Virginia City Hybrid Energy Center
Response to Data Request
Vivian Thomson, Vice Chair, Virginia Air Pollution Control Board

Question (Page No. 1 - 2):

The BACT and MACT determinations cannot be made separately. So the BACT determination for this facility cannot be finalized until DEQ has received the MACT comments and has incorporated those comments into a combined BACT/MACT determination.

Given all of the above information, how can the proposed permit's mercury emission rate of 0.014 lb/GHw (12-month rolling average) be deemed MACT (Virginia Department of Environmental Quality 2008)?

Response:

BACT does not apply to mercury emissions. BACT is a requirement of the Prevention of Significant Deterioration ("PSD") permit program per Clean Air Act ("CAA") § 165. Mercury is a listed hazardous air pollutant ("HAP") (CAA § 112(b); 40 C.F.R. § 61.01; *see also* 9 VAC 5-10-20 defining HAPs based on EPA's determination) and Congress explicitly excluded HAPs from the PSD program.

> The provisions of part C of this subchapter (prevention of significant deterioration) shall not apply to pollutants listed under this section.

CAA § 112(b)(6). Under the Virginia regulations, BACT is applied to regulated NSR pollutants and HAPs are specifically excluded from the definition of regulated NSR pollutants. 9 VAC 5-80-1650.

BACT and MACT determinations are required to be done separately. As discussed above, BACT is a PSD requirement that does not apply to any emission of HAPs. A MACT analysis and determination is the basis for establishing emission limitations for HAP emissions. CAA § 112(g); 9 VAC 5-80-1420. While there may be some similarity in how a BACT analysis and MACT analysis are conducted and in the technologies considered, the analyses and determinations have distinct authorities, have distinct factors to be considered and are for different pollutants and thus are independent of each other. To the extent technologies have co-benefits in controlling multiple pollutants, that is taken into account in the BACT or MACT analysis and determination.

1.0 Supplement to Case-by-Case MACT Review, Introduction

In February 2008, the United States Court of Appeals for the D.C. Circuit granted petitions filed by State of New Jersey, et al, to vacate USEPA's decision to delist electric utility steam generating units (EGUs) as a source category under Section 112 of the Clean Air Act and the regulations under Section 111 of the Clean Air Act, known as Clean Air Mercury Rule (CAMR) (United States Court of Appeals for the District of Columbia Circuit, Case No. 05-1097, Decided February 8, 2008). CAMR would have limited the allowable mercury emission rate from the proposed Virginia City Hybrid Energy Center's (VCHECs) two circulating fluidized bed (CFB) EGUs, allowed for its participation in a national mercury cap and trade program, and required continuous mercury emission monitoring.

Until such time as USEPA should properly delist EGUs or adopt a National Emission Standard for Hazardous Air Pollutants (NESHAP) for coal-fired EGUs under Section 112 of the Clean Air Act, proposed new EGUs that are a major source of hazardous air pollutants (HAPs), such as VCHEC, are subject to Section 112(g), commonly referred to as case-by-case Maximum Available Control Technology (MACT). In accordance with the applicable substantive requirements of 9 VAC 5-60-150 et seq. (Article 7), and the applicable procedural requirements of 9 VAC 5-80-1100 *et seq.* and 9 VAC 5-80-1400 et seq., Virginia Electric and Power Company, a subsidiary of Dominion Resources, Inc. (hereinafter referred to as Dominion), submitted an application for an Article 7 Permit, including a case-by-case MACT analysis for the proposed EGUs at VCHEC. As demonstrated in that application, the proposed CFB boilers will employ MACT for each HAP that USEPA has associated with this source category. The analysis addressed mercury emissions, non-mercury metallic HAP emissions, inorganic acid gas HAPs (hydrogen chloride and hydrogen fluoride), and organic HAPs This document has been prepared to supplement the original case-by-case MACT evaluation based on requests and inquiries from various reviewers.

2.0 Determination of Case-by-Case MACT

Case-by-case MACT is defined in 9 VAC 5-80-1410(C) as;

> *"The emission limitation which is not less stringent than the emission limitation achieved in practice by the best controlled similar source, and which reflects the maximum degree of reduction in emissions that the executive director, taking into consideration the cost of achieving such emission reduction, and any non-air quality health and environmental impacts and energy requirements, determines is achievable by the constructed or reconstructed source."*

40 CFR 63.43(d) provides the principals of case-by-case MACT determination:

(1) The MACT emission limitation or MACT requirements recommended by the applicant and approved by the permitting authority shall not be less stringent

than the emission control which is achieved in practice by the best controlled similar source, as determined by the permitting authority.

(2) Based on the available information, as defined in this subpart, the MACT emission limitation and control technology…recommended by the applicant and approved by the permitting authority shall achieve the maximum degree of reduction in emissions of HAP which can be achieved by utilizing those control technologies that can be identified from the available information, taking into consideration the costs of achieving such emission reduction and any non-air health and environmental impacts and energy requirements associated with the emission reduction.

(3) The applicant may recommend a specific design, equipment, work practice, or operational standard, or a combination thereof, and the permitting authority may approve such a standard if the permitting authority specifically determines that it is not feasible to prescribe and enforce an emission limitation under the criteria set forth in Section 112(h)(2) of the Act.

(4) If the Administrator has either proposed a relevant emission standard pursuant to section 112(d) or section 112(h) of the Act or adopted a presumptive MACT determination for the source category which includes the constructed or reconstructed major source, then the MACT requirements applied to the constructed or reconstructed major source shall have considered those MACT emission limitations and requirements of the proposed standard or presumptive MACT determination.

The emission limitation, or in the absence of a comparable emission limitation that control technology, that is determined to be not less stringent than the emission limitation achieved in practice by the best controlled similar source is sometimes referred to as the "MACT Floor". The case-by-case MACT evaluation established a MACT floor for each HAP or category of HAP from the best controlled similar source(s). USEPA, in proposing a NESHAP for EGUs, subcategorized coal-fired EGUs based on the rank of coal fired (e.g., bituminous, subbituminous, etc.) and identified IGCC units separately. *See* 69 Fed. Reg. 4652, 4662-63 (Jan. 30, 2004). VCHEC will burn a blend of fuels including bituminous coal, coal refuse and biofuels, a fuel blend that currently has only been used in CFB units for utility generation. Similar sources to the proposed VCHEC EGUs are therefore multi-fuel (eastern bituminous and waste coal) CFB boilers. The determination of case-by-case MACT performed also considered levels of control beyond the MACT floor.

MACT limits also must be achievable, that is, they must be able to be met continuously under reasonably foreseeable worst-case conditions. *See Sierra Club v. EPA*, 167 F.3d 658, 665 (D.C. Cir. 1999). To ensure the MACT limits are continuously achievable, it is appropriate to include a margin of safety in the limit, particularly when basing a limit on limited data such as short-term stack test results. *See, e.g.,* 69 Fed. Reg. at 4678 (describing approach EPA used in developing proposed MACT limits for new EGUs to address uncertainty and variability in emission test results). HAP emissions such as

metals and acid gases are directly related to the amount of the pollutant in the fuel, which varies even within the same fuel type. Short-term stack test results do not adequately account for that variability. Thus, when evaluating data from a best controlled similar source to apply to VCHEC, it is not appropriate to translate that data directly into a MACT limit as it may not be continuously achievable under reasonably foreseeable worst-case conditions due to variability and the conditions under which the data were collected.

3.0 Expected HAP Emissions

The hazardous air pollutants (HAPs) that are expected to be emitted from the proposed VCHEC boilers were estimated from proposed case-by-case MACT emission limits for Hg, HCl and HF, from published fuel composition and control factors cited in *"Study of Hazardous Air Pollutant Emissions from Electric Utility Stem Generating Units – Final Report to Congress," U.S. EPA, February 1998*, and from USEPA AP-42, and are re-listed here for reference in Table 1. These may be subcategorized as either mercury, non-mercury metals, acid gas and organic HAPs. Mercury is unique among HAP metals in that it exists in vapor form at typical stack temperatures. All other HAP metals exist as solid particulate at stack temperatures, and are therefore controlled together with, and as a subset of, the criteria air pollutant category "filterable PM_{10}". Organic HAPs are similarly a subset of the PSD pollutant category Volatile Organic Compounds (VOC), and are controlled together with non-HAP VOC. Acid gas HAPs (such as HF and HCl) are neutralized together with criteria pollutant acid gases such as H_2SO_4 and SO_2. The control technologies capable of achieving the maximum degree of reduction for mercury, PM_{10}, acid gases and VOC from the best controlled similar sources (multi-fuel circulating fluidized bed boilers) were determined to represent the case-by-case MACT Floor for each category of HAP emissions.

Based on reasonable inquiry, Dominion determined that most multi-fuel and coal-fired CFB boilers do not have permit limits for individual HAPs (with the exception of Hg, HCl, HF, and Pb), and therefore little publicly available emission data were identified for the majority of individual HAPs emitted from multi-fuel CFBs. For all similar multi-fuel CFBs, with the exception of Hg, HCl and HF, MACT has been demonstrated based on the application of the best control technology for each *category* of HAP.

As previously discussed, It is not appropriate to prescribe and enforce a MACT emission limitation based on limited snapshot stack tests from one or more similar units. Case-by-case MACT seeks to establish a level of control that can be reliably met all of the time. The HAP levels in coal as well as myriad other performance variables (for example fuel moisture content, heating value, boiler load, transient vs. base load operation, variations in sorbent properties and air pollution control system performance to name just a few) vary in real time. All identified historical HAP testing for multi-fuel CFB boilers has been performed based on a snapshot (typically 3-hr) stack test, performed once, or at most a few times over the life of the facility. Performance stack tests under 40 CFR 60 Appendix B are always performed at or near full load, and always under steady state conditions. When an EGU fails a stack test, it is adjusted and retested to demonstrate compliance. Statistically, some stack tests will capture a low emission rate while others

will capture a median or high emission rate. In every case, enforceable permit limits need to include a margin to ensure that continuous compliance can always be maintained every hour of every year under every operating condition. If a MACT limit were to be established for an existing similar source based on the lowest emission level that source had ever achieved, that unit would by definition be out of compliance with that limit every other hour of the year. Case-by-case MACT must acknowledge the limitations of statistically insufficient stack test data and the high level of variability in HAP emissions from this source category.

Mercury emissions from the proposed VCHEC multi-fuel CFB's were proposed based on a number of factors, including the fact that compliance will be determined based on continuous mercury monitoring. A MACT limit for Hg that is based on real-time continuous monitoring is by definition a more stringent standard (even if numerically equivalent) than one that is simply based on an initial performance test. No similar operating multi-fuel CFB was identified that has a MACT compliance limit requiring continuous monitoring. Therefore, performance data from such a facility is of little value in determining MACT for VCHEC. .

The Hg MACT limit that was proposed actually is lower than the MACT floor for any similar unit since it will be the first to operate with a Hg limit subject to continuous monitoring to demonstrate compliance.

The Hg limit established as case-by-case MACT reflects variability in coal properties (notably coal mercury content) that will be experienced by a multi-fuel CFB, since it expects to receive low grade local coals, including waste coal, from various Virginia sources and is not a mine-mouth plant. Due to the high variability of coals and HAP contents (such as mercury), the comparison of % removal for any given HAP from one facility to another is useful as a basis for equipment design when normalized to a design basis fuel, but because of its inherent variability is not useful for establishing a MACT Floor. Percent HAP removal estimation based on EPA's generic factors that were presented in Table 1 are not relevant to the actual performance of the VCHEC boilers – they are simply published EPA estimates based on what is typical from the generation of CFB boilers that were operating in the years that EPA collected the data.

HAPs other than Hg, HCl and HF presented in Table 1 are a collection of many individual HAP species for which little or no test data is available to otherwise determine "*the best level of control achieved in practice"* from similar units. Due to the lack of statistically significant test data for multi-fuel CFBs, a combination of the specific design, equipment and operation standards were determined to reflect case-by-case MACT for these categories of HAP emissions, since in each case they are subsets or surrogates of a criteria air pollutant for which continuous or periodic monitoring is proposed to ensure optimal function of the MACT control device. This combination of design, control equipment selection and compliance monitoring for related criteria air pollutants was determined to constitute case-by-case MACT for the non-mercury HAPs from the proposed multi-fuel CFBs.

Table 1 is simply a list of typical or expected HAP emission rates from a hypothetical CFB boiler firing typical Virginia coal, and scaled to the output of the two VCHEC boilers (based on several USEPA sources as noted). Note that Table 1 does not take into account the substantial amount of HAPs contained in coal that remains with or is captured in bottom or fly ash within the process, and therefore % removal values reported across a control device do not necessarily reflect the total % reduction from fuel HAP content. This summary was used to provide a conservative estimate (conservative because the data were compiled from an earlier generation of CFB technology) of annual HAP emissions, but with the exception of Hg, HCl and HF (which are based on actual proposed limits) is in no way specific to the actual HAP emissions expected from the proposed VCHEC boilers. By virtue of employing the same or better control technologies (in-situ desulfurization with polishing spray dryer absorber, powdered activated carbon (or alternative) Hg sorbent injection followed by fabric filter) employed by the best performing similar source(s), the actual HAP emissions from the VCHEC boilers will exhibit the same actual levels of control being achieved in real time for each category of HAP as the best performing similar source(s).

Table 1: Estimated Tons Per year of HAP Emissions

Emission Point	HAP Emitted	Uncontrolled HAP Emissions (tpy)	Controlled HAP Emissions (tpy)	Control Technology[a]
CFB1	Mercury Compounds[b]	0.62	0.012	FGD/FF/ACI
	Hydrogen Chloride[c]	1,810	36.25	LI/FGD/FF
	Hydrogen Fluorides[d]	1,596	6.45	LI/ FGD/FF
	Antimony Compounds[e]	1.7	0.005	FF
	Arsenic Compounds[e]	14.9	0.0300	FF
	Beryllium Compounds[e]	3.1	0.004	FF
	Cadmium Compounds[e]	0.023	0.001	FF
	Chromium Compounds[e]	10.1	0.203	FF
	Cobalt Compounds[e]	11.1	0.011	FF
	Manganese Compounds[e]	32.8	0.065	FF
	Lead Compounds[e]	107	0.107	FF
	Nickel Compounds[e]	13.25	0.15	FF
	Selenium Compounds[e]	4.0	0.04	FF
	Organic HAPs[f]	2,448	24.48	GCP/FF/ACI
CFB2	Mercury Compounds[b]	0.62	0.012	FGD/FF/ACI
	Hydrogen Chloride[c]	1,810	36.25	LI/FGD/FF
	Hydrogen Fluorides[d]	1,596	6.45	LI/ FGD/FF
	Antimony Compounds[e]	1.7	0.005	FF
	Arsenic Compounds[e]	14.9	0.0300	FF
	Beryllium Compounds[e]	3.1	0.004	FF
	Cadmium Compounds[e]	0.023	0.001	FF
	Chromium Compounds[e]	10.1	0.203	FF
	Manganese Compounds[e]	32.8	0.065	FF
	Cobalt Compounds[e]	11.1	0.011	FF
	Lead Compounds[e]	107	0.107	FF
	Nickel Compounds[e]	13.25	0.15	FF
	Selenium Compounds[e]	4.0	0.04	FF
	Organic HAPs[f]	2,448	24.48	GCP/FF/ACI

a. LI means furnace limestone injection, FGD means dry flue gas desulfurization, FF means fabric filter baghouse, GCP means good combustion practices, and ACI means activated carbon injection.

b. Beyond the MACT Floor for Hg. Equivalent to 9.0×10^{-6} lb/MMBtu.

c. Proposed HCL case-by-case MACT limit of 0.0066 lb/MMBtu.

d. Proposed HF case-by-case MACT Floor of 0.0047 lb/MMBtu.

e. Generic EPA estimates based on fuel composition and control factors cited in *"Study of Hazardous Air Pollutant Emissions from Electric Utility Stem Generating Units – Final Report to Congress,"* U.S. EPA, February 1998.

4.0 Control Technologies Selection

As will be reviewed again in the following sections, the proposed VCHEC CFB boilers will incorporate MACT control technologies for each class of HAPs; i.e., 1) combustion of fuels within a bed or sorbent inherent to operation of CFB boilers followed by carbon (or other sorbent) injection upstream of a fabric filter for mercury control, 2)fabric filter technology for control of metallic HAPs, 3)combustion of fuels within a bed or sorbent inherent to operation of CFB boilers followed by a spray dryer absorber / fabric filter for control of acid gasses, 4) and good combustion practice (time, temperature and turbulence inherent to CFB boilers) to limit emissions of organic HAPs. These control technologies constitute the maximum degree of reduction, and therefore case-by-case MACT for each category of HAP expected to be emitted from the proposed VCHEC CFB boilers. This is the same combination of control technology used by the best controlled multi-fuel CFB boilers, and reflects the maximum degree of reduction in emissions from the proposed EGUs. In fact, VCHEC is the only CFB implementing ACI for mercury control.

5.0 Selection of Case-by-Case MACT for the VCHEC Multi Fuel CFB Boilers

The operating efficacy of the various pollution control stages will be continuously assured due to requirements in the draft air permit to continuously monitor emissions of CO (a good indicator of proper combustion control), SO_2 (a good indicator of effective acid gas neutralization), filterable PM (a good indicator of fabric filter performance) and Hg. The combination of the use of continuously monitored surrogate performance indicators together with selection of the same or better control technology employed by the best controlled similar sources was used to establish case-by-case MACT for all HAPs emitted from the proposed VCHEC multi-fuel CFBs.