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Mercury Emissions from Electric Generating Units: A Review of EPA Analysis and MACT Determination

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January 21, 2005

Abstract. A number of controversies have arisen concerning the proposed MACT standards. In general, critics argue that the proposed standards are not sufficiently stringent to meet the statutory requirements for MACT. The EPA responds that technology to meet more stringent standards is not currently available, and that the standards reflect the best performance achieved by currently installed control equipment. This report examines this controversy, i.e., whether the proposed MACT standards do reflect the best emission control achieved at existing coal-fired electric generating units as required by statute. This report begins by describing the statutory requirements and the standards proposed by EPA. It then proceeds to describe the sampling methods used by EPA to generate data on existing mercury control levels. The methodology used by EPA to determine the proposed MACT standard, based on the sampling data, is described. Finally, some of the comments received by EPA on the proposed standards are reviewed.

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Summary

The Environmental Protection Agency (EPA) has identified mercury as the hazardous air pollutant emitted from electric generating units that is of greatest public health concern. As a result, EPA proposed regulations limiting electric generating unit (EGU) mercury emissions. In December 2000, EPA committed to promulgating Maximum Achievable Control Technology (MACT) emissions limits under Section 112 of the Clean Air Act.

Section 112 sets specific requirements for MACT standards. For new facilities, the MACT standard must be at least as stringent as the degree of emissions control achieved at the best controlled similar source. For existing facilities, the MACT standard must generally achieve limits equal to the average performance of the best 12% of comparable sources. Determination of this performance is complicated by the lack of installed commercial technology specifically for capture of EGU mercury emissions, thereby necessitating data collection on other existing technologies and extensive analysis of potential control levels. To determine the level of allowable mercury emissions, EPA collected data regarding coal composition and mercury emissions from an 80 EGU sample. Analysis of these data led EPA to subcategorize EGUs and propose MACT standards for each subcategory in January 2004.

The proposed MACT standards have been criticized by a wide range of stakeholders on several criteria, including EPA methodology to determine the allowable emissions threshold. The EPA methodology incorporates two statistical treatments, the use of, first, a 97.5% upper confidence limit to account for the variability in input coal, and, second, another 97.5% upper confidence interval to account for variance in plant operation. The result is proposed standards that are substantially less stringent than the average emissions rate of the top 12% of the 80 unit sample. While EPA justifies these statistical treatments, others assert they unnecessarily weaken the proposed regulation. Indeed, the proposed MACT standard allows a greater amount of mercury emission than most stakeholders, from all viewpoints, had recommended prior to the EPA proposal. The proposed MACT standards (pounds of mercury per trillion Btu) are shown, along with the average mercury emission and the results of the first statistical treatment, in the table below.

Coal Subcategory	Average Measured Mercury Emission	Average 97.5% Upper Confidence Limit	Proposed MACT Level
Bituminous	0.1	1.1	2.0
Subbituminous	0.8	3.1	5.8
Lignite	5.0	7.8	9.2
IGCC	5	6	19
Waste Coal	0.09	0.14	0.38

The EPA has agreed to promulgate final mercury emission standards by March 15, 2005 for EGUs. Whether these standards should follow the proposed regulation in its current form, an alternate form, or through an alternate mechanism is a topic of likely congressional interest. This report will not be updated.

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Note: Thomas Chapman is on detail with the Congressional Research Service from the National Science Foundation.

Mercury Emissions from Electric Generating Units: A Review of EPA Analysis and MACT Determination

Introduction

Mercury is a heavy metal and potent neurotoxin that bioaccumulates and concentrates as it passes through the food chain. The Environmental Protection Agency (EPA) considers it "both a public health concern and a concern in the environment."[1] These concerns have grown in recent years as research has indicated mercury's presence at significant levels in numerous species of fish. Analyses of human dietary intake and resulting levels of mercury in blood have pointed to potential health risks from mercury ingestion, particularly for women of child-bearing age.[2]

To limit mercury exposure, 45 states have issued fish consumption advisories.[3] At the same time, EPA and the states have promulgated a series of regulations to reduce the amount of mercury used in products[4] and limit emissions for most sources of mercury emitted to the atmosphere.[5]

U.S. emissions of mercury to the air come from eight principal sources. Of these, the largest source, and the only major source for which emission standards have not yet been promulgated, is coal-fired electric generating units. Coal-fired

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[1] U.S. EPA, "Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units," 65 Federal Register 79830, December 20, 2000.

[2] For specific information see U.S. EPA, "Office of Children's Health Protection, *America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses*, 2nd edition, February 2003. See also Kathryn R. Mahaffey, "Methylmercury: Epidemiology Update," presented at U.S. EPA National Forum on Contaminants in Fish, San Diego, CA, January 26, 2004, p. 5, available online at [http://www.epa.gov/waterscience/fish/forum/2004/presentations/monday/mahaffey.pdf].

[3] Twenty-one states (primarily in the Midwest and Northeast) have issued statewide advisories for mercury in all their freshwater lakes and/or rivers. In all, these advisories cover more than 13 million acres of lakes and roughly 767,000 river miles. Eleven states, primarily in the South, have statewide advisories for mercury in their coastal waters. In addition, Hawaii has a statewide advisory for mercury in marine fish. For more information, see U.S. EPA, Office of Water, "National Listing of Fish Advisories," Fact Sheet, August 2004, p. 4, available at [http://www.epa.gov/waterscience/fish/advisories/factsheet.pdf].

[4] For more information, see *Mercury in Products and Waste: Legislative and Regulatory Activities to Control Mercury*, CRS Report RL31908 by James E. McCarthy.

[5] For more information, see *Mercury Emissions to the Air: Regulatory and Legislative Proposals*, CRS Report RL31881, pp. 2-4 (federal regulations) and p. 7 (state regulations).

electric generating units account for between one-third and one-half of total U.S. mercury emissions. In January 2004, EPA proposed regulations to limit emissions from these units, positing two possible control mechanisms. One is to establish Maximum Achievable Control Technology (MACT) standards for emissions of mercury from coal-fired electric power plants; the other is to develop a cap-and-trade mechanism for those same emissions. This report focuses on the proposed EPA MACT standards, including critiques thereof, and does not treat the proposed cap-and-trade alternative model.

A number of controversies have arisen concerning the proposed MACT standards. In general, critics argue that the proposed standards are not sufficiently stringent to meet the statutory requirements for MACT. The EPA responds that technology to meet more stringent standards is not currently available, and that the standards reflect the best performance achieved by currently installed control equipment.[6]

This report examines this controversy, i.e., whether the proposed MACT standards do reflect the best emission control achieved at existing coal-fired electric generating units as required by statute. This report begins by describing the statutory requirements and the standards proposed by EPA. It then proceeds to describe the sampling methods used by EPA to generate data on existing mercury control levels. The methodology used by EPA to determine the proposed MACT standard, based on the sampling data, is described. Finally, some of the comments received by EPA on the proposed standards are reviewed.

Maximum Achievable Control Technology

On January 30, 2004, under Section 112(d) of the Clean Air Act, the EPA proposed the establishment of Maximum Achievable Control Technology (MACT) standards for emissions of mercury from coal-fired electric power plants.[7] The standards rely on the statutory requirements in Section 112(d)(3) of the Clean Air Act, which states that for new sources, "the degree of reduction ... shall be not less stringent than the emission control that is achieved in practice by the best controlled similar source." For existing sources, the degree of reduction shall be (with some qualifications) "not less stringent, and may be more stringent than ... the average emission limitation achieved by the best performing 12 percent of the existing sources (for which the Administrator has emissions information)...," or, if there are fewer than 30 sources in a category or subcategory, it shall be not less stringent than "the average emission limitation achieved by the best performing 5 sources (for

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[6] U.S. EPA, *Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units,* Preamble, Section IV.D.2, 69 Federal Register 4698, January 30, 2004.

[7] Standards were also proposed for nickel emissions from oil-fired power plants, but these standards have not proven as controversial, and are not discussed in this report.

which the [EPA] Administrator has or could reasonably obtain emissions information)....”[8]

The statute establishes a minimum requirement (a “MACT floor”), but it explicitly permits the Administrator to impose more stringent requirements. It is unclear how often EPA has used this authority to go “beyond the floor,” although two examples of the Agency’s doing so involve mercury controls imposed on municipal and medical waste incinerators in the mid-1990s.[9] This report focuses on EPA’s calculation of the current MACT floor for mercury emissions from coal-fired powerplants, not whether the Agency should have gone beyond it.[10] Thus, this report will not discuss at any length beyond-the-floor technologies or standards.

No U.S. power plant has, as yet, installed emission control technologies specifically designed to capture mercury emissions. Therefore, the currently proposed MACT floor for these sources relies on calculations of mercury removal rates (“co-benefits”) achieved by other technology that was installed to control sulfur dioxide, particulates, or other regulated pollutants. The EPA’s objective was to identify the technologies designed for other pollution control objectives that have the maximum level of these co-benefits for mercury emissions.

The proposed MACT standards for mercury emissions from coal-fired powerplants are shown in **Table 1**. Using the authorities provided in Section 112(c) and (d), EPA divided coal-fired plants into five subcategories — four based on coal type (bituminous, subbituminous, lignite, and coal refuse) and the fifth based on combustion technology (integrated gasification combined cycle, also known as IGCC). Each type of coal has differing properties and mercury contents. Additionally, the number of facilities burning each type of coal varies, with the majority of facilities burning bituminous or subbituminous coal. The EPA set standards that vary by as much as a factor of 30, depending on the coal type. The most stringent standards apply to coal-refuse-fired and bituminous-fired facilities, while the other categories have less stringent standards. As shown in **Table 2**, the size of the five subcategories also varies widely: 95% of the existing units fall into

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[8] 42 U.S.C. 7412

[9] At the time these regulations were promulgated, these technologies were considered “beyond the floor,” although now they are standard controls on incinerators. The most common of the technologies is activated carbon injection (ACI), which, when used with a fabric filter (or “baghouse”), captures more than 90% of mercury emissions from incinerators. Similar technology has been the subject of successful full-scale field tests at at least four coal-fired power plants, but has not yet been commercially installed.

[10] Considerable controversy has arisen over whether EPA is correct in deciding not to go “beyond the floor.” This determination is generally supported by industry groups, who agree that mercury-specific controls are not commercially available. Others, including environmental groups and some state and local agencies, contend that because technologies such as ACI exist, EPA’s MACT standards for mercury from electric utilities should have been more stringent by imposing standards that would be achieved by the use of ACI or some other promising technology. For an example, see comments from State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials, Docket ID No. OAR-2002-0056 (June 29, 2004), p. 3.

the bituminous or subbituminous groups while the other three subcategories have relatively few units.

The proposed standards would apply on a unit-by-unit basis for each unit with a capacity greater than 25 megawatts electric (MW); but the proposal allows facilities three forms of flexibility in achieving compliance. First, emissions can be averaged among all of the units at a facility.[11] A large power plant commonly has several units, so this provision might allow facilities to comply by installing stringent controls on one or more of their units, while leaving other units uncontrolled.

Second, compliance will be determined not by whether a facility is within the standard continuously, but by whether the rolling 12-month average of emissions is within the standard. This would allow a facility to exceed the standard for days or weeks, provided that it lowers emissions sufficiently at other times during the 12 months to offset peak emissions. The EPA states that use of an averaging period is appropriate because mercury emissions from power plants are not an acute health hazard.

Table 1. Proposed MACT Emission Limits for Coal-Fired Electric Generating Units

	Emission Limit for Existing Sources		Emission Limit for New Sources
	Input Basis or	Output Basis	
Unit Type	(lb Hg/TBtu)[a]	(10^{-6} lb Hg/MWh)[b]	(10^{-6} lb Hg/MWh)[b]
Bituminous-fired	2.0	21	6.0
Subbituminous-fired	5.8	61	20
Lignite-fired	9.2	98	62
IGCC	19	200	20
Coal-refuse-fired	0.38	4.1	1.1

Source: 69 Federal Register 4662, January 30, 2004. Limits for all sources are based on a 12-month rolling average.

[a] Pounds of mercury per trillion British thermal units.
[b] Millionths of a pound of mercury per megawatt-hour.

Third, the standards for existing facilities are expressed both in input-based (lbs/trillion Btu) and output-based (lbs/megawatt-hour) form. Output-based standards provide an incentive for more efficient generation: a plant that can exceed the efficiency factor used by EPA to correlate the input-based and output-based standards would be able to burn more coal before reaching the mercury emissions limit.

[11] A facility is defined as "a contiguous plant site where one or more electric utility steam generating units are located."

The proposed standards do not include a percentage emission reduction requirement. The EPA estimates that the standards would result in emissions of 34 tons of mercury from the affected sources, a 29% reduction as compared to the 1999 emission level of 48 tons.[12]

Sampling

The MACT standard is based on data obtained during an information collection request (ICR) initiated by the EPA in April, 1998 to gather data on mercury emissions from electric generating units.[13] The industry was canvassed and those data were used to determine the amount of mercury emitted with respect to the coal burned. The collection of comprehensive data is key to understanding the range of possible plant configurations, coal compositions, and subsequent mercury emissions.

EPA recognized that competing considerations, the cost of the data collection effort versus the comprehensiveness of the data obtained, were important factors in determining the final number of sites sampled.[14] The EPA decided that, due to the factors of cost and effectiveness, 3 units would be selected for each combination of mechanical sulfur dioxide control, coal type, and particulate matter control.[15] This led to a maximum of 135 units considered, assuming that at least three units populated each combination.[16] In practice, no site existed for several of the combinations. Data was subsequently obtained from 80 sites and considered to establish the MACT floors.[17] **Table 2** provides a comparison of the number of existing coal-fired power plants to the number of plants used to determine the proposed MACT standard.

EPA Methodology for Generating MACT Levels

EPA chose to subcategorize the mercury-emissions data by unit type because of the different mercury collection characteristics following combustion. A different MACT floor was determined for each of these categories by examining the mercury-emission rates. In the case of coal-refuse-fired, lignite-fired, and IGCC units, fewer than 30 units exist. For these subcategories, the MACT floor was to be established by the average emission limitation achieved by the best performing 5 sources. In the case of subbituminous-fired and bituminous-fired units, more than 30 units exist, and

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[12] 69 Federal Register 4661, January 30, 2004.

[13] 63 Federal Register, 17406, April 9, 1998.

[14] 63 Federal Register, 17408, April 9, 1998.

[15] The EPA referred to the last category as electrostatic precipitator control, though it included other forms of particulate control, such as fabric filters.

[16] Office of Air Quality Planning and Standards, *Standard Form 83-I Supporting Statement for OMB Review of EPA ICR No. 1858.01: Information Collection Request for Electric Utility Steam Generating Unit Mercury Emissions Information Collection Request*, U.S. EPA, Research Triangle Park, NC, p. 13, November 16, 1998.

[17] 69 Federal Register 4661, January 30, 2004.

so the MACT floor was to be determined by the best performing 12% of existing units.

Table 2. Existing Coal-Fired Electric Generating Units Compared to MACT Sample

Unit Type	Number of Existing Units	Number of Units in Sample
Bituminous-fired	701	32
Subbituminous-fired	236	32
Lignite-fired	24	12
IGCC	2	2
Coal-refuse-fired	17	2

Source: 69 Federal Register 4662, January 30, 2004. Memorandum from Clark Allen, RTI International to Jeffrey Cole, RTI International, December 2003.

The EPA found it necessary to statistically treat the data received from the information collection request. Because the mercury-emission measurements were limited in time, often described as a snapshot, EPA determined that it was necessary to project the probable mercury emissions from coal burned at the facility over the course of a year. Coal mercury-content and heating-value data were combined with estimates of control efficiencies, based on the observed data, of various air-pollution control equipment, in some cases taking into account the effect of coal chlorine level, to estimate the distribution of mercury emitted.[18]

Rather than use the directly measured mercury emissions, EPA chose instead to use the range of coal compositions reported by each plant to estimate an emissions value which would be exceeded no more than 2.5% of the operating time, the 97.5% upper confidence limit. The EPA considers this value to represent the operation of the unit under conditions reasonably expected to occur at each unit.[19]

Table 3 presents the average measured mercury emissions for the facilities included in the MACT determination, the results of the first statistical treatment, and the proposed MACT level for each coal subcategory.

[18] In cases where a sufficient correlation was established between the coal chlorine content and the emitted mercury, the coal chlorine content was used to predict mercury emissions from coal data. In cases where this correlation was insufficient, the estimated control efficiencies of the existing air-pollution control equipment was used to predict mercury emissions from coal data.

[19] 69 Federal Register 4673, January 30, 2004.

Table 3. Comparison of Measured Mercury Emissions, 97.5% Upper Confidence Limits, and Proposed MACT Standard
(in pounds of mercury per trillion Btu coal)

Coal Subcategory	Average Measured Mercury Emission[a]	Average 97.5% Upper Confidence Limit	Proposed MACT Level
Bituminous	0.1	1.1	2.0
Subbituminous	0.8	3.1	5.8
Lignite	5.0	7.8	9.2
IGCC	5	6	19
Waste Coal	0.09	0.14	0.38

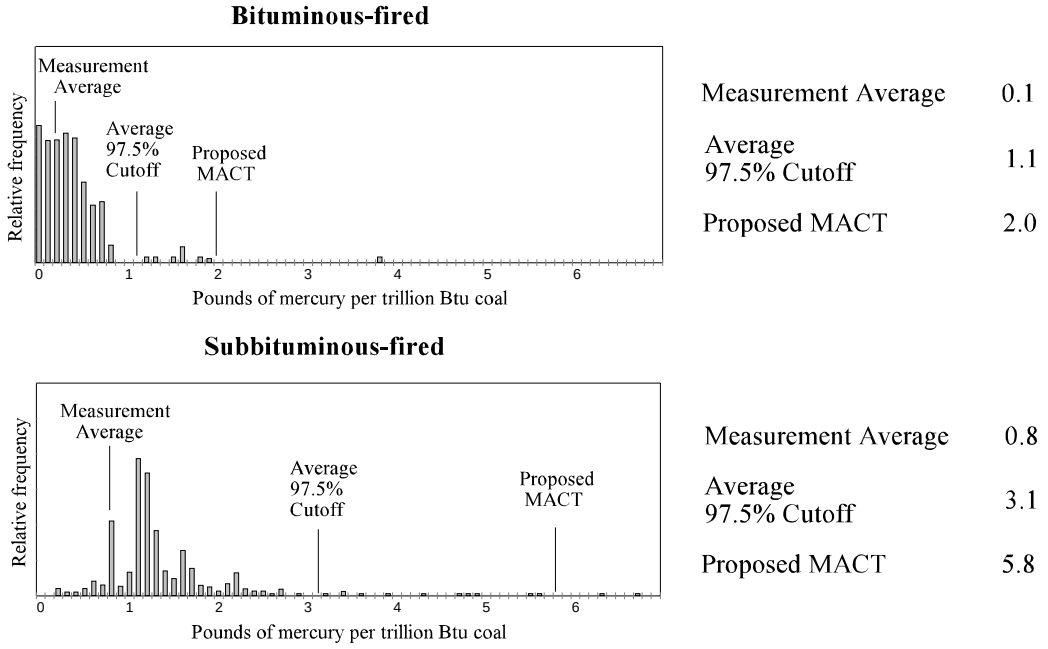
Source: CRS analysis from EPA data.

a. The average measured mercury emission is for those facilities directly included in the MACT determination, not for all facilities within the subcategory.

For bituminous and subbituminous-fired units, there are more than 30 established units; thus the MACT floor is established by the best performing 12% of units. The EPA determined that the sample obtained from the information collection request was representative of existing facilities, and therefore the best performing 12% of the sample would suffice to establish the MACT floor. In both the bituminous- and subbituminous-fired cases, EPA took the four units which had the lowest measured mercury emissions and combined the observed collection efficiencies with coal-composition values reported by those units over the course of a year to calculate the expected mercury emission. From these estimated emission rates, EPA determined, for each unit, the projected mercury-emission level that would not be exceeded more than 2.5% of the time. These four values were averaged, and their average was then statistically adjusted to a level which would not be exceeded more than 2.5% of the operating time. This second statistical adjustment is intended to reflect the possible variability in operation of different units burning the same fuel type.[20] This final value was assigned as the MACT standard. For a graphical representation of the effects of the statistical treatments on the MACT standard, see **Figure 1**.

[20] *Ibid.*

Figure 1. Effect of Statistical Treatment on Proposed MACT Standard for Bituminous- and Subbituminous-fired Facilities



Source: Figure developed by CRS from EPA data regarding coal composition for electric generating units chosen by EPA for determination of proposed MACT.
Note: The above figures display the EPA projected mercury emissions based on coal analyses of those facilities included in the MACT determination. The horizontal axis is displayed in units of pounds of emitted mercury per trillion Btu coal. The vertical axis is displayed in relative frequency, the number of times a projected mercury emission was predicted for a given value divided by all predictions for that facility. The data has been normalized by CRS so as to appropriately weight uneven reporting between facilities. The average 97.5% cutoff is the average of the upper-97.5% confidence limit determined from the calculated distributions for each set of facilities. The measurement average refers to the average mercury emissions measured for the facilities included in the MACT standard determination, not the average mercury emissions measured for all facilities of that subcategory. The incorporation of each statistical treatment serves to make the proposed MACT standard less stringent.

Similarly, for lignite-fired units, the observed mercury emissions from the five best performing units were adjusted to reflect the coal variability, being adjusted to a value which would be exceeded no more than 2.5% of the operating time, and then averaged. This average value was then adjusted so that it would not be exceeded more than 2.5% of the operating time. This final value was assigned as the MACT floor.

For IGCC and coal-refuse-fired units, EPA had mercury-emissions data from only two units, even though the MACT floor is to be set from the five best performing units.[21] The EPA used the same method as was used to determine the MACT floor for lignite-fired units, except that they only used the data for the two units.

[21] While there are only 2 existing IGCC units, there are 17 existing coal-refuse-fired units. The information collection request only gathered data from 2 coal-refuse-fired plants.

The outcome of the EPA efforts to account for variations with fuel composition within the performance of a single unit and between different units burning the same types of coal is to significantly increase the MACT floor. The resulting MACT floor is higher than the average of the measured emissions and higher than the emissions average corrected for coal variability in all cases. For a graphical example of the effect of the statistical treatments on the MACT analysis for other MACT subcategories, see **Appendix A**.

Alternate Interpretations

EPA received over 680,000 public comments on its 2004 proposed mercury rule, including almost 5,000 unique comments.[22] The comments represent another phase in a regulatory process that began in earnest with EPA's 1998 identification of mercury as the hazardous air pollutant emitted by electric utilities that was of the "greatest potential concern."[23] Many of these comments build on recommendations provided by forums and stakeholder groups that met before release of the 2004 proposal.

During the formulation of the proposed mercury rule process, EPA convened a stakeholder forum called the Utility MACT Working Group. Consisting of industry, environmental groups, and state and local agencies, the working group attempted to develop recommendations to assist EPA in setting a utility mercury MACT. Unable to develop consensus, the working group's efforts resulted in separate sets of recommendations from four groups of stakeholders: (1) an environmental group;[24] (2) a state and local agencies group;[25] (3) a major industry group;[26] and (4) a minority industry group (the Clean Energy Group, CEG).[27] Many

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[22] Environmental Protection Agency, *Proposed National Emission Standards for Hazardous Air Pollutants*; Notice of Data Availability, p. 10.

[23] U.S. EPA, *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units — Final Report to Congress*, 1998.

[24] Environmental Stakeholders included Natural Resources Defense Council, National Wildlife Federation, National Environmental Trust, Clean Air Task Force, and Environmental Defense.

[25] State and Local Agencies included The Northeast States for Coordinated Air Use Management (NESCAUM), State and Territorial Air Pollution Program Administrators / Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), State of New Jersey, and the Regional Air Pollution Control Agency (Dayton, Ohio).

[26] Majority Industry Group included Cinergy, National Mining Association, West Associates, Latham & Watkins, Southern Company Generation, the United Mine Workers of America, the Utility Air Regulatory Group, the Class of 85 Regulatory Response Group, American Public Power Association, and the National Rural Electric Cooperative Association.

[27] CEG members included PG&E National Energy Group, Consolidated Edison, Public Service Enterprise Group, Conectiv, Exelon Corporation, KeySpan, Northeast Utility, and Sempra Energy.

of the comments subsequently received by EPA referred to recommendations developed during this process.

As analyzed and summarized by the Northeast States for Coordinated Air Use Management (NESCAUM) in **Table 4**, the four stakeholder groups developed recommendations considerably different from each other and from EPA's proposal.[28] The following observations are among those that can be made:

- Unlike EPA's proposal, all the stakeholder groups determined that fluidized-bed combustion (FBC) units could achieve a more stringent mercury MACT than other facilities.

- Like EPA's proposal, the industry groups used some form of subcategorization, generally based on coal type, while the environmental group and state and local agencies group did not.

- EPA's variability analysis resulted in less stringent MACT floors than those discussed or recommended by any of the four stakeholder groups.

The rationale behind these recommendations intersect in interesting ways with the rationale of EPA's proposals. These interactions are evident in the comments various members of these groups submitted in response to the EPA proposal. The following **Table 4** examines these intersections in three categories: the recommended mercury emission standard, the relevant annual mercury baseline (in tons), and the post-MACT annual mercury emissions (in tons).

[28] See NESCAUM, *Mercury MACT Under the Clean Air Act: An Assessment of the Mercury Emissions Outcomes of Stakeholder Group Recommendations* (May 8, 2003). The National Mining Association (NMA) characterized the MACT floor attributed to the majority industry group as "illustrative," not definitive recommendations. See NMA, Docket ID No. OAR-2002-0056 (May 14, 2004), p. 9.

Table 4: Pre-proposal Stakeholder Group Recommendations

Stakeholder Group	Recommended Mercury Emission Standard	Relevant Annual Baseline (tons)	Post-MACT Annual Emissions (tons)
Environmental Stakeholders	• 0.19 lbs/TBtu for FBC facilities • 0.21 lbs/TBtu for all other facilities for all coal types	44.6	1.9
State and Local Agencies	• 0.4-0.6 lbs/TBtu for bituminous and subbituminous coal	41.5	6.3-6.7
Clean Energy Group (CEG)	• 0.320 lbs/TBtu for bituminous or subbituminous FBC facilities • 11.984 lbs/TBtu for lignite FBC facilities • 1.223 lbs/TBtu for all other bituminous or subbituminous boilers • 9.091 lbs/TBtu for all other lignite boiler types	44.6	13.1
Majority Industry Group[a]	• 3.7 lbs/TBtu for hot stack bituminous facilities • 2.2 lbs/TBtu for saturated stack facilities burning bituminous coal • 3.2 lbs/TBtu for wet stack facilities burning bituminous coal • 4.2 lbs/TBtu for subbituminous facilities • 6.5 lbs/TBtu for facilities burning lignite • 2.0 lbs/TBtu for FBC facilities	44.6	25.0-30.0
Environmental Protection Agency Proposed MACT	• 2.0 lbs/TBtu for bituminous coal facilities • 5.8 lbs/TBtu for subbituminous coal facilities • 9.2 lbs/TBtu for lignite coal facilities • 19 lbs/TBtu for IGCC facilities • 0.38 lbs/TBtu for waste coal facilities	48	34

Source: NESCAUM, *Mercury MACT Under the Clean Air Act: An Assessment of the Mercury Emissions Outcomes of Stakeholder Group Recommendations* (May 8, 2003), Appendix A, and 69 Federal Register 4662, January 30, 2004.

Note: NESCAUM's analysis generally uses a 44.6 ton annual mercury baseline (instead of EPA's 48 ton estimate) because a small subset of units in EPA's Utility Air Toxic Study database lack either the coal supply or mercury emissions data used to calculate projected mercury reductions. NESCAUM further reduced the baseline for the State and Local Agency Stakeholder group as that group's recommendations did not cover the 11 lignite units (3.1 tons mercury) contained in the database.

a. The National Mining Association (NMA) characterized the MACT floor attributed to the majority industry group as "illustrative," not definitive recommendations. See NMA, Docket ID No. OAR-2002-0056 (May 14, 2004), p. 9.

Sampling Concerns

While the EPA is confident the data sample is representative of the industry,[29] others have raised concerns whether the method used to select both the number of sites sampled and the specific sites included in the dataset provides sample data representative of those units already employed in industry settings. For example, the National Mining Association (NMA) states:

> The ICR emissions data represent, at best, a limited 'snap shot' of emissions from a few units, taken over a very short period of time, with a limited number of fuels, and cannot account for the wide variability of coals and process conditions encompassed by the full fleet of U.S. utility boilers. In addition, the units chosen by EPA for mercury emissions sampling in the ICR program is [sic] unrepresentative of U.S. coal-fueled power plants.[30]

Based on an analysis conducted for NMA by AEMS, LLC (a consulting firm), that found inadequacies and biases in the EPA 80 unit sample, NMA states:

> As a result of these inadequacies the ICR Part III data cannot be used to identify and evaluate the emissions performance of specific units that would rank in the top 12 percent of their subcategory (or among the 5 best) on an annual basis.[31]

Indeed, NMA argues that the data and related analysis are so flawed that EPA should abandon a MACT-based form of mercury regulation, stating that if EPA proceeds: "NMA and its members reserve all potential objections to such standards arising under the Data Quality Act and other applicable provisions of Federal law."[32]

The State of Missouri, Department of Natural Resources, contending that the MACT standard, at least with respect to subbituminous coal, is too lenient, states:

> The Missouri source calculations indicate that the proposed MACT emission limitation for existing subbituminous coal-fired units is too lenient. This leniency was likely caused by a sampling error resulting from basing the determinations on a sample population too small to be representative of the norm. In this case, the sample size of 32 units used to determine the floor greatly increased the likelihood of sampling errors.[33]

The EPA determined that an appropriate experimental design for the ICR was to vary three parameters, coal type, sulfur dioxide control technology, and particulate

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[29] 69 Federal Register 4670, January 30, 2004.

[30] National Mining Association, Docket ID No. OAR-2002-0056 (May 14, 2004), p. 9.

[31] NMA, Docket Number OAR-2002-0056 (May 14, 2004) pp. 16-17.

[32] NMA, Docket Number OAR-2002-0056 (May 14, 2004) p. 43.

[33] Department of Natural Resources, State of Missouri, Docket ID No. OAR-2002-0056, p. 9-10.

matter control technology, and include one facility for each combination.[34] Some groups have questioned whether an experimental strategy including a more proportionate distribution of facilities or including technologies that are in development, but not yet implemented, would have provided for a more stringent mercury standard. For example, NESCAUM asserts that EPA's attempts to treat variability in the ICR data is flawed, in part, due to the lack of any data from mercury specific controls, such as activated carbon injection.[35] The EPA has stated that mercury-specific control technologies are not yet commercially available for electric generating units, and will likely not be commercially available prior to 2010, and therefore consideration of these technologies in determining the MACT floor would be incorrect.

Subcategories and MACT Floor Levels

A primary source of disagreement about EPA's proposal is the use of subcategories. While Section 112(d) provides the EPA Administrator with the authority to subcategorize MACT standards, the criteria for determining these subcategories are not defined. The EPA used a combination of coal types (bituminous, subbituminous, lignite) and firing configurations (IGCC, boilers) to develop subcategories within the utility mercury MACT. This decision has proven highly controversial, both with respect to the subcategories chosen, and the MACT floor determination for each subcategory.

Environmental groups have attacked the proposed subcategories as "without rational basis, arbitrary and capricious."[36] The groups note that many sources, including some in EPA's data sample, use a blend of different coal types and that combustion technologies vary little with respect to coal type burned. In addition, these groups state that many boilers have some flexibility to adapt to different coal feedstocks. Also criticizing the use of subcategories, the State of New Jersey suggests in its comments that because the proposed standard for subbituminous coal is nearly three times that for bituminous coal, utilities may be able to comply with the proposed MACT standards by simply switching coal supplies, emitting more mercury than before.[37] That the weaker subbituminous proposal could encourage western subbituminous coal production at the expense of eastern bituminous production has been expressed by eastern coal interests.[38]

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[34] Office of Air Quality Planning and Standards, *Standard Form 83-I Supporting Statement for OMB Review of EPA ICR No. 1858.01: Information Collection Request for Electric Utility Steam Generating Unit Mercury Emissions Information Collection Request*, U.S. EPA, Research Triangle Park, NC, p. 28, November 16, 1998.

[35] NESCAUM, Docket Number OAR-2002-0056 (June 29, 2004) p. 5.

[36] Comments of Eleven Environmental and Public Health Organizations, Docket ID No. OAR-2002-0056 (June 29, 2004) p. II-7.

[37] Department of Environmental Protection, State of New Jersey, *EPA's Proposed MACT Floor Standards for Mercury Emissions from Coal-fired Utility Units: A Statistical and Analytical Assessment*, (July, 2004) pp. 11-12.

[38] For example, see "EPA's Leavitt Promises Mercury Rule Will Treat Coal Types Equally," (continued...)

These groups believe that the MACT floor should not be stratified by coal type, but should be a simple average of the best performing facilities.[39] By eliminating coal type and EPA's variability adjustment, the environmental groups' joint comments developed a MACT floor of 1.0 (10^{-6}lbs/MWh output basis) — higher than the environmental stakeholders recommended levels in **Table 4**, but generally more stringent than EPA's proposal. In a similar vein, NESCAUM found that if the average observed mercury emissions from the top-performing 12% of EPA's 80 unit data sample, regardless of coal type, was used as the emissions standard, an emissions reduction of 91.1% would be achieved, in comparison with the predicted 29% reduction in mercury emissions expected under EPA's proposed MACT standard.[40]

Most industry groups agreed with EPA's determination that subcategories were appropriate, but disagreed on their specification. In particular, several commenters argued that North Dakota and Gulf Coast lignite should be regulated separately, not combined. Stating that mercury content of Gulf Coast lignite was at least double that of North Dakota lignite, the Edison Electric Institute (EEI) argued that the proposed lignite standard would be unachievable for units using Gulf Coast lignite.[41] Other concerns were expressed about the absence of any units burning Powder River Basin subbituminous coal in EPA sample data.[42]

Variability and MACT Floor Levels

A major source of disagreement surrounding the proposed mercury rule is EPA's variability analysis. To determine the proposed standard, EPA used a methodology to identify and quantify expected variability in mercury emissions because of the variability of mercury in coal. The result is proposed standards that are substantially less stringent than the simple average emissions rate of the top 12% of its 80 unit sample.

This variability analysis has come under particular scrutiny by all parties. Environmental groups label the analysis as "statistical gimmicks" that result in MACT floors that represent "virtually the worst short-term emissions from the worst performing of the best units, and assumes that these pollution levels will persist through the year."[43] One of the more detailed analyses of EPA's methodology has been done by the State of New Jersey. In a white paper by its Department of

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[38] (...continued)
Energy Washington Week (December 8, 2004).

[39] The environmental groups would allow MACT levels stratified by firing configuration. As noted earlier, both groups believe that "beyond the floor" regulation should be promulgated.

[40] NESCAUM, Docket Number OAR-2002-0056 (June 29, 2004) p. 3.

[41] EEI, Docket Number OAR-2002-0056 (June 29, 2004) pp. 54-55.

[42] NMA, Docket Number OAR-2002-0056 (May 14, 2004) p. 14.

[43] Comments of Eleven Environmental and Public Health Organizations, Docket ID No. OAR-2002-0056 (June 29, 2004) p. II-25.

Environmental Protection, New Jersey attacks EPA's approach that uses variability in short-term peak emissions to set a standard that would be based on a 12-month rolling average,[44] stating:

> If it were essential to identify and quantify variability in emissions, the relevant measure of variability would be what was experienced over 12 months, not what was experienced in any single stack testing event. A transient peak in emissions during the 12-month period will not cause noncompliance with the standard, because lower emissions during the rest of the period will average out the effect of the peak. For that reason, using the short-term worst-case scenario to set an annual standard immediately makes the standard unnecessarily lax. If compliance is to be based on a long-term average, EPA should be estimating long-term averages, not worst case emissions, to determine the MACT floor.[45]

New Jersey proceeds to argue that EPA's proposed standards are indeed less stringent as a result of their variability analysis. Eliminating EPA's variability analysis, including subcategorization, would reduce the MACT floor to 0.18 lbs/TBtu. Alternately, if the data were only stratified by coal type, the average of the observed mercury emissions would be 0.12 lbs/TBtu for bituminous units, in contrast with the proposed MACT standard of 2.0 lbs/TBtu.

In contrast, while industry generally supported EPA's efforts, some industry analysis found that EPA insufficiently dealt with the mercury variability issue. In arguing for MACT floors substantially higher than EPA's proposal, NMA asserted that a combination of data quality and variability concerns require an increase in MACT floor estimates for new sources to 5.1 lbs/TBtu for bituminous units and 7.4 lbs/TBtu for subbituminous units.[46] According to analysis by AEMS, LLC, the EPA MACT standards for new sources, when converted from an output basis to an input basis, are equivalent to 0.63 lbs/TBtu for bituminous units and 2.1 lbs/TBtu for subbituminous units.[47] As stated by NMA when comparing the converted standards developed by AEMS, LLC with those standards suggested by NMA: "These estimates of appropriate emission limits for new units are an order of magnitude higher than those estimated by EPA, reflecting AEMS' more comprehensive

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[44] Department of Environmental Protection, *EPA's Proposed MACT Floor Standards for Mercury Emissions from Coal-fired Utility Units: A Statistical and Analytical Assessment*, (July, 2004).

[45] Department of Environmental Protection, *EPA's Proposed MACT Floor Standards for Mercury Emissions from Coal-fired Utility Units: A Statistical and Analytical Assessment*, (July, 2004), pp. 3-4.

[46] NMA also argued in its comments that "the combination of uncertainty in the emissions analysis and repeat test variability means that the MACT floors for new units must admit the possibility of measured emission levels in excess of the mercury content of the coals (negative removals)." See NMA, Docket Number OAR-2002-0056 (May 14, 2004) p. 34.

[47] In converting from an output basis to an input basis, AEMS LLC assumed a heat rate of 9,500 Btu/kwh. AEMS, LLC, *Review and Critique of Data and Methodologies Used in EPA Proposed Utility Mercury MACT Rulemaking*, (April 2004) p. 79.

approach to variability analyses, as well as the use of available data on mercury content of U.S. coal."[48]

Conclusion

The proposed regulations to limit mercury emissions from electric generating units have been criticized by a wide range of stakeholders based on several criteria, including the method used by EPA to determine the allowed emissions threshold. The proposed emissions threshold incorporates two statistical treatments. This serves to make the proposed MACT standard less stringent than the average of the actual emission measurements, and less stringent than the recommendations of stakeholders, including industry and environmental groups, prior to the MACT proposal. While EPA justifies these statistical treatments as necessary to account for the variability in input coal and plant operation, others assert that they represent a significant, unnecessary weakness of the proposed regulation. Whether mercury emissions from electric generating units should be controlled via the proposed regulation in its current form, an alternate form, or through an alternate mechanism is a topic of likely congressional interest.

[48] NMA, Docket Number OAR-2002-0056 (May 14, 2004) p. 35.

Appendix A: Effects of Statistical Treatment

The effect of each statistical treatment performed by EPA serves to make the proposed MACT standard less stringent than the average of the measured mercury-emissions data. The EPA found it necessary to statistically treat the data received from the information collection request for several reasons. First, the mercury-emission measurements were limited in time, often described as a snapshot, and may not represent the actual emissions performance of the facility. As a consequence, EPA projected the probable mercury emissions from coal burned at the facility over the course of a year.

The EPA developed these projections through one of two methods. In the case of some equipment configurations, it was determined that a correlation between the mercury emissions and the coal chlorine-content existed. In these situations, the coal chlorine content was used to predict the mercury emissions. In other cases, a suitable correlation did not exist. In these situations, the mercury emissions for that facility were determined by using an empirical estimate of the control efficiency for mercury of existing emissions-control equipment. By obtaining these projected mercury emissions, EPA was able to determine the expected mercury emissions level over a twelve-month period.

The EPA took the projected mercury emissions, developed from the coal compositions reported by each plant, and determined the emissions value which would be exceeded no more than 2.5% of the operating time, the upper 97.5% confidence limit.[49] The EPA considers this value to represent the operation of the unit under conditions reasonably expected to occur at each unit.

The proposed MACT standard was then determined from the average of these upper 97.5% confidence limits. Once the average of the upper 97.5% confidence limits was determined, a second statistical treatment was performed to determine the variation between the units. From this variation, a calculation was made to determine what the upper 97.5% confidence limit would be for these averaged units.[50] This value was then set as the MACT standard.

The number of facilities averaged depended on the subcategory considered. In the case of bituminous- and subbituminous-fired facilities, 4 facilities were included in the MACT standard determination. For lignite-fired facilities, 5 facilities were included. For waste-coal-fired facilities and integrated gasification combined cycle (IGCC) facilities, 2 facilities were included.

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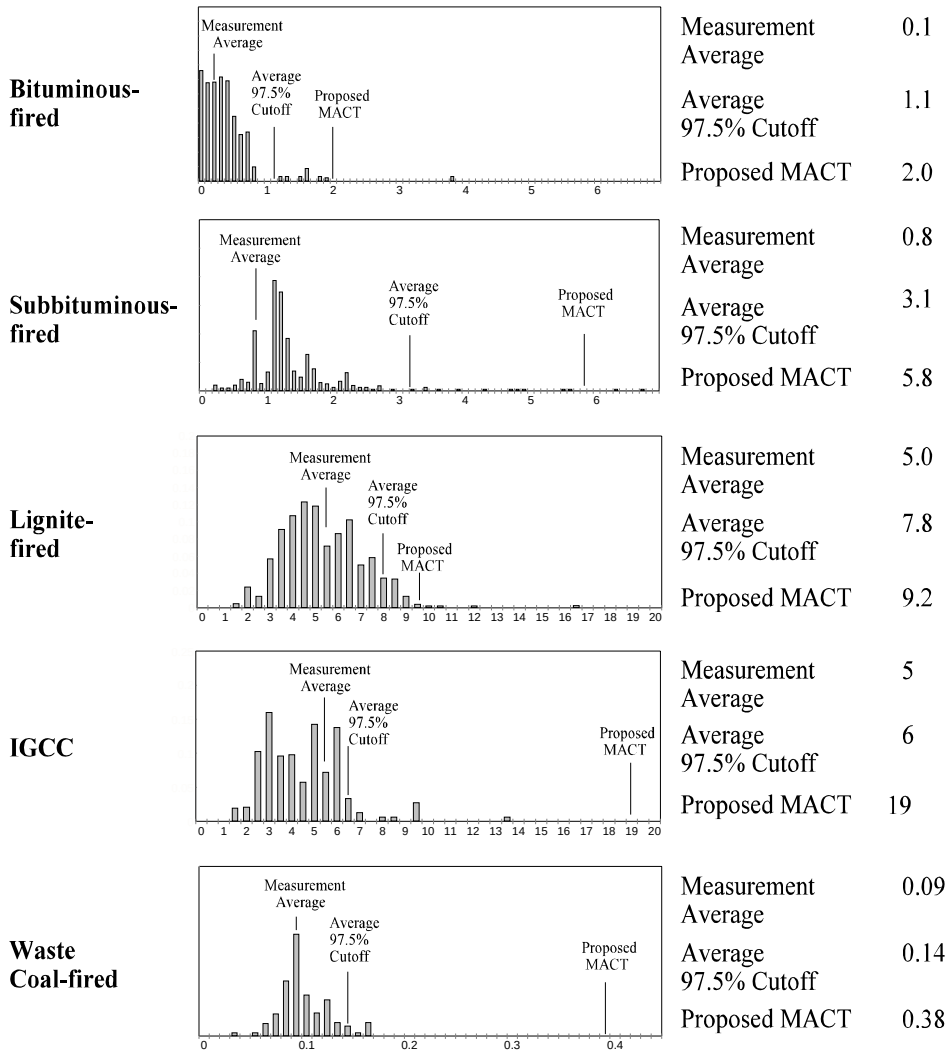
[49] The data at the extremes of the distribution, i.e. the highest and lowest measurements, play a predominant role in determining the confidence interval. Therefore, the quality of these measurements is crucial, since any inaccuracies in this data will be magnified in the calculation of the confidence interval.

[50] The number of facilities averaged influences the width of this confidence interval. The greater the number of facilities averaged together, the lower the uncertainty regarding the distribution of these values. This lower uncertainty translates to a narrower confidence interval.

The effects of EPA's statistical treatment of the data is shown graphically in **Figure 2**.

Figure 2. Proposed Mercury MACT Relative to Projected Mercury Emissions for Facilities Used to Set MACT



Source: Figure developed by CRS from EPA data regarding coal composition for electric generating units chosen by EPA for determination of proposed MACT.

Note: The above figures display the EPA projected mercury emissions based on coal analyses of those facilities included in the MACT determination. The horizontal axis is displayed in units of pounds of emitted mercury per trillion Btu coal. The vertical axis is displayed in relative frequency, the number of times a projected mercury emission was predicted for a given value divided by all predictions for that facility. The data has been normalized by CRS so as to appropriately weight uneven reporting between facilities. The average 97.5% cutoff is the average of the upper-97.5% confidence limit determined from the calculated distributions for each set of facilities. The measurement average refers to the average mercury emissions measured for the facilities included in the MACT standard determination, not the average mercury emissions measured for all facilities of that subcategory.