1. Case-by-Case MACT Analysis: PC-Fired Boiler

1.1 Introduction

Section 112 of the Clean Air Act requires major sources of hazardous air pollutants (HAP) to meet maximum achievable control technology (MACT) standards. (A major source is defined as one that has the potential to emit 10 tons per year of any HAP or 25 tons per year of any combination of HAPs.[1]) EPA is required to develop categories and subcategories of sources in accordance with a defined schedule, and establish MACT emissions standards for each of the categories and subcategories. However, EPA may not have a MACT standard for a particular category promulgated at the time a project is being permitted. Per 40 CFR §63.42(c), the owner of a new major source in a category subject to MACT regulation for which no final MACT standard has yet been promulgated is not allowed to begin actual construction until the permitting authority has made a final and effective case-by-case MACT determination.

On December 20, 2000, EPA announced its finding that regulation of HAP from coal- and oil-fired electric utility steam generating units is appropriate and necessary,[2] effectively adding coal- and oil-fired electric utility steam generating units to the list of source categories to be regulated by MACT standards. Proposed MACT standards were released by EPA December 15, 2003. On March 15, 2005, EPA rescinded its previous finding that regulation of HAP from coal- and oil-fired electric utility steam generating units was appropriate or necessary and instead promulgated NSPS standards under 40 CFR Part 60 for coal-fired electric steam generating units. The DC Circuit Court overturned the March 15, 2005 delisting on February 8, 2008, potentially triggering the case-by-case MACT requirements for proposed new coal fired electric utility steam generating sources.

EPA and industry groups have filed for reconsideration of the February 8, 2008, decision. The applicability of the MACT rules and the applicability of the NSPS standards are thus uncertain at present.

Since the applicability of the NSPS and MACT regulations remains uncertain at present in light of EPA's petition for reconsideration, the Michigan Department of Environmental Quality (MDEQ) has requested that Mid-Michigan Energy, LLC (MME) submit a case-by-case MACT analysis for the proposed pulverized coal (PC)-fired boiler at the Mid-Michigan Energy Station (MMES) pursuant to 40 CFR §63.43. The following sections present the requested application for a case-by-case MACT determination based on MDEQ's November 2004 "Guidelines for Conducting a 112(g) Analysis." Additionally, information is included to satisfy the case-by-case MACT application requirements of 40 CFR §63.43(e)(2).

[1] 40 CFR §63.2.

[2] 65 FR 79825, December 20, 2000.

1.2 CASE-BY-CASE MACT DETERMINATION PROCEDURES

The MMES case-by-case MACT determination utilizes procedures consistent with MDEQ's November 2004 "Guidelines for Conducting a 112(g) Analysis." The procedures and requirements set forth in MDEQ's guidelines are summarized as follows:

Step 1) Pollutant Applicability

MACT applies to the proposed source emitting HAPS, and considers all HAP emissions. While it is not required that each HAP emitted be considered independently, different forms of emissions should be considered separately.

Step 2) Process or Production Unit Applicability

Determine all potential process or production units and emission points. Emission sources can be classified as one of five different types. Process vent or stack discharges; equipment leaks; evaporation and breathing losses; transfer losses; and operational losses. These emission source types should be used as a guide in identifying available control options while considering the concentration and type of constituents of a gas stream.

Step 3) Identification of Available MACT Control Technologies

a) Identify all available control technology options including transferable and innovative control technologies when appropriate. Control technologies include process changes; substitution of materials or other modifications; collecting, capturing or treating pollutants; or other techniques to reduce the quantity of or eliminate emissions of HAP. Alternative processes that inherently produce less pollution and various configurations of the same technology which achieve different control efficiencies should also be reviewed.

b) Rank all possible control technology options in descending order based on the most stringent emission limitation achieved in practice by the best controlled similar source.

Step 4) Evaluation of MACT Control Technologies

MACT cannot be less stringent than the emission limitation which is achieved in practice by the best controlled similar source, unless it has been demonstrated that the emission limitation is not feasible. Identify any non-air quality health and environmental impacts, and energy requirements. If the control technology that achieves the maximum degree of HAP emission reduction is not feasible because of costs, non-air quality health and environmental impacts, and energy requirements, continue evaluating the next most efficient control technologies.

Step 5) Alternative Options

An applicant may recommend a specific design, equipment, work practice or operational standard or a combination thereof as the MACT determination. Such a standard may be approved, if the agency specifically determines that it is not feasible to prescribe or enforce an emission limitation under the criteria set forth in Section 112(h)(2) of the Clean Air Act.

Step 6) <u>Selection of MACT</u>

MACT is the most effective emission limitation, work practice and/or operation standard that has not been eliminated in Steps 4 or 5.

40 CFR 63.43(d) sets forth the following two principles to be used in the establishment of MACT emission limitations in a case-by-case MACT determination:

> "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."

> "Based upon available information, ... 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 quality health and environmental impacts and energy requirements associated with the emission reduction."

1.3 CASE-BY-CASE MACT ANALYSIS

This section documents the case-by-case MACT analysis for the MMES PC-fired boiler utilizing the procedures and requirements outlined in Section 1.2. Discussions are included for each step delineated in MDEQ's case-by-case MACT guidance.

1.3.1 STEP 1: POLLUTANT APPLICABILITY

In the proposed 2005 MACT standards, EPA determined that only mercury emissions from coal-fired power plants warranted rulemaking; however, the case-by-case MACT determination presented here addresses four categories of HAP emissions, including the following:

- Mercury,
- Non-mercury metals,
- Acid gases, and
- Organic HAP

This categorization of HAP was taken from the archived documents generated by the EPA utility MACT Working Group. These four categories encompass all of the individual HAPs EPA investigated in its process to determine whether utility coal-fired boilers warranted listing as a MACT category. The pollutant categories are briefly discussed below.

<u>Mercury.</u> Mercury is a naturally occurring constituent of soil and mineral deposits, including deposits of coal. When burned, the trace quantities of mercury present in the coal are vaporized at the high temperatures that exist within the furnace. Mercury present in coal combustion flue gas exists in three basic forms: particulate-bound mercury, elemental mercury, and ionic (oxidized) mercury. The characteristics of the coal and the emission control systems installed for criteria pollutants both have a strong influence on the amount and form of mercury that is emitted and on the overall amount of mercury that can be captured.

Non-Mercury Metals. Particulate matter emitted from the PC boiler will include entrained metals that are contained in the coal. The non-mercury metals may include the following HAPs: antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, and selenium.

Acid Gases. The acid gases, hydrogen fluoride and hydrogen chloride, will be emitted from the PC boilers due to trace concentrations of fluoride and chloride compounds present in the coal.

Organic HAP. Organic HAP emissions can be created during the combustion process due to interactions between carbon, hydrogen, and other components occurring at high temperature. Organic HAP emissions from the PC-fired boilers may include the organic HAP species listed in Appendix C of the September 2007 Prevention of Significant Deterioration Air permit to Install Application for the MMES ("the MMES PTI Application").

1.3.2 STEP 2: PROCESS OR PRODUCTION UNIT APPLICABILITY

The emission unit subject to case-by-case MACT requirements is the PC-fired boiler (that is, an electric utility steam generating unit). This emission source is most appropriately classified as a process vent under MDEQ guidance since emissions from the PC-fired boiler are products of the combustion process within the boiler.

1.3.3 STEP 3: IDENTIFICATION OF AVAILABLE MACT CONTROL TECHNOLOGIES

The available MACT control technologies which have been shown to be technically feasible for each pollutant type are listed and ranked by overall removal efficiency (highest to lowest) in **Table 1-1** and discussed below. The control technologies listed as available below have been demonstrated in practice and operated at a full-scale installation.

Table 1-1. Available MACT Control Technologies

Pollutant	Control Technology and Ranking
Mercury	Halogenated Activated Carbon Injection with Fabric Filter Baghouse Co-Benefit Removal with Wet Scrubber and Electrostatic Precipitator (ESP) Co-Benefit Removal with Selective Catalytic Reduction (SCR) and Fabric Filter Baghouse

Pollutant	Control Technology and Ranking
Non-Mercury Metals	Fabric Filter Baghouse Electrostatic Precipitator (ESP) Venturi Scrubber Wet Scrubber Centrifugal Separator (Cyclone)
Acid Gases	Dry Scrubber and Fabric Filter Baghouse with polishing wet ESP Wet Scrubber with polishing wet ESP Dry Scrubber and Fabric Filter Baghouse Wet Scrubber Fabric Filter Baghouse Electrostatic Precipitator (ESP) Sorbent Injection
Organic HAP	Combustion Controls No Controls

1.3.3.1 MERCURY CONTROLS

Mercury present in pulverized coal combustion flue gas exists primarily in three basic forms: particulate-bound mercury, elemental mercury, and ionic (oxidized) mercury. The characteristics of the coal and the emission control systems installed for criteria pollutants both have a strong influence on the amount and form of mercury that is emitted and on the overall amount of mercury emissions that can be captured.

One available add-on control for mercury removal is halogenated activated carbon. Elemental and oxidized mercury adsorb onto the carbon sorbent for subsequent capture in a particulate control device. Control efficiencies for halogenated activated carbon injection systems have been demonstrated to achieve 90% control in some tests.[3]

"Co-benefit" mercury removals have been observed as a result of control devices intended to remove other pollutants such as sulfur dioxide, nitrogen oxides, and particulate mater. For units using subbituminous coal fuels, co-benefit mercury removals with wet scrubber systems and electrostatic precipitators have been demonstrated at an average of 29%, while removals with dry scrubber systems and fabric filter baghouses have been demonstrated at an average of 19%.[4]

[3] Laumb, J. et al., DOE-NETL Report: "Large-Scale Testing of Enhanced Mercury Removal at W.A. Parish Unit 8, Hoot Lake Unit 3, and Hawthorn Unit 5," October 2006.

[4] Miller, C.E., et al., "Mercury Capture and Fate Using Wet FGD at Coal-Fired Power Plants," presented at DOE/NETL Mercury and Wet FGD R&D, August 2006.

Several experimental technologies for the oxidation (removal) of mercury are under development and are mentioned here only to provide MME's rationale for not considering them in the ranking above. These technologies typically include a *honeycomb catalyst system* to oxidize the elemental mercury and downstream equipment capable of capturing the oxidized mercury. The Electric Power Research Institute (EPRI) is working on furnace *injection of chlorine compounds* in order to oxidize the mercury. A German company is testing furnace *injection of liquid sodium tetrasulfide*, an oxidizing agent that does not create the same corrosion and plugging problems as chlorine compounds. *Coal blending* is the same concept as furnace injection where small amounts of higher chlorine content bituminous or anthracite coal are co-fired with PRB coal. *Photochemical oxidation* is a process where flue gas is irradiated with ultraviolet light causing the oxidation. *Electrocatalytic oxidation* (ECO) is designed to oxidize mercury and other pollutants in a barrier discharge reactor, a region of high electron energy. The ECO technology has been demonstrated in slip stream trials but has not been implemented in full-scale operations.[5] All of these technologies have shown some promise, but additional development work and full-scale testing is required based on the initial test results presented in the literature. Since these developing control technologies have not been demonstrated in long-term operation at full-scale facilities, they are not considered available options for reliably controlling mercury emissions from a PC-fired boiler.

Three other new novel experimental techniques for control of mercury have been proposed. W. L. Gore & Associates developed *an insert for the bags in fabric filters* that has shown potential for removing mercury during firing with PRB and lignite fuels. The insert is designed to fit with existing fabric filter technology, thus removing the need for additional infrastructure.[6] The second novel technology is *MerCAP™*. MerCAP™ is a fixed structure of gold that is designed to capture mercury for later regeneration through removal of the bound mercury. The structure has not yet been tested at full scale, but miniature versions tested on slipstreams have shown potential. *K-Fuel*, the third method, is a beneficiated coal derived from PRB coal. The beneficiation process has shown 43% lower mercury content on a mass basis and 60% lower mercury content on a Btu basis. K-Fuel is produced commercially but not at a scale sufficient to support the coal requirements of the proposed PC-fired boiler. Accordingly, since these developing control technologies also have not been demonstrated in long-term operation at full-scale facilities, they are not considered available options for reliably controlling mercury emissions from a PC-fired boiler.

[5] http://www.powerspan.com

[6] http://epw.senate.gov/108th/Bucher_060503.htm

1.3.3.2 NON-MERCURY METALS CONTROLS

Section 13.3.1 of EPA's Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress, February 1998 (Utility RTC) indicates that HAP metals, including arsenic, beryllium, cadmium, chromium, lead, and manganese, are emitted from electric utility boilers primarily in the particulate form and are readily controlled by particulate control devices.[7] In addition, antimony, cobalt, nickel, and selenium all have melting points above 400°F, which would indicate that they too would exist in the particulate form in the flue gas locations downstream of all boiler heat transfer surfaces and would therefore be readily controlled by particulate control devices. The relative control efficiencies for the various particulate control devices are documented in the particulate Best Available Control Technology (BACT) analysis in Appendix D of the MMES PTI Application and are reflected in the ranking in **Table 1-1** above.

Fabric Filter. A fabric filter baghouse removes particles and metals from the flue gas by drawing dust-laden flue gas and condensables through a bank of filter tubes suspended in a housing. A filter cake, composed of the removed particulate, builds up on the dirty side of the bag. Periodically, the cake is removed through physical mechanisms (e.g., blast of compressed air from the clean side of the bag, mechanical shaking of the bags, etc.) which causes the cake to fall. The dust is then collected in a hopper and removed. This technology has been demonstrated in practice in similar PC-fired boiler installations and is considered available.

Electrostatic Precipitator. An electrostatic precipitator (ESP) removes dust, metals, or other fine particles from the flue gas by charging the particles inductively with an electric field and then attracting the particles to highly charged collector plates, from which they are removed. An ESP consists of a hopper-bottomed box containing rows of plates forming passages through which the flue gas flows. Centrally located in each passage are emitting electrodes energized with a high-voltage, negative polarity direct current. The voltage applied is high enough to ionize the gas molecules close to the electrodes, resulting in a corona current of gas ions from the emitting electrodes across the gas passages to the grounded collecting plates. When passing through the flue gas, the charged ions collide with, and attach themselves to, fly ash particles suspended in the gas. The electric field forces the charged particles out of the gas stream towards the grounded plates, and there they collect in a layer. The plates are periodically cleaned by a rapping system to release the ash layer into ash hoppers as an agglomerated mass. ESPs have been demonstrated in practice in similar PC-fired boiler installations and are considered available.

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[7] U.S. EPA, Office of Air Quality Planning and Standards, "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress," EPA Document No. EPA-453/R-98-004a, page 13-22, February 1998.

Venturi Scrubber. In a venturi scrubber, metal-containing, dust-laden gases are wetted continuously at the venturi throat. Flowing at 12,000 to 18,000 feet per minute, the high-velocity gases produce a shearing force on the scrubbing liquid due to the initial high velocity differential between the two steams. This shearing force causes the liquid to become atomized into very fine droplets. Impaction takes place between the dust entrained in the gas stream and the liquid droplets. As the gas decelerates, collision continues and agglomerated dust-laden liquor droplets discharge through a diffuser into the lower chamber of a separator vessel. Impingement of the stream into the liquid reservoir removes most of the particulate. Venturi scrubbers have been demonstrated in practice in similar PC-fired boiler installations and are considered available.

Wet Scrubber. Wet scrubbers achieve metal-containing particulate removal through liquid-to-gas contact. In a spray tower scrubber, the particulate-laden stream is introduced into a chamber where it contacts the liquid droplets generated by the spray nozzles. Particulate removal is accomplished via physical absorption of the particles into the liquid droplets. The size of the droplets generated by the spray nozzles is controlled to maximize liquid-particle contact and, consequently, scrubber collection efficiency.[8] Wet scrubbers have been demonstrated in practice in similar PC-fired boiler installations and are considered available.

Centrifugal Separator (Cyclone). The centrifugal separator, or cyclone separator, achieves metal-containing particulate removal by centrifugal, inertial, and gravitational forces developed in a vortex separator. The dust-laden gas is admitted either tangentially or axially over whirl vanes to create a high velocity in the cylindrical portion of the device. Particles are subjected to a centrifugal force and an opposing viscous drag. The balance between these two forces determines whether a particle will move to the wall or be carried into the vortex sink and be passed on to the clean-gas outlet tube. Because these collectors depend primarily on differential inertia, collection efficiencies vary with particle size. Efficiencies can be high on materials greater than 20 μm in size but drop off rapidly for smaller particles. Due to their efficiency in removing coarse particles, the modern-day use of a cyclone is typically limited to first-stage particulate removal for stoker-fired and fluidized-bed boilers, which produce a large amount of coarse particles as compared to pulverized coal boilers. Centrifugal separators have been demonstrated in practice in similar PC-fired boiler installations and are considered available.

1.3.3.3 Acid Gas Controls

Dry Scrubber. The dry scrubber is a once-through pollution control technology. In a dry scrubber system a reagent is slurried with water and

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[8] U.S. EPA, document no. EPA-452/F-03-016: *Air Pollution Control Technology Fact Sheet – Spray-Chamber/Spray-Tower Wet Scrubber*, p. 3.

sprayed into the flue gas stream in an absorber vessel. The acid gas is removed from the flue gas by sorption and reaction with the slurry. The by-products of the sorption and reaction are in a dry form upon leaving the system and are subsequently captured in a downstream particulate collection device, typically a fabric filter baghouse. Dry scrubbers have been demonstrated in practice in similar PC-fired boiler installations and are considered available.

Wet Scrubber. The wet scrubber is a once-through pollution control technology. In a wet scrubber system, a reagent is slurried with water and sprayed into the flue gas stream in an absorber vessel. The acid gas is removed from the flue gas by sorption and reaction with the slurry. The by-products of the sorption and reaction are in a wet form upon leaving the system and must be dewatered prior to transport/disposal. Wet scrubbers have been demonstrated in practice in similar PC-fired boiler installations and are considered available.

The wet scrubber can be further classified on the basis of the reagents used and the by-products generated. The typical reagents are lime and limestone. Additives, such as magnesium, may be added to the lime or limestone to increase the reactivity of the reagent. Seawater has also been used as a reagent since it has a high concentration of dissolved limestone. The main reaction by-products are calcium sulfite and/or calcium sulfate. The calcium sulfite to calcium sulfate reaction is a result of oxidation, which can be inhibited or forced depending on the desired by-product. The most common wet scrubber application utilizes limestone as the reagent and forced oxidation of the reaction by-products to form calcium sulfate.

Wet Electrostatic Precipitator. A wet electrostatic precipitator (WESP) works under the same general principles as an ESP described above although the collected particles are washed from the collection surfaces with water rather than the rapping process. WESPs are more commonly used in applications where the gas stream has high moisture content, is below the dew point, or includes sticky particulate. A WESP has not been found to be MACT for any PRB fired facilities, nor has a WESP been applied as part of BACT for PRB fired facilities. Therefore it cannot be considered available.

Particulate control devices that remove acid gas vapors are discussed in Section 1.3.3.2 above. The relative control efficiencies for the various acid gas control strategies are documented in EPA's 1998 Utility RTC[9] or the BACT analysis in the MMES PTI application and are reflected in the ranking in **Table 1-1** above.

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[9] U.S. EPA, Office of Air Quality Planning and Standards, "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress," EPA Document No. EPA-453/R-98-004a, page 13-28, February 1998.

1.3.3.4 Organic HAP Controls

Combustion Controls. Optimization of the design, operation, and maintenance of the furnace and combustion system is the primary mechanism available for lowering organic HAP emissions. This process is often referred to as combustion controls and is also applicable to the control of volatile organic compound (VOC) emissions.

The furnace/combustion system design on modern PC-fired boilers provides all of the factors required to facilitate almost complete combustion of organic emissions. These factors include continuous mixing of air and fuel in the proper proportions, extended residence time, and consistent high temperatures in the combustion chamber. As a result, a properly designed furnace/combustion system is effective at limiting organic HAP formation by maintaining the optimum furnace temperature and amount of excess oxygen.

Proper operation and maintenance of the furnace/combustion system helps to minimize the formation and emission of organic HAP by ensuring that the furnace/combustion system operates as designed. This includes maintaining the air/fuel ratio at the specified design point, having the proper air and fuel conditions at the burner, and maintaining the fans and dampers in proper working condition.

As reflected in the VOC BACT analysis in Appendix D of the MMES PTI Application, other potentially applicable organic HAP control technologies, such as afterburners or catalytic oxidizers are not technically feasible due to the high volume, low heating value, and particulate loadings associated with the PC-fired boiler exhaust. Thus, other add-on controls are not considered available for organic HAP control.

1.3.4 Step 4: Evaluation of MACT Control Technologies

Per MDEQ policy and EPA requirements, MACT cannot be less stringent than the emission limitation achieved in practice by the best-controlled similar source (i.e., the "MACT floor"), unless it is demonstrated that the emission limitation is not feasible due to environmental, energy, or economic impacts.[10] This section documents the emission rates achieved by the best-controlled similar sources and the environmental, energy, and economic impacts associated with the various available control options.

1.3.4.1 MACT Floor Determination

Mercury. Based on the available data, there are two operating PC boilers that utilize permanently installed add-on controls for mercury. These boilers utilize, activated carbon injection, which has been shown to achieve 90% control. For the remaining operating sources, any mercury removal is achieved through the

[10] 40 CFR §63.43(d).

use of co-benefit controls, that is, SCR, scrubbers, and particulate control devices for control of NO_X, SO_2 and PM.

Thus, the MACT floor is mercury removal based on the use of add-on control for mercury achieving an emission reduction of 90% of the uncontrolled emission level.

Non-Mercury Metals. The emissions of non-mercury metal HAPs from a PC-fired boiler are dependent on the concentration of the non-mercury metals in the coal feed to the boiler. Given the wide range of coals burned in PC boilers, and the lack of readily available data, it is not possible to determine a MACT floor expressed in terms of a numerical emission limitation for non-mercury metals. However, recent EPA correspondence[11] lists control efficiency ratings as another method for establishing the MACT floor. EPA's Utility RTC listed fabric filters as the best control for particulate HAPs at a 99% to 99.8% removal efficiency.[12]

Based on the Utility RTC, the MACT floor is non-mercury metal removal based on the use of fabric filters which have been determined to achieve an emission reduction of 99% of the uncontrolled emission level.

Acid Gases. Due to fluoride being a PSD pollutant, the RACT/BACT/LAER Clearinghouse (RBLC) contains information regarding its control and emission limits in permits since 1978. The majority of fluoride emissions from PC boilers are in the form of hydrogen fluoride (HF), so for this particular HAP, the RBLC serves as a potential source of data for determining the MACT floor.

The RBLC and recent permits and applications for other similar facilities with HF limits are shown in the BACT analysis in Appendix D of the MMES PTI Application. Of those facilities listed, most have not been constructed, are in construction, or are still in the permitting phase (Longview, Thoroughbred, Prairie State, Municipal Energy, Plum Point, Spruce 2, Nevada Power Co., Sandy Creek, and White Pine). Testing was not required at SEI Birchwood. The remaining units listed are from the RBLC database and insufficient information is available in the database to determine if the units were constructed or if testing was required or occurred.

The Springerville Unit 3 facility has completed construction and had a MACT limit for HF of 90% removal. It has begun operation and demonstrated compliance with that requirement. Springerville Unit 3 determined MACT for acid gases to be a dry scrubber with a fabric filter. Data from EPA's Utility RTC indicates that the combination of a dry scrubber and fabric filter provides

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[11] http://energycommerce.house.gov/Press_110/110-resp.033007.EPA.Wehrum.pdf

[12] U.S. EPA, Office of Air Quality Planning and Standards, "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units - Final Report to Congress," EPA Document No. EPA-453/R-98-004a, page 2-14, February 1998.

the highest level of control for acid gases. The use of a WESP in conjunction with a dry scrubber and fabric filter was discussed in the BACT analysis and came with significant costs and environmental impacts in the form of a highly corrosive wastewater stream.

EPA's Utility RTC states in Section 13.3.3 that there is only a limited amount of data available on the removal efficiencies of air pollution control devices for HCl and HF.[13] The limited test data that is described indicates that combinations of emission control equipment in operation at existing coal-fired electric utility boilers can achieve acid gas control efficiencies as follows:

- Electrostatic Precipitators: <6% removal for HCl and HF
- Fabric Filters: Approximately 44% removal for HCl and 0% removal for HF
- Wet Scrubbers: Approximately 80% removal for HCl and 29% for HF
- Dry Scrubber/Fabric Filter Combination: Approximately 82% removal for HCl and HF

Thus, based on available data and the previous MACT determinations for the Springerville units and Plum Point facility, the dry scrubber/fabric filter combination represents the most stringent control strategy for acid gases and is therefore the MACT floor.

Organic HAPs. In the March 4, 2002, Non-mercury HAP presentation to the Utility MACT Working Group, EPA noted that with respect to organic emissions, including dioxins, "estimated emissions, even uncontrolled, are very low from coal-fired boilers" and "organics, including dioxin, from coal are not removed by existing controls . . . but there does not appear to be a significant problem."[14] Accordingly, a numerical MACT emission limit or finding of necessary add-on control technology with respect to organics does not appear to be appropriate for the PC boiler.

As further support for this position, it should be noted that the permit issued by Arizona DEQ for the Tucson Electric Power Company Springerville Generating Station did not include MACT standards for any organic compounds. For MidAmerican Energy's Council Bluffs project, the Iowa DNR found that good combustion practices are the MACT floor for organic HAP emissions based on the lack of units with any type of add on control. Thus the MACT floor for the PC-fired boiler is the use of good combustion practices and no other controls to minimize organic HAP emissions.

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[13] Ibid, page 13-28

[14] Maxwell, B., "Non-Mercury HAP," presentation to the Utility MACT Working Group, U.S. EPA, March 4, 2002.

1.3.4.2 Step 4: Environmental, Energy, and Economic Impacts

Environmental, energy, and economic impacts associated with dry scrubbers and fabric filter baghouse controls are documented in the BACT analysis in Appendix D of the MMES PTI Application and were found not to preclude the use of these technologies; thus, this section only evaluates the technology for which the environmental, energy, and economic impacts have not previously been discussed: halogenated activated carbon injection for mercury removal.

Based on available information, there are no adverse environmental or energy impacts associated with the use of halogenated activated carbon injection for mercury control. Economic impacts were estimated as part of the research studies funded in part by DOE-NETL and were estimated as $9,000/lb Hg removed for 85% removal[15] which included loss of ash sales and disposal costs and $10,950/lb Hg removed for 90% removal[16].

1.3.5 Step 5: Alternative Options

Although MDEQ policy allows applicants to recommend a specific design, equipment, work practice, or operational standard or a combination thereof as an alternative MACT determination, MME does not propose such an alternative. The proposed MACT determinations are provided in Step 6 below.

1.3.6 Step 6: Selection of MACT

Per MDEQ guidance, MACT is the most effective emission limitation, work practice, and/or operation standard that has not been eliminated in Steps 4 or 5. Proposed case-by-case MACT determinations are listed in **Table 1-2** and discussed below.

Table 1-2. Proposed Case-By-Case MACT Determinations

Pollutant	Proposed MACT	Proposed Emission Limit
Mercury	Halogenated Activated Carbon Injection and Fabric Filter Baghouse	90% control, annual average, as determined by fuel sampling and a continuous emission monitoring system (CEMS)
Non-Mercury Metals	Fabric Filter Baghouse	0.015 lb/MMBtu (measured in terms of filterable PM as surrogate), average of 3 test runs with EPA Method 5 (front half only) and continuous opacity monitoring

[15] http://www.netl.doe.gov/publications/proceedings/07/mercury/presentations/Dillon_Pres%20.pdf
[16] http://www.netl.doe.gov/publications/proceedings/07/mercury/presentations/Amrhein_Pres.pdf

Pollutant	Proposed MACT	Proposed Emission Limit
Acid Gases	Dry Scrubber and Fabric Filter Baghouse	0.027 lb/MMBtu (measured in terms of total PM as surrogate), average of 3 test runs with EPA Method 5 with a back-half catch AND 0.09 lb/MMBtu when uncontrolled $SO_2 \geq 1$ lb/MMBtu and 0.065 lb/MMBtu when uncontrolled $SO_2 < 1$ lb/MMBtu (measured in terms of SO_2 as surrogate), 24-hour average as determined by CEMS
Organic HAP	Combustion Controls	0.15 lb/MMBtu (measured in terms of CO as surrogate), 24-hour average as determined by CEMS

1.3.6.1 Proposed Mercury MACT

For the control of mercury, MME proposes halogenated activated carbon injection in conjunction with a fabric filter baghouse to achieve 90% control on an annual averaging period. As discussed in the previous text, this level of control represents the maximum achievable control technology for mercury. Compliance with the 90% control requirement will be demonstrated through fuel sampling and the use of a mercury CEMS.

1.3.6.2 Proposed Non-Mercury Metals MACT

The fabric filter baghouse is the maximum achievable control technology. This is supported by the January 13, 2003, proposed MACT standard for new sources in the Industrial/Commercial/Institutional Boilers and Process Heaters. In the preamble, it states that "EPA still considers the fabric filter to be the best performing control for non-mercury metallic HAP, PM, and mercury."[17]

Given that non-mercury metals are a subset of PM emitted from PC boilers, it is reasonable to use a PM emission limit as a surrogate for the MACT standard for individual non-mercury metal HAP. Four EPA precedent cases (discussed below) have been identified where MACT standards were established for HAP metals using a PM emission limit as a surrogate. Also, several recent case-by-case MACT determinations (discussed below) made for PC boilers have used either PM or good operation of the PM control device as the surrogate for non-mercury metal HAP.

[17] 68 FR 1675, January 13, 2003.

The first case involved EPA's proposed MACT standards for the iron & steel manufacturing industry. In this case, EPA stated:

"For the proposed rule, we decided that it is not practical to establish individual standards for each specific type of metallic HAP that could be present in the various processes (e.g., separate standards for manganese emissions, separate standards for lead emissions, and so forth for each of the metals listed as HAP and potentially could be present). When released, each of the metallic HAP compounds behaves as PM. As a result, strong correlations exist between air emissions of PM and emissions of the individual metallic HAP compounds. The control technologies used for the control of PM emissions achieve comparable levels of performance on metallic HAP emissions. Therefore, standards requiring good control of PM will also achieve good control of metallic HAP emissions. Therefore, we decided to establish standards for total PM as a surrogate pollutant for the individual types of metallic HAP. In addition, establishing separate standards for each individual type of metallic HAP would impose costly and significantly more complex compliance and monitoring requirements and achieve little, if any, HAP emissions reductions beyond what would be achieved using the surrogate pollutant approach based on total PM."[18]

The second case involved the Portland cement manufacturing industry. In the preamble to the final National Emissions Standards for Hazardous Air Pollutants (NESHAP) for the Portland Cement Manufacturing Industry, EPA stated: "In today's notice, the EPA is establishing emission standards for particulate matter (as a surrogate for HAP metals)."[19]

EPA also proposed the use of PM as a surrogate for HAPs emitted from hazardous waste combustors, as indicated by the following statement contained in the Combustion Emission Technical Resource Document Executive Summary – Draft for Hazardous Waste Combustion Units: "EPA is evaluating PM emission levels because controlling PM will control emission of most toxic metals and toxic organic compounds adsorbed onto the PM."[20]

The fourth case involved EPA's January 13, 2003 proposed standard for Industrial/Commercial/Institutional Boilers and Process Heaters. In the preamble, EPA stated: "For the non-mercury metallic HAP, EPA chose to use PM as a surrogate. Most, if not all, non-mercury metallic HAP emitted from combustion sources will appear on the flue gas fly-ash. Therefore, the same control techniques that would be used to control the fly-ash PM will control non-mercury metallic HAP. ... The use of PM as a surrogate will also

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[18] http://www.epa.gov/ttn/atw/iisteel/fr13jy01.pdf, page 36842 (or 66 FR 36842, July 13, 2001).
[19] http://www.epa.gov/ttn/atw/pcem/fr14jn99.pdf, page 31900.
[20] http://www.epa.gov/epaoswer/hazwaste/combust/general/cctred.txt, page 2.

eliminate the cost of performance testing to comply with numerous standards for individual metals."[21]

Finally, this same approach was used in previous case-by-case MACT determinations for coal-fired power plants. The Arizona Department of Environmental Quality (DEQ), in its December 21, 2001 Technical Support Document and Statement of Basis issued in support of the draft PSD permit for Tucson Electric Power Company's coal-fired Springerville Generating Station, determined "the BACT emission limits for PM and PM-10 will suffice as MACT standards for Unit 3 and Unit 4." In its April 24, 2002 Permit Application Analysis for the Wygen 2 Coal-fired Power Plant, the Wyoming DEQ found that "[t]he emission limits and control efficiency requirements for criteria pollutants serve as surrogates for HAP limits." The Kentucky Department of Environmental Protection (DEP) used measurement of the voltage across the wet and dry ESP's at the Thoroughbred Generating Facility as a surrogate for removal of metals in the December 6, 2002 air permit. The Iowa Department of Natural Resources (DNR) April 21, 2003 Technical Support Document for the MidAmerican Energy Company Council Bluffs project determined demonstration of a PM emission limit shows compliance with reductions of non-mercury metals. The Arkansas DEQ determined that the MACT standard was to control PM emissions to the BACT level for the recent Plum Point Energy Project.

Given the precedent established by EPA and other states in setting non-mercury metals MACT standards using a surrogate pollutant, the emission limit for PM is proposed as the MACT standard for non-mercury metals for the MMES PC boiler.

A fabric filter baghouse provides the maximum achievable control technology particulate matter and is proposed as MACT for non-mercury metals. Compliance with the non-mercury metal MACT standard will be verified by compliance with the PM BACT limit through stack testing and continuous opacity monitoring.

1.3.6.3 PROPOSED ACID GASES MACT

Data from the 1998 Utility RTC indicates that the combination of a dry scrubber and fabric filter provides the highest level of control for acid gases. Since a dry scrubber/fabric filter combination is proposed as BACT for control of SO_2 and PM (and the BACT determination for HF), the MMES configuration will include the emission control equipment found by EPA to achieve the maximum achievable control technology for acid gases.

As discussed above for non-mercury metals, setting a MACT emissions limit using a surrogate pollutant is acceptable in cases where the desired effect on

[21] 68 FR 1671, January 13, 2003.

targeted emission control is achieved. The dry scrubber/fabric filter combination provides the best level of control for both HCl and HF according to EPA's findings in the Utility RTC, thus the use of pollutants that are controlled by this combination would appear to serve as valid surrogates.

In its MACT decision document analysis of public comments, the Wyoming DEQ found for the Wygen 2 project that "[t]he Division considers surrogate emission limits to be the appropriate method. As discussed in the analysis, hydrogen fluoride reacts with lime (the reagent for the spray dryer absorber) to form calcium fluoride. Calcium fluoride is a stable solid and is removed with the fabric filter. ...These control devices will be operated to control SO_2 and PM_{10} emissions, respectively, and the emission limits for SO_2 and PM_{10} act as surrogates for control of HF."

Compliance with the sulfur dioxide emission limitations was determined by Kentucky DEP to assure MACT compliance with the HF and HCl limitations for the Thoroughbred Generation Station. The Iowa DNR permit for the MidAmerican Energy's Council Bluffs project provides for a continuous sulfur dioxide monitor as well as continuous monitoring of the sorbent injection rate in the scrubber to monitor compliance with acid gas MACT.

For the PC boilers proposed for the MMES, the Applicant proposes that compliance with the SO_2 and PM limits be used as the surrogates for both acid gases. Compliance with the SO_2 and PM BACT limits demonstrates proper operation of the dry scrubber/fabric filter combination and demonstrates compliance with the maximum achievable control technology.

1.3.6.4 Proposed Organic HAP MACT

Given the precedents for surrogates established in previous MACT determinations, it is reasonable to use the CO emissions as a surrogate for the MACT standard (good combustion practices) for organic HAP emissions.

Tucson Electric Power Company Springerville Generating Station did not include MACT standards for any organic compounds. MidAmerican Energy's Council Bluffs permit only included monitoring of the CO emissions to insure that combustion controls were being used. The Kentucky DEP permit for the Thoroughbred project provided an annual limit on organic HAPs, but only required compliance with the CO emissions limit to assure use of combustion controls and compliance with the organic HAPs. The draft standard for Industrial/Commercial/Institutional Boilers and Process Heaters found that CO monitoring is MACT for organic HAPs for new solid fuel units.[22]

For the PC boilers proposed for the MMES, the Applicant proposes that compliance with the CO BACT limit will demonstrate good combustion

[22] 68 FR 1682, January 13, 2003.

practices and therefore compliance with the maximum achievable control technology proposed for the Facility for organic HAP emissions.

1.4 INFORMATION REQUIRED BY 40 CFR §63.43(e)(2)

The following table of information is included to satisfy the case-by-case MACT application requirements specified in 40 CFR §63.43(e)(2).

Table 1-3. Required Case-by-Case MACT Information

Item	**Required Information in Response**
(i) The name and address (physical location) of the major source to be constructed or reconstructed;	Mid-Michigan Energy, LLC South Saginaw Road and Waldo Avenue Midland, Michigan 48640
(ii) A brief description of the major source to be constructed or reconstructed and identification of any listed source category or categories in which it is included;	The proposed source will generate steam to produce a nominal 750 megaWatts of electric power for sale and is included in the electric utility steam generating unit source category.
(iii) The expected commencement date for the construction or reconstruction of the major source;	Expected to commence construction in 2009
(iv) The expected completion date for construction or reconstruction of the major source;	Expected to complete construction in 2013
(v) the anticipated date of start-up for the constructed or reconstructed major source;	Initial startup expected in 2012
(vi) The HAP emitted by the constructed or reconstructed major source, and the estimated emission rate for each such HAP, to the extent this information is needed by the permitting authority to determine MACT;	Refer to Section 1.3.1 and Table 1-2 of this case-by-case MACT analysis. Also see Appendix C of the MMES PTI Application ("Air Emissions Calculations")
(vii) Any federally enforceable emission limitations applicable to the constructed or reconstructed major source;	Federally enforceable emission limitations are proposed in the MMES PTI Application and this case-by-case MACT analysis and will be included in the PTI issued by MDEQ.
(viii) The maximum and expected utilization of capacity of the constructed or reconstructed major source, and the associated uncontrolled emission rates for that source, to the extent this information is needed by the permitting authority to determine MACT;	8,760 hours per year. For uncontrolled emission rates, where known, refer to Appendix C of the MMES PTI Application ("Air Emissions Calculations").

Item	Required Information in Response
(ix) The controlled emissions for the constructed or reconstructed major source in tons/yr at expected and maximum utilization of capacity, to the extent this information is needed by the permitting authority to determine MACT;	Refer to Appendix C of the MMES PTI Application ("Air Emissions Calculations")
(x) A recommended emission limitation for the constructed or reconstructed major source consistent with the principles set forth in paragraph (d) of this section;	Refer to Section 1.3.6 of this case-by-case MACT analysis
(xi) The selected control technology to meet the recommended MACT emission limitation, including technical information on the design, operation, size, estimated control efficiency of the control technology (and the manufacturer's name, address, telephone number, and relevant specifications and drawings, if requested by the permitting authority);	Refer to Sections 1.3.4 and 1.3.6 of this case-by-case MACT analysis
(xii) Supporting documentation including identification of alternative control technologies considered by the applicant to meet the emission limitation, and analysis of cost and non-air quality health environmental impacts or energy requirements for the selected control technology; and	Refer to Sections 1.3.3 and 1.3.4 of this case-by-case MACT analysis
(xiii) Any other relevant information required pursuant to subpart A.	Refer to the previous text