, SO<sub>3</sub>, and Particulate Matter (AQV) and participation and presentation at other conferences or forums that are directed to stakeholders; 3) distribution of the *CATM Newsletter*; 4) updating and maintaining the CATM Web page; 5) serving on environmental advisory committees; 6) education through various publications; and 7) overall administration of the CATM Program.

### ***Progress***

#### **Meetings**

The eleventh annual CATM RAC meeting was held at the Omni Shoreham Hotel in Washington, DC, August 30, 2004, in conjunction with the Mega Symposium. The purpose of the meeting was to provide a forum by which industry, government, and the research community could exchange information on CATM results and provide direction for future CATM research, development, and commercialization programs. Fourteen people participated, representing government (including EPA and DOE), industry, and other research organizations. Of particular interest was CATM research into the health effects of mercury, new methodologies for measurement of trace metals, and continued development of a model that explains the possible means by which activated carbon sorbs mercury. The group expressed appreciation for CATM's continued role in communicating about appropriate technologies for emission control of various air pollutants.

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CATM's standing in the international community has been enhanced by greater opportunities to present results of CATM and EERC mercury research. CATM will be represented at a meeting for Canadian stakeholders through the Canadian Council of Ministers of the Environment. At this meeting, technical information will be conveyed to a diverse group of Canadian stakeholders who are facing pending Canadian mercury regulations. Key components of this conversation will include issues related to mercury removal technologies, scientific evidence of achievable mercury removal rates based on recent and current large-scale demonstrations, and preliminary economic information related to these technologies.

### **97th Annual Air & Waste Management Conference**

John Pavlish presented at the A&WMA Annual Conference on June 23, 2004, as part of a panel to address technologies and control issues related to mercury. The presentation, titled "Mercury Measurement and Control Technologies for Coal-Fired Utilities: A Research Perspective," addressed many of the issues surrounding measurement, characterization, and control technologies for mercury. This conference was structured to allow for a great deal of interaction with the other panelists, as well as with the audience. Other panelists included representatives from DOE NETL, EPRI, American Electric Power, ADA-ES, Babcock & Wilcox, Cooper Environmental, and Reaction Engineering International.

Brandon Pavlish, an undergraduate student research assistant, also presented a poster.

### **First International Conference on Mercury Emissions from Coal**

Mercury has become more of a concern globally, with complex political and scientific interactions. To address the global nature of mercury emissions, an international conference was held in Glasgow, Scotland, in May 2004. This conference included 45 representatives from Austria, Australia, Belgium, Canada, Denmark, Finland, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, and the United States. In order to facilitate a dialogue concerning the scientific basis for mercury concerns, technical discussions related to the means of controlling mercury emissions, and the newest evidence regarding developing technologies, the CATM Director was invited to serve as a representative from the United States.

It was clear from this conference that the United States is the leader in mercury research and has much to share with the world, especially as the European Union is now developing an approach to reduce mercury emissions in its respective countries. The CATM Director, John Pavlish, gave a paper titled "Improving Sorbents by Understanding Mercury-Sorbent Interactions." An EERC Senior Research Advisor, Dennis Laudal, also attended and presented "State-of-the-Art Mercury Semicontinuous Emission Monitors for Coal-Fired Power Plants."

### **19th International Conference on Lignite, Brown, and Subbituminous Coals**

A conference specifically addressing low-rank fuels of the western United States was presented in Billings, Montana, October 12-14, 2004. Preconference workshops were also held that provided in-depth training on specific topics related to low-rank fuels. Several CATM and EERC researchers presented papers.

John Pavlish and Mike Holmes of the EERC presented a preconference short course at the Western Fuels Symposium on October 11, 2004. The workshop, titled "Mercury Control for Western Coals" presented information related to progress being made toward mercury regulations, possible regulation scenarios, mercury sampling and measurement issues related to continuous mercury monitors, mercury

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variability and data reliability, especially as it pertains to low-rank fuels from the western U.S., and the ability of various control technologies to meet likely regulatory standards. At this same conference, former CATM Director, Steve Benson, presented a workshop titled “Advancements in Predicting Ash Behavior in Western Coal-Fired Power Plants.” Stan Miller, a Senior Research Advisor at the EERC, presented a workshop on fine particulate matter control for western fuels. These workshops included research conducted through the CATM program.

### **Environmental Mercury Research Forum**

On November 16, 2004, 33 participants from research organizations, government agencies, and educational institutions gathered at the EERC in Grand Forks, North Dakota, to discuss the environmental and health-related research that their organizations have been conducting, much of which was ongoing and had not yet been published. This was an opportunity for Nick Ralston and Laura Raymond, together with their doctoral student, Carla Jordan, and undergraduate research assistant, Scott Reay, to present their CATM research into the interactions between mercury and selenium and possible environmental and health issues. Most of the researchers were from the northern United States and Canada, giving particular emphasis to issues of mercury in water. Of particular interest were perspectives on areas that required more research in the near term. Researchers underscored the vital need for the most current information available.

### **PowerGen International**

The mercury short course, “Mercury Measurement, Transformations, Speciation, and Control—Power Generation Conference Short Course,” was presented at the PowerGen International Conference on November 29, 2004. The conference was held in Orlando, Florida, and draws many stakeholders who are involved in decisionmaking and implementation of mercury control technologies. Various comments were received attesting to the quality and application of these data to the needs of stakeholders, particularly those in the electric generating sector.

### **CATM Newsletter**

A large issue of the *CATM Newsletter* was published and distributed to industry and other interested parties throughout the United States and 40 countries. In particular, many Canadian stakeholders have been requesting the newsletter and have consequently had numerous discussions with the CATM Director and others at the EERC regarding technical issues related to pending Canadian mercury regulations. The newsletter is designed to inform interested parties on air toxic issues and CATM activities and to encourage further participation and collaboration between industry and government. Upcoming issues of the newsletter will feature articles regarding activated carbon and CATM research related to mercury–selenium health issues. The newsletter, along with topical mercury reports published through the Canadian Electricity Association (CEA), can be accessed electronically via the CATM Web site at [www.undeerc.org/catm](http://www.undeerc.org/catm).

### **CATM Web Page**

The CATM Web page continues to serve as a vehicle for easy access to recent developments and results from the CATM Program. General information about CATM is also maintained and includes background; role and activities; accomplishments; key education and training activities; conferences, short courses, workshops, and academic programs; and CATM personnel.

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### **Committees**

CATM researchers and managers continue to serve on several advisory committees to provide expert advice and technical guidance on a number of issues related to air toxics. Below are a few of the committees that CATM researchers serve on:

- Binational Strategy Utility Mercury Reduction Committee
- AQV Planning Committee
- International Mercury Conference Planning Committee
- North Dakota Mercury Task Force
- Subbituminous Energy Coalition (SEC)
- Western Fuels Symposium, Technical Director
- American Chemical Society (ACS), 2004 Chair, Fuel Division
- ACS, Executive Committee, Fuel Division
- ACS, Councilor, Fuel Division
- ASME Committee on Corrosion and Deposition Resulting from Impurities in Gas Streams, Advisory Member
- Elsevier Science, *Fuel Processing Technology*, Editorial Board Member

### **Education Through Publications**

CATM disseminates information in several ways. In 2004, 18 refereed journal articles were published or in preparation. In addition, two papers were submitted to Preprint Papers—American Chemical Society, Division of Fuel Chemistry, a well-respected journal that is not refereed.

“Status Review of Mercury Control Options for Coal-Fired Power Plants,” published in a special issue of *Fuel Processing Technology* in August 2003, will be updated, enlarged in scope, and submitted for publication by a peer-reviewed journal next year. CATM staff plan to have this ready for submission near the end of 2005 or the first quarter of 2006.

2004 was a productive year for books and bound proceedings that contained CATM-related research. Ten books or bound proceedings were published.

CATM has also been involved in several related project reports. CATM staff members also gave presentations at and participated in several conferences and workshops throughout the year. In 2004, CATM researchers presented 15 papers at conferences and workshops around the world, with some noted above. In addition to attending workshops and conferences, CATM is also organizing and coordinating the AQV Conference for September 2005.

### **Educational Opportunities for Students**

Through CATM, numerous students have been involved in hands-on research into air toxic metal and related research. Not only does this provide access to research opportunities with key researchers in this area, but it provides a venue for students to be active participants while gaining valuable insights into the scientific and technical issues that face us on a local, regional, and global level. In addition to this benefit, these students enter the energy and environmental fields with real-world knowledge that increases their worth to employers.

In 2004, one postdoctoral researcher, Laura Raymond, and one doctoral student, Carla Jordan, were involved in CATM research. Yongzin Zhao, a previous master’s degree student who worked on CATM

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research, is completing his master's thesis titled "Investigation on Mercury Chlorine and Capture." In addition, four undergraduate students were involved in various aspects of CATM research projects.

### ***Status***

Educational and information-sharing activities will continue throughout the year. Involvement in community environmental activities will continue, as well as the programs in place to reach out to and help area schools in their efforts to educate students and teachers on energy and environmental issues.

The newsletters and the CATM Web site have also become valuable outlets for disseminating information, and both will continue to provide valuable, up-to-date information. The CATM Web page has been maintained throughout the year and can be accessed at [www.undeerc.org/catm](http://www.undeerc.org/catm). Copies of the *CATM Newsletter* and the CEA topical reports related to mercury are available for download to the general public via the CATM Web page.

### **Scientific and Institutional Peer Review**

The last peer review of the CATM program was held on April 23–25, 2003. The EERC was visited for the purpose of conducting a scientific and institutional review of the program. The 3-day review was conducted by an external peer review committee on behalf of EPA's Office of Research and Development. The peer review panel noted that CATM has a number of strengths and important technical achievements and provided suggestions on how to further improve and grow the CATM Program. The following statements were provided by the peer review panel:

- "Overall, the Center appears to be among the best of those funded by EPA."
- "The CATM research program has clearly distinguished itself in the areas of combustion engineering and chemistry, particularly as it pertains to mercury, and in the estimation of this Panel, they currently are viewed as world leaders in this field of study."
- "The CATM–EERC interaction is well established. The individual research personnel appear to be well qualified and communicate well with each other and with the outside technical community."
- "Although the focus is almost entirely on mercury, the overall goals of the Center are well thought out and well integrated. There also is a good balance between more basic science and engineering studies."

On a continual basis, we strive to improve and grow the CATM Program and appreciate the suggestions provided by the peer review panel. Specifically, we will incorporate, over the course of the next few years, many of the suggestions provided by the panel, which should further strengthen CATM.

### **Air Quality V**

Although a mercury rule is now law, many other trace metals and air toxins still require scientific investigation. Control technologies, especially multipollutant controls, are topics of continuing discussion. The state of technology development, the related economics, and balance-of-plant issues are areas for which many stakeholders request additional information. Significant questions persist regarding how various control technologies work and possible unintended negative impacts. While a standard

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finally addresses the amount of control needed for mercury, many utilities are attempting to adopt a cost-effective, proactive stance that will likely meet other future regulations. These issues continue to justify follow-on conferences to the very successful AQI–AQIV Conferences.

The intent of the AQV conference is to provide the opportunity for representatives from industry, environmental groups, the research community, and state and federal governments to present and discuss critical issues facing our nation and the world. Conference participants will gain up-to-date information and benefit from discussions on potential health risks, available and developing control technologies, control strategies and research needs, and current and pending regulatory policies.

### ***Quality Assurance/Quality Control***

The EERC is committed to delivering consistent, high-quality research. An organizationwide quality management system (QMS), authorized and supported by EERC managers, is in effect and governs all programs within the organization. The EERC established and formalized a QMS in August 1988. A quality manual defines the requirements and the organizational responsibilities for each major element of the QMS and references the supporting documents needed to provide a comprehensive program. Compliance with this manual and its supporting documents ensures that the EERC adequately fulfills governmental and private client requirements relating to quality and compliance with applicable regulations, codes, and protocols. Additionally, the CATM Program at the EERC has a quality assurance (QA) plan in effect that addresses trace metal research (16). The CATM QA plan has been reviewed and accepted by EPA. The project reported on herein has complied with the quality manual, the CATM QA plan, and all revisions. An independent QA auditor has reviewed all aspects of QA/quality control associated with this project and report.

### ***Potential Users/Technology Transfer***

Industry and government agencies (specifically EPA and DOE) will benefit from the results of the project, with information and data that will provide a much better understanding of air toxic issues and the control of air toxic emissions. The general public will benefit through the publication of refereed papers and documents, college courses, workshops, and numerous outreach programs initiated and supported by CATM.

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