Mercury Emissions from Coal-Fired Power Plants:

Emission Standards Discussion

Options Summary

The current draft of the of the Washington mercury rule considers requiring reductions in mercury emissions from existing facilities to meet the 2018 cap. To accomplish this, we are reviewing several options to establish emission standards for coal-fired power plants.

Options

1. Input based measurement, i.e., pounds per Trillion British Thermal Unit (TBTu)
2. Output based measurement, i.e., pounds per gigawatt hour (GWh)
3. Percent capture efficiency, i.e., % removal from raw coal content
4. Technology-based standard , i.e., installation of specific control technology

Assumptions

1. An emission standard would apply to all plants.
2. New plants are more efficient than existing plants. Therefore, it seems reasonable to hold them to a higher standard (lower emissions per unit of production).
3. The emission standard selected would have to be sufficient to meet the 2018 cap of 156 lbs.
4. One emission standard would be established for all coal types.
5. The standard must easily translate into a pound per year value for each plant.
6. The form of the standard should promote installation of efficient power plants.
7. The standard must be easily measured, simplifying compliance.

Discussion

Option 1: Input based emission limitation

Input-based limitations allow units with a lower operating efficiency to emit more pollution per megawatt of electricity produced than more efficient units. Considering two units of equal generating capacity, the less efficient unit will emit more per unit of electricity generated because it uses more fuel to produce the same amount of electricity. Examples of units like this are lb/MMBtu of heat input, lb/ton of fuel.

This option focuses the emission limitation on the raw material (coal) consumed in the unit rather than the amount of product produced. As such, there is little regulatory reason for the unit's owner to invest in projects to improve the unit's overall efficiency and effectiveness. Market forces working to minimize costs of production per unit of product will still exist outside of the regulatory requirements.

Option 2: Output based emission limitation

An output based emission standard would provide an incentive to enhance unit operating efficiency and reduce emissions. Using the scenario in Option 1, the less efficient unit would need to install more emission control to meet the emission limit compared to the more efficient unit. Examples of units like this are lb/MWh, lb/ton aluminum produced.

In general, output based emission standards reward new, highly efficient plants and those whose owners make regular investment in maintenance and upgrades in capacity and efficiency. This provides an additional regulatory reason to go with the normal business interests in minimizing the cost of production for an owner to reduce the cost of production.

In addition, the concentration output from the Continuous Emissions Monitor or Method 324 can be converted to an emission rate format in lb/TBtu or lb/MWh. Both methods give the plant credit for mercury removed from the coal through the process from scrubbers, coal washing, etc.

Option 3: Percent capture

Percent capture of mercury at a coal fired power plant can be evaluated in two ways: mercury capture from the coal as received at the plant to the stack or, the reduction provided across the whole emission control system or just a specific control device. This is the measure of control efficiency often specified in permits for VOC control equipment - % reduction of VOC across the control device.

While most states not using the EPA emissions allocation scheme are using (at least in part) the percent reduction from the coal, this is not the cheapest control method from the standpoint of monitoring or assuring that a given plant will meet is mercury allocation. In addition to the required stack sampling program, daily coal sampling is necessary in order to determine the mercury content of the raw coal. Using percent capture as the standard or emission limitation does not promote plant efficiency, but neither does it reward inefficiency. As implied above, where other states are using a percent capture standard, it is usually paired with an emission rate limitation (lb/year, lb/MW-h, etc.). Percent capture on its won does not control emissions significantly, but is simply a way to assure that a pollutant is removed from the exhaust flow. In the specific case of coal fired power plants, the coals used appear to have a range of mercury contents and is not homogenous or consistent. This impacts the ability to reliably convert a percent removal requirement to a pound per year limitation

Option 3: Install specified control technology

Under the control technology option, the rule would require a specific technology must be installed on a particular unit. There would potentially be a specified set of emission controls specified for each applicable emission unit. An assumption would be that installation of the specified control technology would equate to compliance with the emission standard. Such an approach currently exists in our regulations for a few source categories.

A likely control technology choice for an installation at a new or existing pulverized coal unit is the use of a brominated Activated Carbon Injection system and a fabric filter.[1] Emissions reductions that could be expected by such a system would be in the range of 90 – 93% from current emission rates. While ACI injection can eliminate the potential to

[1] http://www.icac.com/files/public/POWER_GEN_2005_Durham.pdf

sell the fly ash to make concrete, there alternatives being explored and implemented to work around or eliminate this problem.

For installation on an IGCC plant, the likely control technology would be use of sulfur impregnated activated carbon bed plus routine bed change out.

A downside of Option 3 is that the Washington rule would still need to include a provision for converting the control technology effectiveness to a pounds per year limit for each plant to ensure we remain under our emissions cap. Further, specifying a technology could be considered to be in conflict with one of the features of the BACT process – to force control technology advancements.

Recommendation

We propose Option 2, the output based limitation as our primary emission standard for this rule. We propose that Option 1, the input based measurement, continue to be evaluated for effectiveness and appropriateness. Continuing our further evaluations with these two options for compliance provides additional flexibility in determining the final limitations in the rule. The rule would not prescribe the technology to be used to meet the standard, leaving that decision to the source.

Tiered Approach to Emission Standard

New plants are more efficient than existing plants. Therefore, it seems reasonable to hold them to a higher emissions control standard. If so, what would be a reasonable approach to include in the rule?

Option A – Age-based standard

a. New plant
b. Old plant

Option B – Technology based standard

a. Pulverized coal
b. IGCC

Option C – One standard for all

Option A: Aged based standard

Under this option, new plants and old plants would have different emission standards to meet. This approach would likely require an existing plant to meet a specific emission limitation and direct a new plant to meet the lower of BACT or the existing plant limitation. This is reasonably functional and looks like what we do today in normal new source review.

The difficulties under option A is that it conceptually does not differentiate between different power plant technologies; i.e., pulverized coal and IGCC.

Option B: Technology based standard

Under this option, specific technologies for the major coal fired power plant technologies could be evaluated and different emission limitations reflecting the ease of each power plant type to control mercury emissions.

To be careful, this option should not set limits that substitute for BACT, but instead set the minimum emission control requirements necessary.

Option C: Uniform standard

Under this option we would set one emission standard that does not differentiate between power plant technologies but instead focuses on how to divide the limited mercury emissions pie between the competing facilities and interests.

This is conceptually the simplest approach in that the focus is on assuring the total emissions limit for the state is not exceeded rather than some level based on current control technology that will undoubtedly change in the future.

Of these 3 options, Option C is the simplest of all in that it is not dependent on reality, but is simply a methodology to divide the limited mercury emissions cap.

Emission Standard Discussion

Rationale for proposing 0.6 pounds/TBtu

This number represents a targeted reduction of about 90% for the existing power plant.

Rationale for proposing 0.0087 pounds per gigawatt hour

This value is based on an evaluation by the state of Arizona of the capabilities of existing control systems on a family of western sub-bituminous coals.

"An October 21, 2005, EPA document indicates that the maximum mercury content for sub-bituminous coals is 9.1 lb/TBTU. The EPA document states "the analysis was based on a reasonable maximum Hg content in coal (represented by the 90th percentile of measured Hg concentrations in coal) as listed in the ICR coal data (ICR-2)". The resulting limit is 0.0087 pounds per gigawatt-hour." (Arizona Mercury rule response to comments October, 2006)[2]

Rationale for proposing 0.0088 pounds per gigawatt hour

This value assumes that we need to divide the 2018 Washington mercury allocation between the public health set aside, Centralia, and PMEC. The net output of the 2 power plants is roughly a 70%/30% split. Applying this to the 140 lb/yr remaining after the public health set aside is removed results in a per net gigawatt – emission rate of 0.0088 lb/GWh.

[2] http://www.azdeq.gov/function/laws/download/mercurysub.pdf Arizona Notice of Final Rulemaking. Page 7.