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MEMORANDUM

FROM: Ralph L. Roberson, P.E. 

DATE: August 1, 2011

SUBJECT: Comments on EPA's 2011 Proposed Utility MACT Rule

INTRODUCTION

On May 3, 2011 EPA proposed its National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units¹ (76 Fed. Reg., 24,976). Because the emission standards set forth in this NESHAPs are based on emission reductions assuming application of maximum achievable control technology (MACT), such rules are often referred to as "MACT rules" or "MACT standards." I, in my capacity as a Senior Consultant with RMB Consulting & Research, Inc. was asked to review and to provide technical comments on EPA's proposed EGU MACT Rule. Specifically, I was asked to focus on the proposed emission limits that affect new, coal-fired units, recognizing that the emission limits for new units are applicable to any EGU that commenced construction after the proposed MACT Rule was published in the Federal Register.

Based on my review of the proposed MACT Rule, and based on my ~40 years of experience in air pollution control, I have significant concern that new coal-fired electric generating units will be unable to meet the standards for new units in EPA's proposed MACT rule.² If my concerns are correct and EPA fails to increase the emission limits in the final rule, the result will be that constructing new coal-fired electrical generation capacity in the United States will no longer be a viable option. The basis for my conclusion is provided in this memorandum.

OVERVIEW

Over the 20 plus years since the U.S. Congress amended Section 112 of the Clean Air Act (CAA), it has generally become accepted that EPA is required to determine MACT floors for new units that reflect the emission control that is achieved in practice by the best controlled similar source. On first glance, this may appear to be a relatively straightforward procedure. However, in reality, determining what "achieved in practice" actually means as well as defining a similar source has proven to be very challenging for the Agency.

I have several levels of concern as to the effect the new unit emission limits presented in Table 1 of the proposed rule will have on new coal-fired units.³ First, EPA employs what has become known as a "Franken-Plant" approach to set emission limits for individual hazardous air

¹ 76 Fed. Reg., 24,976 (May 3, 2011).

² My review and reference to new coal-fired units does not include IGCC units, which are regulated in a different subcategory from coal-fired units in EPA's proposed MACT rule.

³ 76 Fed. Reg., 25,124 (May 3, 2011).

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pollutants (HAPs) under which no single existing unit has been shown to meet all of the proposed standards. Second, given the huge database generated by EPA's massive 2010 EGU information collection request (ICR), simple probability theory informs us that there will be some extremely low concentrations measured – even though those measurements likely cannot be replicated. Third, when EPA identifies the best performing unit as the one with the lowest emissions, the Agency is often working with data points that are at or below the method detection limits.

TECHNICAL DISCUSSION

Franken-Plant Approach

The way in which EPA developed its proposed MACT emission limits has become known as the “Franken-Plant” approach. EPA has determined each individual MACT limit based on emissions of the best performing unit for that particular pollutant or HAP. In reality, however, no actual single plant meets all of the MACT standards that EPA has proposed, just as Dr. Frankenstein's fictitious monster bore no resemblance to an actual human being.

Although EPA's “Franken-Plant” approach for setting emission limits for existing sources is equally flawed to the Agency's approach for setting emission limits for new sources, it is easier to demonstrate and comprehend the Agency's error for new sources. The relevant statutory provision is, *the maximum degree of reduction in emissions that is deemed achievable for new sources in a category or subcategory shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source.*⁴ Note that the statute refers to a single source – not multiple sources. If Congress had intended for EPA to set emission limits based on a “Franken-plant” approach, the statute would read -- *best controlled similar sources.*

Using three EPA spreadsheets that the Agency posted on one of its web sites,⁵ it is fairly straightforward to determine which individual unit EPA used to set the MACT floor for new units. Those units are listed in Table 1. From Table 1, it should be obvious that no existing unit meets all of the proposed emission limits for a new EGU.

Table 1. EPA's Franken Plant Approach For New Units.

Pollutant	Facility	99% UPL (lb/MWh)	Total Metal Ranking
Total PM	AES Hawaii	0.049	11 th
Total Metals	Cedar Bay Unit A	3.3×10^{-5}	--1 st --
Antimony (Sb)	AES Hawaii Unit 2	7.6×10^{-8}	11 th
Arsenic (As)	Oak Grove Unit 1	1.6×10^{-7}	104 th
Beryllium (Be)	Chamber Cogen Unit 2	2.2×10^{-8}	7 th
Cadmium (Cd)	Walter Scott Unit 4	3.7×10^{-7}	3 rd
Chromium (Cr)	PSEG Mercer Unit 1	1.7×10^{-5}	56 th
Cobalt (Co)	Cholla Unit 3	7.2×10^{-7}	62 nd

⁴ 42 U.S.C. §7412(d)(3), emphasis added.

⁵ See, *floor_analysis_coal_pm_031611.xlsx, floor_analysis_coal_hcl_031611.xlsx, and floor_analysis_coal_hg_051811.xlsx.*

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Lead (Pb)	Oak Grove Unit 1	8.8×10^{-7}	104 th
Manganese (Mn)	Weston Unit 4	3.1×10^{-6}	3 rd
Nickel (Ni)	Weston Unit 4	3.2×10^{-6}	3 rd
Selenium (Se)	PSEG Mercer Unit 1	2.5×10^{-5}	56 th

Hydrogen Chloride (HCl)	Logan Unit 1	2.6×10^{-4}	n/a
Mercury (Hg)	Nucla Unit 1	1.7×10^{-5}	n/a

In the above table, I have included dotted horizontal lines to differentiate among the optional emission limits for non-Hg metallic HAPs. The mercury and hydrogen chloride limits must be complied with individually, independent of the option chosen for non-mercury metallic HAPs.

I believe Table 1 clearly demonstrates the fallacy in the EPA's Franken-Plant approach. Consider the following EPA statements:

For the non-Hg metallic HAP, we chose to use PM as a surrogate. Most, if not all, non-Hg metallic HAP emitted from combustion sources will appear on the flue gas fly-ash. Therefore, the same control techniques that would be used to control the fly-ash PM will control non-Hg metallic HAP.⁶

Oak Grove Unit 1 is EPA's basis for two individual metallic HAP emission limits, arsenic and lead. The key question is how or what control technology could the Oak Grove owners add to meet the other metallic HAP limits given (1) EPA's statement that the same control techniques that work for fly-ash PM also work for non-Hg metallic HAPs and (2) Oak Grove is already the best performing unit for not one but two non-Hg metallic HAPs. EPA's rejoinder to this argument may very well be that compliance with the individual non-Hg metallic HAP limits is an option and not a requirement. This is an inadequate response and misses the point. EPA should not be permitted to base a portion of a suite of emission limits upon the performance of a single unit when that same unit cannot comply with the other enforceable components of that same suite of emission limits. Moreover, the unit that formed the basis for one of the regulated HAPs (e.g., total PM) may not meet one of the other mandatory limits (e.g., HCl). AES Hawaii Unit 1 is the basis of the new unit total PM limit, but the HCl results reported in the ICR data are 66 times the proposed new unit HCl limit. Nucla Unit 1 is the basis of the new unit total Hg limit, but the total PM results reported in the ICR data are almost an order of magnitude higher than the proposed new unit total PM limit.

Best Performing Similar Source

Section 112(d)(3) of the CAA has been interpreted to direct EPA to set emission limits for new sources no *less stringent than the emission control that is achieved in practice by the best controlled similar source*. As noted in Table 1, EPA's PM limit for new coal-fired EGU units is based on test results from AES Hawaii Unit 1. AES Hawaii is the only coal-fired plant in Hawaii, and the plant has a generating capacity of 180 MW. Unit 1 is only capable of supplying

⁶ 76 Fed. Reg. 25,039, col. 3 (May 3, 2011).

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one-half of the steam required by the 180 MW turbine/generator, so Unit 1 in effect has a capacity of 90 MW. The AES Hawaii unit burns coal, which is imported from Indonesia. To supplement the imported coal, the unit also burns old tires, used motor oil, and carbon from Board of Water Supply filters. While EPA is mandated to set limits for new sources based on the *maximum degree of reduction in emissions that is deemed achievable*, such degree of emission control must be *achieved in practice by the best performing similar source*. It is quite clear there is not or most probably will not be another similar source to AES Hawaii in the continental United States.

Beyond the *similar source* issue, I believe EPA made a computational error in converting the AES Unit 1 total PM results from input units (lb/10⁶ Btu) to output-based units (lb/MWh). EPA mistakenly assumed that both AES units have a capacity of 180 MW; in point of fact, the capacity of the two-unit plant is 180 MW. This error is easily verified in EPA's spreadsheet, because the spreadsheet shows Unit 1 to have a heat rate of 5.03 million Btu per MWh, when the correct value is exactly twice that or 10.06 million Btu per MWh. When I correct the heat rate or conversion error in three individual total PM runs and simply repeat EPA's UPL calculation, I obtain 0.10 lb/MWh. Even as an unrepresentative unit that AES Hawaii may be, it does not support an emission limit of 0.05 lb/MWh.

EPA's approach is also flawed with respect to "achieved in practice." It is possible and perhaps even likely that emission rate at which the AES Hawaii Unit 1 was tested at is not achieved very often. Clearly, EPA analysis has no way of knowing whether the reported AES emission rate can be achieved 10 percent of the time, 50 percent of the time or maybe even 90 percent of the time. Regardless, EPA has used this value to propose an emission limit that must be complied with continuously and even include periods or start-up and shutdown. However, EPA has placed no data or analysis in the rulemaking docket to demonstrate that its proposed emission limits can be achieved in practice.⁷

Issues With EPA's Variability Analysis

EPA's attempt to address emission variability through the use of an upper prediction limit (UPL) is fundamentally flawed. The UPL approach does not accomplish what the Agency purports it to accomplish. Failing to address variability correctly means EPA's proposed rule is technically

⁷ I am aware of some informal discussion that EPA may realize that the AES Hawaii Unit 1 is not a representative unit to rely on for setting the PM standard and that it might now seek to justify its proposed, new unit PM limit based on the performance of NRG's Dunkirk Unit 1. I observe at least three problems with such a potential revision. First, the EPA spreadsheet that is posted on the web and used to calculate the PM floors for coal-fired units is linked directly to AES Hawaii for the new unit PM limit. Second, Dunkirk Unit 1 has a new fabric filter and a dry sorbent injection (DSI) system. However, Dunkirk 1 does not comply with EPA's proposed new unit HCl emission limit. Undoubtedly, Dunkirk will need additional technology (e.g., flue gas desulfurization (FGD) system) to comply with the new unit HCl limit. Since the mist eliminators required by FGD systems are less than 100 percent efficient, I would expect PM emissions to increase on the Dunkirk unit once an FGD system is installed. (This is another fallacy in EPA's "Franken-Plant" approach.) Third, the same EPA spreadsheet that shows AES Hawaii to be the basis of the new unit PM limit (UPL = 0.049 lb/MWh) also shows that Dunkirk's UPL is equivalent to 0.14 lb/MWh. Thus, if EPA wishes to rely on Dunkirk Unit 1 rather than AES Hawaii Unit 1, it will have to significantly increase the new unit PM emission limit.

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deficient and also at odds with several rulings by the D.C. Circuit Court of Appeals.⁸ EPA used the following formula to estimate the UPL for the best performing unit:

$$UPL = \bar{x} + t(0.99, n - 1) \times \sqrt{s^2 \left(\frac{1}{n} + \frac{1}{m} \right)}$$

Where:

n = the number of test runs for best performing source

m = the number of test runs in the compliance average

\bar{x} = mean of the data for top performing unit

t(0.99, n - 1) = 99th percentile of the T-Student distribution with n - 1 degrees of freedom

s² = variance of the data from the top performing source.

The problem with EPA's approach is that the Agency is applying the UPL formula to very incomplete data, especially for the new unit analysis. For each HAP, EPA typically has three sampling runs that were performed very close in time (i.e., at a maximum, over 3 consecutive days) for the single, best performing unit. The variance (s²) that EPA calculates using the formula above is only representative of a very limited set of operating conditions and probably little, if any, fuel variability. Thus, EPA is only predicting the 99th percentile of a very limited range of operation and not necessarily a level that can be complied with at all times and under all operating conditions.

Issues With Detection Limits

EPA's handling of measurements at or below method detection limits (MDLs) exacerbates the variability flaws discussed above. For example, the proposed emission limit for hydrogen chloride (HCl) for new, coal-fired units is 0.30 lb/GWh. This limit is based on measurements from Logan Unit 1, all of which are reported to be less the MDL. EPA's proposed MACT floor for HCl is calculated as three times the highest MDL for the three sampling runs. In other words, the HCl floor is based in one constant (3) multiplied by another constant (MDL). Thus, the proposed HCl limit is not only based on non-detected concentrations, but also fails to account for any process variability.

A simple calculation further demonstrates why the proposed HCl limit for new units is neither feasible nor achievable, expect perhaps for a unit burning coal with low chlorine content. The proposed limit, 0.30 lb/GWh, is equal to 0.000033 lb/10⁶ Btu, assuming a heat rate of 9,000 Btu/KWh. As the following calculation shows, to burn bituminous coal with a nominal chlorine content equal to 750 ppm will require approximately 99.95 percent removal to comply with the proposed new unit limit. This is a significant scrubbing requirement and will almost certainly require wet scrubbing.

⁸ See, for example, *National Lime Association v. EPA*, 627 F.2d 416 (DC Cir 1980) (holding that EPA failed to show how the standard proposed was achievable under the range of operating conditions that might affect the emission that was being regulated).

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$$HCl\ inlet = \frac{750\ ppm}{12,000\ Btu/lb} \times \frac{36.5\ lb\ HCl}{35.5\ lb\ Cl} = 0.064\ lb/10^6\ Btu$$

$$Removal = \frac{In - Out}{In} = \frac{0.064 - 0.000033}{0.064} \times 100\% = 99.95\%$$

It is inconceivable that any vendor would ever warrant or guarantee 99.95 percent removal of any pollutant. Another touchstone comparison that EPA staff apparently did not address is comparing the proposed existing unit HCl limit to the proposed new unit limit. The proposed limit for new units is 66 times more stringent than for existing units; yet all of the existing units selected for acid gas testing pursuant to EPA's 2010 ICR used either wet or dry scrubbing systems. There is no plausible explanation for how a new scrubber can be 66 times more efficient than the average of the best performing 12 percent of existing scrubbers.

Lastly, while working on several new coal-fired facilities (e.g., Plant Washington, Longleaf Energy and Holcomb 2) in various phases of the permitting process, I did not observe any willingness of PM control technology vendors to entertain performance guarantees below the range of 0.009 to 0.01 lb/10⁶ Btu. Of course, this was for filterable PM – not total PM. I do not believe it will be possible to obtain a performance guarantee for EPA's proposed total PM limit. If a prospective power developer cannot obtain a performance guarantee, project financing will be jeopardized and no new coal-fired units will be constructed.

Issues With the Form of the PM Emission Limits

EPA proposes to regulate total PM, which is defined as the sum of filterable PM and condensable PM, solely on the basis of the behavior of selenium (Se). I disagree with EPA's decision on several levels. First, there is overwhelming data (both historical and the 2010 EGU ICR) that support using filterable PM as the surrogate for antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, and nickel. While there is variability in the Se results, EPA's own data show exceptionally high removal percentages for all of the metals for all coals and all control technology configurations.⁹ EPA states that the results for Se removal were less consistent. However, when we examine EPA's results closely, it appears that EPA is trying to distinguish Se where there is very little real difference. For example, EPA states that the results for Se control were consistently very good when subbituminous coal was fired. EPA also states that when a fabric filter was the primary control device, Se control was consistently good. Thus, the only questionable configuration for Se control appears to be when bituminous coal is fired and an electrostatic precipitator (ESP) is the only control technology. I believe EPA has unnecessarily complicated the control and regulation of non-Hg HAP metals based on shaky technical grounds. My analysis of the ICR data leads us to conclude that a unit cannot comply with the emission limits in the proposed rule while burning bituminous coal and only having ESP control technology. EPA's own analysis projects the installation of fabric filters for 166 GW of capacity.¹⁰

⁹ 76 Fed. Reg. 25,038, col. 3 (May 3, 2011).

¹⁰ *Regulatory Impact Analysis of the Proposed Toxics Rule*, U.S. Environmental Protection Agency, p. 8-14, March 2011.

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Second, total PM consists of two components, filterable PM and condensable PM. Since no single EPA method measures both filterable and condensable PM, a minimum of two different EPA sampling methods must be utilized to determine total PM emissions. For the ICR, EPA specified OTM-28 for condensable PM measurement. Since the section 114 ICR letters were mailed by EPA to EGUs (December 2009), the requirements of OTM-28 have been incorporated into EPA Method 202, which is one of the proposed compliance methods. Method 202 has been flawed since it was issued by the Agency 20 years ago. Despite recent cosmetic changes to Method 202 by the Agency, the method remains flawed and yielded very inconsistent ICR test results. As EPA is aware, the Electric Power Research Institute (EPRI) has conducted numerous analyses on the EGU ICR data, and EPRI will be submitting detailed comments under its own cover. Among the EPRI results I am privy to are a series of regression analyses of the individual metals versus the various PM fractions (i.e., filterable, condensable and total). The PM component with clearly the least explanatory power was condensable PM. Part of the reason for lack of correlation is likely due to the poor quality of condensable PM data collected with EPA Method 202.

CONCLUSION

For the reasons provided in this memorandum, proposing MACT emission limits based on an EGU that is not similar to other EGUs; that no EGU in existence now meets; and that are below detection limits for many of the regulated HAPs is not a technically defensible approach. EPA's approach to setting MACT limits will, in all likelihood, result in reversible error that simply will lead to delay in new EGU construction without any quantifiable environmental benefits whatsoever.