

Testimony to the Pennsylvania House of Representatives Environmental Resources & Energy Committee

**Dr. Terrence M. Sullivan
Environmental Research and Technology Division
Brookhaven National Laboratory
Upton, New York**

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Chairman Adolph and members of the Committee, thank you for the opportunity to appear before you today to discuss research conducted on the impacts of mercury deposition arising from coal-fired power plants. This testimony will include a review of the literature on mercury deposition emphasizing measurements within ten miles of a coal-fired power plant, a review of Brookhaven National Laboratory's work on mercury deposition and the potential for hot spots, and the impacts that the deposition may have in terms of health effects.

Mercury Emissions and Deposition

Mercury is everywhere in the environment. Release of mercury to the air comes from natural and man-made processes. Natural releases of mercury comprise approximately two thirds of all emissions and arise from continual release from water, soils, and vegetation, as well as catastrophic events such as forest fires and volcanoes. Man-made releases of mercury arise from combustion, as well as other uses of mercury containing materials. Mercury emissions from coal-fired power plants in the United States are approximately 46 tons per year, roughly one third of all man-made sources. Thus, mercury emissions from coal-fired power plants account for 11 percent of all emissions in the U.S. Of the 150 tons per year of mercury emitted from man-made sources in the U.S., one third of this amount deposits within the U.S., while the remainder enters the global mercury cycle.

If the Clean Air Interstate Rule (CAIR) and the Clean Air Mercury Rule (CAMR) as currently proposed by the U.S. Environmental Protection Agency (EPA) were implemented, mercury emissions from coal-fired power plants would be reduced 70 percent to fifteen tons per year by 2018. The EPA estimates that mercury deposition would be reduced 8 percent on average in the Eastern United States. Independent estimates by the Electric Power Research Institute predict a 2.6 percent reduction in deposition in Pennsylvania.

Mercury emissions from coal-fired power plants are categorized into three types, depending on how readily they deposit. These types are elemental mercury, reactive gaseous mercury, and particulate mercury. Elemental mercury is not soluble in water and enters the global mercury cycle. Reactive gaseous mercury and particulate mercury are soluble and readily deposit during precipitation events. These two forms of mercury deposit more readily under dry conditions than elemental mercury. The percentages of the three types of mercury emitted from a coal-fired power plant depend on the type of coal, plant characteristics, and pollution control technologies. Particulate and reactive gaseous mercury are removed easily by filters and other means, whereas elemental mercury is not. Based on 1999 data mercury emissions data collected from 81 coal-fired power plants for the EPA, 54 percent of emissions are elemental mercury, 43 percent are

reactive gaseous mercury, and 3 percent are particulate mercury. Modeling suggests that 50 percent of the reactive gaseous mercury will deposit within 300 miles of a large coal-fired power plant and less than 2 percent of elemental mercury will deposit over this distance. This is consistent with the observation that one third of the mercury emitted by man-made processes deposits within the borders of the U.S.

Hot-Spots

The currently proposed CAMR is based on the cap-and-trade principal that limits the total mercury emissions from all plants, but permits any single power plant to have emissions in excess of a specified rate for a cost. This has led to concerns that there may be hot-spots of mercury contamination near power plants. Partially because of this concern, many states including Pennsylvania have implemented, or are considering, state regulations that are stricter on mercury emissions than those in the CAMR.

Prior to determining if coal-fired power plants create mercury hot spots, we must define what is meant by a hot spot. Although the term “hot spot” appears frequently in the health and environmental literature, precise definitions do not. A “hot spot” is a region whose properties exceed those generally expected in the area. Although mercury emissions from a coal-fired power plant indeed constitute an emissions “hot spot,” they do not necessarily constitute a human health risk hot spot. The primary health risk from mercury is to the developing fetus through consumption of fish by the mother. Therefore, to pose a health risk hot spot, a women of child-bearing age would have to routinely consume high-mercury fish from an affected water body for several months. This requires a substantial body of water, of the order of tens of square kilometers near the plant. In addition, it requires demonstration that the emissions from the coal-fired power plant are responsible for the high levels of mercury in the fish. The EPA defines a utility hot spot as “a waterbody that is a source of consumable fish with Methylmercury tissue concentrations, attributable solely to utilities, greater than the EPA’s Methylmercury water quality criterion of 0.3 mg/kg.” They also claim that under CAMR, there will be no utility hot spots. The EPA definition is difficult to prove or disprove because it would require knowledge of the levels of methylmercury in fish prior to the start of coal power use in the region. Thus, for the purposes of this discussion, a hot spot is a region of several square kilometers in which mercury concentrations are 2 to 3 times the expected value for the area.

Local Deposition

Let us look more closely at the evidence for increases in mercury deposition near coal-fired power plants. Several studies have examined the mercury concentrations in soil, sediment, vegetation, and fish within a few miles of a coal-fired power plants. The following summarizes our findings from published reports on the impacts of local deposition. In terms of excesses over background, the following increments have been observed within five miles of the plant:

- local soil concentration mercury increases of 30 to 60 percent, sediment concentration increase of 18 to 30 percent, and wet deposition increases of 11 to 12 percent,
- fish mercury increases of about 5 to 6 percent,
- environmental concentrations were consistent with background measurements at distances in excess of ten miles.

Brookhaven National Laboratory staff have conducted field studies at three large coal-fired power plants (Plant A, Kincaid, and Monticello) examining the mercury concentration in soil and vegetation within ten miles of the plant. Surface soil and subsurface soil samples were collected

to determine if the mercury concentration was related to deposition (higher surface levels of mercury) or soil characteristics (surface and subsurface levels equal). Vegetation samples were collected to examine mercury deposition patterns over the current growing season. Sixty-four to one hundred - twenty locations were sampled at the sites. As part of this work, deposition of mercury was modeled using local meteorological records and plant mercury emissions characteristics. The objectives of each study were to determine if the measured concentrations correlated with deposition model predictions, and to determine if local mercury hot-spots exist and could be attributed to deposition of mercury emissions from the coal-fired power plant. These studies found the following:

- At all three sites, there was no correlation between modeled mercury deposition and either soil or vegetation concentrations. Based on computer modeling, mercury deposition was primarily reactive gaseous mercury with much lower deposition from elemental mercury. Predicted deposition rates from emissions from coal-fired power plants would more than double the expected (background) deposition rate for a few square miles at Plant A to a tens of square miles at Monticello. However, doubling of soil or vegetation concentrations was not observed in the regions. Further, the measured mercury concentrations in soil and vegetation did not exhibit the predicted deposition pattern.
- Measured soil concentrations showed a range of values with the maximum value two to four times the average value. This is typical for environmental concentrations of many metals in soils. While there was a range of values in measured soil mercury concentrations, evidence for hot spots did not exist. Taking the highest measured soil mercury concentration and averaging this with the concentrations at the four to eight nearest sample locations, gave average values within 50 percent of the average of all samples. Thus, we did not see hot spots, large regions of elevated concentrations.
- At all three sites, the subsurface (5 to 10 centimeter depth) samples the mercury concentration correlated strongly with the surface samples (0 to 5 centimeter depth). This suggests that the soil composition, and not deposition, plays a major role in determining the level of mercury in soil.
- Estimates of the percentage of total mercury emitted from the plant and deposited within ten miles ranged between 0.3 and 1.7 percent. A similar range is estimated using the measured soil concentrations. These small percentages of deposition are consistent with other empirical findings of only minor perturbations in environmental levels, as opposed to hot spots, near the plants.

To summarize, the results of these three studies showed that a few percent of the mercury emitted from the coal-fired power plant deposited within ten miles of the plant, the soil and mercury vegetation concentration patterns did not match the predicted deposition pattern, and large regions of elevated mercury were not seen.

Health Impacts

A complete discussion of health impacts is beyond the scope of this testimony. However, a convenient method for examining health impacts is to assess the percentage of the population that has mercury levels in their body above the EPA's reference dose level. The EPA's reference dose is the level at which EPA believes that exposures below this level pose no risk to the individual. The reference dose for mercury is set at 1/10 of the value of the lowest observed health effects based on epidemiological studies. These health effects are degraded performance in memory or coordination skills. The most recent National Health and Nutrition Evaluation

Survey (NHANES) measured mercury levels in the general population and determined that approximately 6.5 percent of women of child-bearing age are above the EPA's reference dose. Assuming that the combined effects of CAIR and CAMR reduce deposition by 8 percent in the Eastern U.S. and that this translates into an 8 percent reduction in mercury exposure and using the current NHANES distribution, 6.1 percent of the population would be above the reference dose level. This is an improvement of 0.4 percent. This assumes that all of the fish levels of mercury would decrease by 8 percent. In fact, they would decrease by less because much of the fish consumed in this country is from the Ocean or the West Coast which will not see as large a reduction in deposition.

Summary

There is a concern that mercury hot spots near coal-fired power plants might arise. From a public health perspective, such a hot spot must be attributable to the power plant and it must affect water bodies large enough to support a population of subsistence fishers. The results of the three studies performed by Brookhaven National Laboratory indicate that these conditions have not been met. Our results suggest that only a few percent of the mercury emitted deposits within 10 miles of the plant, large regions of elevated mercury concentrations were not seen, and mercury concentrations did not match the predicted deposition pattern. In terms of health effects as measured by the percentage of the female population with mercury levels above the EPA reference dose level, CAIR and CAMR may reduce the this percentage by at most 0.4 percent.