ENCLOSURE 2

EPA COMMENTS ON NDDH PRELIMINARY BACT DETERMINATION

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I. NDDH'S ANALYSIS OF TECHNICAL FEASIBILITY OF TAIL-END AND LOW-DUST SCR AT MRYS IS INCORRECT AND BASED ON INCOMPLETE INFORMATION.

In previous comment letters, EPA explained that the applicability of SCR downstream of pollution control equipment (tail-end SCR (TESCR) or low-dust SCR (LDSCR)) would effectively eliminate the catalyst plugging and deactivation problems described in the Minnkota BACT analysis and that the costs associated with plant modifications and flue gas reheat in order achieve proper catalyst operating temperatures are a matter of cost and not technical feasibility.[1] B&McD's response to EPA's comments was that the information provided by the Energy & Environmental Research Center (EERC) shows that, "effective solutions to prevent or remove micropore pluggage and blinding of SCR catalyst from sodium-sulfur compounds evident in the flue gas stream exhausted from a North Dakota lignite-fired boiler, whether installed in a conventional hot-side or cold-side application downstream of a wet scrubber, have not been developed by SCR catalyst vendors" and that, "these are credible arguments that adequately describe the reasons that preclude the successful deployment of this technology on the cyclone boilers at MRYS."[2] B&McD does not agree that an economic analysis would be required because, "[t]he extensive plant modifications anticipated to deploy SCR at Unit 1 and Unit 2 at MRYS still do not resolve the catalyst micropore plugging and blinding problems evident in the Coyote Station pilot-scale testing."[3] EERC adds that, "[t]here is evidence of sodium, potassium, calcium, and sulfur deposition downstream of the ESP as illustrated in Figure 1 presented in response to ERC Core Issue number 2."[4]

Based on these responses, it appears that the basis for Minnkota's assertion that TESCR and LDSCR are technically infeasible is solely based the perceived catalyst micropore plugging and deactivation problems extrapolated from the results of the Coyote Station pilot testing and the flue gas sampling performed on MRYS Unit 1 downstream of the electrostatic precipitator at 300° F.

The NDDH BACT determination states that the site constraint and flue gas reheat issues are a matter of economics instead of technical feasibility, but "catalyst deactivation of a low-dust or tail-gas SCR due to alkali compounds is an issue that will require extensive research, design and pilot testing to determine whether the technology can be successfully applied to units fired on North Dakota lignite. Therefore, these technologies are not

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1 See EPA's January 9, 2007 letter to NDDH (sent via fax), pages 13-16 and October 4, 2007 letter to NDDH and Minnkota, pages 31-35.

2 See Minnkota's November 9, 2007 letter to NDDH, page A-28.

3 See Minnkota's November 9, 2007 letter to NDDH, page A-29.

4 See Minnkota's November 9, 2007 letter to NDDH, page A-29. Figure 1 shows a "Cross-section of a surface exposed to flue gas at about 300° F in MRY Unit 1" and the relative weight percentages of sodium, silicon, sulfur, potassium, calcium, and iron.

considered applicable and not technically feasible at this time."[5,6] The NDDH BACT determination cites the sampling provided in Minnkota's November 9, 2007 letter which showed weight percentages of various compounds collected downstream of the electrostatic precipitator and previous experience at the Minn-Dak Farmer's Coop. coal-fired facility, which had problems maintaining compliance with a particulate limit and subsequently had to limit their fuel sodium content.[7] As more fully set forth below, Minnkota has failed to produce sufficient evidence to show that TESCR or LDSCR would experience extreme catalyst deactivation that would preclude the successful operation at MRYS.

Coyote Station Pilot Testing

Minnkota cites the Coyote Station pilot testing results as they relate to catalyst deactivation and plugging caused by sodium compounds and other alkali compounds as evidence that MRYS would not be suitable for a TESCR or LDSCR installation. This assertion is completely unfounded for a number of reasons. First, as described in previous EPA comment letters and as supplemented by the expert opinion report of Mr. Hartenstein provided herein, the Coyote Station pilot testing was clearly flawed and does not even provide meaningful conclusions to apply to a full-scale installation of high-dust SCR (HDSCR). Furthermore, since the Coyote Station pilot testing used flue gas upstream of the pollution control equipment, there is even less reason to believe that test results (even the qualitative results expounded on by Minnkota) have any relevance to a TESCR or LDSCR application, which would have substantially less ash constituents downstream of an

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5 See NDDH BACT determination, pages 56-57.

6 The NDDH has made the determination that SCR would be technically feasible in its analysis of the Westmoreland Power, Inc. Gascoyne 500 Generating Station. In its May 2007 analysis of the Gascoyne 500 project, the NDDH states, "[b]y reheating the flue gas and locating the SCR downstream of the other air pollution control devices, SCR appears to be technically feasible. However, the Department is not certain that this technology will work with a Dakota lignite-fired unit because it has not been used before. For these reasons, the Department retained, with reservations, it as a technologically feasible control option." (See pages 58-59.) This proposed project would consist of two 285 MW-gross circulating fluidized bed boilers controlled by a dry scrubber and baghouse. The SCR would be located downstream of both control devices. In this case, the applicant (Westmoreland) cited many of the same concerns stated by Minnkota and the NDDH regarding uncertainty with North Dakota lignite and the significant engineering involved in applying SCR to this facility (Westmoreland even cited the EERC report on the pilot testing at Coyote Station), but concluded low-dust SCR was still technically feasible. In their permit application, Westmoreland states, "it is likely that Westmoreland would incur significant engineering and testing to ensure the viability of a low-dust SCR control system on a lignite-fired CFB boiler. However, there does not appear to be any technical basis to exclude low-dust SCR from the BACT determination." Apparently, the NDDH agrees with Westmoreland that the significant engineering and testing does not preclude technical feasibility AND agrees with Minnkota who believes that such activities do preclude technical feasibility. Low-dust SCR was eventually eliminated from consideration for mainly economic reasons, primarily due to the low uncontrolled NOx emissions from the Gascoyne boilers. While the configuration in the Westmoreland determination is referred to as low-dust SCR, it should be considered tail-end SCR, as it is downstream of a both a particulate control device and SO_2 scrubber.

7 See NDDH BACT determination, pages 55-56.

electrostatic precipitator (for LDSCR) and wet scrubber (TESCR). Thus, the Coyote Station pilot testing did not provide any meaningful data in terms of evaluating HDSCR and is even less useful for evaluating technical feasibility of TESCR and LDSCR.

MRYS Unit 1 Sampling

Minnkota's November 9, 2007 letter, which is cited in the NDDH BACT determination, explains that flue gas sampling of MRYS Unit 1 was conducted downstream of the electrostatic precipitator and a cross-sectional analysis of the constituents was performed. Minnkota and the EERC asserts that the sampling shows a high degree of sulfated potassium and sodium compounds similar to the compounds observed at the Coyote Station pilot test. Therefore, Minnkota believes that the electrostatic precipitator would not remove much of the vaporized sodium and potassium and implies that similar results would have been produced during the Coyote Station pilot test if conducted downstream of the electrostatic precipitator. Aside from the fact that the Coyote Station pilot testing had significant design and operational problems, the results of the flue gas sampling presented in Minnkota's November 9, 2007 letter in no way quantifies the total amount of particulate material that was collected and would be expected to exist in a LDSCR environment. The data that was presented is only in terms weight percentages and only provides evidence that there will be sodium and potassium downstream of the electrostatic precipitator. While these compounds may exist in a LDSCR environment, no attempt was made by Minnkota to quantify how these weight percentage would translate to loading to a LDSCR and how that would affect catalyst life. Therefore, using this data to show that the presence of sodium and potassium compounds downstream of the electrostatic precipitator would preclude the successful operation of a LDSCR is completely speculative and highly questionable.

The NDDH BACT determination uses this data in conjunction with an emission factor comparison presented in the NDDH analysis to reach a similar conclusion. Without knowing what the total amount of loading is downstream of the electrostatic precipitator and how these weight percentages relate to LDSCR loading and catalyst life, however, the conclusions in the NDDH BACT determination are pure speculation and highly questionable. The NDDH BACT determination also uses this data to support that conclusion that these catalyst poisons will enter a TESCR, even though the sampling was done without wet scrubbing. Using this data in any way to support the conclusion that a TESCR could not be successfully operated is completely without merit. As explained in the expert opinion report by Mr. Hartenstein provided herein, soluble compounds would almost completely be removed by a wet scrubber and the flue gas temperatures after gas reheat for either a TESCR or LDSCR system would be higher than those expected for condensation of any trace sodium or potassium compounds remaining. Therefore, the MRYS Unit 1 sampling presented does not

demonstrate, to any degree, that a TESCR or LDSCR could not be successfully operated at MRYS.[8]

Minn-Dak Farmer's Coop. Experience

As explained in detail in Mr. Hartenstein's expert opinion report, using the experience at the Minn-Dak Farmer's Coop. facility to make the claim that TESCR and LDSCR is technically infeasible at MRYS is unfounded. First, the pollution control at the Minn-Dak facility is completely unlike that at MRYS. The Minn-Dak boilers are equipped with multiclones and a venturi scrubber. The lack of similarity of MRYS to other facilities that have successfully operated SCR has been used extensively elsewhere in the NDDH BACT determination to support the claim of SCR technical infeasibility, yet this fact seems to be unimportant to the NDDH in this instance. The NDDH BACT determination also makes no attempt to relate the particulate matter emissions experienced at Minn-Dak to a theoretical TESCR sodium loading rate and catalyst life at MRYS that would support the claim that the Minn-Dak situation is evidence that TESCR would not be technically feasible at MRYS. This is likely because no such case could be made. Furthermore, as explained elsewhere herein and in Hans Hartenstein's expert opinion report, stack temperature conditions (and how those temperatures relate to the physical state of catalyst poison compounds) during a particulate matter stack test (as would have been the case in the Minn-Dak situation) and the operation of a TESCR after flue gas reheat are very different. Therefore, to use the NDDH's experience with the Minn-Dak facility to support the conclusion that TESCR could not be successfully operated at MRYS is completely speculative and highly questionable.

SCR System and Catalyst Vendor Responses on TESCR

The NDDH BACT determination fails to adequately address the vendor responses provided by Minnkota in the evaluation of TESCR or LDSCR. This is likely because the B&McD SCR system and catalyst vendor query appears to have been specifically directed at only getting responses related to a HDSCR application and with no attempt made to get information about vendor opinions or guarantees related to TESCR or LDSCR.

As detailed in Mr. Hartenstein's expert opinion report, an additional query was made to the same vendors that were contacted by B&McD to get information on technical feasibility, the need for additional research, and guarantees related to TESCR.

8 Although not referenced in the NDDH BACT determination, Minnkota also submitted some sampling information for Unit 2 that may have been taken downstream of the electrostatic precipitator and SO_2 scrubber (although the bypass was operating during the sampling). As explained in Mr. Hartenstein's expert opinion report, this data cannot be considered relevant for any reasonable judgment concerning the technical feasibility of a TESCR.

The responses received from SCR system suppliers (Alstom and Babcock Power) and catalyst vendors (Argillion, CERAM, and Haldor Topsoe) that have extensive experience with TESCR demonstrate that TESCR is available and applicable to MRYS without the need to do additional pilot testing. This information is very important, because these experts have actual experience with these installations. While much of this experience is outside of the United States, that should not influence the analysis of technical feasibility. Clearly, these companies will make TESCR available to Minnkota and believe the physical and chemical characteristics of the flue gas at MRYS in a TESCR environment poses no significant differences that would preclude the successful operation at MRYS.

Conclusion on TESCR Technical Feasibility

Based on the evidence outlined above, in addition to the substantial explanation provided in the expert opinion report of Mr. Hartenstein, a leading expert in SCR installations at power plants, TESCR is a technically feasible control option at MRYS and needs to be evaluated to at least step 4 of the Top-Down BACT analysis.

Conclusion on LDSCR Technical Feasibility

Since no apparent attempt was made to query vendors related to LDSCR, this analysis remains incomplete. While both Minnkota and the NDDH have made technical arguments as to why LDSCR would be technically infeasible at MRYS due to catalyst plugging and deactivation, these arguments are based on pure speculation and improper comparisons with other situations that do not quantitatively provide any evidence that LDSCR could not be successfully operated at MRYS. EPA believes LDSCR is very likely technically feasible.

II. NDDH'S TECHNICAL FEASIBILITY ANALYSIS OF HIGH-DUST SCR IS INCORRECT AND BASED UPON FLAWED DATA.

As more fully set forth below, the NDDH BACT determination's conclusion that HDSCR is technically infeasible is not supported by the record and is based upon an incorrect interpretation of EPA's NSR Manual. NDDH's BACT determination provides twelve reasons to support its decision that HDSCR is technically infeasible. These individual points are examined in detail in Mr. Hartenstein's expert opinion report and will not be expounded upon here in detail.

HDSCR Catalyst Plugging & Deactivation

- The catalyst plugging and deactivation problems cited in the NDDH's BACT determination are largely based upon the Coyote Station pilot test conducted by EERC, which was fundamentally flawed and would not be indicative of a full-scale operation.

- The NDDH BACT determination acknowledges the fundamental problems with Coyote Station pilot test and states that it provided little useful data. However, the pilot test is cited throughout the HDSCR technical feasibility analysis as a basis for supporting the position that HDSCR is technically infeasible.[9]

- The comparison of different coal-type emission factors in the NDDH BACT determination is used to support the conclusion that the differences in flue gas characteristics of sodium and total primary alkali constituents (CaO, Na_2O, MgO, and K_2O) would "preclude the successful application of existing (presumably high-dust) SCR technology to the M.R. Young Station."[10] This conclusion is complete speculation. While the NDDH BACT determination correctly points out that a linear relationship does not exist between the loading rates of alkali constituents derived from emission factors and catalyst deactivation, the NDDH BACT determination uses this comparison to draw the conclusion that the flue gas characteristics at MRYS would be sufficiently "different" than other fuel types where SCR has been successfully applied. Again, there is no clear basis for this conclusion. The comparison shows cyclone units firing North Dakota lignite to emit about six times as much NaO and about twice as much primary alkali constituents as wall-fired or tangentially-fired plants burning Wyoming Powder River Basin (PRB) subbituminous coal. The NDDH BACT determination does not attempt to relate these ratios to expected catalyst life.

- For the current coal analyses, the ratios of primary alkali loading for Center Mine cyclone units compared to Texas Lignite cyclones, Texas Lignite pulverized units, and PRB subbituminous pulverized units are 1.7, 2.0, and 2.3 respectively. There is a larger disparity between the same primary alkali constituents on units within other fuel and boiler types that have successfully demonstrated SCR use. For example, the ratio of primary alkali constituent loading between pulverized coal units burning PRB subbituminous coal versus eastern bituminous coal on a lb/MMBtu basis would be 3.0. This difference is higher than the 2.3 ratio between a Center Mine cyclone unit and the same pulverized unit burning PRB. Therefore, based on the methodology and

9 For example, on pages 49-50, the NDDH BACT determination states, "[t]he pilot scale SCR plugged after only 2 months and little useful data was obtained.....Operation of an SCR system for only 2 months between catalyst replacement is not considered successful operation of SCR technology." Based on this discussion, the NDDH is strongly implying that a HDSCR at MRYS would need a catalyst replacement due to deactivation after only two months, although it is widely known that information related to catalyst plugging on a pilot scale is not applicable to full-scale installations and no activation data was obtained on the Coyote Station pilot test. The NDDH BACT determination also states the Coyote Station pilot test was "ill-designed for a unit combusting North Dakota lignite" (see page 7), which makes the use of this 2-month prediction of catalyst replacement based on pilot-scale plugging results even more baffling.

10 See NDDH BACT determination, page 51.

rationale presented in the NDDH BACT determination, HDSCR could not have been successfully applied to pulverized coal units burning PRB subbituminous coal because there was three times as much primary alkali constituent loading in the flue gas compared to the eastern bituminous coal plants, where SCR had already been successfully operated.

- Despite the considerable and varied experience that exists worldwide with applying SCR on different source and fuel types, the NDDH BACT determination dismisses the notion that HDSCR is technically feasible at MRYS as "speculation." However, the NDDH believes a mathematical comparison showing elevated amounts of sodium and other alkali constituents in the flue gas with some unknown effect on catalyst life in a HDSCR location is "evidence" that HDSCR is technically infeasible at MRYS.

- The responses from two of the three catalyst manufacturers (CERAM and Haldor Topsoe) to the B&McD query related to HDSCR indicates that catalyst suppliers would be willing to guarantee HDSCR performance if the temperature issue unique to the units at MRYS was resolved by SCR system suppliers. The catalyst vendors expressed concern about the flue gas constituents of North Dakota lignite, but did not indicate there was a fatal flaw to operating HDSCR based on the fuel type. The issue of sodium poisoning was specifically discussed by CERAM and was not a cause of concern based on their past experience with high sodium applications. Haldor Topsoe was also made aware of the sodium issue and was able to provide an industry-standard guarantee. The catalyst suppliers were able to estimate the catalyst life of a HDSCR application at MRYS based on their previous experience.

- It is apparent that the catalyst suppliers that responded affirmatively to being able to provide performance guarantees on a HDSCR if the temperature variation issue was resolved (CERAM and Haldor Topsoe) were prompted by B&McD to issue statements that pilot testing on North Dakota lignite would be required prior to such guarantees.[11] As noted in Mr. Hartenstein's expert opinion report, catalyst vendors would always be in favor of doing HDSCR pilot testing for a new fuel type, as it minimizes their risks at little or no cost to themselves.

- CERAM responded to B&McD's follow-up by stating that "we agree that there is good cause for further testing on a lignite fired unit to further mitigate the risks and optimize design." This statement is clearly a recommendation that acknowledges testing would enhance the applicability of their catalyst in a HDSCR application to North Dakota lignite, not a requirement in order to develop its availability. In its May 11, 2007 response to the B&McD query, CERAM outlined detailed design of the

11 See April 28, 2008 emails from Robert Blakley (B&McD) to Noel Rasha (CERAM) and Flemming Hansen (Haldor Topsoe).

catalyst and guaranteed a catalyst life of 16,000 hours. Contrary to statements in the NDDH BACT determination that a HDSCR could not be designed at MRYS due to uncertainties in deactivation rates of the catalyst, a very experienced and reputable catalyst vendor has expressed confidence that it could do so (if the temperature variation issue is resolved) and provided such information.

- Haldor Topsoe responded to B&McD's follow-up by stating, "[w]e suggest that the next step is a larger pilot scale experiment with in the order of 2x2m of catalyst installed. We would like to participate in such an experiment. This would allow better catalyst cleaning and give a better determination of the catalyst degradation over time. Based on our current information, we expect 60% deactivation over the first 10,000 operating hours. We can not provide a 'make good' guarantee', but are willing to warrant the catalyst performance up to the contract value." These statements are clearly a recommendation that acknowledge testing would enhance the applicability of their catalyst in a HDSCR application to North Dakota lignite, not a requirement in order to develop its availability. In fact, contrary to statements in the NDDH BACT determination that a HDSCR could not be designed at MRYS due to uncertainties in deactivation rates of the catalyst, a very experienced and reputable catalyst vendor has expressed confidence that it could do so, provided the temperature variation issue is resolved. As explained in Mr. Hartenstein's expert opinion report, the guarantee up to the contract value is a standard industry guarantee. Thus, the statements by Haldor Topsoe do not support the notion that HDSCR would require pilot testing in order for commercial availability, as outlined in the NDDH BACT determination.

- The export opinion report of Mr. Hartenstein clearly indicates that based on his extensive knowledge and experience with SCR applications under widely different flue gas conditions and discussions he had with catalyst vendors and SCR system suppliers, catalyst and plugging and deactivation would not be a fatal flaw to installing HDSCR at MRYS.

- As will be explained in more detail in a later section, the docket information for the TXU Oak Grove New Source Review permit (a proposed project that will include HDSCR and burn 100% Texas lignite) provides further evidence that, despite the challenges that exist in applying HDSCR to a new fuel type, the utility industry believes that SCR is technically feasible and any questions about the its application are a matter of cost. This is evident not only in the permit docket, but also in a letter from the Electric Power Research Institute that was originally sent to the NDDH in EPA's January 8, 2007 letter. In addition, the Texas Commission on Environmental Quality determined that the uncertainties involved with firing a new fuel type and the accelerated HDSCR catalyst plugging and deactivation that was expected from

exclusively firing Texas lignite was not a reason to find that SCR would be technically infeasible. While the properties of North Dakota and Texas lignite might not be the same, the same basic principle applies that the accelerated catalyst replacement requirements are a matter of economics and not technical feasibility.

Based on the information and observations above, EPA concludes that the successful operation and technical feasibility of HDSCR at MRYS would not be precluded by the catalyst plugging and deactivation issues related to the cyclone-firing North Dakota lignite described by Minnkota and in the NDDH BACT determination. Catalyst vendors believe the challenges involved would be manageable and they would be able to design a suitable catalyst with a performance guarantee. While the vendors would prefer to conduct some testing to mitigate risks, optimize the design, and better predict catalyst life, these same vendors also appear willing to make the catalyst commercially available. Therefore, HDSCR should not be eliminated as being technically infeasible on the basis of catalyst plugging and deactivation.

MRYS Temperature Variation Issue Related to HDSCR

- The SCR system supplier responses indicate that the temperature variation issue would likely be very challenging for a HDSCR installation at MRYS (and more unique than the potential catalyst plugging and deactivation issues for cyclone-firing of North Dakota lignite). Although the B&McD query was clearly directed toward a response only on HDSCR, SCR system suppliers (Alstom and Backbock Power) suggested looking at the possibility of TESCR as a way of avoiding both the concerns with temperature variations and fuel characteristics.

- The other SCR system supplier (Babcock & Wilcox, which does not have extensive TESCR experience) certainly did not dismiss the possibility of being able to overcome the challenges presented at MRYS for SCR installation and welcomed working with Minnkota to explore "creative solutions."

- EPA received information in response to a Clean Air Act Section 114 request pertaining to the vendor query conducted by B&McD.[12] This information is included herein. Babcock & Wilcox (B&W), who was the original manufacturer of the boilers at MRYS, indicates that modifications to the boiler likely could be made that would address the temperature problems, or that out of boiler modifications/changes (e.g. auxiliary fuel drying) would be necessary. In either case, the temperature issue appears to a resolvable technical problem, albeit at a likely high cost.

12 See July 18, 2007 e-mail from Steve Moormann (Babcock & Wilcox) to Robert Blakely (Burns & McDonnell).

EPA believes that the technical issue with the temperature variation in the backpass end of the boilers at MRYS where a HDSCR would be located presents a significant challenge. However, it appears that the technical challenges with the temperature variation can be resolved. Furthermore, the issue of backpass boiler temperature variation completely goes away in the case of TESCR and LDSCR. Therefore, no matter what the implications are of resolving the temperature variation issue, there are other options for installing SCR technology that would avoid this problem altogether.

EPA's Conclusion on HDSCR

In summary, EPA believes the NDDH BACT analysis incorrectly eliminates HDSCR as technically infeasible at MRYS because pilot testing would be required on Center Mine lignite fuel before application at MRYS. The uniqueness of the fuel at MRYS (Center Mine lignite) does not appear to pose technical problems that catalyst vendors do not believe can be managed in order to provide a reasonable guarantee. The soluble sodium deactivation issue cited in the NDDH BACT determination as a fatal flaw to installing HDSCR is not supported by any useful or relevant data and is speculative. Furthermore, the opinions of catalyst suppliers and leading SCR expert Mr. Hartenstein indicate that catalyst poisoning by sodium is only an issue during periods when the catalyst is allowed to cool well below its normal operating temperature. This would be an infrequent occurrence and can be managed by isolating the catalyst during shut-downs. Additionally, catalyst regeneration is a viable option (that is currently used in practice) for restoring catalyst life by either in-situ, on-site, or off-site water washing.[13] The temperature variation problem appears to be a more significant challenge for the successful operation of HDSCR (but not TESCR or LDSCR), but the necessary modifications to resolve this problem would be a matter of cost.

III. THE NDDH BACT DETERMINATION INCORRECTLY APPLIES THE CONCEPT OF PILOT TESTING IN EPA'S NSR MANUAL TO CONCLUDE THAT SCR IS NOT TECHNICALLY FEASIBLE.

NDDH has misinterpreted EPA's NSR Manual to support a finding of technical infeasibility of SCR at MRYS because it has been suggested pilot testing and/or engineering research would be required. EPA has previously clarified for Minnkota and the NDDH that this reference in EPA's NSR Manual is only relevant to whether a control option was

13 On page 46, the NDDH BACT determination states that there are "no known engineering solutions to....restore the catalytic reactions by removing particles from catalyst pores." This is simply not true and it appears that the NDDH did not investigate this possibility in any depth. As one example of actual regeneration experience, EPA is enclosing a 2007 NOx Round Table & Expo Presentation by Reinhold Environmental Ltd (February 5-6, 2007 in Cincinnati, OH) that details in-situ and on-site catalyst washing experience at the Avedore Station in Denmark.

"available." There is little question that SCR is "available" for installation at MRYS and, in fact, the Minnkota BACT analysis already conceded that SCR is "available."[14]

The NDDH BACT determination relies upon the lack of demonstrated application of SCR technology and mitigating tools used to manage ash deposition and catalyst deactivation (such as screens, baffles, soot-blowing, rejuvenation, etc.) on a cyclone boiler firing North Dakota lignite to conclude that it is necessary for the source to do additional pilot testing and engineering studies. According to NDDH's interpretation of EPA's NSR Manual, this additional step precludes the technology from being considered technically feasible.

The NDDH BACT determination states that, "[t]he fundamental question for this BACT determination is whether SCR is an available technology for North Dakota lignite-fired cyclone boilers such as Minnkota Units 1 and 2."[15] The concept of availability of a control technology is introduced in the NDDH BACT determination by quoting EPA's NSR Manual, which states, "[a] control technique is considered available, within the context presented above, if it has reached the licensing and commercial state of development. A source would not be required to experience extended time delays or resource penalties to allow research to be conducted on a new technique. Neither is it expected that an applicant would be required experience extended trials to learn how to apply a technology on a totally new and dissimilar source type. Consequently, technologies in the pilot scale testing stages of development would not be considered available for BACT review."[16]

The NDDH BACT determination concludes, "SCR has not reached this stage for North Dakota lignite-fired cyclone boilers, and because of the difference in the gas stream[17], the Department concludes that Minnkota need not experience extended trials to learn how to apply the technology on such a dissimilar source type."[18]

With this statement, NDDH has erroneously combined two steps which are described in EPA's NSR Manual as separate steps for determining technical feasibility of a control option,

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14 See EPA's October 4, 2007 letter to NDDH and Minnkota, page 31 and Minnkota BACT analysis, page A1-32, where B&McD states, "SCR technology is an available technology which has been installed on numerous powerplant facilities around the world and there are a large number of manufacturers that market the technology. The question is whether SCR technology is "applicable" for a unit firing North Dakota lignite." In its November 13, 2007, letter, Minnkota appears to have reversed course on the issue of SCR availability, and attempts to focus on the dissimilar aspects of MRYS to other facilities that have installed SCR. Notwithstanding the statements in this letter, however, there is no disputing that the Minnkota BACT analysis clearly stated that SCR is available and that the only question is whether it is applicable.

15 See NDDH BACT Determination, page 5.

16 See EPA's NSR Manual, page B.18.

17 The concept of evaluating differences in the gas stream between the source under review and other sources where a control option has been applied is introduced in EPA's NSR Manual during the discussion of whether an available control option is also applicable.

18 See NDDH BACT Determination, page 6.

namely, availability and applicability. A plain reading of EPA's NSR Manual shows that EPA saw the technical feasibility determination as two separate steps. First, the reviewing authority should determine whether a control option is available. As stated in the EPA NSR Manual, if a ***new*** control option is only in the early developmental stage, it is not considered (commercially) available. Therefore, under the Top-Down BACT analysis, the control option is eliminated from consideration as being technically infeasible, without any analysis on whether the control option is applicable to the source under review and does not require the same degree of technical analysis and judgment on the part of the reviewing authority. EPA's NSR Manual specifically mentions pilot testing as a component of determining availability, which is defined as the "process commonly used for bringing a control technology concept to reality as a commercial product.

- concept stage;
- research and patenting;
- bench scale or laboratory testing;
- ***pilot scale testing;*** (emphasis added)
- licensing and commercial demonstration; and
- commercial sales." [19]

For determining whether a control option is available, EPA's NSR Manual does not describe the comparison of gas stream characteristics between the source under review and other sources. Commercial availability of SCR is a plain fact, evidenced by the SCR system supplier and catalyst vendor responses garnered by B&McD and supplemented by EPA herein, the extensive applications of SCR to coal-fired power plants and other industrial sources worldwide for decades, and even as stated in the Minnkota BACT analysis. [20]

The second step of the technical feasibility analysis is to determine whether an available control option is also applicable to the source under review. As noted correctly in the NDDH BACT determination, the EPA's NSR Manual "provides that technical judgment of the review authority must be exercised in determining whether a control alternative is *applicable* to the source type under consideration"[21] (emphasis added) and cites a portion EPA's NSR Manual regarding applicability, which states, "a commercially *available* control option will be presumed to be *applicable* if it has been or is soon to be deployed (e.g. is

19 See EPA's NSR Manual, page B.17.
20 EPA also strongly disagrees with the assertion in the NDDH BACT determination that a control option can be eliminated under the Top-Down BACT process if any "engineering study" is required. This very vague and broad term could be applied to any phase of designing a piece of pollution equipment or technique. Presumably, every major piece of pollution control equipment (i.e. scrubber, SCR, baghouse, Electrostatic Precipitator, etc.) applied to a utility boiler has entailed engineering study. EPA categorically dismisses use of this term in NDDH's BACT determination and believes that this extremely narrow view of what is required in the Top-Down BACT process is particularly problematic.
21 See NDDH BACT Determination, page 5 and EPA's NSR Manual page B.18.

specified in a permit) on the same or similar source type. Absent a showing of this type, technical feasibility would be based on examination of the physical and chemical characteristics of the pollutant-bearing gas stream and comparison of the gas stream characteristics of the source types to which the technology has been applied previously."[22] (Emphasis added.) Hence, a comparison of gas stream characteristics would only be required once it has already been established that the control option is available. Furthermore, the question of whether pilot testing and conducting additional research is necessary no longer applies to the analysis, since it is only relevant for a determination of availability, which would have already been confirmed. Contrary to EPA's NSR Manual, the NDDH BACT determination makes a determination of availability based, in part, on the comparison of gas stream characteristics.

The NDDH BACT determination states, "all responses (to the B&McD vendor query) indicated the following: 1) The need for additional testing to either determine if there were any fatal flaws or to obtain data for the design of a potentially successful SCR system."[23] Clearly, this is not the type of pilot testing that is referenced in the EPA NSR Manual for developing a new control technology from concept stage to the commercial state of development. This type of testing would instead provide more certainty to designers and likely result in a more optimum SCR system design at MRYS, as it would to any application of SCR to a new plant. In other words, this type of testing would be used to enhance the applicability of SCR at MRYS. The responses from SCR system suppliers and catalyst vendors are speaking to the advantages of doing additional testing on North Dakota lignite to enhance the applicability of (HD)SCR at MRYS, not on whether SCR is a commercially available control technology. For example, when prompted by B&McD on the prospect of doing pilot testing, CERAM stated, "we would agree that there is good cause for further testing on a lignite fired unit to *further mitigate the risks and optimize design.*"[24] (Emphasis added.)

Since SCR has been so widely applied to coal-fired boilers and other industrial sources, commercial availability of SCR should be determined primarily based on whether the SCR system suppliers and catalyst suppliers are willing to commercially provide and install the technology on the source in question, not based on whether the reviewing authority believes additional testing would provide more certainty and lead to a better designed SCR. It is clear from the record that vendors are willing to do so. Many of the vendors responses from the B&McD query clearly indicate that they believe SCR can work at MRYS[25] and do not

22 See EPA's NSR Manual, page B.18.
23 See NDDH BACT Determination, pages 39-40.
24 See May 6, 2008 email from Ceram Environmental, Inc. to B&McD.
25 See May 30, 2007 and May 5, 2008 letters from Alstom Power to B&McD; see May 11, 2007 and May 6, 2008 emails from Babcock Power Environmental, Inc. to B&McD; see May 11, 2007 and May 6, 2008 emails from Ceram Environmental, Inc. to B&McD; see May 10, 2007 and May 5, 2008 emails from Haldor Topsoe, Inc. to B&McD. Note that these responses have been greatly supplemented by the vendor responses related to TESCR

require that pilot testing be conducted upfront to make the technology commercially available.

Lastly, the NDDH BACT Determination for LDSCR and TESCR at MRYS also concludes, "catalyst deactivation of a low-dust or tail gas SCR due to alkali compounds is an issue that will require extensive research, design and pilot testing to determine whether the technology can be successfully applied to units fired on North Dakota lignite. Therefore, these technologies are not considered applicable and not technically feasible at this time."[26] Again, this rationale is a misinterpretation of the EPA NSR Manual. The question of whether LDSCR and TESCR are in the pilot testing stage of development is only relevant in terms of whether it is an available control option. Both LDSCR and TESCR are not only available control options, but would also be applicable to MYRS. In fact, the responses from the supplemental SCR system catalyst vendor query conducted by Mr. Hartenstein, and provided in the Enclosure herein, clearly indicates that vendors would provide a TESCR at MRYS with a guarantee and do not support doing any additional pilot testing.

IV. THE NDDH BACT DETERMINATION FRUSTRATES THE TECHNOLOGY-FORCING FUNCTION OF THE BACT PROCESS THAT WAS INTENDED BY CONGRESS.

The NDDH BACT determination is not only at odds with EPA's NSR Manual, but it also frustrates the technology-forcing function of the BACT process. As described above, the NDDH BACT determination repeatedly notes a lack of actual experience with SCR on North Dakota lignite and cyclone boilers as a primary basis for concluding that "experimentation" and/or "extensive, and correspondingly expensive, engineering studies" would be necessary to determine if uncertainties could be overcome. Congress developed the case-by-case BACT process so that the best technology becomes as widespread as possible. The NDDH BACT determination takes the position that a control option is technically infeasible because no other power plant with the exact same design and fuel source has applied the control option. Under this presumption, the best technology would not become widely used, unless some independent "proof" of it working on the exact type of source and flue gas characteristics under review was provided. This application of the BACT process is contrary to the technology-forcing function of the BACT process that congress intended when enacting Clean Air Act.

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gathered by Mr. Hartenstein.
26 See NDDH BACT Determination, page 57.

V. OTHER COMMENTS ON THE NDDH BACT DETERMINATION

1. Page 4 of NDDH BACT Determination: "Information from Sargent and Lundy indicates that not enough information is available to determine whether SCR technology can be successfully adapted to units burning North Dakota lignite."

   EPA Response: This is not what Sargent & Lundy actually said in the May 2007 presentation to NDDH and EPA. In Sargent and Lundy's Conclusion Summary, they state, "[s]ome important unanswered questions pose significant risks for an SCR design engineer:

   An unknown catalyst deactivation rate will prevent:

   - optimum selection of a catalyst design
   - selection of an appropriate reactor size

   This could burden the operator with a long term costly maintenance requirements (sic) and unscheduled outages"

   Sargent & Lundy states that premature catalyst failure will require more frequent catalyst replacement, ammonia slip and subsequent airheater pluggage, and higher auxiliary power requirements. These conclusions suggest that Sargent & Lundy's opinion is that the lack of data specific to North Dakota lignite on SCR operation would result in a less than optimal design and as a result increased capital and operating costs. While this opinion indicates that applying SCR to North Dakota lignite without obtaining further data might not be the best engineering approach, Sargent & Lundy did not opine that SCR could not be "successful" on units firing North Dakota lignite.

2. Page 7 of the NDDH BACT determination: "The advances made in the last few years for controlling popcorn ash are not shown to be applicable to a cyclone boiler burning North Dakota lignite. Extensive engineering analyses, and likely pilot scale testing, will be necessary to determine if these advances can be applied at M.R. Young Station."

   EPA Response: This statement and conclusion is inconsistent with the discussions between NDDH, EPA, and Minnkota at the May 23, 2007 meeting held in Bismarck. During this meeting popcorn ash was discussed and EPA's consultant, Roger Christman, stated that he believed the popcorn ash problem had been dealt with successfully at many other facilities and that it would not pose a significant problem at MRYS. Mr. Christman asked Minnkota and B&McD whether they agreed that the

effects of popcorn ash is solvable at MRYS and whether it could be "taken off the table" as a real issue in the discussion of HSSCR technical feasibility. Minnkota agreed that it was a solvable issue and certainly did not indicate that pilot testing would be required to address the effects of popcorn ash at MRYS. In light of these discussions, it is unclear why NDDH still believes that this is a technical barrier for the successful operation of HDSCR at MRYS.

3. Pages 13-15 of the NDDH BACT determination: In identifying all control technologies under Step 1 of the Top-Down BACT analysis, the NDDH BACT determination lists, "Fuel Switching/Blending/Cleaning." In the Step 2 analysis for this control option, the NDDH BACT determination cites experience at the Big Stone Power Plant in South Dakota with switching to PRB fuel as not lowering NO_x emissions and then references a Seventh Circuit Appeals Court decision regarding the Prairie State Generating Station PSD permit that stated fuel switching is not required for mine mouth power plants in the BACT analysis. Therefore, the NDDH BACT determination concludes that switching or blending fuels other than Center Mine lignite in order to mitigate the effects of the fuel on other control options would not be required.

   EPA Response: While the NDDH BACT determination appears to have looked at fuel switching and blending, it ignores the possibility of fuel cleaning in Step 2, although fuel cleaning was correctly listed under Step 1. Many of the technical problems described in the NDDH BACT determination for installation of other control options, such as SCR, are due to downstream conditions caused by the poor quality of the Center Mine lignite fuel (i.e. high ash, high sodium, high moisture, low heating content, the need to do fuel predrying in the cyclone boiler, etc.). Therefore, it appears that NDDH should explore potential fuel cleaning possibilities to address these effects. While EPA does not agree that fuel cleaning would be required in order for SCR to be considered technically feasible, the conclusions of the NDDH BACT determination are further flawed and incomplete without such an analysis.

4. Page 29 of the NDDH BACT determination: "Consumers Energy indicated they purchase coal from several western mines as well as eastern mines. They also indicated that none of the coal obtained from the Spring Creek Mine is fed to a unit equipped with an SCR system. Based on this information the Department is not aware of any power plant that is equipped with an SCR system and burns Spring Creek Mine coal."

   EPA Response: There is a reference to a May 13, 2008 email from Bradely Plummer of Consumers Energy to Tom Bachman of NDDH. This email was not made part of the administrative record, but appears to be information that the NDDH relied upon in

making its BACT determination. This email should be made publically available and part of the administrative record for this BACT determination.

5. EPA would like to add the documents identified in Sections VI through VIII, below, to the administrative record for the NDDH to consider in its Final BACT determination.

VI. DOCKET INFORMATION FOR THE TXU OAK GROVE NSR PERMIT IS EVIDENCE THAT THE UTILITY INDUSTRY & OTHER STATE AGENCIES BELIEVE THAT SCR IS TECHNICALLY FEASIBLE & CAN BE APPLIED TO NEW FUEL TYPES & BOILER TYPES.

On July 27, 2005, Oak Grove Management Company, LLC (Oak Grove) applied to the Texas Commission on Environmental Quality (TCEQ) for a Prevention of Significant Deterioration (PSD) permit to construct a new 1,600 MW (net) pulverized coal power plant consisting of two 860 MW (gross) units. The proposed facility would be fired on 100% Texas lignite. On February 21, 2006, the TCEQ Executive Director issued a preliminary decision and draft permit that required HDSCR and a limit of 0.08 lb/MMBtu as BACT for NO_x. At Oak Grove's request, the application and determination was referred to the State Office of Administrative Hearings (SOAH) for hearing on whether it complied with all applicable statutory and regulatory requirements.

On August 23, 2006, the SOAH Administrative Law Judges (ALJs) issued a Proposal for Decision (PFD) with a finding that Oak Grove failed "prove by a preponderance of the evidence that its BACT proposal to use SCR with lignite-fired boilers can reasonably be expected to achieve a 0.08 lb/MMBtu NOx emission rate."[27] Essentially, the ALJs found that since HDSCR has not been previously proven in practice on a plant burning 100% Texas lignite, there were uncertainties with the application of, "a relatively new technology that has never been used in the United States on a commercial scale with a lignite-fired electric power plant."[28]

While Oak Grove took the position that there were uncertainties and challenges with the design of an SCR reactor for lignite coal firing, the company argued that SCR is technically feasible and that, "the PFD failed to make the distinction between 'technical practicability' and 'economic reasonableness'."[29] Oak Grove takes the position that, "[t]o the extent that there is any issue or question regarding the use SCR (sic) at the proposed facility, it is a question of cost."[30] Oak Grove's reason for pointing out the uncertainties with

27 See ALJ's Proposal for Decision and Order, August 23, 2006, page 24.
28 See ALJ's Proposal for Decision and Order, August 23, 2006, page 24.
29 See Applicant's Exception to the Proposal for Decision, September 12, 2006 page 10.
30 See Applicant's Exception to the Proposal for Decision, September 12, 2006, page 10.

applying SCR to a fuel type that has never been demonstrated in practice was an attempt to have the NO_x limit raised in the final permit, not to show that SCR should be considered technically infeasible.

Additionally, Babcock Power Environmental, as the Air Quality Control System supplier for Oak Grove, sent a letter to the TCEQ's Executive Director (August 30, 2006) outlining why it believes the ALJ's PFD is incorrect and SCR is technically feasible for the Oak Grove plant. Interestingly, Babcock Power cites the EERC Coyote Station pilot testing results and dismisses those problems based on moisture problems introduced by the sootblowers that caused much of the plugging during that test.

The TCED permit engineer for the Oak Grove permit, Randy Hamilton, also believed that HDSCR should not only be considered technically feasible, but Mr. Hamilton also recommended a lower NO_x limit of 0.07 lb/MMBtu to the TCEQ Environmental Director. Although the ALJs appear to have misconstrued a statement made by Mr. Hamilton in his written deposition to SOAH, where Mr. Hamilton describes the hypothetical best and worst case possibilities of SCR ash deposition on the Oak Grove units,[31] Mr. Hamilton confirmed with EPA that it was never his professional opinion that the worst case scenario he described was a real possibility, but only a rhetorical examination of two logically possible outcomes.[32]

Ultimately, the TCEQ's Final Order (June 21, 2007) rejected the arguments over technical infeasibility of SCR at Oak Grove, overturned the ALJ's PFD, and granted the PSD permit to Oak Grove with a NO_x BACT determination of SCR and a limit of 0.08 lb/MMBtu. In short, the Commission found that the ALJs "placed too much emphasis on the absence of previous applications of the proposed technologies with regard to Texas lignite."[33]

The positions taken by the TCEQ (technical staff, Executive Director, and Final Order), Oak Grove, and Babcock Power largely coincide with and support EPA's position with regard to general technical feasibility of SCR on different fuel types and whether questions of feasibility are a matter of technical feasibility or economic feasibility. EPA also generally agrees with these parties that the position taken by the ALJs (and likewise by Minnkota and the NDDH in the case of MRYS), "will remove an essential element of the air emissions permitting process as contemplated by both state and federal Clean Air Acts – the advancement of air pollution control process.....Simply stated, the ALJ's interpretation of the

31 See ALJ's Proposal for Decision and Order, August 23, 2006, page 15, "[t]he uncertainty with regard to ash deposition is not mathematically convertible to a NOx emission limit adjustment. The ideal outcome would be that plugging proves to be no problem at all. Under this scenario, NOx emissions could be as low as any coal-fired boiler and the BACT emission limit could have been lower. The worst outcome would be that the SCR plugs with flyash rapidly and completely and no engineering solution can be found. Under this scenario, SCR would be technically infeasible, and BACT would have to be higher, based on the next most effective technology..."
32 See April 16, 2008 email from Randy Hamilton (TCEQ) to Hans Buenning (EPA Region 8).
33 See TCEQ Final Order, June 21, 2007, page 45.

technical practicability element of the BACT analysis would categorically prevent the first-time application of new control technologies in Texas."[34] The same could be said of the state of North Dakota under the positions taken in the NDDH BACT determination.

EPA is submitting the TCEQ/SOAH Docket information for the Oak Grove permit proceeding to be entered in the administrative record and considered in NDDH's Final BACT determination (see Enclosure 3). While EPA understands that there are differences between Texas and North Dakota lignites, as well as the boiler configurations at Oak Grove and MRYS that make the technical application of SCR different, the principles illustrated in the Oak Grove permit proceeding related to the BACT process largely parallel those in the Minnkota NOx BACT determination. EPA is also submitting additional information relative to the Oak Grove permit proceeding that is not contained in the docket (also part of Enclosure 3). The docket can be accessed electronically at:

http://www7.tceq.state.tx.us/uploads/eagendas/Agendas/2007/6-13-2007/Oak%20Grove.pdf

VII. B&McD 114 RESPONSE DOCUMENTS

On June 20, 2008, EPA issued a Clean Air Act, Section 114 request for information to B&McD asking for information related to the SCR system and catalyst vendor query that was conducted by B&McD on behalf of Minnkota. EPA received B&McD's response on July 3, 2008. EPA is submitting portions of the response herein as part of Enclosure 3 for the state to include in the administrative record and consider in NDDH's Final BACT determination. To summarize some significant findings, the B&McD response indicates:

- Early draft versions of the vendor query document prepared by B&McD asked for vendor opinions of the temperature variation issue for HDSCR at MRYS and possible boiler modifications that could address this problem. At Minnkota's direction, this request was removed from the final query document.

- Based on B&McD's call notes following up with the vendors that gave more optimistic responses in early 2007 (those that were less optimistic were deemed by Minnkota as not needing follow-up), it is clear that catalyst vendors were not swayed by the arguments set forth by B&McD and EERC related to the potential severity of sodium catalyst poisoning. Also, SCR system suppliers told B&McD that they believe tail-gas SCR would resolve the problems being advanced by B&McD and EERC related to lignite fuel firing. Why B&McD did not pursue the tail-gas option with vendors after it had been suggested is unclear.

34 See Applicant's Exception to the Proposal for Decision, September 12, 2006, page 8.

- In two separate documents (comments on a draft response to EPA comments dated February 6, 2007 and an email correspondence dated May 10, 2007), Robert Johnson (who was working as a consultant, but it is believed previously worked for Argillion and then B&McD) opined on many of the technical issues for an SCR at MRYS. The positions taken by Mr. Johnson largely support positions taken by EPA, namely that there is no useful underlying data that supports the claims of EERC regarding the severity of sodium catalyst poisoning (in HDSCR, LDSCR, or TESCR), the Coyote Station pilot testing "was a flawed test and the results should not be used to draw any conclusions other than that a full scale system design needs to be done very carefully", sodium is not much of a concern as a catalyst poison at SCR operating temperatures, and that TESCR is a likely candidate for MRYS.

- It appears Minnkota has conducted a cost analysis of SCR at MRYS using different expected catalyst life spans of 12,000 and 24,000 hours. This information has not been made publically available to EPA's knowledge.

VIII. DOCKET INFORMATION FOR THE CLEAN AIR INTERSTATE RULE (CAIR), BEST AVAILABLE RETROFIT TECHNOLOGY (BART) GUIDELINES, AND NEW SOURCE PERFORMANCE STANDARDS (NSPS) STATES THAT EPA DETERMINED THAT SCR IS TECHNICALLY FEASIBLE FOR LIGNITE FIRED UTILITY BOILERS.

In a January 8, 2007 letter (sent via fax), EPA provided the NDDH with docket information and references related to various rulemakings (CAIR, BART Guidelines, NSPS), where EPA determined SCR to be feasible at lignite-fired utility boilers. This information does not appear to be completely in the administrative record for the NDDH BACT determination, so EPA is providing information related to these rulemakings herein as part of Enclosure 3 for the NDDH to include in the administrative record and consider in NDDH's Final BACT determination. As mentioned in the January 8, 2007 letter, through these three rulemakings, EPA determined SCR to be technically feasible and rejected commenter's concerns that SCR would not be technically feasible for lignite units, including those fired on North Dakota lignite. EPA reiterates that the position now being taken in the NDDH BACT determination is contrary to that established by EPA in these three national rulemakings.

ENCLOSURE 3

ADDITIONAL DOCUMENTATION FOR ADMINISTRATIVE RECORD

2007 NOx ROUND TABLE & EXPO
PRESENTATION ON CATALYST WASHING
(FEBRUARY 5-6, 2007)