

April 5, 2011  
Project No. G060783FF

Ms. Mary Ann Dolehanty  
MDEQ-AQD Permit Section Supervisor  
PO Box 30260  
Lansing, MI 48909-7760

Re: Supplemental Update GHG BACT Analysis in Support of PTI No. 317-07

Dear Ms. Dolehanty:

Based on further review of the GHG BACT analysis we submitted to the Air Quality Division on March 16, 2011, and the U.S. Environmental Protection Agency's (USEPA's) subsequent release of somewhat revised GHG BACT guidance on March 24, 2011, we wanted to submit the attached Supplemental Update GHG BACT analysis in support of PTI No. 317-07.

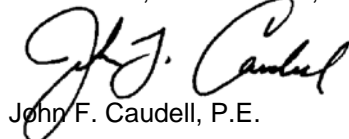
As of the date of this submittal, Wolverine believes there is a basis for concluding that the GHG BACT determination is not legally required for its application, the application having been technically and/or administratively complete well before the proposed date of any GHG BACT requirement arising under the federal Clean Air Act or the Michigan State Implementation Plan.

Accordingly, Wolverine at this time, reserves its right to contend that this submittal is not necessary to address any applicable requirement relative to its pending application, and that any resulting permit conditions relating to GHG emissions are not an applicable requirement.

If you have any questions or require additional information, please contact me at 517-887-4024 or [jfcaudell@ftch.com](mailto:jfcaudell@ftch.com).

Sincerely,

FISHBECK, THOMPSON, CARR & HUBER, INC.



John F. Caudell, P.E.

jjr

Attachment

cc/att: Mr. Brian L. Warner, CHMM - Wolverine Power Cooperative  
Mr. Michael Zebell, P.E. - AECOM Environmental  
Mr. Steven Kohl - Warner Norcross & Judd LLP  
Mr. William Campbell - AECOM Technical Services, Inc.

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**SUPPLEMENTAL UPDATE TO  
MARCH 16, 2011 GHG BACT ANALYSIS (PTI NO. 317-07)  
April 5, 2011**

Based on further review of the GHG BACT analysis we submitted to the Air Quality Division on March 16, 2011, and the U.S. Environmental Protection Agency's (USEPA) subsequent release of somewhat revised GHG BACT guidance on March 24, 2011, the following clarifications are presented for specific sections of the original analysis.

**Section 1.1.4, BACT Cost Estimates**

The costs provided in Table 1 as noted in our original submittal are very rough estimates that are based on very limited information. Therefore, we would like to emphasize that these cost estimates should not be used for determining GHG BACT and are for relative comparison purposes only.

Furthermore, the emission factors used for this analysis were selected from the U.S. Department of Energy (USDOE) database, rather than other available USEPA databases. While other sources of emission factors are available from the USEPA, such as AP-42 and the factors identified in the annual GHG reporting rule, we believe the database we selected is more boiler and fuel specific than the other emission databases. Accordingly, we believe the emission factors from the USDOE database are appropriate for the purpose of this BACT analysis.

**Section 3.1, CO<sub>2</sub> Capture**

The first sentence states: "This report includes post-combustion CO<sub>2</sub> capture technologies currently under investigation that *do not involve pre-combustion or the oxy-fuel approach to control – those technologies do not fit into the WCEV business purpose* and their application would mandate a redesign of the project." There are currently no oxy-fueled CFB units in operation in the world, to our knowledge. Major boiler manufacturers, such as Foster-Wheeler, have stated that their current CFB boiler designs consider future oxy-fuel retrofits; however, there is no planned or existing oxy-fueled CFB that Wolverine is aware of. It is our opinion that to include oxy-fuel in the planned WCEV would constitute a redefinition of the project into a technology demonstration project, and is inconsistent with the WCEV project definition and purpose as otherwise specified in the permitting record.

**Section 3.1, Page 3-6**

The last sentence in this paragraph states: "In addition, installation of a carbon capture system would reduce the net generating capacity of a plant by 29–35% depending on the technology." This range of parasitic loads is derived from various USDOE published information. It is a stated objective of the USDOE CCS program to reduce the parasitic load from CCS systems; however, the additional unit operations for capture and the compression and transport of captured CO<sub>2</sub> to a suitable sequestration site vary widely from project to project, and represent a significant load for a power generation facility.

**Section 3.1, Biomass Co-Firing, Page 3-9, Limitation to 5% Biomass**

As noted in the original permit application, the project's potential use of biomass fuels is up to 20% of the heat input to the boiler. The recently submitted GHG BACT review proposes a requirement that at least 5% of the heat input to the boiler is to come from biomass. The 5% figure represents the level of biomass consumption which is both practically achievable and economically reasonable at this time. The factors affecting this limitation include the following:

- Biomass resource related:
  - Resource competition from other forest product consumers
  - Small parcel land divisions
  - Landowner preferences
  - Limited harvesting from state and federal lands
- Unit related:
  - Efficiency impact on CFB units with greater levels of biomass
  - Material handling investments to process greater levels of biomass

The Life Cycle Assessment study conducted by Michigan Technological University (*Biomass Co-firing for the Wolverine Clean Energy Venture*, January 2008) included in the original GHG BACT confirms that up to 20% of the heat input to the units from biomass can physically be sustained, with proper management, from the forest resources; however, the factors noted above are a significant source of uncertainty about the practical availability of the biomass resource upon commencement of operation of the WCEV.

The unit related issues contributing to the 5% heat input commitment are based on an estimate of the lowest reasonable "Heat Rate" for the facility without actual operating experience using locally available biomass. The heat rate criteria is a measure of heat input for each kilowatt of electricity generated which is an indicator of energy efficiency. Until such time as the local biomass can be used in the boiler and the fuel blends evaluated for the impact on unit heat rate criteria, we believe the 5% usage commitment should be used for the GHG BACT analysis.

The costs related to going from 5% biomass heat input to the CFB units to 20% of the heat input are presented in Table 1. These costs show that for an additional \$25,500,000 in capital investment, CO<sub>2</sub>e from fossil fuel combustion can be reduced at a cost of \$36 per ton. In consideration of the uncertainty of biomass supply and the impact upon "Heat Rate", this level of additional investment is not economically warranted at this time.

**Table 1 – CO<sub>2</sub>e Control Costs from 5% to 20% Biomass Heat Input**

Parameter	Value	Notes
Cost Basis		
Period	20	years
Interest Rate	7	%
Capital Recovery Factor	0.094	
Costs		
Capital Costs	\$25,500,000	Burns and Roe (BRE)
O&M	\$1,020,000	At 4% of Capital Cost
Fuel Differential	\$19,030,012	Based on BRE heat input and fuel cost estimates
Annual Capital Cost	\$2,407,020	
Annualized Cost	\$22,457,032	
CO <sub>2</sub> Removed (metric TPY CO <sub>2</sub> e)	616,227	Based on additional of 15% biomass
Cost Effectiveness (\$/ton)	\$36.44/ton	

### **Section 3.1, CCS Cost Estimates, Page 3-12**

As noted previously, these costs estimates should be used for general comparisons only. These estimated costs are highly variable, due to the lack of actual operating information available. In the event more of these systems are installed and operated in the future, industry and permitting authorities will be in a much better position to refine costs estimates and evaluate equipment performance.

The original submittal included information on the design of the CCS demonstration system contemplated under a USDOE grant for the WCEV project. That proposed system included Hitachi Power Systems America's (Hitachi) CO<sub>2</sub> capture system and advanced amine technology to be provided by a Dow Chemical Company unit. The captured CO<sub>2</sub> was proposed to be compressed and transported for Enhanced Oil Recovery (EOR) and deep saline sequestration purposes. The projected capital costs for the proposed demonstration project were estimated for purposes of responding to the USDOE solicitation, and were included in the original top down BACT review. The Hitachi technology was selected as the most reasonable option for the demonstration project out of the technologies considered in that process.

The DOE grant for a CCS demonstration project contemplated carbon sequestration in geology similar to the existing carbon sequestration demonstration project in Gaylord, Michigan, which is completely independent of the WCEV project. DTE Energy and Core Energy LLC, members of the USDOE's Midwest Regional Carbon Sequestration Partnership, developed and are executing a field test to assess the effectiveness of storing CO<sub>2</sub> in deep underground rock formations existing in the region. The project is funded by USDOE. The CO<sub>2</sub> was stored between oil and gas producing zones within a large geologic structure known as the Michigan Basin. It is understood that the project recently completed validation testing, which involved the injection of up to 50,000 metric tons of CO<sub>2</sub>, during the period of mid-February through July 2009. The project is now monitoring the effectiveness of the storage.

#### ***Terrestrial Sequestration***

Terrestrial sequestration is defined as the net removal of CO<sub>2</sub> from the atmosphere through uptake in terrestrial ecosystems including soil and vegetation. Terrestrial sequestration is a component of the proposed BACT determination for WCEV, as the emissions from 5% of the CFB heat input as biomass combustion will be more than offset by the use of sustainable forestry practices. Other means of terrestrial sequestration include restoring land use, reducing decomposition of organic material, encouraging photosynthesis, and creating energy offsets by using biomass as a fuel (NETL Terrestrial Sequestration Program Facts<sup>1</sup>).

#### ***Energy Efficiency***

Finally, in the March 24 revisions to the GHG BACT Guidance, the USEPA has placed additional emphasis on energy efficiency. The USEPA encourages energy benchmarking as a practice to ensure that full consideration is given to energy efficiency in the design process, and identifies the ENERGY STAR program for industrial facilities as a source of information that can assist with performance benchmarking. However, the level of engineering design performed at the permitting stage of a power generation facility does not warrant use of these tools. Such tools are useful during the design phase to evaluate the energy performance of plant components. Wolverine is committed to requiring the design contractor to use energy benchmarking and ENERGY STAR tools or an equivalent tool in the plant design process.

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<sup>1</sup> [www.netl.doe.gov/publications/factsheets/program/prog024.pdf](http://www.netl.doe.gov/publications/factsheets/program/prog024.pdf)