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

Question (Page No. 16):

By what amount, given the currently designed bag house system design criteria, would allowing the use of unwashed coal and coal wastes increase emissions of PM, $PM_{2.5}$, CO and hazardous air pollutants, including, but not limited to mercury? Based on the reported ash content of Dominion's proposed mix, an increase in emissions of PM and metal HAPs such as antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel and selenium would appear to be possible. It would also appear to be reasonable to assume that coal washing would be even more effective in removing hazardous metals that have specific densities much greater than coal.

Response:

Coal washing will not have a direct impact on the potential emissions of PM, PM2.5 or CO. The washing process is employed to separate the coal from the rock that surrounded the coal seam. In the mining process, the surrounding rock is mixed in with the desired coal, increasing the ash content and reducing the heat content of the coal on a per pound basis. The washing uses the difference in specific gravity of the coal and the rock. The heavier rock sinks to the bottom and is discharged to a waste pile and the lighter coal is skimmed off the surface. There is a practical limit as to how much of the rock can be removed depending on the run-of –mine coal both physically and economically. The cleaner the coal from the wash plant, the more waste is produced and the more energy is lost by sending carbon to the waste pile that could otherwise be burned.

PM and PM 2.5 are controlled by a fabric filter (FF) baghouse. By washing the coal, the ash content would be reduced requiring less tons of fuel to accomplish the same heat output from the boiler. The greater ash content of the unwashed coal will result in a heavier ash loading to the baghouse, but is not expected to increase the plant emissions. The filter bags are physical devices that will block the ash from exiting the facility. Higher volumes of ash will require more frequent cleaning of the bags but will not increase the emissions significantly. This phenomenon is why the bag house efficiency increases with higher volumes of ash in the flue gas.

The impact on the dust loading in the flue gas going to the bag house is further reduced due to the recycling of the fly ash back to the flue gas desulfurization device (FGD). Dust loading into the FGD is expected to be on the order of 25 gr/dscf. The ash collected in the baghouse will be loaded with unreacted lime due to the high SO2 removal rates required by the draft permit limits. This material will be recirculated with fresh lime when needed to react in the FGD with the SO2 in the flue gas causing the dust loading to

the baghouse to be on the order of 300 gr/dscf or 12 times that entering the FGD. Thus the additional dust loading from the high ash coal will not have a significant impact.

CO emissions will not be significantly impacted by coal washing. CO emissions are controlled by good combustion practices in the CFB. The combustion efficiency is limited by considerations for the development of NOx and the need to calcine limestone for SO2 removal. By keeping the temperature of the boiler around 1,600 ^{o}F, thermal NOx emissions are reduced. CO is released by the calcining of limestone in the boiler to free up calcium to react with the sulfur in the fuel. Both keeping the temperature low and using the boiler to calcine limestone has an adverse impact on the boiler efficiency.

Washed coal will have a higher heat content per pound burned, requiring less coal for the same heat output from the boiler, however the amount of carbon entering the boiler will be the same per unit of heat emitted. The temperature of the boiler will be controlled so the CO emissions should not change.

Coal washing and is not expected to significantly reduce the pounds of sulfur (per heat input to the boiler) in the SW Virginia fuel since the sulfur is located in the coal and very little is removed during the washing process. Reduced sulfur in the washed coal could have the effect of reducing the amount of limestone that will need to be calcined in the boiler, thus reducing the amount of CO generated. Since the mass of sulfur into the boiler will be basically the same, the calcium to sulfur ratio will not change, so this effect of calcining the necessary limestone is not expected to have a significant impact.

HAP metal emissions may be reduced by washing the coal in varying degrees depending on where the metals are located. Metals are impurities in the coal and the surrounding rock. Impurities that are located in the surrounding rock will be reduced through the washing process and deposited with the waste coal. Metals can be in both the rock and the coal. When washing coal, the metals in the waste coal are sent to a slurry pond or waste coal pile. When ROM coal is consumed in the VCHEC boilers, those metals (excluding mercury) are controlled at more than 99%, then sent to a controlled landfill where they are encapsulated in a concrete-like ash. Information needed to quantify the reduction of metal HAPs (except mercury) from coal washing was not available to us.

Organic HAPs are generally in the coal matrix and acid gasses will be formed from chlorine and fluoride in the coal. Based on the MACT application the HAPs emissions expected from this facility are very low, due to the use of highly efficient backend pollution controls. The acid gasses are controlled by both the limestone injection into the boiler as well as the dry FGD unit on the tail-end. Metals are efficiently captured in the FF and mercury is addressed with ACI technology.

There are advantages to processing the HAPs through this well controlled facility. The captured HAPs will end up in the ash from the facility. This ash will contain large quantities of calcium which will solidify and encapsulate the ash when water is added. Properly placed, the ash will be in a landfill, above the groundwater table with

stormwater directed around it. In this condition the HAPs will be permanently sequestered.

There are significant trade-offs and costs that increase as the amount of coal washing increases.

- Coal Washing is a trade-off
    - Mercury can be washed and possibly reduced on a lbs per year basis. <u>But, this Mercury will stay at the processing facility and be placed in a waste coal pile or slurry impoundment.</u>
    - As proposed, mercury generated from ROM coal will be safely secured within project's lined landfill subject to DEQ authority
- Mercury and Washing Issues
    - Some Hg can be removed with washing
    - The washed Hg goes to a GOB pile and/or slurry impoundment
    - GOB piles and impoundments are not impervious like the cementatious ash properties of VCHEC.
    - GOB piles occasionally spontaneously combust resulting in uncontrolled release to the atmosphere
    - Hg that goes through the CFB boiler is captured, chemically binds to carbon and then stored in a safe, lined landfill
    - In Central Appalachian Coal (Virginia), the Mercury is generally contained in the ash (rock), Accordingly,
        - Mercury can be reduced by removing the ash (rock) from the coal. <u>Mercury is then left at the processing plant</u>
        - The end result, is little removal of sulfur, some removal of Hg, high use of water, creation of waste coal piles (gob) that contain the mercury removed from washing the coal, creation of carbon fines which have inherent issues within themselves, and a reduction of heat recovery of the coal from 98% to 63% (fuel inefficiency = higher cost).
- Coal Washing will:
    - Increase Thermal NOx
    - Reduce economic advantages to smaller local mining operations
    - Increase coal costs (less suppliers more demand for washed-coal)
    - Washing coal throws away up to approximately15% of the heat energy into a gob pile. A ROM product in a CFB will recover up to 98% of the energy
    - Additional mining required to extract the equivalent of the lost energy due to washing the coal

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 that was lower than for units burning high Btu washed Bituminous coal. These units are represented by the ARIPPA[1] organization listing in the comment.

Mercury is a special metal HAP in that it can exist as a vapor at stack temperatures and depending on its speciation the control efficiency may vary. 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. The mercury that is contained in the structure of the coal itself is not believed to be affected by washing. EPA also determined that 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.

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, as stated above, 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 that was lower than for units burning high Btu washed Bituminous coal.

[1] http://www.arippa.org/membersplants.asp