INSTITUTE OF
CLEAN
AIR
COMPANIES

1660 L Street NW
Suite 1100
Washington, DC 20036-5603
Telephone 202.457.0911
Fax 202.331.1388

David C. Foerter, *Executive Director*
Email: dfoerter@icac.com

Chad S. Whiteman, *Deputy Director*
Email: cwhiteman@icac.com

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Honorable Michael Leavitt, Administrator
U.S. Environmental Protection Agency
EPA Docket Center (Air Docket)
Mail Code: 6102T, Room B-108
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Attention Docket ID No. OAR-2002-0056

Dear Administrator Leavitt:

The Institute of Clean Air Companies (ICAC) is the national trade association of companies that supply air pollution control and monitoring technology. Our members include nearly eighty leading suppliers of air pollution control and monitoring technologies for stationary sources. These companies operate and provide environmental solutions for affected industries as well as employment opportunities across the U.S.

The Institute applauds EPA's efforts to request further information on a much-needed rule that provides for the reduction of mercury emissions from coal- and oil-fired electric generating facilities in order to protect public health. The Institute has a few observations concerning the notice of data availability (NODA) for the Utility Mercury Reduction Rule specifically concerning the performance of control technologies, technology guarantees, commercial availability, control costs, by-product disposal, and availability of construction resources. The Institute continues to work with stakeholders, including the owners and operators of major generating facilities, to develop a better understanding of the control and measurement technologies that can achieve and exceed the requirements of a mercury control rule. These discussions have in part led to the strengthening of our industry's position on the need to instill flexibility in compliance requirements, to promote industrial progress without disadvantaging coal as an energy source, continuing reliable electric generation, and to encourage additional research and development of additional cost-effective control technology options.

The Institute advocates EPA's investigation and use of flexible approaches to promote innovation and early compliance with requirements. Within the MACT framework EPA has used flexible approaches that should be considered again in the utility mercury MACT program. For example, in the large municipal waste combustor MACT, EPA relied on Section 111(d) and 129 to allow State Plans backed up by Federal Plans to achieve compliance. If states did not have an approved State Plan, the Federal Plan would apply with a generic compliance schedule and "increments of progress" toward the retrofits of air pollution control by the compliance deadline. Many states have approved plans, with some inherent flexibility, and did not require the Federal backstop. There are other examples in other MACT programs where beyond the floor technologies have been used as the basis for establishing limits, but EPA has provided a backstop should the technology not perform as expected.

The rapid development of mercury control technologies over the last several years, primarily as a result in public and private investments in research and development, has produced a number of technologies that are available for the implementation of a national mercury control regulation for coal- and oil-fired power plants. A large number of laboratory tests and full-scale demonstrations have been conducted that provide information on the effectiveness of controls for various coal types and control configurations. As demonstrated in the past for a number of other pollutants, market response to a regulatory requirement will provide the single greatest push for the advancement and commercialization of control and measurement technologies. However, despite the lack of any current national control requirement for mercury, a number of options are already commercially available while others are still in the development and testing phases.

Past experience with technology development for other pollutants (SO_2, NO_x, and PM) as well as other source categories such as mobile sources, suggests that delaying the regulation of mercury emissions from power plants would serve to delay further development of innovative control technologies. Research and development efforts are unlikely to be sustained at a vigorous level in the absence of regulatory or other drivers capable of creating a viable market for advanced control technologies. Larger markets provide more incentives for the development of technologies as well as foster competition between vendors that produces more innovative and cost effective solutions for affected sources. Smaller markets such as those that may be developed with the implementation of State regulations (e.g. Massachusetts, Connecticut, Wisconsin, New Jersey, North Carolina) are beneficial to the air pollution control industry but will be less effective in developing healthy markets than a timely implemented national program.

With the implementation of a national program, multiple control options including precombustion, combustion and post combustion technologies will contribute to meeting the required emission reductions. Coal cleaning as well as coal switching are examples of options that have the potential to reduce mercury emissions prior to fuel combustion that are not discussed further in these comments.

Based on the recent test results, significant amounts of mercury can be removed through the use of existing controls. Existing control installations such as fabric filters, electrostatic precipitators, SO_2 scrubbers, and selective catalytic reduction (SCR) are currently achieving high levels of mercury reductions even though these processes were not originally designed nor optimized for mercury capture. With the implementation of mercury regulatory requirements beyond incidental co-benefit levels of control, a number of options for optimization of existing controls will be implemented to provide cost effective reductions in a short period of time.

Mercury specific control technologies such as sorbent injection systems have been demonstrated at full-scale. Multipollutant control approaches as well as other mercury specific technologies have also demonstrated significant progress and will provide additional low cost, innovative approaches to mercury control.

It is important to note that EPA's modeling assumes no advancement in the development of mercury control technology and no reduction in the cost of mercury control technology over time. These assumptions are contradictory to both historical trends with control technology for other pollutants and the current rapid progress in mercury control technology development. As noted, the progress in advancing mercury control technologies has been rapid without increasing opportunities to lower the cost of control. Regulatory drivers are a powerful market tool that drives competition in our industry. Often lower cost solutions emerge after regulatory requirements have been established, rather than before.

There have been a number of arguments made that state that mercury control technologies are not available. Many of these perspectives invoke all too familiar arguments that have been offered in the past to dissuade EPA from promulgating an effective rule. For example, during promulgation of the NO_x Transport SIP Call in 1998 a number of commenters claimed that the prominent control technologies, SCR and SNCR, had not been fully demonstrated on large units (250 MW and larger) or domestically; was an immature technology; would not be attainable on a sustained basis; had not been adequately demonstrated on all U.S. coals; were incapable of meeting guaranteed performance; and were not able to be constructed in time for compliance due to inadequate resources to accomplish what now has already been done with considerable success. As part of these comments on NO_x control for major industrial and electric generating facilities, EPA was urged not to rely on "emerging control technologies" that provide no assurance of being able to achieve mandated emission reduction levels. However, EPA's promulgation of the NO_x SIP Call was steeped in success and advancement of these and other NO_x control technologies. Today, mercury control technology advances and commercial availability have surpassed the position we once held on NO_x control before the NO_x SIP Call. However, the addition of compliance flexibility should reduce any perceived or real uncertainties and would provide opportunities to use additional control options.

1. POST COMBUSTION CONTROL TECHNOLOGIES

i. Sorbent Injection Technology

a. Technology Description

Injecting a sorbent such as powdered activated carbon, bromine, polysulfides, or other sorbent into the flue gas represents a relatively simple approach to controlling mercury emissions from coal-fired boilers. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by the existing particle control device, either an electrostatic precipitator (ESP) or fabric filter (FF).

The air pollution control industry already has considerable experience with the implementation of mercury controls for other industrial sectors. Sorbent injection has been commercially proven to augment the removal of mercury in waste-to-energy plants. Experience controlling mercury emissions has been gained in more than 60 U.S. and 120 international waste-to-energy plants that burn municipal or industrial waste or sewage sludge. For the past two decades, sorbent injection upstream of a baghouse has been successfully used for removing mercury from flue gases from these facilities. Other reagents used include activated carbon, lignite coke, sulfur containing chemicals, or combinations of these compounds. The mercury control experience gained from the municipal and industrial waste combustors demonstrates that the air pollution control industry has been able to control mercury in the past and is able to apply their expertise to the electric power sector.

b. Performance and Applicability

EPA has requested comment concerning the availability of sorbent injection technologies to serve the electric power market. Activated carbon injection equipment is currently being sold to utilities. ACI equipment is identical for all coal types including bituminous, subbituminous, lignites and blends. Therefore, ACI equipment can be purchased for all coals and all plant configurations.

The specific sorbents may vary for different coals and operating conditions. In addition, the ability to accurately predict the levels of mercury removal that will be achieved will vary for different coals depending on the available performance data. For example, there have been a significant number of tests over the past year and a half on PRB coals and North Dakota lignites. Therefore, it is possible to estimate results for these configurations. There is less data on bituminous coals, so predictions will be less precise. Several full-scale field tests will be conducted on bituminous coals during 2005 and 2006. The first test on a Texas lignite will be conducted in 2005. Until this occurs, it is difficult to predict performance on Texas lignite.

The performance of activated carbon injection systems for lignite, subbituminous, and bituminous coals on various coal-fired power plant configurations are given in Table 1. The mercury reduction performance for these power plant scenarios are based on results from full-scale demonstrations that have been documented in various technical papers presented at major electric power conferences.

Table 1. Activated Carbon Injection Control Technology Options

Plant Configuration	**Technology**	**Coal Type**	**% Reduction**				**Cost**		**Year Commercially Available**
			Min	**Max**	**Avg. Total**[a]	**Avg. Incrm.**[b]	**Capital ($/kW)**	**O&M ($/kWh)**	
CESP[d]	ACI[f,g]	Bit	50	90	70	70	1.5 to 3	.0012	2004
	ACI[g,h]	Sub	0	95	80	80	1.5 to 3	.0005	2004
	ACI[i]	Lig	0	80	63	63	1.5 to 3	.0005	2004
CESP/FGD	ACI[j]	Bit	50	90	70	70	1.5 to 3	.0012	2004
	ACI	Sub	0	95	80	80	1.5 to 3	.0005	2004
	ACI[k]	Lig	0	80	60	70	1.5 to 3	.0005	2004
CESP/FGD-dry	ACI	Bit	80	>90	>90	88	1.5 to 3	.00012	2004
	ACI	Sub	0	90	80	85	1.5 to 3	.00017	2004
	ACI	Lig	0	90	70	70	1.5 to 3	.00017	2004
CESP/SCR/FGD	ACI	Bit	50	90	70	70	1.5 to 3	.0012	2004
	ACI	Sub	0	95	80	80	1.5 to 3	.0005	2004
	ACI	Lig	0	80	60	60	1.5 to 3	.0005	2004
FF	ACI[l]	Bit	20	95	85	80	1.5 to 3	.00036	2004
	ACI[l,m]	Sub	20	90	90	80	1.5 to 3	.00054	2004
	ACI	Lig	20	80	80	75	1.5 to 3	.00054	2004
FF/FGD	ACI	Bit	50	95	90	70	1.5 to 3	.00012	2004
	ACI[l]	Sub	30	90	90	80	1.5 to 3	.00027	2004
	ACI	Lig	30	90	85	70	1.5 to 3	.00027	2004
FF/SCR/FGD-dry	ACI	Bit	80	>90	>90	50	1.5 to 3	.00012	2004
	ACI[n]	Sub	0	>90	>90	90	1.5 to 3	.00017	2004
	ACI[o]	Lig	0	90	75	70	1.5 to 3	.00017	2004
FF/SCR/FGD	ACI	Bit	50	95	90	70	1.5 to 3	.00012	2004
	ACI	Sub	30	90	90	80	1.5 to 3	.00027	2004
	ACI	Lig	30	80	80	70	1.5 to 3	.00027	2004
HESP[e]	TOXECON[p]	Bit	20	95	85	80	3 + 15 to 3 + 50	.00036	2004
	TOXECON	Sub	20	90	90	80	3 + 15 to 3 + 50	.00036	2004
	TOXECON	Lig	20	80	80	70	3 + 15 to 3 + 50	.00054	2004
HESP/FGD	TOXECON	Bit	50	95	90	70	3 + 15 to 3 + 50	.00012	2004
	TOXECON	Sub	30	90	90	80	3 + 15 to 3 + 50	.00036	2004
	TOXECON	Lig	30	80	80	70	3 + 15 to 3 + 50	.00027	2004

HESP/FGD-dry	TOXECON	Bit	80	>90	>90	50	3 + 15 to 3 + 50	.00012	2004
	TOXECON	Sub	0	>90	>90	90	3 + 15 to 3 + 50	.00017	2004
	TOXECON	Lig	0	90	88	70	3 + 15 to 3 + 50	.00017	2004
HESP/SCR/FGD	TOXECON	Bit	50	95	90	70	3 + 15 to 3 + 50	.00012	2004
	TOXECON	Sub	30	90	90	80	3 + 15 to 3 + 50	.00036	2004
	TOXECON	Lig	30	80	80	70	3 + 15 to 3 + 50	.00027	2004

[a] This is the percent reduction attributable to the existing pollution controls and the technology.

[b] This is the percent reduction attributable only to the technology.

[c] In EPA's modeling, is it appropriate for an economic forecast to assume an improvement in costs over time (such as through technology cost reductions or through future technology innovation).

[d] CESP – represents cold-side electrostatic precipitator

[e] HESP - represents hot-side electrostatic precipitator

[f] Durham, M., J. Bustard, T. Starns, C. Martin, R. Schlager, C. Lindsey, K. Baldrey, and R. Afonso (2004). "*Full-Scale Evauations of Sorbent Injection for Mercury Control on Power Plants Burning Bituminous and Subbituminous Coals.*" Power-Gen 2002, Orlando, FL, December 10-12.

[g] Nelson, S. Jr., R. Landreth, Q. Zhou, J. Miller (2004). "*Accumulated Power-Plant Mercury-Removal Experience with Brominated PAC Injection.*" Combined Power Plant Air Pollutant Control Mega Symposium, Washington, DC, August 30 – September 2.

[h] Starns, T. Sjostrom, S., J. Bustard, M. Durham et al (2004). "*Full-Scale Evaluation of Mercury Control by Injecting Activated Carbon Upstream of a Spray Dryer and Fabric Filter.*" Presented at PowerGen 2004, Orlando, FL, November 30 –December 4.

[i] Thompson, J.D., J. Pavlish, and M. Holmes (2004). *"Enhancing Carbon Reactivity for Mercury Control: Field Test Results from Leland Olds."* Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

[j] Dombrowski, K., et.al., (2004). *"Sorbent Injection for Mercury Control Upstream of Small-SCA ESPs."* Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

[k] Starns, T, J. Amrhein, C. Martin, S. Sjostom, C. Bullinger, D. Stockdill, M. Strohfus, R. Chang, (2004). *"Full-Scale Evaluation of TOXECONII™ on a Lignite-Fired Boiler."* Presentation at the Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

[l] Ley. T., T. Ebner, K. Fisher, R. Slye, R. Patton, R. Chang, (2004). *"Assessment of Low-Cost Novel Sorbents for Coal-Fired Power Plant Mercury Control."* Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

[m] Haythornthwaite, S., S.Sjostrom, et.al.., (1997). *"Demonstration of Dry Carbon-Based Sorbent Injection for Mercury Control in Utility ESPs and Baghouses."* EPRI-DOE-EPA Combined Utility Air Pollutant Control Symposium, Washington, D.C., August 25-29.

[n] Sjostrom, S., et.al., (2004). *"Full-Scale Evaluation of Mercury Control by Injecting Activated Carbon Upstream of a Spray Dryer and Fabric Filter."* Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

[o] Machalek, T., et.al., (2004). *"Full-Scale Activated Carbon Injection for Mercury Control in Flue Gas Derived from North Dakota Lignite."* Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

[p] Berry, M, J. Bustard., et.al., (2004). *"Field Test Program for Long-Term Operation of a COHPAC® System for Removing Mercury from Coal-Fired Flue Gas."* Combined Power Plant Air Pollutant Control Mega Symposium, Washington, D.C., August 29 – September 2.

c. Availability

Companies are providing firm price proposals with performance guarantees for every coal and boiler type. Activated carbon injection equipment is currently being sold to utilities. ACI equipment is identical for all coal types including bituminous, subbituminous, lignites and blends. Therefore, ACI equipment can be purchased for all coals.

The material resources, labor and time required to install the control equipment is an additional topic to consider. With regards to the items that impact APC vendors, there are sufficient fabrication/manufacturing resources in the U.S. market to support a rapid retrofit of the industry with sorbent injection systems in addition to the systems required for the Clean Air Interstate Rule. These systems are relatively simple compared to FGD and SCR systems and the major components are commonly used in a variety of industrial processes from numerous manufacturers throughout the U.S.

As mentioned in ICAC's previous comments on EPA's proposed mercury rule, there is significant excess production capacity of powder activated carbon and a strong interest in investing significant capital in building new production facilities exists among current suppliers (both in the U.S. and in China). A new mercury regulation would create a significant new market for activated carbon. In order to build new production capacity, between a two- to four-year period would be needed to expand production. However, all of the activated carbon suppliers said that they would be hesitant to invest capital resources to increase capacity based only on the promise of a new regulation. A decade or so ago, the AC industry increased capacity when EPA announced that they were going to tighten up drinking water standards. After the new capacity was added, EPA did not follow up with new regulations, which produced a glut of activated carbon. Some companies went out of business because of this, and the industry as a whole is just now recovering. As a result, it is unlikely that new AC production will move beyond the planning stages until there is the certainty of a regulation.

Concerning resources for fabric filter systems, should the market dictate the need for secondary PM control (not all applications will require this) there will be sufficient engineering and material resources to complete the necessary projects. There are several examples where the industry has had to retrofit a significant number of boilers with APC controls to meet new environmental regulations. Examples include the retrofit of ESPs in the 1970s and the more recent retrofit of almost 100 GW of SCRs for the NO_x SIP Call. These examples support the assertion that, should the utility industry need to retrofit a large number of coal-fired boilers with mercury controls, it can be accomplished in a short period of time. The industries that support this market (APC suppliers, fabricators, construction firms, etc.) have repeatedly demonstrated their ability to meet rapidly increasing market demand. In addition, increasing demand for systems and fabrication can also be met by foreign suppliers of silos, fabric filter systems, fabrication and supply of PAC.

If there is a bottleneck in retrofitting the U.S. fleet of coal-fired boilers, it is not likely to be in the area of the supply of capital equipment or under supply of sorbents but more likely to be impacted by issues that are within the scope of the utility or regulatory community itself. Examples include areas such as project permitting/PUC approval, availability of project financing, and unit outage scheduling. These are all items that are out of the control of APC vendors but may impact the timing for control installation.

d. Costs

EPA reported that the Edison Electric Institute (EEI) estimated that ACI would be less expensive per pound of Hg removed than EPA has estimated. Meanwhile, other power industry models assumed higher capital costs for ACI than EPA in its modeled scenarios. EPA is seeking comment on whether its assumptions for Hg control technology costs are reasonable.

EPA raised several questions in the NODA requesting information on sorbent injection technologies and how best to make modeling assumptions to reflect current and future capabilities of mercury control technologies. One of the questions raised by EPA was concerning the use of discounted variable operating costs for activated carbon injection (ACI). EPA questioned whether it would be appropriate for an economic forecast to assume an improvement in costs over time (such as through technology cost reductions or through future technology innovation), and what level of improvement in costs to assume. Specifically, EPA questioned whether a 2.5 percent annual improvement in variable operating costs for ACI should be incorporated into their modeling as has been done for similar power sector models.

In regards to decreasing costs, it is appropriate to assume that the cost of sorbent technologies will decrease with time due to equipment/technology innovation, improvements in sorbent removal efficiencies, and the reduction in sorbent production costs. The primary cost of sorbent injection technology is due to sorbent usage so the largest cost reductions are likely to be made with the sorbent costs. The capital costs for ACI are relatively low as the equipment is mechanically simple compared to FGD and SCR systems for coal-fired power plants. Activated carbon injection systems consist of a bulk-storage silo; blower/feeder system to convey the activated carbon from the silo through hard piping leading to the flue gas duct; and injection probes located in the flue gas duct. Currently, the annual operating costs for these systems will be more than the cost to construct the system.

Costs are expected to decrease as sorbents are developed specifically for the coal-fired boiler application. It is widely known that the current sorbents have much higher capacity for mercury removal than can effectively be used in a coal-fired power plant application. This is because the injected sorbent will be rapped off the plates of the electrostatic precipitator or cleaned off the bags of the fabric filter before the absorption/adsorption capacity of the sorbent has been fully utilized. Therefore, work is being done to produce a lower capacity, lower cost sorbent that will be more appropriate for use in this industry.

It is also expected that technical innovations will lead to lower cost sorbents. For example, ADA-ES has reported improved mercury removals on full-scale tests with NORIT's new activated carbon named E-3[1,2]. These tests showed that significantly higher levels of mercury could be removed at significantly lower feed rates than earlier tests indicated. With this kind of technology improvement, the overall cost for mercury removal will decrease over this. This is especially true for Western coals (i.e. lignite and subbituminous) as sorbent injection rates are expected to be higher for those units yielding a drop in operating costs by a factor of two to four. It is expected that similar improvements in sorbents will result in similar cost reductions for bituminous coals.

As far as production costs are concerned, there will likely be a reduction in cost to produce sorbent products for the power industry due to economies of scale. Currently, activated carbon is already manufactured by numerous vendors for a wide variety of customized applications requiring inefficient and expensive materials handling to provide the different treatments and particle size requirements. In addition, the demand for activated carbon is seasonal and therefore the use of the equipment is not optimized. To meet the power industry demands, it is likely that new production facilities will be built to produce only a few products so there will be an increase in efficiency and reduction in cost. In addition, the power market will be much more consistent and predictable, which will serve to optimize the production equipment.

Once the sorbents are specifically produced for power industry applications, the pricing trend for activated carbon should act very much like other commodities. On average, pricing for most commodity items will normally stay unchanged or decrease slightly over time as market forces encourage cost reductions. Since inflation in the U.S. normally runs around 2-3 percent, any commodity that does not increase in price decreases (in real terms) by around this amount every year. It is safe to assume that activated carbon prices will decrease by at least 2-3 percent in real terms (net inflation). The most likely scenario is that prices for sorbents will initially decrease by much more than 2-3 percent as the market for this specific application grows and will reach a steady state annual reduction of 2-3 percent.

The final decrease in costs will come about through innovative equipment/technology configurations such as the EPRI TOXECON II. Currently, EPA modeling includes the cost for the loss of sale of power plant fly ash plus landfill costs to dispose of the fly ash. The EPRI TOXECON II process eliminates the cost of loss of sale of the fly ash for concrete without the need for a new fabric filter. As a result, plants will be able to avoid one of the most costly aspects of the technology. As shown in Table 1, the capital cost of installing a COHPAC fabric filter is expected to range between \$15 – 50/kW depending on the plant configuration. Also given in Table 1, the capital cost of installation ACI systems is expected to range between \$1.5 – 3/kW.

When considering the combination of the decrease in cost of sorbent technologies with time due to equipment/technology innovation, improvements in sorbent removal efficiencies, and the reduction in sorbent production costs; it is safe to assume that costs for this technology will decrease over time. A more likely scenario for costs of ACI over the next three to five years would be more significant reductions in overall costs by a factor of 2 or more compared to current EPA and DOE projections of only 2.5 percent.

ii. Electro-Catalytic Oxidation (ECO)

a. Technology Description

Powerspan Corp's Electro-Catalytic Oxidation (ECO) is an integrated multi-pollutant control technology that achieves major reductions in emissions of nitrogen oxides (NO_x), sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), and mercury (Hg). The technology also reduces emissions of other air toxic compounds and acid gases such as arsenic, lead, and hydrochloric acid (HCl). ECO produces a commercial fertilizer co-product, reducing operating costs and avoiding landfill disposal of waste.

ECO is situated downstream of a power plant's existing electrostatic precipitator (ESP) or fabric filter. The system consists of three gas-processing steps, including a barrier discharge reactor, an ammonia-based wet scrubber, and a wet ESP. The barrier discharge reactor oxidizes SO_2, NO_x, and Hg; the ammonia scrubber removes SO_2, NO_2, and oxidized Hg creating an ammonium sulfate nitrate solution; and the wet ESP captures acid aerosols, fine particulate matter, and oxidized Hg.

Liquid effluent produced by the scrubber contains dissolved ammonium sulfate nitrate (ASN) salts, along with mercury and captured particulate matter. The ASN solution is sent to a co-product recovery system, which includes filtration to remove ash and a sulfur impregnated activated carbon adsorption bed, which removes mercury from the effluent stream. The mercury and spent activated carbon are disposed of as hazardous waste. The treated co-product stream, free of mercury and ash, can be used directly in liquid form or processed to form ammonium sulfate nitrate fertilizer in crystalline or granular form.

b. Performance and Applicability

The ECO process is currently being commercially demonstrated in a 50-MW slipstream unit at FirstEnergy Corp.'s R.E. Burger Plant in Shadyside, Ohio. The unit processes flue gas from a plant burning eastern bituminous coal. As of August 2004, ECO performance has met or exceeded most commercial objectives. Mercury removal across the ECO system has ranged from 75 – 85 percent with total inlet mercury concentration up to 16 μg/Nm3. SO_2 removal is routinely greater than 99 percent with inlet SO_2 concentrations up to 2200 ppm and outlet concentrations below 10 ppm. NO_x removal has been as high as 82 percent with outlet levels of 0.05 lb/mmBtu.

Prior to proceeding with the 50-MW commercial demonstration unit, Powerspan conducted pilot testing in a 1-MW slipstream unit at the R.E. Burger Plant. During approximately 18 months of testing, the plant burned a blend of bituminous and subbituminous coals. Typical values for mercury concentration, chlorine, and sulfur content in the coal were 0.09 ppm mercury, 0.06 percent chlorine, and 1.9 percent sulfur. Ontario-Hydro sampling was conducted by Air Compliance Testing (Cleveland, Ohio) at the ECO pilot unit in May 2002. Ontario-Hydro testing measures gas-phase mercury (elemental and oxidized forms) and mercury bound to particulate matter in the flue gas. Air Compliance's testing consisted of three sample runs each on the inlet and outlet flue gas streams. Two of the three sets of sample runs had sample durations in each location of four hours while sampling for the remaining set of runs lasted three hours in each location. The mercury removal for particulate, oxidized, and elemental are provided in Table 2 with the overall mercury removal measured at 88 percent.

Table 2. Mercury Removal at ECO Pilot Demonstration

Hg Fraction	**ECO Inlet**	**ECO Outlet**	**% Removal**
Particle Bound Hg (μg/dscm)	0.62	0.016	97.4
Oxidized Hg (μg/dscm)	5.81	0.022	99.6
Elemental Hg (μg/dscm)	0.16	0.75	
Total Hg (μg/dscm)	6.59	0.79	88.0

Table 2 provides estimates of the ECO process performance for various plant configurations. It is expected that 80 percent mercury removal across the ECO system will be achieved with the application of the ECO process for units burning bituminous coals. The average incremental removal for fabric filter and hot-side ESP applications are expected to be similar to that demonstrated at the ECO commercial demonstration unit at the R.E. Burger Plant, which employs a cold-side ESP. The cost and performance estimates are based on results currently being commercially demonstrated in a 50-MW slipstream unit at FirstEnergy Corp.'s R.E. Burger Plant.

Table 2. Mercury Removal Capability of ECO Commercial Technology

Plant Config.	Coal Type	% Reduction				Cost			Year Commercially Available
		Min	Max	Avg. Total[a]	Avg. Increm.[b]	Capital ($/kW)	O&M ($/kWh)	% Expected Change Cost (+/-) w/ time[c]	
CESP[d]	Bit	(f)	(f)	(f)	80%	$225/kW	$0.0027	Decrease	2006
FF	Bit				80%	$225/kW	$0.0027	Decrease	2006
HESP	Bit				80%	$225/kW	$0.0027	Decrease	2006

[a] This is the percent reduction attributable to the existing pollution controls and the technology.

[b] This is the percent reduction attributable only to the technology.

[c] In EPA's modeling, is it appropriate for an economic forecast to assume an improvement in costs over time (such as through technology cost reductions or through future technology innovation).

[d] CESP – represents cold-side electrostatic precipitator

[e] HESP - represents hot-side electrostatic precipitator

[f] Measurements of the mercury content in the coal and in the flue gas upstream of the plant's ESP have not been made.

c. Availability

The ECO process is currently being commercially demonstrated in a 50-MW slipstream unit at FirstEnergy Corp.'s R.E. Burger Plant in Shadyside, Ohio. Previously, ECO was pilot tested in a 1-MW slipstream unit at the same plant. Commercial demonstration testing is planned to complete in the first quarter of 2005. Based on this project, Powerspan will offer commercial ECO systems with industry standard guarantees and warranties by the beginning of 2006.

d. Costs

It is estimated that the capital cost of the multipollutant ECO process will be $225/kW and the operation and maintenance costs will be $0.0027/kWh. These are the estimated costs for cold-side ESP application based on the experience at the Burger Plant. The cost for fabric filter and hot-side ESP applications are expected to be similar to cold-side ESP application. To estimate the cost effectiveness of the process for mercury removal, it is estimated that the variable cost of mercury removal in the ECO process is $800 per pound of mercury, including the sorbent media and its disposal. The costs are expected to decrease over time due to technology innovations; however, the level of cost reduction has not yet been estimated.

2. PRECOMBUSTION CONTROL TECHNOLOGIES

i. K-Fuel

a. Technology Description

KFx, Inc. has a patented and proven pre-combustion technology that transforms low-cost, low-grade western coal (e.g. lignite or subbituminous) into a clean, affordable, efficient energy source, called K-Fuel. K-Fuel pre-combustion technology applies heat and pressure to boost the heat value of subbituminous coal and lignite by 30-55 percent, from approximately 8,000-8,800 Btu/lb to 11,000-11,500 Btu/lb, optimizing combustion in a manner that produces more generation output per ton of coal while lowering emissions. Moisture in the coal can be reduced by as much as 80 percent from approximately 30 percent in the feedstock to seven percent in K-Fuel.

Similar to post combustion SO_2, NO_x, and PM controls, mercury emission reductions from the K-Fuel technology are a co-benefit of the pre-combustion process. K-Fuel provides a pre-combustion mercury removal solution, reducing mercury content by up to 70 percent or more. In addition to mercury reductions, K-Fuel also reduces emissions of SO_2 and NO_x.

b. Performance and Applicability

Since the K-Fuel process reduces emissions of multiple pollutants, coal-fired facilities that will most benefit from burning K-Fuel to reduce mercury emissions include those units that will achieve the most cobenefit from SO_2 and NO_x emission reductions as well as heat rate improvements. K-Fuel will benefit units burning high sulfur bituminous coal with no SO_2 control, units burning declining supplies of Central Appalachian SO_2 compliant coal, units that have switched from bituminous to subbituminous coal to meet the Title IV Acid Rain requirements with a resulting loss in generating capacity, units with no post-combustion SO_2 or NO_x control, and small generating units that are searching for low capital cost mercury control. K-Fuel can also be burned in units currently burning subbitminous coal and lignite, the feedstocks for K-Fuel.

K-Fuel is a commercially viable pre-combustion solution and proven technology for western coal to reduce mercury emissions from coal-fired power plants. K-Fuel accomplishes mercury reduction through its coal beneficiation process. In effect, by combusting K-Fuel the utility is achieving mercury reduction for free since mercury removal has already occurred during the K-Fuel process prior to combustion by a utility.

Table 4 below provides laboratory data for various feedstocks of subbituminous coal, along with the corresponding reduction in mercury, increase in heat rate (Btu), and reduction in moisture content achieved by the K-Fuel process. The information presented demonstrates that the effectiveness of the process is dependent upon the properties of the unique coal feedstock.

To date, the K-Fuel pre-combustion process has not been optimized for mercury emission reduction but is a co-benefit of the pre-combustion process. In Table 4, the amount of mercury removal listed is the amount of mercury reduced in the coal prior to combustion and does not consider the potential additional reductions from existing control technologies (e.g. electrostatic precipitators, fabric filters, etc.). As a result, the mercury reduction numbers below are a beginning point for the ultimate mercury reduction achievable when burning K-Fuel, not accounting for plant specific characteristics.

A facility knows when it purchases K-Fuel how much mercury has already been removed and what amount of mercury is in the K-Fuel prior to combustion. Additional mercury removal above that already achieved in the K-Fuel will be dependent upon unit specific characteristics such as installed pollution control devices and boiler characteristics, as mentioned below.

Table 4. Emissions Reductions from Laboratory Tests using F-Fuel Process

Coal[a] ID	Coal As Rec. Moisture Percent	Coal As Rec. Btu/Lb	Coal As Rec. Hg Lbs/TBtu	K-Fuel As Rec. Moisture Percent	K-Fuel As Rec. Btu/Lb	K-Fuel Hg Lbs/TBtu	Moisture Removal Percent	Btu Increase Percent	Total Mercury Removal Percent
Coal 1	31.06	8520	1.98	6.06	11667	0.63	80	37	68
Coal 2	27.00	8969	24.17	5.74	11683	3.75	79	30	85
Coal 3	28.41	8536	12.58	6.46	11331	3.10	77	33	75
Coal 4	32.04	7903	7.99	7.06	11162	1.84	78	41	77
Coal 5	31.72	8126	6.30	8.00	11091	2.30	75	37	63
Coal 6	30.93	8235	3.51	6.91	11149	2.02	78	35	42
Coal 7	31.20	8032	4.05	7.09	10535	1.93	77	31	52

[a] Subbituminous coals were used for all of the laboratory tests.

c. Costs

K-Fuel does not impose any installation, capital, or operating costs in addition to the cost of K-Fuel per ton to achieve mercury reduction since mercury reduction is already achieved in K-Fuel prior to combustion in a coal-fired unit. As a solid coal fuel, K-Fuel will not negatively impact system components or by-products since there are no chemicals, additives, or other substances added to the combustion process, flue gas, or to the K-Fuel itself to enhance mercury removal. Currently, KFx conservatively estimates that K-Fuel will be sold for $33 per ton (including transportation costs), though market conditions and other factors may impact the price.

d. Availability

In June 2004, KFx announced its purchase of the Fort Union mine site near Gillette, Wyoming as the location for a commercial K-Fuel production facility. The site includes approximately 1,000 acres of land, a rail loop with load out facilities, a coal crusher, related buildings, water disposal wells and about 500,000 tons of remaining coal reserves. Private money is fully funding the project and the Wyoming Department of Environmental Quality (WYDEQ) has finalized all permits necessary for construction. The final air quality permit was granted from WYDEQ on November 8, 2004 and ground was broken on the site November 10, 2004. Concrete foundations have begun being poured as of December 2004. Fabrication of the major process components of the facility is near completion.

The feedstock coal to produce K-Fuel will be purchased from adjacent mines in the Powder River Basin. Initial output from the facility will be 750,000 tons per year and two-thirds of the output has been pre-sold with the remaining portion to be used for test burns to facilitate additional markets for K-Fuel. The K-Fuel production facility is expected to be in commercial operation in the summer of 2005. The facility can be expanded to produce up to 8 million tons per year of K-Fuel and KFx expects that with the first commercial plant in operation the development of future plants will be accelerated. KFx is examining potential commercial sites in Wyoming, Alaska, South Dakota, and other locations for additional K-Fuel production facilities. KFx plans to own and operate the K-Fuel production facilities, as well as license K-Fuel technology to third parties in the U.S. and internationally.

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The Institute looks forward to working further with you on this important issue, and invite you or your staff to contact me for further information or clarification.

Sincerely,

David C. Foerter
Executive Director, ICAC