Virginia City Hybrid Energy Center
Response to Data Request
Bruce Buckheit, Member, Virginia Air Pollution Control Board

Question (Page No. 12):

The mercury controls considered by DEQ are a combination of spray dryer absorber, activated carbon injection and a fabric filter PM removal system. Again, DEQ provides no rationale as to why the most effective control strategy did not include use of coal washing techniques.

Response:

USEPA considered coal washing techniques during its development of a proposed MACT Floor for new coal-fired boilers in 2003. In a memorandum to Bill Maxwell of USEPA from Jeffrey Cole of RTI International entitled "MACT Floor Analysis for Coal- and Oil-Fired Electric Utility Steam Generating Units National Emission Standards for Hazardous Air Pollutants", December 2003, USEPA provides its evaluation of coal washing in regard to establishment of MACT Standards for new coal-fired units.

That report states "Pursuant to current EPA policy, the development of all MACT standards must consider, as a potential MACT control strategy, any pollution prevention techniques that could reduce or eliminate the pollutants of concern from being produced by the process." EPA considered the use of different coals, including pre-processing (washing). Analysis of the data collected by USEPA indicated that not all mercury contained in coal is created equal, citing differences in speciation of the mercury in the fuel as a major factor.

According to USEPA "The data show that although a coal may have a lower Hg loading in the coal, the Hg emissions may be more difficult to control if that seam of coal tends to speciate to Hg to an elemental form." Dominion's understanding is that washing of Virginia coal may reduce its mercury content by 5-30% (depending on the seam, mining technology, size distribution, differences in specific gravity, etc.). The reason that washing can reduce mercury at all is that some of the mercury present in ROM coal is bound in the rock (rock mercury) that is separated from coal during washing. That mercury that is contained in the structure of the coal itself is not affected by washing. EPA also determined that mercury contained in rock is primarily released in the form of particulate mercury when burned in a CFB boiler, a form of mercury that is very efficiently collected. The "coal mercury", on the other hand, is substantially released as elemental mercury and much more difficult to capture. The data available to EPA showed that CFB's burning coal that includes mercury bound in rock emit *less* mercury/MMBtu fired than units firing high Btu bituminous (washed) coal.

Lower annual emissions may result from actually burning waste coal and unwashed ROM. Coal refuse, or waste coal, is known to contain a higher concentration of Hg per ton of coal than high Btu, or washed bituminous coals. This is presumably because the waste coal includes all of the rock that had been historically washed out of ROM coal. However, EPA determined that CFB units firing waste coal (including an extreme % of rock mercury) emitted substantially less Hg from their stacks than those burning high Btu Eastern Bituminous coals. EPA went on to propose a MACT Floor for boilers that burn waste coal (the extreme opposite of washed coal) that was lower than for units burning high Btu washed Bituminous coal.

Since a Best Available Control Technology (BACT) analysis is not required for mercury, coal washing techniques were not assessed in the PSD permit application. With regard to the MACT permitting process, we are not aware of any other facility that has been required to assess coal cleaning to reduce mercury emissions.

According to a study from Virginia Tech, conventional coal preparation may be able to remove upwards of 30% of the mercury from coal in Virginia. While potentially reducing small amounts of mercury in the coal, washing also reduces chlorine content which acts to reduce mercury emissions by oxidizing the mercury. Washed coal also causes the boiler to operate at a higher temperature thus driving up thermal NOx. In addition, using a high Btu, low ash coal greatly reduces the amount of biomass that can be fired, due to the alkaline content of the wood. This high alkaline content causes corrosion in the boiler. Using 12,000 Btu/lb coal would reduce the amount of biomass that can be burned to no more than 5%.

As has been stated for other pollutants, it is important to note that as uncontrolled mercury emissions decrease, it becomes increasingly difficult to maintain the same control efficiency. The analysis below is purely hypothetical and Dominion is not stating that lowering the coal mercury content would have a direct affect on mercury emissions coming from the stack.

Dominion conducted the following control cost analysis for mercury removal on the basis of coal washing. The analysis is based on a comparison of the design coal which is 7,782 Btu/lb and a typical washed coal of 12,500 Btu/lb, and assuming a 0.3511 ppm mercury content (basis for the proposed limit of 49.46 lbs/yr) for the design coal and 0.2458 ppm mercury content (30% reduction from 0.3511) for the washed coal.

VCHEC Coal	Parameter	Washed Coal
7,782	Coal Heat Content (Btu/lb)	12,500
6,264	Boiler Rating (mmBtu/hr)	6264
3,525,613	Potential Annual Coal Consumption (tons)	2,194,906
0.3511	Coal Mercury Content (ppm)	0.2458
98.00%	Mercury Removal Efficiency	98.00%
2,476	Uncontrolled Mercury Emissions (lbs/yr)	1,079

49.5	Controlled Mercury Emissions (lbs/yr)	21.6
2,426	Mercury Removed (lbs/yr	1,057
$48.05	Cost of Coal ($/ton)	$109.52
$169,397,876	Annual Fuel Cost ($)	$240,383,735
$69,821	Average Cost of Mercury Removal ($/lb)	$227,355
	Incremental Cost of Mercury Removal ($/lb)	$2,541,015

As shown in the table, the cost of mercury removal for the washed coal scenario is $227,000/lb compared to less than $70,000/lb for the proposed VCHEC blend. Making the assumption that lowering the mercury concentration in the coal would have a direct relationship to lower mercury emissions, the cost to reduce controlled emissions from 49.5 lbs/yr to 21.6 lbs/yr goes to over $2.5 million/lb of mercury removed. $227,000/lb and $2.5 million/lb far exceed the commonly used benchmark of $35,000/lb.

Coal washing removes impurities from the run of mine coal such as ash by using the specific gravity differences between the coal and the impurities being removed. In order to separate the impurities from the coal, it is first crushed followed by washing based on the specific gravity of the impurity sought to be removed. A common misunderstanding of coal washing is that it will significantly reduce the unwanted impurities, such as sulfur and metals. The amount of reduction achieved depends on the chemical nature of the impurity.

It is important to note that Dominion would not wash coal on-site due to the lack of available water (VCHEC incorporates dry cooling due to lack of water) and there is inadequate suitable space for coal cleaning facilities and associated retention infrastructure.

Coal washing results in additional environmental impacts as a result of the waste coal piles generated. One of the goals of VCHEC's CFB is to consume waste coal or GOB and reduce the amount of waste coal piles within southwest Virginia. According to the Virginia Department of Mines, Minerals and Energy, there are currently hundreds of waste coal piles in southwest Virginia. These waste coal piles pose environmental risks of water quality degradation, as well as potential fire hazards when they spontaneously combust.

Run off from coal waste piles causes water pollution in the form of sedimentation of streams. Appalachian Technical Services (ATS) conducted a study of the water quality impacts from these waste coal sites and it is our understanding the sediment loading from just one of these sites is contributing over 17,000 pounds per acre of sediment loading annually since the waste coal was deposited on the surface. This is just an example of one waste coal site. There have been significant comments in support of the VCHEC, because it will facilitate the use of waste coal piles in the region reducing sediment loading to streams and tributaries. See response to comment 7 for a further discussion from ATS as well as the Department of Mines Minerals and Energy of the environmental

benefits of waste coal reclamation on the Clinch River. Moreover, coal processing requires water. Using ROM coal rather than processed coal is consistent with VCHEC's commitment to minimize water consumption related to its operations (as evidenced by the use of air-cooled rather than water-cooled condensers).

In addition, these unreclaimed waste coal piles pose an air quality issue when they are ignited spontaneously. When a waste coal pile catches fire, uncontrolled emissions of sulfur dioxide, particulates, nitrogen oxides and mercury are released into the environment. Combusting the waste coal piles utilizing well-controlled, clean coal technology will reduce the potential for significant air emissions should these unreclaimed waste coal piles catch fire accidentally.

Finally, coal washing results in adverse energy impacts (16% loss in heat content or only 84% recovery). Not only is substantial energy required to process the coal, about 15 to 20% of the coal mined ends up as coarse and fine coal waste. Only a CFB can recover the energy. It is possible to estimate the energy in the carbon bearing materials that would be disposed of during coal processing. As an example, research conducted by Miltech Energy Services, Inc. at the Moss 3 mine waste coal piles indicate that there is about a 50% yield in converting ROM coals (~7,000 Btu/lbs) to higher grade processed coal having a heat content of approximately 12,000 Btu/lb. Coal processing refuse consists of 85% coarse coal, refuse containing about 2,000 Btu/lb and about 15% fine coal refuse containing about 4,000 Btu/lb. Therefore:

> ROM Btu/lb = (0.50 x 12,000 Btu/lb) + (0.50 x 0.85 x 2,000 Btu/lb) + (0.50 x 0.15 x 4,000 Btu/lb) = 7,150 Btu / lb
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> ROM Btu Recovery % = (7,150 Btu/lb - 12,000 Btu/lb x 0.5) / (7,150 Btu/lb) x100 = 16%

Based on the data from Moss 3, this example shows that about 16% of the heat content contained in the ROM coal is lost in the coal cleaning process to refuse piles. This same heat content could be recovered to produce electricity by a CFB combusting the 7,150 Btu/lb ROM coal.

Additionally, processing coal requires additional energy expenditures to operate the prep plant. Because there is insufficient water at the VCHEC site to support water cooling, much less coal processing, additional fuel would be consumed to transport the ROM from the variety of operators to a prep plant and then the processed coal to the power plant.