Written Statement
George R. Offen
Manager, Air Emissions and Combustion By-Product Management
EPRI

on

Mercury Controls for Power Plants

before the

Senate Committee on Environment and Public Work's
Subcommittee on Clean Air, Wetlands, and Climate Change

Mr. Chairman and Members of the Subcommittee:

Thank you for inviting EPRI to address the Senate Committee on Environment and Public Work's Subcommittee on Clean Air, Wetlands, and Climate Change on the important subject of mercury reductions from power plants. I am George Offen and I manage EPRI's programs in air emission reductions and the beneficial use of combustion by-products. EPRI was established nearly 30 years ago as a non-profit, collaborative R&D organization to carry out electricity-related supply, delivery, end-use, and environmental R&D in the public interest. EPRI has been supported voluntarily since our founding in 1973. Our funders include electric power companies responsible for over 90% of the electricity sold in the US as well as over 60 companies worldwide. We also cooperate closely with government agencies in our research programs, including EPA and DOE. EPRI operates as an independent technical organization maintaining access to and engaging the best technical talent in the world, and I am both pleased and honored that you have selected two excellent examples from this community of experts to be co-panelists this morning.

For well over a decade, EPRI has been conducting research on all aspects of this environmental concern, from emission source characterization and atmospheric processes that transport, change, and eventually deposit some of the emitted mercury onto land and water bodies to the processes that allow the mercury to end up in fish and the health effects of eating fish containing different concentrations of mercury, to the search for methods to reduce mercury emissions from power plants. My remarks will address just the last topic, presenting you EPRI's conclusions on **today's** state-of-the-technology in mercury control. This written statement is supplemented by an updated version of a viewgraph presentation to staff of several members of the Environment and Public Works Committee in an informal briefing on October 17, 2001.

I just emphasized the word **today** because our understanding of the technology is changing, often dramatically, on a daily basis. In March, I would have said that the addition of selective catalytic reduction (SCR) for NOx control would improve the capture of mercury by an SO_2 scrubber for plants equipped with these devices. Now I'm not so sure. Up until October, I would have said that you need to inject large amounts of activated carbon into the flue gas of a boiler equipped with an electrostatic precipitator in order to capture even 30% mercury, but that you could theoretically capture over 70% of the mercury by injecting even larger amounts of carbon – neglecting the impacts that such large amounts of carbon would have had on the particulate collection device (electrostatic precipitator, ESP) and ash. Now, we think you can capture 30% of the mercury with much smaller amounts of carbon addition, but may never be able to exceed 50-70% capture in this configuration. Finally, all the data we have are short-term, mostly instantaneous snapshots in time, and in all cases no more than 7 days of sustained operation. One 7-day test showed that we could get up to 95% capture on a given day and hour but could only sustain 78% average over the whole week; we do not know if we could sustain that level over a month or a year. Clearly, there is a desperate need for more long-term, full-scale tests to resolve these uncertainties. EPRI thinks 20 such field tests are needed, and these should and could be conducted in the 2003-2005 time frame in a public/private collaboration. EPRI is committed to seeking and coordinating the private partners for such a collaborative effort.

What do we believe is attainable today? 10-99% from existing particulate and SO_2 controls, depending largely on the fuel and air pollution controls. If we focus on units with the most common air pollution controls, the range is more like 40-80% mercury reduction. As a reminder of the percent reduction math, to achieve a total of 90% capture, these units would need to add supplemental technology capable of reducing mercury by an additional 50-83%.

As implied, we believe that it is premature to rely on the combination of SCR and SO_2 scrubbers to capture mercury. Tests on young catalysts do show benefits if enough catalyst is used – about twice as much as would be required to achieve NOx reduction requirements. However, we now have two tests showing a near total loss of benefit after several thousand hours of operation at units firing the popular western low sulfur coal called Powder River Basin, or PRB. EPRI, in collaboration with DOE and EPA, plans to revisit during 2002 and 2003 the sites that were tested in 2001, as well as to conduct laboratory and pilot-scale tests throughout the year, to resolve this uncertainty.

If additional reductions are deemed necessary beyond those that will be realized by controls for particulates, SO_2, and, maybe, NOx, the most likely choice in the near term would be the injection of activated carbon ahead of a particulate control. My co-panelists will (have) describe(d) results from two of the three full-scale tests conducted to date – the only full-scale tests of mercury controls on power boilers in the world; the third was an EPRI project on a small eastern bituminous fueled boiler equipped with an ESP that found similar results.

- Based both on these few results and our many smaller-scale studies, EPRI's tentative assessment is that activated carbon injection ahead of an ESP should be able to provide 50-70% mercury reduction, depending on the size of the ESP. EPRI and DOE are actively discussing possible tests in 2003 on representative small ESPs.

Again, the ability to sustain this level over the long-term is unknown, and the addition of activated carbon to fly ash will make it expensive, if not impossible, to use the ash in concrete – the largest volume user of fly ash.[1]

- Activated carbon injection at a site with a conventional baghouse should provide 90% removals, or maybe somewhat more on an instantaneous basis. However, there is no experience to tell us if this level can be sustained. The unknown is whether the added fine carbon material will cause the resistance across the bags (called pressure drop in engineering terms) to increase too quickly. In the COHPAC configuration (compact baghouse – similar to a few thousand vacuum cleaner bags side-by-side – added after the ESP, and with activated carbon injected between the ESP and COHPAC unit), the 7-day test suggests that this configuration can achieve about 80% mercury removal at a unit where the baghouse is sized for particulate control. At a cost penalty, 90% reduction might be achievable with a larger COHPAC design, again with the uncertainty on sustainable operation. Here, too, EPRI and DOE are discussing a joint long-term evaluation at the COHPAC unit that was tested last year.

I have not yet referred to cost. In brief, capital costs range from a low of $1-3/kW for injection ahead of an ESP to as much as $45/kW for a COHPAC unit (e.g., one-third to one-half the cost of an SCR). Costs for the activated carbon could be around 2 mills/kWh (~$5M/yr for a 500 MW plant) with an ESP and about one-fifth that amount with COHPAC (see the back-up material). None of these figures include potential impacts – a need to enlarge the ESP to handle the added carbon, more frequent bag replacement, loss of ash sales, or other unknown impacts that could appear with longer term operation.

What can we expect in the future? In a nutshell, many more options. They will try to provide lower cost options than carbon injection, methods for taking advantage of the SO_2 scrubber, solutions for applications where carbon injection would be impractical, and/or methods that do not produce a waste. Many firms and institutions – including EPRI and, of course, DOE – are actively engaged in this challenge. While some of these processes are quite innovative and look very promising, all are still in the early stages of development. The recent experience with a simple add-on to an SO_2 scrubber for NOx reduction, however, does remind us that the path to commercialization can have many barriers. In addition, the experience with new technology across all industries tells us that the costs of the commercial systems will be several times greater than the initial projections. Equally important, this experience has shown that the cost of the "nth" installation can be reduced significantly if incentives and implementation timetables are managed in a way that allows rapid feedback from the initial experiences into the final designs. As with carbon injection, multiple long-term, full-scale field tests will eventually be required to determine the sustainable performance and costs of these emerging technologies.

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[1] Replacing Portland cement with fly ash reduces CO_2 emissions by nearly one ton for every ton of cement replaced.

In summary, about 40% of the potential mercury emissions are being removed now by air pollution controls already in place across the electric power industry (more if one considers the mercury removed during coal cleaning), and further reductions are expected as additional NOx and SO_2 controls are added to meet current regulatory programs. Activated carbon injection, if applied today, could be expected to capture about 50-90% of the potential mercury emissions, but a number of long-term, full-scale tests are needed to determine its ability to sustain these reduction levels; associated costs and impacts also need further study. Emerging technologies offer the promise of lower cost and solutions for difficult plant configurations. However, recognizing this promise will require substantial research investment, and, thus, we cannot predict availability dates, performance, and final costs until the research is further along.

Thank you, again, for giving EPRI the opportunity to provide these comments.