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April 4, 2008
Project No. G06783B

Ms. Melissa Byrnes
Thermal Process Unit
MDEQ–Air Quality Division
Constitution Hall, 3rd Floor North
525 West Allegan Street
Lansing, MI 48909-7760

Re: **Wolverine Power Supply Cooperative's (Wolverine's) Air Use Permit to Install**
Application No. 317-07
Response to MDEQ Additional Information Request

Dear Ms. Byrnes:

On behalf of Wolverine, Fishbeck, Thompson, Carr & Huber, Inc. (FTC&H) is submitting our responses to the technical issues you raised in your e-mail to Mr. Brian Warner of Wolverine on the Air Use Permit to Install Application No. 317-07 for a 600 megawatt (net) steam electric power plant. The enclosed responses address:

- The mercury emissions estimates contained on page 5-67 of the original permit application
- A comparison to our proposed PM_{10} BACT limitation related to the recently approved air permit for East Kentucky Power Cooperative's Spurlock #4
- Additional information to support our BACT analysis for IGCC comparison
- A case-by-case MACT analysis for the CFB boilers

We appreciate the Air Quality Division's efforts to expedite their review of the enclosed information. This will allow us to remain on schedule to commence the Public Comment period in May 2008. If you require any additional information, we would appreciate your questions and comments by April 15, 2008, so that we will be in a position to address any additional issues during our next Wolverine Clean Energy Venture / MDEQ permit meeting.

Sincerely,

FISHBECK, THOMPSON, CARR & HUBER, INC.

John F. Caudell, P.E.

tc
Enclosures
By hand delivery
cc/enc: Ms. Mary Ann Dolehanty – MDEQ (By hand delivery)
Ms. Janice Denman – MDEQ (By U.S. mail)
Mr. Brian L. Warner, CHMM – Wolverine (by e-mail)
Mr. Eugene E. Smary – Warner Norcross & Judd, LLP (by e-mail)
Mr. Steven C. Kohl – Warner Norcross & Judd, LLP (by e-mail)
Mr. Michael L. Robinson – Warner Norcross & Judd, LLP (by e-mail)
Mr. William Campbell III – ENSR (by e-mail)
Mr. John Lagomarsino – Burns and Roe Enterprises, Inc. (by e-mail)
Mr. James A. Susan, P.E. – FTC&H (by e-mail)
Ms. Jacquelyn F. Linck, P.E. – FTC&H (by e-mail)
Mr. David M. Yanochko, P.E. – FTC&H (by e-mail)

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Memorandum

Date: April 1, 2008

To: Wolverine Power Supply Cooperative

From: Michael Zebell- ENSR

Subject: Response to Michigan Department of Environmental Quality Questions Concerning the Wolverine Clean Energy Venture IGCC BACT Study

Distribution: W. Campbell B. Warner D. Yanochko

Wolverine Power Cooperative has been asked to provide information concerning the proposed Wolverine Clean Energy Venture (WCEV) project (PTI No. 317-07) as outline in a March 19, 2008 email to Brian Warner fro the MDEQ. The questions are shown below with the response following each question.

1) Page 5-67, paragraph 2 of the application. It is not clear how emission rates for mercury were calculated. Please provide calculations and explain basis.

RESPONSE: The mercury emission information given on page 5-67 is intended to illustrate the minor difference between the emissions from a high performing IGCC unit and the proposed WCEV. These emissions are erroneously reported in the text as 29 lb/yr and 0.0025 lb/GWh and should be 17 lb/yr and 0.0026 lb/GWh (gross) based on the following calculations:

Gross Generation = 740 MW (Mesaba)
IGCC Heat Input = 5,627 MMBtu/hr (Mesaba)
Fuel HHV = 11,900 Btu/lb or 0.0119 MMBtu/lb
Mercury Content of Fuel = 0.08 ppm

(5,627 MMBtu/hr)/(0.0119 MMBtu/lb) = 472,857 lb/hr (coal firing rate)

(0.08 ppm/1,000,000)x(472,857 lb/hr) = 0.0378 lb/hr (mercury firing rate)

(0.0378 lb/hr)x(1 – 0.95) = 0.00189 lb/hr (mercury controlled emission rate)

(0.00189 lb/hr)x(8760 hr/yr) = 16.6 lb/yr

(16.6 lb/yr)/((740 MW)x(8760 hr/yr)) = 2.6×10^{-6} lb/MWh

(2.6×10^{-6} lb/MWh)x(1,000 MW/GW) = 0.0026 lb/GWh

2) Since CAMR was vacated, please submit 112(g) case-by-case MACT determination for the boilers.

RESPONSE: A case-by-case MACT determination is being submitted under separate cover.

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3) MDEQ IGCC BACT Checklist, Item 19, please explain if NOx and SO2 allowances were included.

RESPONSE: The cost of NOx and SO_2 emission allowances was accounted for.

4) MDEQ IGCC BACT Checklist, Item 20, please explain if NOx and SO2 allocations were included.

RESPONSE: The cost basis of the NOx and SO_2 emission allowances is $1.85 per MWh as found in Exhibit 58 of the Technology Selection Study, Wolverine Clean Energy Venture for Rogers City, Michigan, prepared by Burns and Roe Enterprises and included in the application. The IGCC O&M costs are determined by adjusting CFB costs using the ratio of IGCC/CFB for fixed and variable O&M costs from Table 1-6 of Clean Coal Technology Selection Study – Final Report, Black & Veatch, January 2007.

5) MDEQ IGCC BACT Checklist, Item 27, please explain cost differential in cooling water.

RESPONSE: The planned WCEV project includes cooling towers for non-contact cooling water serving the steam turbine condenser. The Polk County IGCC plant and the planned Mesaba IGCC plant include cooling towers for non-contact cooling water serving the steam turbine condenser and the gasification process. The Wabash River IGCC plant has once-through cooling for the steam turbine condenser and a cooling tower for gasification process cooling. The cost of cooling towers would add both capital and O&M cost to the Wabash plant. The inclusion of the costs for cooling towers serving the steam turbine condensers at Polk, and Mesaba and lack of cooling towers for that purpose at Wabash adds to the conservative nature of the cost comparisons to WCEV. If one were to include costs for cooling towers at Wabash, the cost of the Wabash plant would increase, and the cost differential between the Wabash and WCEV would increase.

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Memorandum

Date: March 30, 2008

To: Wolverine Power Supply Cooperative

From: Michael Zebell- ENSR

Subject: Response to Michigan Department of Environmental Quality Questions Concerning the Wolverine Clean Energy Venture Proposed Particulate Matter Limit

Distribution: W. Campbell B. Warner D. Yanochko

Wolverine Power Cooperative has been asked to provide information on the proposed particulate matter (PM) limits for the planned Wolverine Clean Energy Venture (WCEV) facility in Rogers City, Michigan, relative to the East Kentucky Power Cooperative (EKPC) Spurlock, Unit 4 permit. This memorandum provides information that supports the proposed WCEV limits of 0.01 lb/MMBtu for filterable PM and 0.03 for total PM (filterable and condensable).

The EKPC Spurlock Unit 4 permit includes PM limits as follows:

- 0.012 total PM demonstrated through the average of three, one-hour compliance stack tests;
- 0.009 filterable PM demonstrated using continuous emission monitoring on a 30-day rolling average; and
- 0.015 lb/MMBtu filterable PM demonstrated by the average of three, one-hour stack tests (40CFR60 Subpart Da).

Unit 4 is currently under construction and has an operating sister unit (Unit 3) that is an identical CFB firing the identical run of mine coal. Unit 3 has a 0.015 lb/MMBtu filterable particulate matter limit only. Through discussion with the Kentucky Department for Environmental Protection (KDEP) it was learned that when the Unit 4 construction permit was negotiated, the owner agreed to the limits through negotiations with the Sierra Club. The lower limits were not guaranteed by the vendor and were agreed to by EKPC after site specific testing on Unit 3 which is burning coal from the same mine that will fuel Unit 4.

The most significant difference between the planned WCEV units and the Spurlock Unit 4 CFB is that Spurlock is a run of mine (ROM) coal plant and the planned Unit 4 has an identical, operating CFB onsite, while the planned WCEV CFB unit is designed to combust a wide range of fuels with various properties. Unlike the Spurlock situation, there is no existing unit to test with a consistent, ROM fuel supply. Consequently, no CFB vendor will guarantee a condensable PM limit as low as 0.003 lb/MMBtu for a unit such as those planned for the WCEV facility because the limit may not be consistently achievable.

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Review of the Spurlock Unit 4 permit reveals a significant inconsistency in the PM limits and other limits in the permit. The sum of the sulfuric acid mist (SAM) limit (0.005 lb/MMBtu) and the volatile organic compound (VOC) limit (0.002 lb/MMBtu) for Spurlock Unit 4 is 0.007 lb/MMBtu, a value over double the difference between the total and filterable PM limits in the permit (presumably the condensable PM limit or 0.003 lb/MMBtu). Both of these constituents will be measured as condensable PM using USEPA Method 202. The SAM limit has a vendor guarantee and is based on the degree of conversion of SO_2 in the boiler to SO_3 and the subsequent conversion of SO_3 to SAM. Similarly, the VOC emission limit carries a vendor guarantee and is set based on optimizing the combustion efficiency of the unit. It is inconsistent to set a condensable PM limit that is 50% lower than the sum of the SO_3 and VOC limits and is not achievable.

In addition to the inconsistency in the PM limits, it is well established that the condensable PM test method (USEPA Method 202) has a high bias and often has inconsistent results[1]. EPA Method 202 uses water-filled impingers to cool, condense and collect materials that are vaporous at stack conditions and become solid or condensed liquid PM at lower temperatures. Although the preferred application of the method incorporates purging with nitrogen for one hour, options to exclude this purging are included in the procedures. Without the nitrogen purge, essentially all of the SO_2 that passes through the impingers forms sulfuric acid when allowed time to react in the impinger water. Even with a one hour nitrogen purge at the end of a sampling run, some SO_2 will react with the water to form SO_3 and then sulfuric acid before the end of the test run and the resulting sulfuric acid is not removed from the impinger through a nitrogen purge. The mass of sulfuric acid is then incorrectly measured as particulate matter. The amount of sulfuric acid PM resulting from the SO_2 /water reaction is related to the concentration of SO_2 in the stack gas, the quantity of water in the impingers, and the sampling duration. It is reported that the SO_2 purge efficiency is 80 – 90% resulting in a bias of between 10 – 20% (high). The same kind of dissolution occurs for NOx compounds resulting in nitrate formation and another source of high bias in method 202.

In addition, a portion of the ammonia injected in the SNCR system for NOx reduction exists in the stack gas. The unreacted ammonia in the stack gas is known as ammonia slip. The amount of ammonia slip is often specified as part of the SNCR system and is minimized when the system is optimized. Since Method 202 collects the sample in water and free ammonia is highly water soluble, reactions between ammonia and hydrogen chloride and/or between ammonia and sulfur dioxide in the cold, water-filled impingers are another source of a high bias in results.

Tests performed on Reliant Energy's waste coal-fired CFB at the Seward Plant in Pennsylvania illustrate the inconsistency in Method 202. Simultaneous Method 202 sampling runs were conducted by the Pennsylvania Department of Environmental Protection (PDEP)[2] and Air Hygiene International (AHI) under contract to Reliant[3]. The average of PDEP's runs is 0.023 lb/MMBtu and the average of the AHI runs is 0.0011 lb/MMBtu – an order of magnitude difference.

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[1] Richards, J., Holder, T., and Goshaw, D., Optimized Method 202 Sampling Train to Minimize the Biases Associated with Method 202 Measurement of Condensable Particulate Matter Emissions, November 2005.
Satola, J., Kelly, T., Draft Technical Report on Laboratory Evaluation of Method 202 to Determine Fate of SO2 in Impinger Water, September 2005.

[2] Commonwealth of Pennsylvania DEP files, Source Test Results – Reliant Energy Seward Station; To Mark Wayner; From Gregory Parrish; Dated January 12, 2007

[3] Letter from Reliant Energy, Keith Schmidt; to William Charlton; Seward CFB Project PM10 Emission Test Report; Dated November 14, 2006

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Based on the differences between Spurlock Unit 4, the inconsistencies in the Spurlock permit limits, and the bias and variability of USEPA Method 202, the limits expressed in the Spurlock Unit 4 permit cannot be considered BACT limits applicable to WCEV. The current proposed PM permit limits for the proposed WCEV are appropriate and achievable and represent BACT. Wolverine Power Cooperative advocates a total PM limit of 0.03 lb/MMBtu with filterable PM to be determined using USEPA Method 5, and condensable PM to be determined using a modified USEPA Method 202 or equivalent.

Prepared for:
Wolverine Power Cooperative

Case by Case MACT Analysis For Prevention of Significant Deterioration Permit Application for Wolverine Clean Energy Venture

ENSR Corporation
March 2008
Document No.: 12208-001

ENSR

Prepared for:
Wolverine Power Cooperative

Case by Case MACT Analysis For Prevention of Significant Deterioration Permit Application for Wolverine Clean Energy Venture

Prepared By: Michael Zebell, PE

Reviewed By: William Campbell

1.0 Introduction

Wolverine Power Cooperative presents this case-by case determination of Maximum Achievable Control Technology (MACT), for the electric utility steam generating units at the proposed Wolverine Clean Energy Venture (WCEV) in Rogers City, Michigan. The proposed project will consist of two identical solid fuel-fired, circulating fluidized bed (CFB) boilers each having a baseload capacity of 3030 MMBtu/hr which results in approximately 300 megawatts (MW) net generation per unit. The CFB boilers will be fired with subbituminous coal, petroleum coke (petcoke) and supplemental fuels.

Wolverine has already provided a detailed demonstration that the two CFB boilers will employ state-of-the-art air pollution control technology to minimize potential emissions of criteria pollutants and toxic air contaminants as documented in Section 5.0 of the WCEV Permit to Install application document and supplemental information requested by the Michigan Department of Environmental Quality (MDEQ). These same state-of-the-art controls will also minimize the potential emissions of hazardous air pollutants (HAPs). To control SO_2 and acid gas HAP emissions, limestone will be injected along with the fuel into the CFB boiler. Dry flue gas desulfurization downstream of the boiler will provide additional control of SO_2 and acid gas HAPs. The CFB boiler design itself will limit NO_x formation and selective non-catalytic reduction (SNCR) will further reduce NO_x emissions. Activated carbon injection (ACI) will be installed upstream of the fabric filter to enhance the removal of mercury and organic HAPs. A fabric filter is employed to control the emissions of particulate and HAP metals. Following the fabric filter, the cleaned gases will be discharged to the atmosphere via a 450-foot common stack.

2.0 Emission Unit and Pollutant Applicability

On February 8, 2008 the D.C. Circuit issued its opinion in *New Jersey et al. v EPA* invalidating the 2005 CAMR rule. According to the Court's docket, a mandate was issued on March 14, 2008, establishing that the vacatur of CAMR has now "taken effect" and the rules are effectively void. The effect of the decision is to reinstate EPA's December 2000 listing of coal-fired EGU's as a source category under Section 112(c) of the CAA.

The WCEV project is considered a new source within the reinstated source category designation of 2000. Such source categories are subject to MACT standards under Section 112. As EPA has not promulgated MACT standards for the source category under Section 112(d), WCEV acknowledges that a case-by-case MACT determination under Section 112(g)(2)(b) and MAC R 336.1299 may now be an applicable requirement in light of the vacatur of the 2005 CAMR rule.

WCEV has elected to address these requirements in the air permit application. The case-by-case MACT presented here is intended to augment the Permit to Install Application for a 600 Megawatt (Net) Solid Fuel Steam Electric Power Plant submitted to the Michigan Department of Environmental Quality (MDEQ) in September of 2007 (PTI No. 317-07).

The proposed CFB boilers have the potential to emit the following HAPs regulated under the federal MACT standards: antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, selenium, hydrogen chloride, hydrogen fluoride, mercury, and organic HAPs. The HAP emissions are based on CFB design data, fuel composition, emissions from similar units firing petcoke, and emissions factors cited in the document entitled *Compilation of Air Pollutant Emissions Factors*, USEPA Document No. AP-42, Fifth Edition, September 1998. Table 1 presents the controlled HAP emissions assuming that the CFB boilers will operate continuously at baseload capacity of 3030 MMBtu/hr, each boiler, for 8,760 hours per year.

Table 1: HAP Emissions per CFB Boiler[1]

HAP Emitted	Controlled HAP Emissions (Est. TPY)	Control Technology (Level of Control)
Metal HAPs Compounds		
Antimony	0.01	
Arsenic	0.3	
Beryllium	0.2	
Cadmium	0.04	**Fabric Filter (> 99% capture)**
Chromium	0.08	
Cobalt	0.08	
Lead	0.2	
Manganese	0.4	
Nickel	0.6	
Selenium	1.1	
Acid Gases		
Hydrogen Chloride[2]	42	**CFB/Polishing Scrubber (> 95% capture)**
Hydrogen Fluorides[2]	5	
Mercury Compounds	0.02	**Polishing Scrubber/Activated Carbon/Fabric Filter (> 90% capture)**
Organic HAPs[3]	7	**Good Combustion Control (> 99% destruction)**

1 The emission information is based on firing the design fuel blend of 0 to 70% Petcoke and 30% to 100% PRB coal.
2 Acid gas emission rates are based on a minimum of 95% control provided by the polishing scrubber. The controlled hydrogen chloride (HCl) emission rate for one of the planned units running on 100% Illinois Basin Coal is approximately 120 TPY of HCl emissions. Illinois coal is a planned backup fuel for the WCEV facility.
3 Based on the sum of the organic air toxics quantified for Part 2, Rules 224-232.

The proposed air pollution control technologies will effectively limit HAP emissions from the two CFB boilers. Mercury emissions will be controlled by condensation in the dry flue gas desulfurization system, adsorption by activated carbon injected prior to the fabric filter, and collection in the fabric filter. Hydrogen chloride and hydrogen fluoride will be controlled by limestone injection in the CFB furnace and introduction of alkaline material in the dry flue gas desulfurization system. Lead emissions will be controlled by condensation before the fabric filter, enabled by a low exit temperature from the dry flue gas desulfurization system. The other HAP metals will be collected with the rest of the particulate matter in the fabric filter. Organic HAPs will be controlled by good combustion practices in the CFB boilers. The control technologies used to limit HAP emissions are also summarized in Table 1.

3.0 Michigan T-BACT

The State of Michigan addresses air toxics in Part 2, Rules 224-232 of the Administrative Rules for Air Pollution Control. Unlike the federal MACT standards, there is no list of all toxic air contaminants in the Michigan rule. The rule defines a toxic air contaminant as any air contaminant for which there is no National Ambient Air Quality Standard and which is or may become harmful to public health or the environment when present in the outdoor atmosphere in sufficient quantities and duration. As such, the toxic air pollutants identified as emitted from the proposed WCEV facility and regulated at the state level includes all pollutants regulated through the federal MACT standards. The Michigan rule requires ambient air impact modeling of regulated toxics and that a control technology determination, T-BACT, is made for each state regulated toxic air pollutant to ensure a high level of control of these compounds. The WCEV permit application includes the modeling and T-BACT for the regulated compounds.

4.0 MACT Control Technology Selection

Wolverine has selected the air pollution control technology that will effectively limit HAP emissions from the CFB boilers. Based on the comparison of controls applied to similar installations, the proposed control technologies are considered representative of MACT.

4.1 Mercury Compounds

Mercury is a naturally occurring constituent of coal. When coal is burned, any trace quantities of mercury present can be vaporized at the high temperatures within the furnace section of the boiler and be emitted in the flue gas. The capture of mercury by flue gas cleaning devices is dependent on the chemical and physical speciation of mercury. There are three basic forms or species of mercury in the flue gas from coal combustion: elemental mercury (Hg); divalent oxidized forms (Hg(II)); and particulate-bound mercury (Hg(p)).

Particulate-bound mercury can be removed by conventional particulate control devices, such as fabric filters. The available data indicates that CFB boilers may have a higher carbon content of the fly ash. In addition, activated carbon may be injected into the flue gas upstream of the fabric filter for further mercury control. As a result, elemental and divalent forms of mercury will be reduced through adsorption onto the carbon and subsequent capture in the fabric filter.

To satisfy MACT, Wolverine proposes to limit mercury emissions to 0.008 lb/GWh, consistent with the emission limit established in the PSD permit application. This emission limit is based on the proposed Michigan mercury rule.

These proposed controls are equivalent to the proposed MACT controls for Dominion Resources' CFB units at the Virginia City Hybrid Energy Center (VCHEC) in Virginia City, Virginia. Because the proposed controls are as stringent as the controls proposed for the best similar source (VCHEC), dry FGD, activated carbon injection, and fabric filtration is considered MACT for mercury compounds.

4.2 Acid Gases (Hydrogen Chloride and Hydrogen Fluoride)

Chloride and fluoride emissions from CFB boilers result from the reaction between fuel-bound chlorides and fluorides during the combustion process. The fuel-bound chlorides and fluorides are hydrogenated during combustion producing hydrogen chloride and hydrogen fluoride. Wolverine proposes the use of a polishing scrubber to control hydrogen chloride and hydrogen fluoride emissions from the proposed units. The overall acid gas control efficiency is expected to be about 95%.

Using the combination of a CFB and a polishing scrubber are as stringent as the controls proposed for the best similar source (VCHEC) and therefore are considered MACT for hydrogen chloride and hydrogen fluoride. To comply with MACT for these pollutants, Wolverine agrees to meet the SO_2 emission limit established in the PSD permit application as a surrogate. The units will be equipped with SO_2 continuous emission monitors (CEM) for compliance demonstration purposes.

4.3 Other HAP Metals (Arsenic, Beryllium, Cadmium, Chromium, Lead, and Manganese Compounds)

The other HAP metals will be controlled in the same manner as particulate matter by a fabric filter. This particulate control device is considered BACT for coal-fired boilers, especially in light of the higher efficiencies achieved for fine particulate when compared to other particulate control technology. As USEPA has indicated for other source categories, particulate emissions are an effective surrogate in lieu of establishing standards for the individual metals. Based on use of particulate as surrogate for other HAPs, the estimated control efficiency of the combined technologies is expected to be in excess of 99%.

Because the proposed controls are as stringent as the controls proposed for the best similar source (VCHEC), fabric filtration is considered MACT for other HAP metals. Rather than establish emission limits for individual HAP metals, Wolverine proposes that the particulate emission limit be used as a surrogate for other trace metal emissions.

4.4 Organic HAPs

Organic HAPs will be controlled by means of good combustion control used to limit carbon monoxide (CO) and volatile organic compound (VOC) emissions. In general, a combustion control system seeks to maintain the proper conditions to ensure complete combustion through one or more of the following design features: providing sufficient excess air, staged combustion to complete burn out of products of incomplete combustion, sufficient residence time, and good mixing. Coal-fired CFB boilers are designed specifically for efficient fuel combustion with thorough mixing and residence time at temperature, plus staged combustion. The volatile organic HAPs will be further controlled by the activated carbon injected into the flue gas upstream of the fabric filter for mercury control. The organic HAPs will be adsorbed to some degree by the activated carbon collected in the filter media of the fabric filter bags. USEPA has indicated for other source categories, VOC emissions are an effective surrogate in lieu of establishing control standards for the individual organic compounds.

The proposed control for volatile organic HAPs is as stringent as the controls proposed for the best similar source (VCHEC) and therefore is considered MACT. Rather than establish emission limits for individual organic HAPs, Wolverine proposes that the VOC emission limit be used as a surrogate for organic emissions.

5.0 Establishment of MACT

Under Michigan Rule R 336.1228, the MDEQ has determined that a separate emission limitation for mercury is required. To provide for monitoring of the proposed MACT standard for mercury, Wolverine will conduct initial and periodic compliance tests for mercury to demonstrate compliance with the corresponding emission limits established in the permit.

As federal law (*National Lime Ass'n. v EPA*, 233 F3d. 625, D.C. Cir. 2000) clearly sanctions the use of surrogates for establishing MACT emission standards and monitoring compliance with those standards, incorporation of MACT compliant standards into the permit for the remaining HAPs should otherwise be relatively straightforward. For acid gases, Wolverine proposes that SO_2 is used as a surrogate for compliance. For HAP metals, Wolverine proposes that the PM10 (filterable) emission limit be used as a surrogate for trace metal emissions. Likewise, Wolverine proposes that the VOC emission limit be used as a surrogate for organic HAP emissions. Monitoring, recordkeeping, and testing requirements will be otherwise defined in the final PSD permit for both SO_2 and PM10.

The combination of good combustion control, polishing scrubber, activated carbon injection, and fabric filter represent control measures as stringent as those applied to any best controlled similar source and, therefore, should be accepted as the MACT for HAP emissions from the CFB boilers at the planned WCEV power plant.