On the Air

Technical Notes on Important Air Quality Issues

April 2003

Mercurial Standards

Science: Mercury is a unique element that circulates the globe, originating from many natural and human-caused sources. At this time, very little can be predicted regarding the environmental benefits of costly attempts to regulate mercury emissions from fossil fuel plants in the United States. Furthermore, both monitoring and control technologies essential for complying with such regulations are still in their infancy.

Policy: A phased-in approach to regulating mercury emissions at fossil fuel plants has many advantages over the U.S. EPA's current regulatory proposal for a hurried, one-stage approach to massive emissions reductions. Time always is an essential element when developing and testing new technologies and when researching costs and benefits to the environment of various levels of emissions reduction.

On December 14, 2000, EPA announced that mercury air emissions from power plants should be regulated and that power plants should be required to use maximum achievable control technologies. Although EPA acknowledged that sufficient information still was not available to determine how to accomplish this feat, proposed regulations are scheduled for release in December 2003, with final regulations to be issued by December 2004, and with compliance required by December 2007.

EPA's recent strategy to regulate mercury air emissions differs greatly from the regulatory methods followed for other chemical compounds that have been EPA's focus in the past—particularly sulfur dioxide and nitrogen oxides. The differences include:

- Magnitude and sources of releases
- Cost of regulatory technology per unit of pollutant removed
- Differences between compounds and elements
- Status of development of control technology
- Proven efficiency of monitoring technology
- Phased-in reductions versus seemingly immediate and large reductions

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Magnitude and Sources of Releases. Mercury in coal is the source of mercury air emissions from coal-fired power plants. However, the mercury content in the average

U.S. coal is quite low. Total U.S. utility mercury air emissions are estimated to be between 45 and 48 tons per year. Furthermore, power plants are not the sole source for the release of mercury into the environment. In addition to mercury emitted from various natural sources, thousands of tons per year were released in the United States and around the world as a result of mercury's common use during the 20th century in many products and chemical processes.

Because it is a volatile element, mercury can continue to recirculate in the environment once it is released. So little is known about the cycling of mercury in the environment that the relative importance of various mercury sources in the ultimate formation of the toxic form of mercury—methylmercury—cannot be determined. Furthermore, very little is known regarding the difference in natural releases of mercury when compared with the re-circulation of past human-caused mercury releases, and, in turn, when compared with current power plant releases.

What is known is that U.S. utilities currently emit only about 2 percent of the annual global human-caused emissions of mercury, while Asia emits about half of the worldwide total. Since these mercury emissions eventually are scattered widely over the earth's surface as they are gradually washed out of the atmosphere, what will be the impact of strict regulations on utility air emissions from within the boundaries of the United States?

Cost of Control. While the benefit of controlling U.S. power plant emissions is unknown, the cost for environmental control equipment may be very high—in the range of $200 million per year for each ton of mercury removed. These costs, on a per-ton-of-pollutant-removed basis, are many orders of magnitude higher than the costs of sulfur dioxide or nitrogen oxides removal (Figure 1). To meet the high removal efficiencies currently being discussed—90 percent—the total cost to the U.S. economy could easily reach $4.5 billion per year or more.

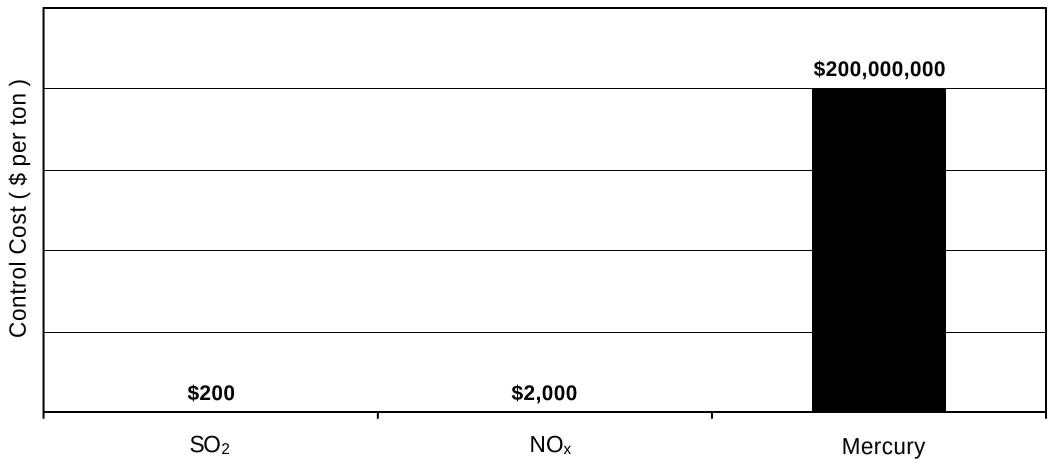

Figure 1. Comparison of control costs for sulfur dioxide, nitrogen oxides, and mercury for coal-fired power plants. Mercury costs assume activated carbon injection method.

Compound vs. Element. In contrast to most other pollutants, mercury is a chemical element that cannot be destroyed. It can only be converted from one form to another. If it is removed from flue gas, mercury will be deposited elsewhere, most likely being concentrated into solids that must then be disposed of.

Status of Control Technology. The current highly efficient removal of sulfur dioxide from coal-fired power plants is the culmination of over 30 years of research and development that included several expensive "wrong turns." In contrast, the development of control technology for mercury emissions from power plants is very new. It simply is not yet possible to know whether high removal efficiencies can be achieved at a commercial scale in the real world.

One promising technology for mercury capture is activated carbon injection, with a subsequent downstream baghouse used to collect the mercury-containing carbon. Unfortunately, very few coal-fired power plants are equipped with baghouses because of their very high cost. Moreover, the use of this technology to control mercury air emissions was only tested on a full-scale plant level for the first time in April 2001. And this test was limited to a few weeks because of extremely high costs. Similarly, the injection of activated carbon for subsequent collection by electrostatic precipitators presents many problems that have yet to be resolved. The presence of activated carbon in fly ash may prevent its beneficial reuse, thus, dramatically increasing fly ash disposal costs.

While the above-mentioned technologies currently are being promoted as the likely technologies of choice for mercury removal from flue gas, DOE, EPRI, EPA, and a number of electric utilities very recently have been investigating the combined use of scrubbers and selective catalytic reduction (SCR) technology for mercury removal. These SCR systems, currently being installed on a massive scale to reduce nitrogen oxide emissions, could make it easier for mercury to be removed using existing and planned environmental control equipment. This technique has been shown to remove up to 85 percent of the mercury from eastern bituminous coals, but it may not work well for all coals.

Monitoring Technology. To date, no mercury sensors have been found that can work reliably to detect actual emissions from power plant stacks and maintain accuracy over any substantial period of time. One of the measurement problems is the extremely low levels of mercury in the flue gas. Such poor monitoring performance is unacceptable in a regulatory environment where long-term reliability, accuracy, and precision are essential.

The Need for Phased-In Reductions. As mentioned earlier, the EPA is requiring that a single massive reduction in mercury emissions from coal- and oil-fired power plants be achieved in a matter of a few years. This timetable is in sharp contrast to past approaches. Why force many utilities to install unproven and expensive technologies at coal-fired plants when a phased-in series of mercury emissions reductions offer several significant advantages?

- First, significant, but as yet unquantifiable, mercury air emission reductions will likely be achieved over the next decade by the installation of already-mandated sulfur dioxide and nitrogen oxides emissions control equipment.
- Second, a phased-in approach would allow additional time to perfect mercury measurement and control technologies and to avoid costly failures that could also jeopardize the reliability of the electrical supply grid.
- Third, achieving initial, even though somewhat modest, mercury air emission reductions would allow time for additional scientific study of the many issues surrounding mercury in the environment. Some examples include:

(1) determining the relative magnitude of various sources of mercury emissions, including those in other countries; (2) establishing the form and fate of these various mercury air emissions; and (3) gaining a better understanding of how, when, and how much mercury is converted to toxic methylmercury forms.

EPA has allowed several stages in the U.S. sulfur dioxide reduction program, spanning a period of about 30 years. Similarly, nitrogen oxide reductions currently are being phased in as part of a regulatory process that began in the early 1990s and probably will continue until the end of this decade, 2010 at least. The current situation with mercury, as well as the lessons learned from history and experience, would seem to argue strongly for EPA to consider a similar "take-it-slow" approach in the regulation of mercury air emissions.

NOTE: This issue is a summary of a longer article, "Mercurial Standards," by Thomas A. Burnett, that appeared in *Forum for Applied Research and Public Policy*, Fall 2001, 16(3):34-42.

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