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Written Testimony of

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Before the Senate Committee on Environment and Public Works Hearing on Mercury Legislation

May 13, 2008
Dirksen Office Building Room 406

Chairman Boxer, Senator Inhofe and Members of the Committee:

Good morning, I am Dr. Michael Durham, President and CEO of ADA Environmental Solutions (ADA-ES). ADA-ES is a company that develops and commercializes air pollution control technology for the power industry. I am here today representing the Institute of Clean Air Companies (ICAC), for which I serve as an Officer and a Director. ICAC is the national trade association of more than one-hundred companies that supply air pollution control and monitoring technologies for electric power plants and other large industrial facilities across the United States. Our industry deploys control technologies for emissions from the combustion of fossil fuels, such as flue gas desulfurization (FGD), selective catalytic reduction (SCR), fabric filters (FF), electrostatic precipitators (ESPs), and activated carbon injection (ACI) systems to control criteria pollutants (e.g. SO₂, NO_x, PM), air toxics (e.g. mercury), and greenhouse gases.

ICAC would like to thank Chairman Boxer and Senator Inhofe for the invitation to participate in this hearing on Mercury Legislation. It is my privilege to present this testimony on our current understanding of mercury control technologies for coal-fired power plants and their application to meet regulatory requirements. In this testimony, I would like to focus on the following key points:

- ICAC believes that the continued use of our natural resource coal for a significant portion of our electrical power generation is critical to both our economy and natural security. We are working with the electric power industry to develop clean coal technology to allow the industry to maintain progress demonstrated over the past decades toward burning coal with significantly lower emissions.

- Regulations provide certainty that drive investments, innovation, cost reductions, and implementation of emission control technology.
- The accelerated development of mercury control technology has been a major success story with significant improvements in technologies resulting in higher mercury capture efficiencies and lower costs.
- Because of differences in the age, location, and design of the 1100 plants in the US coal-fired generating fleet, there will be differences in the costs and difficulties of achieving high levels of mercury control at each plant.
- The commercial mercury control market is well under way with over 85 contracts awarded to date for mercury specific control technologies driven by new regulations in over a dozen states, as well as existing Federal regulations on new power plants.
- Multiple control technologies are now commercially available to meet the needs for controlling mercury from different coals and various equipment configurations.
- Mercury control technologies can also take advantage of co-benefits with other air pollution control equipment for criteria pollutants. Therefore, costs can be minimized under a multi-pollutant regulatory framework in which decisions about mercury control can be integrated with decisions to address control of sulfur dioxide, nitrogen oxides, and fine particles.
- There are still challenges remaining that provide additional opportunities for technology innovations and further cost reductions.
- Flexibility in a mercury control regulation can be used to address differences in plant by plant operations resulting in reducing overall costs of implementation, overcoming technical challenges of the most difficult applications, and minimizing potential impacts on the reliability of electrical supply, while still obtaining overall high mercury removal. The recent mercury control regulations enacted in a number of states provide good examples of providing flexibility in the form of safety valves, phase in periods, and averaging between plants.

Regulations Drive Technology Investment, Innovation, and Implementation

As you should be aware, air pollution control technologies follow and respond to regulatory drivers. The synergies of state-specific actions and federal requirements have created control technology markets with considerable certainty as to when and what technologies will be needed. These regulations drive implementation of emission control technology; stimulate innovation to overcome operating issues, ultimately resulting in improved reliability, increase emission reductions, and lower costs.

For example, over the for the past four decades, ICAC member companies, working in collaboration with power generation partners have developed technology and solutions that have achieved reductions in emissions of criteria pollutants SO₂, NO_x, and particulates from the existing fleet of coal fueled power plants that are lower today than they were in 1970 even as power produced from coal plants has increased by 173% (See

Figure 1). This has been the result of more stringent regulations on emissions, which were in turn based on numerous improvements in control technologies. As an example, in the early 1970's flue gas desulfurization equipment, commonly referred to as "scrubbers", was new and suffered from poor reliability and performance. Over time, as experience was gained and equipment modified, efficiencies rose from about 70 percent sulfur dioxide (SO₂) removal to today's 95-98 percent with similar improvements in reliability.

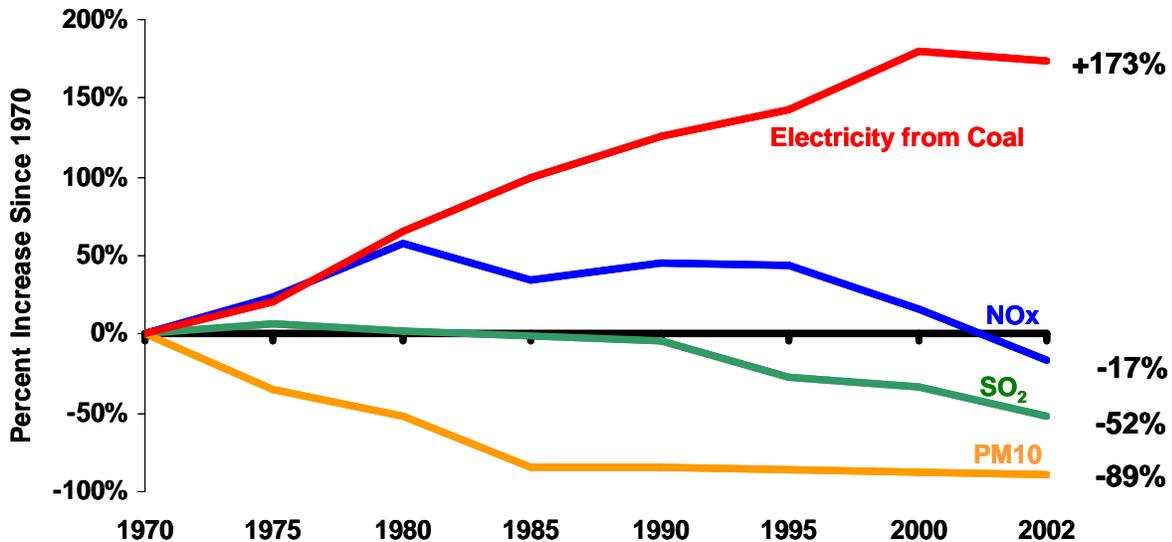


Figure 1. Changes in Coal-Fueled Electricity & Emissions since 1970.

Another example of this has been the case with the application of NO_x control technologies on coal-fired boilers and it will be the case for mercury control technologies as well. In the mid-1990s, States in the Northeast began requiring selective catalytic reduction technologies to be installed on coal-fired boilers to address regional ozone issues. Selective catalytic reduction technology is a major capital project that requires the integration of the technology with boiler components and other downstream emissions control equipment. A typical 500 MW installation requires over 1,000 tons of steel; 200 tons of catalyst; 300,000 man-hours of construction labor; and 2-3 years to engineer and construct. At the time, SCR technology had not been commercially applied on any coal-fired boilers in the U.S. although the technology had been applied on 100s of boilers in Germany and Japan. State regulatory agencies in the Northeast provided the regulatory drivers that required the installation of the technology even though it had never been tested at full scale on any boilers in the U.S. Currently, there are over 200 commercial, full-scale SCR systems installed on coal-fired boilers in the U.S. with an additional 100 installations projected to start-up over the next several years due to regional clean air regulations. Selective catalytic reduction installations on coal-fired power plants in the U.S. demonstrated that strong, flexible policies that rest on a sound technical basis drive emissions control installations.

Multiple Technologies Are Available for Reducing Mercury Emissions

There are many approaches that can be taken to achieve mercury emission reductions depending on the stringency of the regulatory requirement and the boiler's operating parameters (e.g. coal type, existing emissions control systems, boiler size). Technology demonstrations have proven that significant amounts of mercury are being removed through the use of existing control technologies. Installed technologies including fabric filters, electrostatic precipitators, flue gas desulfurization, selective catalytic reduction, and others currently achieve high levels of mercury reductions. Although these processes were not originally intended, designed, nor optimized for mercury capture, the collateral mercury control is often sufficient to meet current requirements. Because mercury is captured as a co-benefit from these control technologies, the reductions are cost effective.

Recent clean air regulations for coal-fired power plants have required the installation of a significant number of flue gas desulfurization systems on coal-fired boilers to reduce emissions of SO₂. Approximately one-third of the coal-fired power plant capacity has some form of FGD installed and an additional one-third of the units are expected to have FGD systems installed by 2015. Wet flue gas desulfurization systems or wet scrubbers are able to simultaneously capture mercury as a co-benefit of the SO₂ control process.

Additional mercury control can be achieved by modifying these emission control technologies to enhance their operation to capture mercury. Enhancing the performance of flue gas desulfurization systems provides one method of achieving mercury control with existing emissions control equipment. The mercury that is captured in the FGD is in the form of oxidized mercury, which is soluble in liquids. The extent of capture varies based on a number of parameters but can be enhanced with the addition of chemicals to the wet scrubber and/or through the oxidation of mercury as it passes through a selective catalytic reduction system situated upstream of the wet scrubber. Full-scale test results have demonstrated greater than 90 percent mercury removal from coal-fired power plants with SCR and wet scrubber emissions control combinations. Co-benefit control of mercury through a wet-FGD is likely the least cost option as a minimal amount of new capital equipment is required to achieve enhanced mercury removal.

For other mercury control options, elemental mercury can be converted to oxidized mercury so that the mercury is more easily captured in downstream air pollution control equipment. A number of these approaches are being tested and deployed today. One example of a mercury oxidizing technology that will provide additional mercury reductions is with the addition of an oxidation catalyst upstream of a wet scrubber. The catalyst oxidizes elemental mercury to oxidized mercury, which is more readily captured in liquids such as those found in wet scrubber processes. The oxidation catalyst can be installed upstream of an SCR system or as an alternative to installing an SCR system. The Department of Energy has funded a project on a 200 MW coal-fired boiler that will test this method of mercury control starting in April 2008. A second generation of oxidation catalyst is currently being developed and tested that would both oxidize and bind both elemental and oxidized mercury. This oxidation catalyst technology would be placed downstream of the particulate control device. Short term testing has been successful with longer term demonstrations scheduled for 2008. Another method of achieving mercury control reductions is by optimizing the combustion conditions in the furnace to enhance native mercury oxidation that occurs under firing conditions. The mercury oxidation technologies

mentioned above provide a few examples of mercury control approaches that can enhance mercury capture and optimize control costs.

Mercury Specific Control Technology

Concerning mercury specific control technologies, activated carbon injection (ACI) has been successfully applied in the United States and Europe on waste-to-energy plants for over a decade with the technology being transferred to coal-fired power plants in the U.S today. The technology injects activated carbon upstream of a particulate collection device and has demonstrated mercury emission reductions as high as 80-95 percent.

The technology, which is shown in Figure 2, is relatively simple in comparison to typical emission control equipment such as the SO₂ scrubber and fabric filter shown in the photograph. An ACI system consists of a storage silo for the activated carbon and pneumatic conveying system that injects the activated carbon at a controlled feed rate at the desired locations in the ductwork prior to the particulate control device. The mercury reacts with the particulate sorbent which is then removed in the particle control device along with the flyash. Tests have shown that the mercury is not leachable from the sorbent so that it can be disposed of in a landfill without concern for contamination of waterways. Because of their simplicity and small size, ACI systems can be retrofit on virtually any power plant with minimal engineering. In most cases, installations can be completed in as little as nine months after an order is placed. ACI technology has been tested at full-scale on over 50 coal-fired boilers in the U.S. under the Department of Energy's demonstration program and through the Electric Power Research Institute (EPRI) and other self-funded electric power industry initiatives. Because of the extensive number of full-scale demonstrations on a variety of power plants burning different coals with a broad range of equipment configurations, we now have more full scale operating and performance data on activated carbon injection technology for coal-fired power plants than was available in past instances for any other emissions control technology, such as selective catalytic reduction, prior to the development of regulations by state and federal clean air agencies.

In general, the science and understanding of mercury control technology has moved rapidly from research through development, demonstration and into full system deployment. The success of this rapid progression is the result of strong support from federal and public-private partnerships, and the ability of regulators, particularly in the states, to enact regulatory programs that harnessed the suite of control options in a flexible regulatory framework. For example, the strong research and demonstration program conducted through the U.S. Department of Energy overturned the previous assumption that sub-bituminous coals would be the most difficult and expensive to control. This issue was highlighted in a January 2005 report by the Energy Information Administration report to the Senate Environment and Public Works Committee entitled "Analysis of Alternative Mercury Control Strategies". In this report, EIA projected that mercury control regulations could increase electricity prices by as much as 2.5 cents per kW-hr. because of difficulties in treating mercury from Western coals. As a result, the report concluded that a 90% mercury control regulation would increase resource costs by \$358 billion.

Through these demonstration programs, the better understanding of western, sub-bituminous coals led to successes in dramatically reducing the cost of controlling mercury

emissions while increasing the control effectiveness. With the improvements in technology developed under DOE and EPRI funding, the most recent cost analyses by both EPA and DOE suggest that the costs will be less only a small fraction of the earlier EIA estimates. Today, technology vendors are addressing challenging issues surrounding sorbent injection technology as it applies to eastern, bituminous coals, particularly in the presence of sulfur trioxides (SO_3).

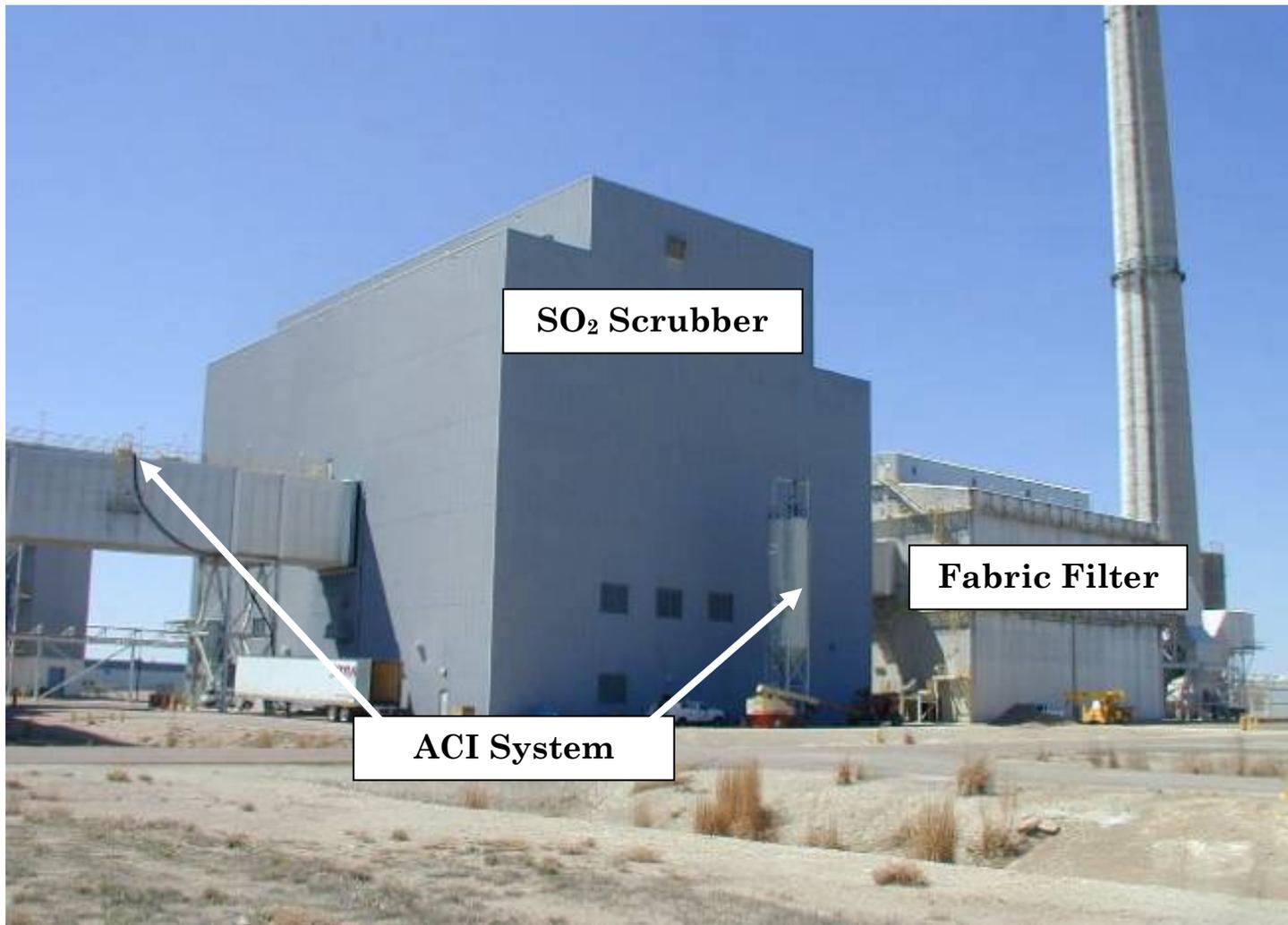


Figure 2. Activated Carbon Injection System Capable of Achieving 90% Capture of Mercury Emissions at a Power Plant.

Other innovations have also occurred in control technology to address specific issues. Given that a number of power plants sell flyash that is captured in a particulate control device such as an electrostatic precipitator (analogous to a large scale home electric air cleaner), the presence of activated carbon in flyash became a challenge. To avoid the potential loss of flyash sales to the concrete industry, the Electric Power Research Institute (EPRI) developed two control systems to meet these challenges including: TOXECON™ and TOXECON II™. TOXECON allows flyash to be collected by the electrostatic precipitator, and then injects the sorbent downstream where it is collected in a fabric filter. This preserves the flyash for sale, and controls mercury emissions. In a second system, TOXECON II™ injects the sorbent between the last two fields in an electrostatic

precipitator, allowing at least 90 percent of the flyash to be sold and only 10 percent of the flyash to be commingled with activated carbon. The activated carbon can be regenerated, recycled or disposed of with the flyash. Both systems continue to be tested to optimize their performance, and both systems preserve most of the flyash for sale for cement manufacturing.

The installation of a TOXECON™ system at the WE Energies Presque Isle Power Plant in Marquette, Michigan as part of a DOE Clean Coal Program represented the first commercial operation of a mercury specific control system to the power industry. Typical of many first installations of emission control technology, some operating problems were encountered during startup. The root cause of the problems was discovered, and new operating procedures were developed and implemented. The Presque Isle system has been operating at 90% mercury control levels for well over a year now. The new operating procedures are being implemented with all of the new TOXECON™ systems being installed.

Commercial Market

Today, control technology vendors are actively installing mercury control systems across the United States, particularly in states that have called for more aggressive implementation schedules and more stringent requirements than those mandated by the federal Clean Air Mercury Rule. State programs in Massachusetts and New Jersey have gone into effect, with systems and control strategies in place to meet these requirements. Also a few newly built power plants have begun operation and mercury control has been integrated into their design. In addition, the combination of installed selective catalytic reduction (SCR), primarily designed for NO_x control, and wet flue gas desulfurization (wet FGD), primarily designed for SO₂ control, already achieve mercury control as part of the integrated co-benefits approach. There have been reports of high performance of many systems, however, at a minimum all mercury control systems are designed to meet the regulatory requirements as well as any regulatory flexibility mechanisms. Typically, technology performance guarantees will be written around the performance requirements of regulations.

For mercury specific control technologies, primarily activated carbon injection, the air pollution control industry has reported booking new contracts for mercury control equipment on coal-fired power plant boilers across the U.S. representing a vast range of boiler configurations, sizes, and coal-types. This has been a very competitive market with more than six companies having won contracts for ACI systems. Over 85 commercial contracts have been awarded to date with an additional 70 expected to be awarded in the next two years. The cumulative generation capacity of these initial contracts is more than 40,000 MW, which is around twelve percent of the nation's coal-fired power plant capacity. These bookings are for controlling mercury on new and existing boilers ranging in size from 52 to 880 MW in capacity with the average size unit being 500 MW in size. The technology bookings are for all three of the predominant types of coal burned in U.S. electric power plant boilers including subbituminous, bituminous, and lignite coals. The diversity of coal burned by the units is broad including units burning high sulfur bituminous, low sulfur subbituminous, bituminous blended with biomass, western bituminous and subbituminous blends, bituminous blends, and lignite/subbituminous multi-fuel applications.

The mercury control technology bookings are also to be integrated with a broad range of existing emissions control technology configurations that are designed to control other emissions from the coal-fired boilers. The complete list of the mercury specific control bookings is given at the end of this document. The following is a list of each of the different control configurations that the mercury specific controls that have been booked to date will be applied to, including boilers with:

- Cold-Side ESP
- ESP
- ESP/FF
- ESP/FF (TOXECON)
- ESP/FF Parallel Flow
- ESP/WFGD
- ESP/WFGD/WESP
- FT-SNCR/CDS/FF
- HS-ESP/FF/WFGD
- Lime Injection/ESP/WFGD/WESP
- Lime Injection/ESP/WFGD/WESP
- Multi-pollutant
- SCR/FF
- SCR/FF/WFGD
- SCR/FF/WFGD
- SNCR/ACI/CDS-DFGD/FF (CFB Boiler)
- SDA/FF
- TOXECON

Mercury control is a good example of the fact that once mercury control regulations are put in place, the resulting market forces stimulate investment by the private sector.

Recognizing the market demand for activated carbon driven by the State regulations, the air pollution control industry continues to make plans and investments into new and expanded activated carbon production facilities. ICAC member companies have announced several hundred million dollars in expansion plans to production activated carbon to meet the market of approximately 400 million pounds per year of AC for the existing state regulations. In addition, permitting is under way for new Greenfield AC production facilities to produce the approximately 1 billion pounds per year activated carbon that may be required to meet a strict Federal rule. This would result in capital investments of nearly \$2 Billion.

Flexibility in the Regulation Reduces Costs and Enables Smooth Implementation

All power plants are not created equally; all are engineered for specific conditions and needs. Different coal types, boiler designs, and power plant configurations will provide a variety of technical challenges that will result in significant plant by plant variations in the costs to implement high levels of mercury reductions. This has also been the challenge for the application of emissions control technologies for other pollutants on coal-fired power plants that has spurred the development of a suite of control technology options for each pollutant.

Flexibility within regulations is good for technology suppliers and users so that risks are reduced and least cost options can be deployed. Some means of providing flexibility include developing market-based cap-and-trade programs or averaging, phased approaches that incrementally require more emissions reductions over time, and “soft landings” and “safety valves” that permit the installation of the technology and set the emissions limits based on the best performance achievable from the newly installed technology. There are many examples of this type of flexibility that have been used in the more than a dozen state regulations that have been implemented for mercury control. ICAC supports flexibility in a regulation because it reduces overall costs including significant burdens for the most challenging applications. In addition, a well designed program will ultimately result in achieving greater reductions in mercury emissions without jeopardizing the reliability of electricity supply.

In summary, the air pollution control industry continues to work responsibly with power plant operators to ensure that mercury control systems are integrated into the facility’s design and specific coal requirements, and that any operational issues can be addressed. Significant advances continue to be made in mercury control technology and commercial deployment is ongoing.

For further information of the recent advances in mercury control technologies, I have attached a bibliography of a few of the many technical papers describing full-scale demonstrations of different approaches to reducing mercury emissions from coal-fired power plants.

Sincerely,

Dr. Michael D. Durham
Officer and Director

Terminology:

- ESP – Electrostatic precipitators use electrical fields to remove pollutants such as particulates and mercury from boiler flue gases. The electric field drives particulates to the collecting electrodes where they are periodically dislodged using a mechanical process.
- Cold-Side ESP – Cold side electrostatic precipitators are ESPs located on the downstream side of the air preheater or heat exchanger (which transfers heat from the flue gas to the air to be fed into the furnace) and therefore operates at relatively low temperatures (i.e., temperatures of no more than about 200° C).
- HS-ESP – Hot side electrostatic precipitators are ESPs are located on the upstream side of the air preheater and therefore operate at relatively high temperatures (i.e., more than about 250° C).
- WESP – Wet electrostatic precipitators use electric fields to remove pollutants such as particulates and mercury from boiler flue gases. The electric field drives particulates to the collecting electrodes which are periodically washed off with a liquid.
- ACI – Activated carbon injection is a form of sorbent injection technology that injects powdered activated carbon into the flue gas where it mixes with the gas to contact the sorbent. The sorbent is then collected in the particulate control device where there is a second opportunity for sorbent to contact the mercury in the flue gas.
- FF – Fabric filter, commonly referred to as a baghouse, is a particulate control device that also captures mercury. Fabric filter collectors pass the flue gas through a tightly woven fabric where the particulates in the flue gas will be collected on the fabric by sieving and other mechanisms. The dust cake which forms on the filter is periodically removed from the fabric and collected in a hopper.
- TOXECON – TOXECON is an EPRI patented technology in which sorbents, including activated carbon is injected into a pulse-jet baghouse installed downstream of the existing particulate control device.
- WFGD – Wet flue gas desulfurization or wet scrubber is control system designed to remove SO₂ from flue gases and can also capture mercury. In a wet scrubber, a liquid sorbent is sprayed into the flue gas in an absorber vessel. The pollutant comes into direct contact with the sorbent and forms a wet slurry waste that is separated from the process stream.
- DFGD – Dry flue gas desulfurization or dry scrubber injects an alkaline sorbent into the flue gas to remove SO₂ and particulates but can also capture mercury. Dry flue gas desulfurization produces a dry solid by-product as the flue gas leaving the absorber is not saturated like in a WFGD.
- SDA – Spray dryer absorber is a form of dry flue gas desulfurization system.
- SCR – Selective catalytic reduction is a NO_x control device that can oxidize mercury. The basic principle of SCR is the reduction of NO_x to N₂ and H₂O by the reaction of NO_x and ammonia (NH₃) within a catalyst bed.
- SNCR – Selective non-catalytic reduction is a NO_x control device that utilizes a chemical process where a reducing agent, typically ammonia or urea, is injected into the process gases to convert nitrogen oxides into molecular nitrogen.
- CFB – Circulating fluidized bed is a combustion process where crushed coal is mixed with limestone and fired in a process resembling a boiling fluid.
- APC Configuration – Air pollution control configuration refers to the emissions control technologies that are currently on the boiler or that contribute to mercury control.

Mercury Control Technical Papers & Presentations

Technology Overview

Current and Emerging Mercury and Multi-Pollutant Control Technologies - Oct 2003

Mercury Control Technology: Tools for Planning and Implementing

Mercury: Myths and Realities - Mar 2003

Mercury Control Alternatives for Coal-Fired Power Plants - Dec 2002

Field Experience

TOXECON Clean Coal Demonstration for Mercury and Multi-Pollutant Control at We Energies Presque Isle Power Plant –August 2006; Steven Derenne, Paul Sartorelli, We Energies, Jean Bustard, Robin Stewart, Richard Schlager, Sharon Sjostrom, ADA-ES, Inc., Ramsay Chang, EPRI, Ron Utter, Jeffrey Cummings, Cummins & Barnard, Inc., Ted McMahon and Fred Sudhoff, U.S. DOE-NETL

Multi-Pollutant Emissions Control with SDA/FF Technology at Black Hills Power–August 2006; Bryan J. Jankura, Kevin E. Redinger, P.E. and Scott A. Renninger, The Babcock & Wilcox Company, Royd Warren, Black Hills Power

Enhanced Vapor Phase Mercury Removal Using Activated Carbon Injection Across the Indigo Agglomerator –August 2006; Robert Glesmann, ADA-ES, Inc., Mark Berry Southern Company Generation, Theron Furr, Mississippi Power Company, Rodney Truce, Bob Crynack, Ph.D., Indigo Technologies USA, Ralph Altman, EPRI, Kenneth Cushing, Southern Research Institute, Wallis Harrison, Particulate Control Technologies, Inc.

Mercury Reduction in Coal Fired Power Plants using MinPlus Sorbent through Furnace Sorbent Injection –August 2006; Joep J.P. Biermann, MinPlus, Inc.; Brian Higgins, Mobotec USA; Peter Hoeflich, Progress Energy; Bruce W. Ramme, We Energies.

Impact of Coal Blending and SO₃ Flue Gas Conditions on Mercury Removal with Activated Carbon Injection at Mississippi Power's Plant Daniel–August 2006; Tom Campbell, Sheila Glesmann, Robert Glesmann, ADA-ES, Inc., Mark Berry, Southern Company Generation, Richard Semmes, Mississippi Power Company

Testing of K-Fuel™ at Coal-Fired Units- August 2006; Ted Venners, Carrie Atiyeh, KF_x Inc.;

SCR Catalyst with High Mercury Oxidation and Low SO₂ to SO₃ Conversion- August 2006; Keiichiro Kai*, Hirofumi Kikkawa, Yasuyoshi Kato, Yoshinori Nagai, Kure

Division, Babcock-Hitachi K.K., William J. Gretta, P.E., Hitachi Power Systems America, Ltd.

Mercury Oxidation Across SCR Catalyst at LG&E's Trimble County Unit 1 - August 2006; William J. Gretta, P.E, Hitachi Power Systems America, Ltd., Isato Morita, Babcock Hitachi, John W. Moffett, EON-US Services, Inc.,

Field Test Program to Evaluate Mercury Emissions from Coal-Fired Facilities with SCR-FGD Systems - Oct 2003; J.A. Withum, S.C. Tseng, J.E. Locke, Consol Energy

Full-Scale Results of Mercury Control by Injecting Activated Carbon Upstream of ESPs and Fabric Filters - Oct 2003; Michael Durham, ADA-ES;

Full-Scale Evaluation of Mercury Control across a Wet Particulate Scrubber - May 2003; Sharon Sjostrom, ADA-ES

Modeling Mercury Control with Powdered Activated Carbon - May 2003; James Staudt, Andover Technology Partners, Wojciech Jozewicz, ARCADIS, Ravi Srivatava, EPA-ORD

Operating Experiences of Mercury Collection by PAC Injection in Bag Filters - May 2003 ; Leif Lindau, Alstom Power

PM_{2.5} and Mercury Emissions From a High Ratio Fabric Filter after a Pulverized Coal Fired Boiler - May 2003; L. Lillieblad, P. Wieslander, Alstom Pwer, J. Hokkinen, T.Lind, VTT Technical Research Center of Finland

We Energies; *Results of Activated Carbon Injection for Mercury Control Upstream of a COHPAC Fabric Filter* - May 2003; Jean Bustard, Michael Durham, Charles Lindsey, Travis Starns, Camerson Martin, Richard Schlager, Sharon Sjostrom, ADA-ES, Scott Renninger, Ted McMahon, US DOE-NETL, Larry Monroe, John Goodman, Southern Company, Rich Miller, Hamon Research Cottrell, Ramsay Chang, EPRI and Dick Johnson ,

Results of Activated Carbon Injection Upstream of Electrostatic Precipitators for Mercury Control - May 2003 Travis Starns, Jean Bustard, Michael Durham, Cam Martin, Richard Schlager, Sharon Sjostrom, Charles Lindsey and Brian Donnelly, ADA-ES, Rui Afonso, Energy and Environmental Strategies, Ramsey Chang, EPRI and Scott Renniger, US DOE-NETL

Characterization of Fly Ash from Full-Scale Demonstration of Sorbent Injection for Mercury Control on Coal-Fired Power Plants - Mar 2003; Contance Senior, Reaction Engineering Intl., Jean Bustard, Kenneth Baldrey, Travis Strarns, Michael Durham, ADA-ES

Demonstration of Additive Use for Enhanced Mercury Emissions Control in Wet FGD Systems - Sept 2002; Paul Nolan, Kevin Redinger, B&W, Gerald Amrhein, Gregory Kudlac, McDermott Technology

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On-Line LOI Analyzers for NO_x and Mercury Control - Oct 2003 ; Stephen Johnson, Quinapoxet Solutions, John Comer and Cal Lockert, Stock Equipment, Travis Starns, ADA-ES

Catalytic Oxidation

Study of Speciation of Mercury under Simulated SCR NO_x Emissions Control Conditions - Oct 2003
C.W. Lee and Ravi Srivastava, USEPA-ORD, S. Behrooz Ghorishi, ARCADIS, Thomas Hastings and Frank M Stevens, Cormetech, Inc.

Sorbents

FA100: Mineral Based Mercury Sorbents - August 2006; Pascaline Tran, PhD., Xiaolin Yang, PhD., Larry Shore, PhD., William Hizny BASF

Full-Scale Evaluation of Carbon Injection for Mercury Control at a Unit Firing High Sulfur Coal – August 2006; Sharon M. Sjoström, Cody Wilson, Jean Bustard, ADA-ES, Inc., Gary Spitznogle, Aimee Toole, American Electric Power Corporation, Andrew O’Palko-US DOE-NETL, Ramsay Chang, EPRI;

Field Evaluations of Carbon Sorbents-August 2006; Nicholas Pollack, Ward Rogers, Nicholas Pollack, David Fair, Calgon Carbon Corporation , Trevor Ley Apogee Scientific, Inc.

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Mercury Controls for PRB and PRB/Bituminous Blends-Nov. 2005; Michael Durham, Sharon Sjostrom, Travis Strans, Cody Wilson, ADA-ES, Ramsey Chang, EPRI, and Andrew O’Palko-US DOE-NETL;

Coal-Fired Power Plant Mercury Control by Injecting Sodium Tetrasulfide - Oct 2003; Anthony Licata, Babcock Power Environment Inc. , Roderick Beittel and Terence Ake, Riley Power

A Novel Technology to Immobilize Mercury from Flue Gases - May 2003; Vincent Durant, Stephen Stark, Richard Gebert, Zhengtian Xu and Richard Bucher, W.L. Gore, Robert Keeney and Behrooz Ghorishi, ARCADIS

Development and Demonstration of Mercury Control by Adsorption Processes (MerCAPTM) - May 2003 ; Sharon Sjostrom, ADA-ES, Ramsay Chang, EPRI, Mark Strohfus, Great River Energy, Dick Johnson, We Energies, Tim Hagley, Minnesota Power, Tim Ebner, Apogee Scientific, Carl Richardson, URS Corp., Vic Belba, Belba & Associates

Evaluation of Amended Silicate Sorbents for Mercury Control - May 2003; James Butz, John Lovell, Thomas Broderick, Rod Sidwell, Craig Turchi, ADA Technologies Alfred Kuhm, CH2M Hill

Amended Silicates™ for Removing Mercury from Power Plant Flue Gas - Jan 2003; James Butz, ADA Technologies, Inc., Gary Brown, CH2M Hill

Multi-Pollutant Applications

Impact of Fabric Filter Media and SDA Operations on Multi-Pollutant Emissions-August 2006; Michael McMenus, Kansas City Power & Light, Robert E. Snyder, P.E.* and Kevin E. Redinger, P.E.,The Babcock & Wilcox Company

Commercial Demonstration of ECO Multi-Pollutant Control Technology - Nov. 2005; John Boyle, Powerspan, Corp.

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Additional Information: available at www.icac.com

ICAC Mercury Control Fact Sheets:

1. MERCURY CONTROL WITH FABRIC FILTERS FROM COAL-FIRED BOILERS
2. SORBENT INJECTION TECHNOLOGY FOR CONTROL OF MERCURY EMISSIONS FROM COAL-FIRED BOILERS
3. ENHANCING MERCURY CONTROL ON COAL-FIRED BOILERS WITH SCR, OXIDATION CATALYST, AND FGD
4. PRE-COMBUSTION AND COMBUSTION TECHNOLOGY FOR CONTROL OF MERCURY EMISSIONS FROM COAL-FIRED BOILERS

ICAC Comments to EPA & U.S. Senate

Mercury Control Technologies - January 3, 2005, Utility MACT Rule NODA Comments

U.S. Senate Hearing - July 9, 2004, Democratic Policy Committee Hearing on Mercury

Mercury Control Technologies - June 2004, Utility MACT Rule Comments

Mercury Monitoring Technologies - June 2004, Utility MACT Rule Comments