Pollution controls for SO2 are cost effective at $10,000 per ton of air pollutant removed or prevented. Wisconsin Department of Natural Resources, *Analysis and Preliminary Determination for the Construction and Operation Permits for the Proposed Construction of a 650 TPD Preheater Lime Kiln for C L M Corporation-Superior, To Be Located at Hill Ave and Winter St, Superior, Douglas County, Wisconsin*, July 7, 2006; attached as Exhibit A. In order to eliminate the Atop,@ 100% waste wood, control option the NMU would have to demonstrate that the increase in cost, compared to the use of coal, as a secondary fuel exceeds the following level:

Economic Infeasibility Threshold for Use of Wood as Sole Fuel
= 1,555 TPY SO_2 x $10,000 per of pollutant removed
= $15,550,000 per year

Based solely on fuel cost, the difference between waste wood and coal would have to be extreme for NMU to be able to demonstrate that 100% waste wood is infeasible.

Required Difference in Wood and Coal Fuel Costs
= $15,550,000 per year / (205 MMBtu/hr x 8,760 hrs/yr)
= $8.66/MMBtu

As discussed below, the *difference* in fuel cost does not come close to $8.66/MMBtu. Moreover, fuel cost, alone, is not the only cost factor that the NMU would need to consider if it were to attempt to demonstrate that 100% wood is not feasible. Because 100% wood does not necessitate SO2 controls (other than the fuel choice), the facility can avoid the capital and operating costs associated with limestone and the disposal costs of the significant solid waste created by limestone injection. Moreover, an economic feasibility analysis choosing coal over wood must look at the cost effectiveness as to *all* pollutants. Coal will generate hazardous air pollutant emissions not generated by the

waste wood including mercury, arsenic, HCl, HF, H_2SO_4 and dioxins/furans. Therefore, the use of wood results in overall pollution decrease much greater than the 1,555 tons SO2/year and would be cost effective even at fuel cost differences *greater than* $8.66/MMBtu.

The difference in cost between wood and coal is not $8.66/MMBtu and, therefore, the use of 100% wood waste is cost-effective, assuming the source of the waste wood does not have unintended environmental impacts, as discussed above.[6] For example, a 2007 Energy Center of Wisconsin report indicates the availability of wood fuel in northern Wisconsin. attached as Exhibit B. Xcel Energy currently burns large amounts of wood waste in its Bay Front Generating Station in Ashland, Wisconsin, and is seeking to convert all boilers to consume 100 percent biomass. *Id.* at 3. The Xcel Bay Front facility is currently paying between $25.00 and $29.00 per ton of wood waste, which provides between 5,500 and 6,500 Btu/pound ($3.85 to $5.27/MMBtu). Conservatively assuming a moderate cost of coal at $1.50/MMbtu and assuming NMU demonstrates that wood waste is available, the difference in cost between 100% wood waste and coal is nowhere close to $8.66/ton. There remain significant questions about the amount of waste wood available in the Upper Peninsula according to a 2000 Northern Initiatives study. This study indicates that waste wood from primary and secondary manufacturing operations is not available in large quantities in the UP.[7]

[6] Again, we are not condoning the use of wood absent information about the source of the wood and the environmental impacts associated with harvesting such wood resources.
[7] http://www.northerninitiatives.com/000511_sam_s_residue_final_report.pdf (last visited 12/24/2007).

In a top-down BACT analysis, 100% wood waste cannot be rejected as the top-ranked pollution control option. BACT limits must be based upon 100% wood waste.

D. There is No Analysis of Natural gas As a Clean Fuel Option

Natural gas is a fossil fuel, but is significantly cleaner than coal. It contains no sulfur, no mercury and emits a fraction of the carbon dioxide emissions. Natural gas is an available fuel – it is currently the fuel that powers the existing NMU steam boilers. The top-down BACT analysis should consider the use of high-efficiency combined cycle natural-gas fired cogeneration plant or a plant that could co-fire natural gas and biomass gas as an alternative to a CFB boiler. Such a boiler would be more efficient, i.e. less fuel, and would emit a fraction of the emissions.

E. Even If 100% Wood and Natural Gas Could Be Rejected In A Top-Down Analysis, BACT Must Be Established Based On Low Sulfur Coal.

Even if the NMU could demonstrate that it is not economically feasible to burn wood (its planned primary fuel) as a cleaner fuel, the SO2 BACT limit must nevertheless be established based on lower sulfur coal. MDEQ proposes a 0.20 lb/MMBtu limit based on a 24-hour average and a 0.15 lb/MMBtu limit based on a 30-day average, which assumes 92% control of SO2 through the use of limestone in the boiler. *See* Public Participation Documents; Permit Application No. 60-07 at 4 (October 19, 2007). The Application also identifies a 92% removal from limestone in the boiler. Application at 26. However, a 92% removal would result in a limit of 0.11 lb/MMBtu or lower based on low sulfur coal.

Both the Application and MDEQ's review indicate that the NMU proposes to use low sulfur Powder River Basin coal from either We Energies' Presque Isle plant or Marquette Public Utilities' plant. Application at 3; Public Participation Documents at 2. The draft permit limits coal sulfur content to 1.5% by weight, and assumes 12,000 Btu per ton of coal. Draft Permit § 1.3. This equates to approximately 2 lb/MMBtu. However, a review of the EPA's Clean Air Markets web database shows that the PRB coal burned at the Presque Isle plant ranges from 1.12 to 1.30 lb SO2/MMBtu, based on uncontrolled emission rates. Even 1.5 lb/MMBtu is in the high range for PRB coal. *See* EPA Region 7 Comments on Sunflower Holcomb Station Expansion Project for New Units H2, H3, and H4 at 2-3 (November 9, 2006), attached as Exhibit C; USEPA Region 7 letter to the Missouri Department of Natural Resources, Re: City Utilities of Springfield, Southwest Power Station Unit 2, attached as Exhibit D; Letter from JoAnn M. Heiman, Air Permitting and Compliance Branch, U.S. EPA Region 7, to W. Clark Smith, Nebraska Department of Environmental Quality (August 4, 2006), attached as Exhibit E (stating that EPA gathered western subbituminous coal data from a number of sources which "shows the sulfur content (SO2 equivalent) of the PRB-Wyoming coal delivered to coal combustion units in the Region to be on average of 0.74-0.76 lbSO2/MMBtu.").

There is no reason to assume a higher sulfur content coal at the NMU unit, and NMU has not offered any reason. Therefore, even if NMU could demonstrate that 100% coal firing was the only cost-effective option (i.e., wood fuel in any percentage is not cost effective), BACT must still be calculated by applying the 92% control in the boiler to the

more realistic coal sulfur content of 0.75 lb/MMBtu typical of PRB coal, and in no case higher than 1.12 to 1.39 lb/MMBtu that is typical of the Presque Isle plant. This would result in a BACT limit of 0.06 lb/MMBtu, and in no case higher than 0.090 to 0.111 lb/MMBtu[8]—much lower than the 0.20 lb/MMBtu limit proposed in the draft permit. 42 U.S.C. § 7479(3) (BACT "means an emission limit based on the maximum degree of reduction of each pollutant... through application of... clean fuels..."). Moreover, as shown below, the plant can achieve a much lower emission rate through the use of additional SO2 controls.

F. NMU Incorrectly Implies That A Proposed BACT Limit That Is "Within The Range" of Previously-Issued BACT Determinations Is Sufficient.

In its application, the NMU suggests that so long as it proposes an emission limit based on the RACT/BACT/LAER Clearinghouse ("RBLC"), no further analysis is necessary in establishing the BACT limit. Application at 36, 42 (proposed SO2 limit is "within the nation-wide range of accepted SO2 emissions that represent BACT"). This is inconsistent with the Clean Air Act and with the purpose of BACT. BACT is technology-forcing and intended to be more stringent with each permit. The RACT/BACT/LAER Clearinghouse is inherently backward looking—consisting only of previously issued permit limits. A proposed limit that is based only upon backward-looking reference to the Clearinghouse, rather than the maximum achievable emission reduction with the most effective combination of pre-combustion and post-combustion controls is not sufficient to satisfy the statutory requirement of BACT. 42 U.S.C. § 7479(3).

---

[8] The Richardton Plant, a lignite coal boiler in the RBLC has a 0.09 lb SO2/MMBtu BACT limit. RBLC ID # ND-0020.

NMU's assertion appears to be based on informal MDEQ guidance for conducting BACT determinations laid out in Operational Memorandum No. 20, "Best Available Control Technology (BACT) Determinations." (Aug. 24, 2005) This guidance presents a four level process that MDEQ uses to evaluate BACT determinations. However, the guidance is in direct conflict with statutory and regulatory requirements that BACT consist of a case-by-case determination of the maximum degree of reduction achievable at a proposed source, as described above. Only the Level 4 analysis articulates an acceptable BACT process, as it closely follows the U.S. EPA's "top-down" process. Informal agency guidance cannot be used to determine BACT in the face of clear statutory and regulatory requirements delineating a more stringent process and outcome.

G. The Coal-Based-BACT Determination For SO2 Is Inadequate.[9]

There are a number of pollution controls that could be used on the proposed NMU boiler (if coal is assumed as the basis for the BACT limit), that were not sufficiently considered in the applicant's BACT analysis. Scrubbers are common in the electric utility and large industrial boiler sectors and are an "available" as a transfer technology and must be considered in a top-down BACT analysis. An option that is available and results in the greatest emission reduction must be used to establish the BACT emission limit

[9] As noted above, BACT limits for this source should be based upon 100% wood firing, which results in nominal sulfur emissions. The consideration of scrubbing is not necessary for SO2 emissions when wood is presumed in establishing the SO2 limit. This discussion about scrubbing is only provided as background, to the extent that MDEQ fails to comply with the BACT process by establishing SO2 BACT based on coal fuel.

unless the applicant can demonstrate that site-specific factors justify rejection of the technology.

Scrubbers are used on CFB boilers following the combustion/limestone process. For example, the Roquette America, Inc., CFB boiler in Iowa uses both limestone injection in the CFB boiler and a post-combustion scrubber. *See* RBLC ID # IA-0083. This allows post-combustion emission control in addition to the reduction achieved in the boiler through the use of limestone. However, the NMU failed to consider (or at least failed to document in the application and the other publicly-available support materials) the combined effectiveness of post-combustion scrubbing in addition to the use of limestone in the boiler.[10] Rather, NMU only compared limestone injection to scrubbing—as if the two controls were mutually exclusive. Application at 40-41.

1. The BACT Analysis Failed To Consider A Circulating Dry Scrubber.

The first step in the top-down BACT analysis is to identify all potentially applicable and available control options. The semi-dry circulating dry scrubber process is a technically and commercially viable scrubber technology. Black & Veatch Corp., *Wisconsin Public Service Weston Unit 4 Flue Gas Desulphurization System Analysis* at p. 2-1

[10] The only indication in the permit record that the applicant considered scrubbing is found in a letter dated September 18, 2007. See Letter from Jeffrey Jaros, NTH, to David Riddle, MDEQ, Re: Addendum to Application No. 60-07 to Update SO2 Emission Limit; Northern Michigan University-Ripley Heating Plant (September 18, 2007). In that letter, NMU's consultant admits that BACT limits have been proposed for CFB boilers based on post-combustion scrubbing. However, the letter asserts, ipse dixit, that vendor guarantees are not likely for lower emission rates than those proposed by NMU. This unsupported assertion is unlikely and irrelevant. Vendor guarantees are neither necessary nor demonstrative of BACT. The relevant question is whether the technology at issue—scrubbers—can achieve a lower emission rate. Moreover, as demonstrated in these comments, scrubbers can and do achieve a 98+% reduction in post-combustion SO2, and are cost-effective for SO2 control.

(March 12, 2003) , attached as Exhibit F; Application of Wisconsin Power & Light Company for a Certificate of Authority to Install SO2 Scrubbers and Baghouses at the Nelson Dewey Generating Station Units 1 and 2, Wis. P.S.C. Docket No. 6680-CE-172, Document # 77419 (June 8, 2007), attached as Exhibit G; Babcock Power, Babcock Power Environmental Adds New Advanced Technology to Reduce Power Plant Emissions (October 3, 2005), attached as Exhibit H; Babcock Power Environmental, Turborsorp (September 29, 2005), attached as Exhibit I; Von Roll, Turbosorp flue gas purification, attached as Exhibit J; Douglas J. Roll, et al., *Comparison of Economic and Technical Features of Fluid Bed and Spray Dryer FGD Systems* (2006), attached as Exhibit K.

Circulating dry scrubbers are widely used in Europe. There are also three installations in the U.S. A circulating dry scrubber is used at the Black Hills Power & Light Neil Simpson 2 plant in Gillett, Wyoming, the Roanoak Valley facility in Virginia, and the Greenridge facility in Pennsylvania. The Neil Simpson plant burns low sulfur western coal from Wyoming—the fuel planned for Holcomb units 2-4—and achieves 98% SO2 control with a circulating dry scrubber. A circulating dry scrubber is used at the Black Hills Power & Light Neil Simpson 2 plant in Gillett, Wyoming. The plant burns low sulfur western coal from Wyoming and achieves 98% SO2 control with a circulating dry scrubber. Black & Veatch Corp., Conference Memorandum (September 10, 2001), attached as Exhibit R. This is much greater SO2 control than the 92% maximum control efficiency in the boiler that is assumed to be BACT for the Ripley boiler here. One type of circulating dry scrubber, the Turbosorp sold by Babcock Power in the United States,

achieves over 95% control of SO2, while controlling mercury and other pollutants, for lower cost than traditional dry scrubber systems. *Id.* This post-combustion control, after 92% reduction in the boiler, would result in an overall 99.6% control. This must be used to establish BACT unless adequately rejected by the applicant in a documented, top-down analysis.

2. A Wet Scrubber Is The Top-Ranked Pollution Control Options for SO2 (If Coal Fuel Is Assumed).

Critical to establishing a BACT limit is determining the top-ranked pollution control. For the proposed Ripley boiler, presuming coal fuel, a wet scrubber is the top-ranked option. After Sierra Club commented on the then-draft permit for the Weston 4 plant in Wisconsin, the consultants for the developer issued a memo acknowledging that they could no longer justify using dry scrubbing as the basis for BACT determinations. The memo stated:

> Currently SO2 emission level limits in Japan are set at 10 ppm, which is available from several wet scrubbing systems. Spray dryers are currently limited to limited periods of operation at outlet SO2 emission of approximately 25 ppm... We believe this situation will be the driving force that will likely eventually push the flue gas de-sulfurization industry to more frequent use of wet scrubbing systems for PRB-fueled projects.

Sulfur Emission Considerations at WPS 006557 (October 19, 2004) (emphasis added), attached as Exhibit M. In other words, the industry recognizes that wet scrubbing can achieve much lower SO2 emissions, even with low sulfur coal, and that once permitting agencies realize this, the industry will be required to use wet scrubbing.

EPA has recognized that new state-of-the art wet scrubbers "have been demonstrated above 98 percent." *Standards of Performance for Electric Generating Units for Which Construction is Commenced After September 18, 1978*, 70 Fed. Reg. 9706, 9711 (Feb. 28, 2005). Even "[e]xisting wet FGD systems ... installed in the past 10 years, are capable of consistently achieving SO2 removal efficiencies of 95 percent and higher." *Id.* at 9715. Multiple plants have demonstrated that 95 percent and higher control is achievable on a long-term basis with a wet scrubber, as opposed to lower SO2 removal efficiencies for existing dry injection systems. *Id.* at 9711. When U.S. EPA recently issued a draft PSD permit for two 750 MW supercritical pulverized coal boilers burning subbituminous coal, it established BACT based on the superior control of a wet scrubber. U.S. EPA, Desert Rock Energy Center (AZP 04-01) Proposed Permit Conditions.

> EPA's independent analysis of available control technologies for pulverized coal fired boilers included reviewing the DOE/NETL (National Energy Technology Laboratory) database, EPA's RACT/BACT/LAER Clearinghouse, EPA's National Coal BACT Workgroup database, and the EPA spreadsheet of recently permitted and proposed coal-fired power plants as well as... other sources...
>
> EPA's review of all available data and technologies demonstrates that the choice of low sulfur coal and wet limestone desulfurization is the most stringent combination of control technologies available for pulverized coal fired boilers. The emission rate of 0.06 lb/MMBtu that [the applicant] has proposed, as a 24-hour average, is lower than other SO2 emission rates that have been proposed for pulverized coal fired boilers recently.
>
> EPA is also persuaded that 0.06 lb/MMBtu SO2 is BACT for [Desert Rock] based on the information in the National Coal Workgroup database...

Desert Rock AAQIR p. 18, attached as Exhibit N.

Certain types of advanced wet scrubbers, particularly a jet bubbling reactor or magnesium enhanced lime scrubber, can achieve 99 percent or greater SO2 removal. Yasuhiko Shimogama, *Commercial Experience of the CT-121 FGD Plant for 700 MW Shinko-Kobe Electric Power Plant*, attached as Exhibit O. A number of facilities have installed the Chiyoda CT-121 jet bubbling reactor. Exhibit P. Chiyoda's bubbling jet reactor (a type of wet FGD) has consistently achieved >99% SO_2 removal during long-term operation at the Shinko-Kobe power plant in Japan. This facility consists of two 700-MW coal-fired utility boilers. The wet FGD was designed to achieve 0.014 lb SO_2/MMBtu (9 ppmv at 3% oxygen) on an instantaneous basis, which is the applicable SO2 emission limit in Japan. It has also been achieved at several coal-fired power plants in Japan and is proposed for several U.S. coal fired power plants. *Id.* Georgia Power recently contracted for the installation of four CT-121 jet bubbling reactors to be installed at Bowen Station. Exhibit Q. Georgia Power expects to achieve 98% reduction of SO2 and 90% reduction of PM with the jet bubbling reactors (in addition to the PM control achieved with the PM control devices). *Id.*

The jet bubbling reactor has been guaranteed by Chiyoda to achieve 99% SO_2 removal on three coal-fired boilers in Japan.[11] It also has been demonstrated in the U.S. at the University of Illinois's Abbott power plant and Georgia Power's Plant Yates[12] and recently was licensed for use on several additional plants in the US, including Dayton

[11] *See* CT-121 FGD Process – Jet Bubbling Reactor, http://www.bwe.dk/fgd-ct121.html.

[12] Emission-control Technologies Continue to Clear the Air, Power, May/June 2002.

Power & Light's Killen and Stuart plants, and AEP's Big Sandy Unit 2, Conesville Unit 4, Cardinal Units 1 and 2, and Kyger Creek, among others.[13] Mitsubishi, a vendor of scrubber systems, reports it has guaranteed SO_2 removal efficiencies up to 99.8 percent, including four coal-fired boilers.[14, 15, 16]

Magnesium Enhanced Lime wet scrubbing technology also achieves SO2 control of 99%. Lewis Benson, et al., *The New Magnesium Enhanced Lime FGD Process* (Exhibit R). Documented experience at the Mitchell Station in Pennsylvania demonstrates that magnesium enhanced lime, a type of wet scrubbing, regularly achieves 99% control of SO2.

In summary, wet scrubbing can achieve 99% control or greater on low sulfur coals. NMU attempts to reject scrubbing – wet and dry scrubbing – based on cost effectiveness. With no supporting documentation and scant discussion, NMU merely asserts that scrubbing would only reduce post-combustion emissions by 40%. September 18, 2007, Letter at 2. Based on this under-estimation of control, NMU asserts that the cost-effectiveness is $15,980 per ton of SO2. *Id.* In addition to applying the cost-effectiveness test wrongly (the entire pollution control train must be included and not each incremental

---

[13] Chiyoda Licenses Its Flue Gas Desulfurization Technology in USA Newly for 5 Coal-Fired Generation Units, Press Release, May 2, 2005; Chiyoda Licenses its Flue Gas Desulfurization Process in USA for Georgia Power Owned 4 FGD Units, January 26, 2005.

[14] Jonas S. Klingspor, Kiyoshi Okazoe, Tetsu Ushiku, and George Munson, High Efficiency Double Contact Flow Scrubber for the U.S. FGD Market, Paper No. 135 presented at MEGA Symposium, Air & Waste Management Association, May 19-22, 2003, p.8, Table 4.

[15] Yoshio Nakayama, Tetsu Ushiku, and Takeo Shinoda, Commercial Experience and Actual-Plant-Scale Test Facility of MHI Single Tower FGD.

[16] http://www.mhi.co.jp/mcec/product/fgd.htm.

component), the NMU consultant assumes a very low control efficiency which results in a high cost per ton. If a more reasonable control efficiency of 90-99% is used, the cost per ton drops well below the $10,000/ton threshold most often used for cost-effectiveness determinations.[17] For example, an outlet rate of 0.02 (additional 90% control from scrubber), would result in a cost effectiveness of $7411/ton, using the same assumptions that NMU makes.

Moreover, NMU's incomplete cost analysis for a post-combustion scrubber (a/k/a "polishing scrubber") makes a number of spurious assumptions. First, the attachment to the September 18, 2007, Letter from Jeffrey Jaros, NTH, to David Riddle, MDEQ, assumes an equipment life of 20 years. A properly maintained scrubber lasts for the life of the unit it serves: 30 to 50 years. Second, the analysis assumes 6% for sales tax and 1% for property tax, but presumably, as a public entity, NMU does not pay either tax. Moreover, the taxes, insurance, and administrative charges are calculated as a percentage of total capital, rather than the more common method of estimation based on a percentage of operating labor. Max S. Peters and Klaus D. Timmerhaus, Plant Design and Economics for Chemical Engineers, McGraw-Hill Inc., 4th Ed., 1991, pp. 206-207.

To reject scrubbing (assuming 100% waste wood fuel is also rejected) based on cost, the NMU must provide a comprehensive demonstration, based on objective factors, that the cost of wet scrubbing is disproportionately high and significantly beyond the range of

---

[17] A recent report by the Lake Michigan Air Directors Consortium ("LADCO") and the Midwest Regional Planning Organization ("MRPO") demonstrates that advanced FGD technologies achieve 99.5% control for $1,240 to $2,875 per ton of SO_2 removed and wet FGD could achieve 99% SO_2 control for $1,881 to $3,440 per ton of SO_2 removed. *See* Exhibit S.

recent costs normally associated with BACT for the type of facility. The NMU has not made this demonstration. Therefore, BACT for SO2 must be based upon 92% sulfur dioxide reduction in the boiler through limestone injection, plus an additional 95+% reduction through the use of a scrubber post-combustion (total 99.6% reduction).

Additionally, to ensure BACT (i.e., maximum degree of reduction), the permit must include either an SO2 removal requirement, or establish different emission limits based on the various inlet concentrations to the scrubber. U.S. EPA has instructed other agencies to do just this. Email from Ethan Chatfield, U.S. EPA, to Rajen Vakharia, Wisconsin Department of Natural Resources (Sept. 5, 2004), attached as Exhibit T; U.S. EPA Comments on PSD Permit for City Utilities of Springfield at 4 (Exhibit U) (requesting that the permit include a 92% control requirement). For example, U.S. EPA instructed the state of Missouri to include either a removal efficiency or a tiered BACT limit to ensure maximum reduction regardless of coal sulfur content:

> [I]n this case, establishing SO2 BACT at 0.12 #SO2/mmBtu effectively allows City Utilities to operate the SDA at an efficiency of 79% when burning PRB coal with an average SO2 inlet concentration of 0.58 #SO2/mmBtu and 87% when burning PRB coal with an average SO2 inlet concentration of 0.93#SO2/mmBtu. These SO2 inlet concentrations correspond to the average and worst case monthly average inlet concentrations for all NSPS Subpart D affected public power units in Region 7 between 1997 and 2002. Both percent reduction efficiencies fall well below the long-term design performance anticipated for the SDA [dry scrubber] as BACT. To compensate for potential under-performance of the SDA when burning lower sulfur PRB coals, we believe the final permit should condition City Utilities to achieve a 92% reduction, based on a 30-day rolling average, in addition to the appropriate BACT emission limit. To assure that the SDA is