APPENDICES

Appendix 9.1: Identification of BART-Eligible Sources in Minnesota

To identify the BART-eligible emission units, MPCA used the following *Guideline*s criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

On July 28, 2005, the MPCA sent a Request for Information by certified mail to 130 facilities that are major for New Source Review a request for information (RFI) about any BART-eligible units at their facility. Facilities are major for New Source Review if they emit more than 100 or 250 tons per year of a criteria pollutant, the threshold depends on the source category of the facility. Since one criterion to be a BART-eligible source is for a source to emit more than 250 tons per year of a visibility impairing pollutant, the RFI was sent to all facilities that could possibly have a BART-eligible unit(s).

Table 1 of this Appendix contains the materials sent to each of the 130 facilities. A preliminary survey was sent to facilities in October 2001 asking them to identify whether they had BART-eligible units. Depending on the response (or lack of response) to that survey, a facility was sent either the cover letter in Attachment A or B. The Request for Information consisted of the following materials that were sent to each facility:

Attachments A and B: Cover letters

Attachment C: BART Request for Information Questionnaire
http://www.pca.state.mn.us/publications/bart-questionaire.pdf

Attachment D: BART Request for Information Data Spreadsheet
http://www.pca.state.mn.us/publications/bart-eligibleunitspreadsheet.xls

Attachment E: Instructions to Complete BART Spreadsheet
http://www.pca.state.mn.us/publications/bart-spreadsheetinstructions.pdf

Table 9.1.1: Facilities Asked to Identify BART-Eligible Sources

ID	NAME	ADDRESS	CITY	STATE	ZIP
12300694	3M - Administrative Offices - Maplewood	PO Box 33331	St. Paul	MN	55133
04100003	3M - Alexandria	2115 Broadway St S	Alexandria	MN	56308
16300080	3M - Cottage Grove - Tape Manufacturing	PO Box 33131	St. Paul	MN	55133
08500049	3M - Hutchinson Tape Manufacturing Plant	915 Adams St SE	Hutchinson	MN	55350
12300015	3M - R & D Facility - Maplewood Bldg 201	PO Box 33331	St. Paul	MN	55133
01300006	ADM - Mankato	PO Box 728	Mankato	MN	56002
04900001	ADM - Red Wing	PO Box 74	Red Wing	MN	55066
08300038	ADM Corn Processing - Marshall	400 Erie Rd W	Marshall	MN	56258
07300002	Ag Processing Inc - Dawson	800 Diagonal St	Dawson	MN	56232
04700055	Agra Resources Coop dba EXOL	78242 150th St	Albert Lea	MN	56007
05700005	Ainsworth Engineered (USA) LLC - Bemidji	29647 US Highway 2 E	Bemidji	MN	56601
06100010	Ainsworth Engineered (USA) LLC - GR	502 County Road 63	Grand Rapids	MN	55744
13700083	Ainsworth Engineered (USA) LLC-Cook OSB	9358 Highway 53	Cook	MN	55723
11900001	American Crystal Sugar - Crookston	101 3rd St N	Moorhead	MN	56560
11900002	American Crystal Sugar - E Grand Forks	101 3rd St N	Moorhead	MN	56560
02700001	American Crystal Sugar - Moorhead	101 3rd St N	Moorhead	MN	56560
13900005	Anchor Glass Container Corp - Shakopee	4343 Anchor Plaza Pkwy	Tampa	FL	33630
16300001	Andersen - Main	100 4th Ave N	Bayport	MN	55003
11300014	Arctic Cat Inc	601 Brooks Ave S	Thief River Falls	MN	56701
09900001	Austin Utilities - NE Power Station	PO Box 368	Austin	MN	55912
16900069	Badger Equipment Co	217 Patneaude Dr	Winona	MN	55987
16900012	Badger Foundry Co	PO Box 1306	Winona	MN	55987
06100001	Blandin Paper/Rapids Energy Center	115 1st St SW	Grand Rapids	MN	55744
07100002	Boise White Paper LLC - Intl Falls	400 2nd St	International Falls	MN	56649
02700022	Busch Agricultural Resources - Moorhead	2101 26th St S	Moorhead	MN	56560
13900013	CertainTeed Corp	PO Box 506	Shakopee	MN	55379
09100059	CHS Oilseed Processing - Fairmont	1833 130th St	Fairmont	MN	56031
01300007	CHS Oilseed Processing - Mankato	PO Box 3247	Mankato	MN	56002
05300400	Covanta Hennepin Energy Resource Co LP	505 6th Ave N	Minneapolis	MN	55405
14700012	Crown Cork & Seal Co Inc - Owatonna	2929 Bridge St W	Owatonna	MN	55060
13100007	Crown Cork & Seal USA Inc - Faribault	PO Box 38	Faribault	MN	55021
11900017	Dahlgren & Co Inc	PO Box 609	Crookston	MN	56716
12300028	Diamond Products Co	310 5th St E	St. Paul	MN	55101
12300063	District Energy St Paul Inc-Hans O'Nyman	76 Kellogg Blvd W	St. Paul	MN	55102
13700022	Duluth Steam Cooperative Association	1 Lake Place Dr	Duluth	MN	55802
03300025	Ethanol 2000 LLP	40212 510th Ave N	Bingham Lake	MN	56118
09100009	Fairmont Power Plant	PO Box 751	Fairmont	MN	56031
15700015	Federal-Mogul Corp Powertrain Systems	PO Box 456	Lake City	MN	55041
03700011	Flint Hills Resources LP - Pine Bend	PO Box 64596	St. Paul	MN	55164
03700006	Flint Hills Sulfuric Acid/Alum Rosemount	PO Box 64596	St. Paul	MN	55164
12300039	Ford Motor Co - Twin Cities Assembly Plt	966 Mississippi River Blvd S	St. Paul	MN	55116
13700031	Georgia-Pacific - Duluth Hardboard	1220 Railroad St W	Duluth	MN	55802
12300055	Gerdau Ameristeel US Inc - St Paul Mill	1678 Red Rock Rd	St. Paul	MN	55119
03700016	Gopher Resource Corp	3385 Highway 149 S	Eagan	MN	55121
06900014	Great Lakes Gas Transmission - Station 1	5250 Corporate Dr	Troy	MI	48098
08900012	Great Lakes Gas Transmission - Station 2	5250 Corporate Dr	Troy	MI	48098
02900004	Great Lakes Gas Transmission - Station 3	5250 Corporate Dr	Troy	MI	48098

ID	NAME	ADDRESS	CITY	STATE	ZIP
05900014	Great River Energy - Cambridge	PO Box 800	Elk River	MN	55330
09100058	Great River Energy - Lakefield Junction	PO Box 800	Elk River	MN	55330
17100020	Great River Energy - Maple Lake	PO Box 800	Elk River	MN	55330
09900048	Great River Energy - Pleasant Valley	PO Box 800	Elk River	MN	55330
11500011	Great River Energy - Rock Lake	PO Box 800	Elk River	MN	55330
00900026	Grede - St Cloud Inc	5200 Foundry Cir	St. Cloud	MN	56303
14300014	Heartland Corn Products	PO Box A	Winthrop	MN	55396
05300002	Hennepin County Energy Center	600 10th Ave S	Minneapolis	MN	55415
13700027	Hibbing Public Utilities	PO Box 249	Hibbing	MN	55746
13700061	Hibbing Taconite Co	PO Box 589	Hibbing	MN	55746
00900011	International Paper - Sartell	100 Sartell St E	Sartell	MN	56377
09100007	Interstate Power & Light - Fox Lake	PO Box 367	Sherburn	MN	56171
13700062	Ispat Inland Mining Co	PO Box 1	Virginia	MN	55792
14500016	KPLOP - Sauk Centre Products Terminal	7340 W 21st St N Ste 200	Wichita	KS	67205
16300087	LSP Cottage Grove Cogeneration Facility	9525 105th St Court S	Cottage Grove	MN	55016
16300003	Marathon Ashland Petroleum LLC	PO Box 9	St. Paul Park	MN	55071
13500002	Marvin Windows & Doors	PO Box 100	Warroad	MN	56763
10900084	Mayo Medical Center Rochester	200 1st St SW	Rochester	MN	55905
12300053	Metropolitan Wastewater Treatment Plant	230 5th St E	St. Paul	MN	55101
03100001	Minnesota Power - Taconite Harbor Energy	30 Superior St W	Duluth	MN	55802
06100004	Minnesota Power Inc - Boswell Energy Ctr	1210 3rd St NW	Cohasset	MN	55721
13700013	Minnesota Power Inc - Laskin Energy Ctr	30 Superior St W	Duluth	MN	55802
13700015	Minnesota Power Inc - ML Hibbard	30 Superior St W	Duluth	MN	55802
01500010	New Ulm Public Utilities-Municipal Power	310 1st St N	New Ulm	MN	56073
16300010	Newport Terminal Corp	4567 American Blvd W	Bloomington	MN	55437
00700019	Norbord Minnesota	4409 Northwood Rd NW	Solway	MN	56678
01700019	Northern Natural Gas Co - Carlton	1650 82nd St W Ste 1250	Bloomington	MN	55431
03700014	Northern Natural Gas Co - Farmington	1650 82nd St W Ste 1250	Bloomington	MN	55431
02500002	Northern Natural Gas Co - North Branch	1650 82nd St W Ste 1250	Bloomington	MN	55431
01700011	Northern Natural Gas Co - Wrenshall LNG	1650 82nd St W Ste 1250	Bloomington	MN	55431
13700032	Northshore Mining Co - Babbitt	10 Outer Dr	Silver Bay	MN	55614
07500003	Northshore Mining Co - Silver Bay	10 Outer Dr	Silver Bay	MN	55614
05300011	NRG Energy Center Minneapolis LLC	816 4th Ave S	Minneapolis	MN	55404
02300012	NSP dba Xcel Energy - Minnesota Valley	414 Nicollet Mall	Minneapolis	MN	55401
03700003	NSP dba Xcel Energy - Black Dog	414 Nicollet Mall	Minneapolis	MN	55401
13900010	NSP dba Xcel Energy - Blue Lake	414 Nicollet Mall	Minneapolis	MN	55401
12300012	NSP dba Xcel Energy - High Bridge	414 Nicollet Mall	Minneapolis	MN	55401
04900005	NSP dba Xcel Energy - Red Wing	414 Nicollet Mall	Minneapolis	MN	55401
14100004	NSP dba Xcel Energy Sherburne Generating	414 Nicollet Mall	Minneapolis	MN	55401
14500008	Order of St Benedict/St John's Abbey	Power Plant	Collegeville	MN	56321
11100002	Otter Tail Power Co - Hoot Lake Plant	PO Box 496	Fergus Falls	MN	56538
14700002	Owatonna Public Utilities - Power Plant	PO Box 800	Owatonna	MN	55060
05300020	Pechiney Plastic Packaging Inc - Mpls	150 26th Ave SE	Minneapolis	MN	55414
05300301	Pechiney Plastic Packaging Inc - St L Pk	150 26th Ave SE	Minneapolis	MN	55414
05300326	Port of Minneapolis	3750 Washington Ave N	Minneapolis	MN	55412
04500049	Pro-Corn LLC	PO Box 440	Preston	MN	55965
12300054	Rexam Beverage Can Co - St Paul (Eva)	8770 Bryn Mawr Ave W Ste 175	Chicago	IL	60631
10900011	Rochester Public Utilities - Silver Lake	4000 E River Rd NE	Rochester	MN	55906
01700002	Sappi Cloquet LLC	PO Box 511	Cloquet	MN	55720

ID	NAME	ADDRESS	CITY	STATE	ZIP
03700043	Seneca Wastewater Treatment Plant	230 5th St E	St. Paul	MN	55101
12900014	Southern Minnesota Beet Sugar Coop	PO Box 500	Renville	MN	56284
13700141	Stora Enso DPM & DRPM	100 Central Ave N	Duluth	MN	55807
04700004	Streater Inc	411 1st Ave S	Albert Lea	MN	56007
03500031	Trus Joist - A Weyerhaeuser Business	PO Box 460	Deerwood	MN	56401
13700113	United Taconite LLC - Fairlane Plant	PO Box 180	Eveleth	MN	55734
13700011	United Taconite LLC - Thunderbird Mine	PO Box 180	Eveleth	MN	55734
05301050	University of MN - Twin Cities	2701 University Ave SE Ste 105	Minneapolis	MN	55414
13700063	US Steel - Keewatin Taconite	PO Box 217	Keewatin	MN	55753
13700005	US Steel Corp - Minntac	PO Box 417	Mountain Iron	MN	55768
01700006	USG Interiors Inc - Cloquet	35 Arch St	Cloquet	MN	55720
04900007	USG Interiors Inc - Red Wing	27384 Highway 61 Blvd	Red Wing	MN	55066
12300707	Viking Drill & Tool Inc	PO Box 65278	St. Paul	MN	55165
10700012	Viking Gas Transmission - Ada	PO Box 542500	Omaha	NE	68154
11900029	Viking Gas Transmission - Angus	PO Box 542500	Omaha	NE	68154
15300004	Viking Gas Transmission - Cushing	PO Box 542500	Omaha	NE	68154
11100016	Viking Gas Transmission - Frazee	PO Box 542500	Omaha	NE	68154
06900015	Viking Gas Transmission - Humboldt	PO Box 542500	Omaha	NE	68154
09500004	Viking Gas Transmission - Milaca	PO Box 542500	Omaha	NE	68154
13700028	Virginia Dept of Public Utilities	PO Box 1048	Virginia	MN	55792
12300410	Waldorf Corp - A Rock-Tenn Co	2250 Wabash Ave	St. Paul	MN	55114
03700156	Waste Management - Burnsville Landfill	2650 Cliff Rd W	Burnsville	MN	55337
03500002	Wausau Paper Co of Minnesota	100 Paper Pl	Mosinee	WI	54455
13700112	Western Lake Superior Sanitary District	2626 Courtland St	Duluth	MN	55806
06700005	Willmar Municipal Utilities	PO Box 937	Willmar	MN	56201
16300005	Xcel Energy - Allen S King Generating	414 Nicollet Mall	Minneapolis	MN	55401
01300015	Xcel Energy - Key City/ Wilmarth	414 Nicollet Mall	Minneapolis	MN	55401
17100019	Xcel Energy - Monticello Generating Plt	414 Nicollet Mall	Minneapolis	MN	55401
05300015	Xcel Energy - Riverside Generating Plant	414 Nicollet Mall	Minneapolis	MN	55401
03700064	Xcel Energy - Wescott LNG Plant	414 Nicollet Mall	Minneapolis	MN	55401
00900021	Xcel Energy Granite City Generating Plt	414 Nicollet Mall	Minneapolis	MN	55401
03700015	Xcel Energy Inver Hills Generating Plant	414 Nicollet Mall	Minneapolis	MN	55401
13100003	Xcel Energy W Faribault Generating Plant	414 Nicollet Mall	Minneapolis	MN	55401
08500002	Hutchinson Utilities Commission - Plant	225 Michigan Street SE	Hutchinson	MN	55350

Attachment A: Cover Letter Sent to Facilities that Responded They May Have BART-eligible unit(s) in Oct. 2001 Preliminary Survey

RE: Clean Air Act – Regional Haze Rule
Request for Information
Identification of Sources Potentially Subject to Best Available Retrofit Technology (BART)

Dear Minnesota Air Emissions Permit Holder:

This Request for Information (RFI) is the second solicitation of information to complete the Minnesota Pollution Control Agency's (MPCA) list of facilities with BART-eligible units. You received a preliminary survey from the MPCA in a letter dated October, 2001 asking you to identify BART-eligible units. You responded that you have BART-eligible units or the MPCA has information that indicates that you may have BART-eligible units at your facility. This RFI, issued under Minn. Stat. § 116.07, subd. 9 (b), is the MPCA's notice to you of your obligation to verify information about the BART status of emission units at your facility and provide any additional information needed for the MPCA to determine whether the BART-eligible units at your facility cause or contribute to visibility impairment in any Class I area. Even if you do not have BART-eligible units, you must still return the RFI within 30 days of receipt of this letter.

Why is this information requested?
The Clean Air Act (CAA) contains requirements for the protection of visibility in 156 scenic areas across the United States. To meet the CAA's requirements, the U.S. Environmental Protection Agency (EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas in July 1999. This rule is commonly known as the "regional haze rule" [64 Fed. Reg. 35714 (July, 1999)] and is found in 40 CFR part 51, in §§ 51.300 through 51.309. Under EPA's 1999 regional haze rule, certain emission sources "that may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas are required to install Best Available Retrofit Technology (BART). On June 15, 2005 EPA issued a revised final rule, including final guidance for implementation of BART. To view the final guidance, go to http://epa.gov/visibility/actions.html.

Within its boundary, Minnesota has two Class I areas – the Boundary Water Canoe Area Wilderness and Voyageurs National Park. In addition, emissions from Minnesota may contribute to visibility impairment in other States' Class I areas such as Michigan's Isle Royale National Park and Seney Wilderness Area. Therefore, Minnesota must prepare a Regional Haze plan that identifies sources that cause or contribute to visibility impairment in these areas. The BART requirements in the regional haze plan are intended to reduce emissions specifically from large sources that, due to age, were exempted from other control requirements of the Clean Air Act (CAA). For an emissions source to be considered eligible for BART, it must fall into one of 26 specified categories, must have the potential to emit at least 250 tons per year of any haze forming pollutant, and must have been in existence on August 7, 1977, but not in operation before August 7, 1962.

What do you need to do to complete the attached Request for Information?
Please complete the attached Request for Information and have it signed by a responsible official as defined in Minn. R. 7007.0100. If you identify any BART-eligible units, please provide information about the unit(s) in the requested spreadsheet format. An electronic version of the spreadsheet and instructions may be found on the MPCA's website at: http://www.pca.state.mn.us/air/criteria-emissioninventory.html. You may provide the spreadsheet electronically on a CD-ROM. Both the Request for Information and a complete and accurate spreadsheet must be returned to the MPCA.

How will the MPCA use the information it receives?

The BART guidance allows a state to exempt individual sources if they do not cause or contribute to any significant impairment of visibility in a Class I area. The MPCA will use the information provided by your facility to determine if it causes or contributes to visibility impairment in a Class I area. The MPCA expects to complete this analysis within 2 months of receiving facility information. You will be notified as to the outcome.

If your facility is found to contribute visibility impairment, then you will need to perform a BART determination for BART-eligible units at your facility. A BART determination is an engineering analysis to determine a BART limit, considering five factors. In some instances, BART-eligible units may already be controlled to BART levels and no additional controls may be needed. The MPCA expects to require facilities to provide the information needed for a BART determination by spring 2006.

By December 2007, the MPCA must submit its initial Regional Haze plan to EPA. This plan must include a list of all BART-eligible sources within the state as well as an inventory of all the haze-related pollutant emissions from these sources and proposed emission limits.

The deadline for your response is 30 days from the date of receipt of this letter. It is important that you give this matter your full attention. An inadequate response or lack of response could result in enforcement action. Please direct any questions about the data in the spreadsheet or completing the Request for Information to Paul Kim at (651) 296-7320 (e-mail: paul.kim@pca.state.mn.us). Please contact Mary Jean Fenske at (651) 297-5472 (e-mail: maryjean.fenske@pca.state.mn.us) for information about the MPCA's plans for implementation the BART portion of the regional haze rules. Please mail your Request for Information to:

Paul Kim
Environmental Outcomes Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Sincerely,

Michael J. Sandusky
Division Director
Environmental Outcomes Division

Attachment

Attachment B: Cover Letter Sent to Facilities that Did Not Have BART-eligible unit(s) in Oct. 2001 Preliminary Survey

RE: Clean Air Act – Regional Haze Rule
Request for Information
Identification of Sources Potentially Subject to Best Available Retrofit Technology (BART)

Dear Minnesota Air Emissions Permit Holder:

This Request for Information (RFI) is the second solicitation of information to complete the Minnesota Pollution Control Agency's (MPCA) list of facilities with BART-eligible units. A preliminary survey was sent by the MPCA in October, 2001 asking facilities to identify BART-eligible units. If you did receive the preliminary survey, you either responded that you do not have BART-eligible units or you did not submit the survey. This RFI, issued under Minn. Stat. § 116.07, subd. 9 (b), is the MPCA's notice to you of your obligation to provide information about the BART status of emission units at your facility. If you do have BART-eligible units at your facility, you must provide any additional information needed for the MPCA to determine whether the BART-eligible units cause or contribute to visibility impairment in any Class I area. <u>Even if you do not have BART-eligible units, you must still return the RFI within 30 days of receipt of this letter.</u>

Why is this information requested?
The Clean Air Act (CAA) contains requirements for the protection of visibility in 156 scenic areas across the United States. To meet the CAA's requirements, the U.S. Environmental Protection Agency (EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas in July 1999. This rule is commonly known as the "regional haze rule" [64 Fed. Reg. 35714 (July, 1999)] and is found in 40 CFR part 51, in §§ 51.300 through 51.309. Under EPA's 1999 regional haze rule, certain emission sources "that may reasonably be anticipated to cause or contribute" to visibility impairment in downwind Class I areas are required to install Best Available Retrofit Technology (BART). On June 15, 2005 EPA issued a revised final rule, including final guidance for implementation of BART. To view the final guidance, go to http://epa.gov/visibility/actions.html.

Within its boundary, Minnesota has two Class I areas – the Boundary Water Canoe Area Wilderness and Voyageurs National Park. In addition, emissions from Minnesota may contribute to visibility impairment in other States' Class I areas such as Michigan's Isle Royale National Park and Seney Wilderness Area. Therefore, Minnesota must prepare a Regional Haze plan that identifies sources that cause or contribute to visibility impairment in these areas. The BART requirements in the regional haze plan are intended to reduce emissions specifically from large sources that, due to age, were exempted from other control requirements of the Clean Air Act (CAA). For an emissions source to be considered eligible for BART, it must fall into one of 26 specified categories, must have the potential to emit at least 250 tons per year of any haze forming pollutant, and must have been in existence on August 7, 1977, but not in operation before August 7, 1962.

What do you need to do to complete the attached Request for Information?
Please complete the attached Request for Information and have it signed by a responsible official as defined in Minn. R. 7007.0100. If you identify any BART-eligible units, please provide information about the unit(s) in the requested spreadsheet format. An electronic version of the spreadsheet and instructions may be found on the MPCA's website at: http://www.pca.state.mn.us/air/criteria-emissioninventory.html. You may provide the spreadsheet electronically on a CD-ROM. Both the Request for Information and a complete and accurate spreadsheet must be returned to the MPCA.

How will the MPCA use the information it receives?
The BART guidance allows a state to exempt individual sources if they do not cause or contribute to any significant impairment of visibility in a Class I area. The MPCA will use the information provided by your facility to determine if it causes or contributes to visibility impairment in a Class I area. The MPCA expects to complete this analysis within 2 months of receiving facility information. You will be notified as to the outcome.

If your facility is found to contribute visibility impairment, then you will need to perform a BART determination for BART-eligible units at your facility. A BART determination is an engineering analysis to determine a BART limit, considering five factors. In some instances, BART-eligible units may already be controlled to BART levels and no additional controls may be needed. The MPCA expects to require facilities to provide the information needed for a BART determination by spring 2006.

By December 2007, the MPCA must submit its initial Regional Haze plan to EPA. This plan must include a list of all BART-eligible sources within the state as well as an inventory of all the haze-related pollutant emissions from these sources and proposed emission limits.

The deadline for your response is 30 days from the date of receipt of this letter. It is important that you give this matter your full attention. An inadequate response or lack of response could result in enforcement action. Please direct any questions about the data in the spreadsheet or completing the Request for Information to Paul Kim at (651) 296-7320 (e-mail: paul.kim@pca.state.mn.us). Please contact Mary Jean Fenske at (651) 297-5472 (e-mail: maryjean.fenske@pca.state.mn.us) for information about the MPCA's plans for implementation of the BART portion of the regional haze rules. Please mail your Request for Information to:

Paul Kim
Environmental Analysis & Outcomes Division
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Sincerely,

Michael J. Sandusky
Division Director
Environmental Outcomes Division

Attachment

Appendix 9.2: BART Strategy, Modeling Protocols, Results, and Analyses

Many documents relating to Minnesota's BART strategy, modeling, and implementation can be found on the MPCA's Regional Haze website. Some specific documents that are helpful in understanding Minnesota's BART process are noted here.

BART Implementation Strategy for Minnesota

Proposed strategy: http://www.pca.state.mn.us/publications/aq-sip2-01.pdf

MPCA's response to comments on this strategy: http://www.pca.state.mn.us/publications/aq-sip2-04.pdf

BART Modeling Protocol Used to Determine Subject-to-BART Sources

Draft modeling protocol, published for comment: http://www.pca.state.mn.us/publications/aq-sip2-02.pdf

MPCA's response to comments on draft protocol: http://www.pca.state.mn.us/publications/aq-sip2-06.pdf

Final BART modeling protocol: http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

Results of Modeling to Determine Sources Subject to BART

http://www.pca.state.mn.us/publications/aq-sip2-07.pdf

BART Analyses for the Subject-to-BART Sources

BART analyses were submitted by the following facilities in fall of 2006. Detailed modeling files submitted by the facility may be requested from MPCA staff. In some cases, facilities submitted updated information in response to requests from the MPCA, once it was determined that BART determinations for EGUs would be made. That is also noted here.

Taconite Facilities

- Hibbing Taconite
  http://www.pca.state.mn.us/publications/bart-facility-hibbingtaconite.pdf
- ArcelorMittal Steel USA, Minorca Mine
  http://www.pca.state.mn.us/publications/bart-facility-mittal.pdf
- Northshore Mining Company- Taconite Processing
  http://www.pca.state.mn.us/publications/bart-facility-northshore.pdf
- United Taconite, LLC
  http://www.pca.state.mn.us/publications/bart-facility-unitedtaconite.pdf
- U.S. Steel Corporation, Keetac
  http://www.pca.state.mn.us/publications/bart-facility-keetac.pdf
- U.S. Steel Corporation, Minntac
  http://www.pca.state.mn.us/publications/bart-facility-minntac.pdf

Electric Generating Units

- Minnesota Power, Taconite Harbor Unit 3
  http://www.pca.state.mn.us/publications/bart-facility-mnpowertaconite.pdf
  http://www.pca.state.mn.us/publications/bart-rev1108-tacharbor.pdf
- Northshore Mining Company, Silver Bay Power Facility Unit 2
  http://www.pca.state.mn.us/publications/bart-facility-northshoreminingsilverbay.pdf
  http://www.pca.state.mn.us/publications/bart-rev1108-nsm.pdf
- Xcel Energy, Sherburne County Plant Units 1 & 2
  http://www.pca.state.mn.us/publications/bart-facility-xcelshercounit1.pdf
  http://www.pca.state.mn.us/publications/bart-rev1108-sherco.pdf

These documents can also be provided by contacting the MPCA's Regional Haze contact person, Catherine Neuschler, who may be reached at 651-757-2607.

Appendix 9.3: BART Determinations by MPCA – Taconite Facilities

Summary
As stated in the body of Chapter 9, the MPCA has determined that BART for NO_X for all taconite pellet furnaces is generally an operating standard of good combustion practices in combination with some process changes. BART for direct PM emissions is equivalent to the taconite MACT, which requires control of PM emissions to control HAPs. Because of the taconite MACT, all facilities have some form of particulate control, and BART for SO_2 is generally the existing particulate scrubber optimized for SO_2 removal.

Due to the lack of emissions data, the inability to predict emissions using operating parameters, and the apparently variability of emissions (particularly NO_X emissions) MPCA is unable at this time to set emission limits that corresponds to BART, and it would be difficult to determine continuous compliance with a limit. The MPCA has included draft emission limits that represent BART for SO_2 for facilities that burn only natural gas. Other BART limits will be set prior to the Five Year SIP Assessment.

Tables 9.3.4 – 9.3.6 provide more information on the MPCA's BART determinations for the taconite facilities.

Source Description and Background
Iron ore is mined and processed in the U.S. mainly on the Mesabi Range of northern Minnesota and the Marquette Range of the Upper Peninsula of Michigan. The Michigan Department of Environmental Quality will be making the BART determinations for the two plants located in the Upper Peninsula of Michigan. Some description of the Michigan plants is included as there are only eight plants located in the United States and the Michigan and Minnesota plants have common owners and operators.

Mesabi Range
The Mesabi Range is located approximately 65 miles north of Duluth, MN, consists of an iron formation belt (the Animikie Biwabik), approximately 120 miles long from Grand Rapids to Babbitt with a thickness of 400 to 750 feet. The iron ore material that is mined, concentrated, and pelletized is magnetite (Fe_3O_4), or magnetic taconite.

Table 9.3.1 U.S. Taconite Iron Ore Facility Location*

State	Company	Mine	Pelletizing Plant
Minnesota	U.S. Steel Corporation, Keetac	Keewatin	
	Hibbing Taconite Company (Hibbtac)	Hibbing	
	U.S. Steel Corporation, Minntac	Mt. Iron	
	United Taconite (Utac)	Eveleth	Forbes
	ArcelorMittal Steel USA, Minorca Mine (ArcelorMittal)	Virginia	
	Northshore Mining Company	Babbitt	Silver Bay
Michigan	Tilden Mining Company L.C.	Ishpeming	
	Empire Iron Mining Partnership	Palmer	

* Companies from top down are listed in the order of the westernmost to the easternmost. A map of Minnesota plant locations can be found in Appendix 10.4.

There are two types of magnetic taconite: 1) magnetite associated with minnesotaite, stilpnomelane, and cherty quartz with minor greenalite and carbonates, and 2) magnetite associated with iron amphiboles (grunerite, cummingtonite, actinolite), pyroxenes, garnet, fayalite, and finely granular quartz. The first type occurs westward from near Aurora, where five taconite mining and processing companies (ArcelorMittal, Utac, Minntac, Hibbtac, and Keetac) are located. The second type is found from Aurora eastward, in an area where the iron formation has been metamorphosed by the intrusion, on the south, of the Duluth Gabbro; Northshore Mining Company is located in this area. Table 9.3.1 lists facility locations.

The difference in ore type affects grinding circuit design. According to one facility, a typical east Mesabi magnetic taconite concentrate ground to 90% finer than 325 mesh (43 µm) contains about 8% silica. Half of the total silica is in the 10% by weight +325 mesh portion. Currently, a flotation step is added to further remove silica to make a marketable taconite concentrate for standard or fluxed pellet production. At a west Mesabi facility, ore ground to 75% finer than 325 mesh is all that is required. No flotation step is needed for further silica removal, in order to make a marketable taconite concentrate for standard pellet production.

The difference in ore type also affects crushing circuit design. At the west Mesabi facility mentioned above, single stage crushing (gyratory crushers) is used ahead of single stage autogenous (using large pieces of the ore to grind/mill the smaller pieces) grinding, although grinding is now enhanced with pebble crushers. Most facilities, especially those at the eastern end of the Mesabi Range, use three or four stages of crushing, followed by rod and ball grinding mills.

The difference in ore type is also apparently relevant to the content of sulfur, mercury and fine mineral fibers in the taconite ore processed on the Mesabi Range, and hence also the emission rates of these constituents.

Marquette Range
The Marquette Range is located in the northern part of the Upper Peninsula of Michigan with its eastern end 10 miles west of the Lake Superior port of Marquette. The range is approximately 30 miles long and 6 miles wide, including from east to west the towns of Palmer, Negaunee, Ishpeming, Humboldt, Republic, and Michigamme.

Empire Iron Mining Partnership at Palmer and Tilden Mining Company at Ishpeming are the two facilities currently operated on the Marquette Range. The Empire plant uses magnetite to make pellets, and the Tilden plant uses both hematite (Fe_2O_3) and magnetite. In the finished (fired) pellets, magnetite is converted to hematite.

Taconite Pellets - Basics
Taconite concentrate pellets, or taconite pellets for short, are of 3/8 to 1/2 inches in diameter, made of taconite concentrate with a binding agent (e.g., 10 to 20 lb of powdered bentonite per ton of concentrate) and other additives and heat hardened at about 2400 °F. Taconite pellets have an iron content of about 65% by weight.

Iron making blast furnaces have used taconite pellets for decades, because of their requisite strength, consistency in size and chemical composition, and optimum metallurgical properties. If taconite concentrates, which are very fine particles, were used instead to build the burden of a blast furnace, they would be blown out of the furnace before the metallurgical process starts. The physical strength of taconite pellets also facilitates transportation and handling.

Pellet Types
There are basically two types of pellet products – standard pellets (SP), often called "acid" pellets in the past, and fluxed pellets. Fluxed pellets contain a certain amount of fluxstone (limestone and/or dolomite) in addition to all the constituents of standard pellets.

Fluxed pellets of equal to or greater than 1.0 basicity ratio can be called fully fluxed pellets (FFP). As an industry convention, the basicity ratio is a mass ratio of several of the pellet constituents defined as $(CaO + MgO)/(SiO_2 + Al_2O_3)$. Energy demand in the pelletizing process for fully fluxed pellets is increased due to the added calcination requirement for the fluxstone. Auxiliary burners are usually added to the pelletizer (agglomerator or indurating furnace) in order to make fully fluxed pellets Fluxed pellets of less than 1.0 basicity ratio, or partially fluxed pellets (PFP), do not require auxiliary burners. The difference in emissions between PFP and SP production is often not apparent.

The various pellet products are made to meet the blast furnace operator's requirements. Blast furnace operators can build their burden with FFP without adding any more fluxing agent. Alternatively, they can build their burden with PFP or SP while also adding some additional fluxing agents.

Pellet chips (PC) are broken pieces of fired pellets. They can be sent back to the balling process, after regrinding, and remade into furnace feed (unfired pellets or "green" balls). Pellet chips can be sold as feed to sinter plants.

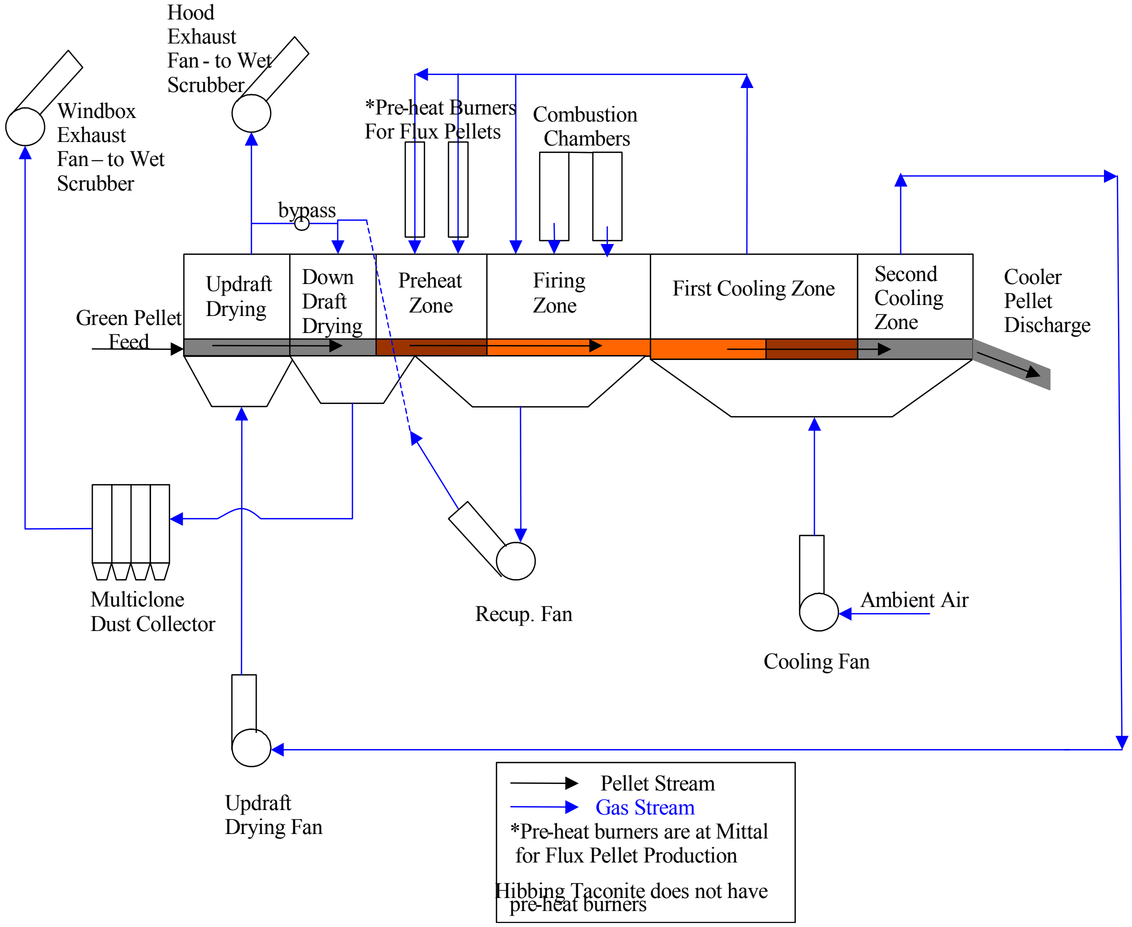
Types of Pelletizers

The U.S. taconite iron ore industry uses two types of pelletizing machines or processes: straight grate (Figure 9.5.1) and grate-kiln (Figure 9.5.2), with their respective first units installed in 1954, 1957, and 1963. An industry profile is provided in Table 9.5.2.

In the straight grate machine, a continuous bed of agglomerated green pellets is carried through different temperature zones with upward draft or downward draft blown through the pellets on the metal grate. Pellet residence time inside the machine is about 40 minutes. Fuel combustion chambers supply hot flue gas to a zone in the middle portion of the machine (combustion zone). (In order to make fully fluxed pellets, auxiliary burners need to be added to the preheating zone.) Fired pellets are cooled on the remaining portion of the machine. To protect the metal grate and other parts of the machine, about 20 percent of the cooled, fired pellets are used to make a hearth layer at the bottom and two sides of the pellet bed.

For the straight grate machine, used process gas consists of exhaust gas from the updraft drying zone and exhaust gas closer to the firing zone. The former can be called "hood exhaust" and the latter "windbox exhaust." For many straight grate machines, both hood exhaust and windbox exhaust are directed to one common header. The common exhaust header has one "hot side" inlet to receive windbox exhaust and one "cold side" inlet to receive hood exhaust. From the common exhaust header, the exhaust gas is vented through four parallel stacks, which are outfitted with air pollution control equipment. For some older machines, two separate common headers are used to vent hood exhaust and windbox exhaust. The hood exhaust header vents through three stacks, and the wind exhaust (often referred to as "waste gas") header vents through two stacks.

Figure 9.3.1: Diagram of Straight-Grate Induration Furnace[154]

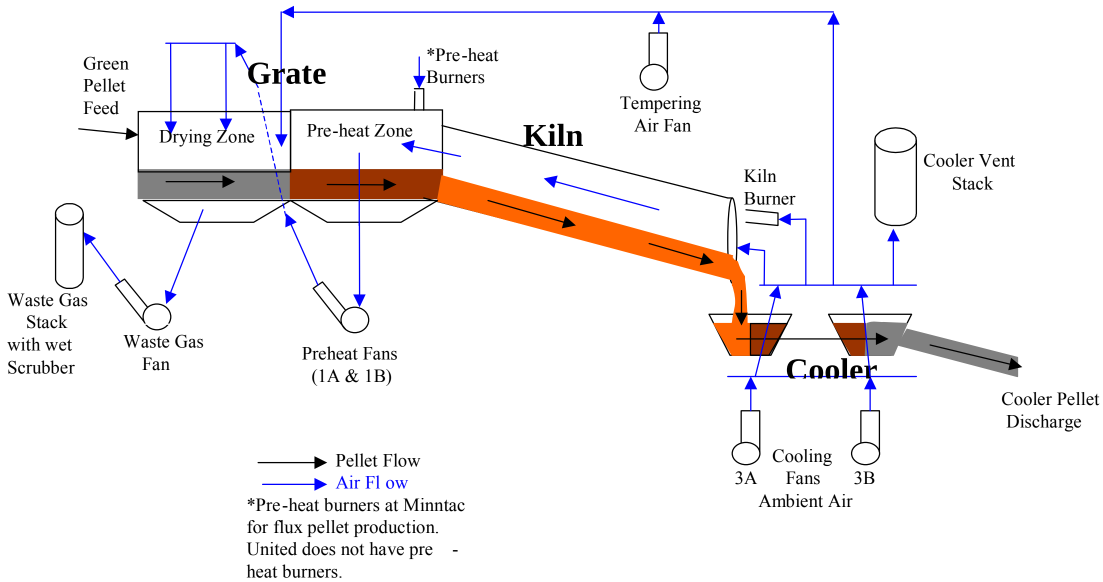


Gases are passed numerous times through the pellet bed in order to heat and cool the pellets as they pass along a large grate. "Windbox exhaust" gases are derived from the down draft and preheat zones, but are passed through multiclone dust collectors before entering the wet scrubber/ exhaust system. "Hood exhaust" gases from the updraft drying zone originate from the second cooling zone and pass directly into the wet scrubber/ exhaust system. Windbox and hood exhaust gases partially mix in a common header before being vented to the atmosphere through a series of four stacks.

The grate-kiln system actually consists of a traveling grate, a rotary kiln, and an annular cooler (Figure 9.3.2). Pellet residence time inside the system is about 55 minutes (less than 10 minutes in the grate, about 20 minutes in the kiln, and about 30 minutes in the cooler). The grate-kiln system does not need a hearth layer for the grate, which handles only drying and preheating. The rotary kiln does not need a hearth layer, either, because it is lined with refractory material. One waste gas stack, or two side-by-side waste gas stacks, is used for the grate-kiln system.

[154] Berndt & Engesser. Used with permission.

Figure 9.3.2: Diagram of a Grate-Kiln Induration Furnace[155]



Combustion gases for heating the pellets are directed up a large rotating kiln and then down through the pellet bed in the preheat zone. The gases are then used for initial heating and drying of the greenball (or green pellet) feed. Gases used for cooling the hot pellets are also used to dry and heat the pellets. Depending on the operation, the waste gases are passed through either one or two scrubbers and vented through one or two separate stacks.

It is very common to use intermediate cyclones to clean the gas stream in the straight grate and grate-kiln pelletizers, as it is ducted to various locations in the grate. The cyclones protect the blades of gas movers (fans) and recover good materials (particles of high iron content). Inclined plates are also used along with periodic water wash to remove "solid spills" under the grate to recover the iron units. These measures also help reduce dust loading near the waste gas stack, even though they are not considered air pollution control equipment.

Pelletizing Process

Pelletizing is a high temperature process with air in excess. The process is responsible for the largest portion of emissions of air pollutants from any individual taconite ore mining and processing facility. Natural gas is commonly used as the primary fuel for pelletizing. Distillate fuel oil is often used as a back up fuel, especially during natural gas curtailment in winter. Other types of fuel, e.g., coal, petroleum coke, and sawdust, are also being used at shown in Table 9.3.2.

Over the years, efforts have been made to recuperate some of the heat loss associated with the various hot air streams associated with the pelletizers. For grate-kiln and straight grate pelletizers, most of the hot air in the cooling zone for fired pellets is directed to combustion zone and/or preheat and drying zones of the pelletizer. At the waste gas stack, the gas stream does not have much thermal energy to be recovered (gas

[155] Berndt & Engesser. Used with permission.

temperature ranges from 100 to 150 °F for a stack controlled with a wet scrubber or a wet wall electrostatic precipitator.

Energy usage difference among the individual facilities varies significantly when comparing the MMBtu/long ton pellet. Most of the difference is attributed to a combination of the following: process equipment age, equipment retrofits, pellet products made, ore characteristics, process control, and operator's training and skills.

More factors influence NO_X formation in pellet furnaces compared to typical industrial or utility boilers and the degree to which these factors influence NO_X emissions is not well understood. We know that NO_X emissions are influenced by the amount and type of fuel burned, but we are uncertain about the influence that the amount of oxygen available, the pellet production rate, the air flow amount and design of the furnace, the flame temperature, the combustion zone temperatures, the amount of heat from exothermic reactions in the furnace, the temperature and moisture content of solid fuels burned, and other factors have on NO_X generation. As each of these factors varies, NO_X emissions are impacted. The degree to which each of these factors influences NO_X emissions varies and has not been well examined. For example, while burner design in a boiler may be the primary determiner of NO_X emissions from a boiler, the primary factor influencing NO_X emissions for the pellet furnaces is not known. In addition, units that do not have add-on controls, such as the pellet furnaces, typically have a wider spread in emissions compared to units with add-on controls.

SO_2 emissions from the pellet furnace waste gas stacks are a function of the amount of sulfur in the fuel burned, the sulfur content of the green ball, and the control efficiency of the particulate control device. The SO_2 removal efficiency of particulate wet scrubber is dependent on the pH of the water entering and leaving the scrubber and total volume of the water entering the scrubber.

Table 9.3.2: Characteristics of Minnesota Taconite Pellet Furnaces

Plant (line)	Pelletizer type	Pellet type	Pellets fired, Long ton/hr	Fuel	Existing Control	Air Flow Rate, kscfm	Heat Input, MMBtu/hr
Keetac	Grate Kiln	Acid	600-660	PRB coal NG	Wet scrubber[a]	680-700	340-350
Hibbing Taconite[b] 1	Straight Grate	Acid	250-380	NG	Wet scrubber	670-750	70-110
2	Straight Grate	Acid	250-380	NG	Wet scrubber	670-750	70-110
3	Straight Grate	Acid	250-380	NG	Wet scrubber	670-750	70-110
Minntac[c] 3	Grate Kiln	Acid	200-250	NG	Wet scrubber	180-250	105-175
4	Grate Kiln	Flux/acid	400-450	60%wood 40% NG	Wet scrubber	350-500	150-300
5	Grate Kiln	Flux/acid	400-450	60%wood 40% NG	Wet scrubber	350-500	150-300
6	Grate Kiln	Flux	400-450	PRB coal NG	Wet scrubber	370-450	200-280
7	Grate Kiln	Flux	400-450	PRB coal NG	Wet scrubber	370-450	200-280
United Taconite[d] 1	Straight Grate	Acid	170-270	NG	Wet scrubber	310-340	120-200
2	Grate Kiln	Acid	480-550	Pet coke coal	Wet scrubber	670-750	180-260
ArcelorMittal[e]	Straight Grate	Flux	310-440	NG	Wet scrubber	600-680	165-220

Plant (line)	Pelletizer type	Pellet type	Pellets fired, Long ton/hr	Fuel	Existing Control	Air Flow Rate, kscfm	Heat Input, MMBtu/hr
Northshore[f] 11	Straight Grate	Acid	235-255	NG	Wet-Wall ESP	350-360	126-131
12	Straight Grate	Acid	235-255	NG	Wet-Wall ESP	350-360	126-131

[a] Scrubber adds lime to enhance SO_2 removal
[b] Hibbing Taconite's data are based on a May 2007 stack test report. Air flow rate (kscfm) is the sum of all 4 stacks' flow.
[c] Minntac can fire wood + NG in L3 through L7 but typically uses the fuels as shown above.
Minntac can make acid or flux pellets in L3 through L7 but typically schedules production as shown above.
Minntac's heat input data are taken from the results of stack tests when pelletizers were fired mostly with NG
[d] United Taconite's Line 1 data are taken from extended NO_X ppm, NO_X and SO_2 stack tests conducted in 2007.
United Taconite's Line 2 is permitted to burn coal and petroleum coke with no coal type specified. Line 2 data are taken from SO_2 and NO_X stack test results.
[e] ArcelorMittal can make acid pellets but typically does not. Its data come from stack test results during flux pellet production.
[f] Northshore can make flux pellets in its furnaces without adding auxiliary burners in the preheat zone; pellet type is not seen in the stack test reports, though. Data are taken from F11 test (at SV 104) on 12/22/05 & F12 MACT test on all five stacks on 4/18-19/2006

Taconite Mining and Processing

As stated previously, pelletizing is responsible for the largest portion of the emissions of air pollutants from a taconite ore mining and processing facility. However, a taconite ore mining and processing facility has unit processes other than just pelletizing. Some of these other processes such as mineral liberation and taconite concentrating are upstream of pelletizing, while others such as pellet product storage and shipping are downstream of pelletizing. The following describes mineral liberation, taconite concentrating, pellet product storage and shipping.

Liberation – The first step in processing crude taconite ore is crushing and grinding. The ore must be ground to a particle size sufficiently close to the grain size of the ironbearing mineral to allow for a high degree of mineral liberation and removal of the waste material (gangue). Most of the taconite used today requires very fine grinding.

The grinding is normally performed in successive stages of dry crushing, followed by wet grinding in rod mills and ball mills. Gyratory crushers are generally used for primary crushing, and cone crushers are used for secondary and tertiary fine crushing. Intermediate vibrating screens remove undersize material from the feed to the next crusher and allow for closed circuit operation of the fine crushers. The rod and ball mills are also in closed circuit with classification systems such as cyclones. An alternative is to feed some coarse ore directly to wet or dry semiautogenous or autogenous (using large pieces of the ore to grind/mill the smaller pieces) grinding mills, then to pebble or ball mills.

Ideally, particles of iron minerals and barren gangue should be removed from the grinding circuits as soon as they are liberated, with larger particles returned for further grinding.

Concentrating – As the iron ore minerals are liberated by the crushing steps, the ironbearing particles must be concentrated. Since only about 33 percent of the crude taconite becomes a shippable product for iron making, a large amount of gangue is generated. Magnetic separation and flotation are most commonly used for concentration of taconite ore.

Magnetite is concentrated by magnetic separation since most of the recoverable iron is magnetic. The crude ore may contain 30 to 35 percent total iron by assay, but theoretically only about 75 percent of this is recoverable magnetite. The majority of the remaining iron is discarded with the gangue.

Nonmagnetic taconite ore (hematite and liminite) is concentrated by froth flotation or by a combination of selective flocculation and flotation. The method is determined by the differences in surface activity between the iron and gangue particles. Sharp separation is often difficult.

Various combinations of magnetic separation and flotation may be used to concentrate ore containing various iron minerals (magnetite and hematite) and wide ranges of mineral grain sizes. Flotation is also often used as a final polishing operation on magnetic concentrates.

Pellet Product Storage and Shipping – Fired pellets, just leaving the pelletizer, are conveyed to stockpiles for cooling and storage. Most pellet products are transported to blast furnaces in the Great Lakes region by ships, which are loaded at Duluth, Silver Bay, Taconite Harbor, Escanaba, and Marquette at the shorelines of Lake Superior and Lake Michigan. Except for Northshore Mining Company, which is located on the shore of Lake Superior, the remaining taconite facilities use the railroad to transport their pellet products to the ports.

In the winter, the Great Lakes are closed, and most pellets are stockpiled on site at the facilities or at the docks to wait for the next shipping season. A portion of the pellets produced on the Mesabi Range is shipped by railroad trains to other locations, for which transportation is carried out all year round.

BART Analyses and Determinations

A summary of the BART analyses submitted by each taconite facility (see Appendix 9.2) is contained in each of the following BART Determination memoranda prepared by MPCA technical staff. These memoranda provide the MPCA's technical documentation for its BART determinations.

Nitrogen Oxides BART Determination for U.S. Steel Corporation – Minnesota Ore Operations
Sulfur Dioxide BART Determination for U.S. Steel Corporation – Minnesota Ore Operations

Sulfur Dioxide and Nitrogen Oxides BART Determination for U.S. Steel Corporation –Keetac

Nitrogen Oxides BART Determination for Hibbing Taconite
Sulfur Dioxide BART Determination for Hibbing Taconite

Nitrogen Oxides BART Determination for Arcelor Mittal USA
Sulfur Dioxide BART Determination for Arcelor Mittal USA

Nitrogen Oxides BART Determination for United Taconite LLC, Line 1
Sulfur Dioxide BART Determination for United Taconite LLC, Line 1

Sulfur Dioxide and Nitrogen Oxides BART Determination for United Taconite LLC, Line 2

Nitrogen Oxides BART Determination for Northshore Mining- Silver Bay
Sulfur Dioxide BART Determination for Northshore Mining- Silver Bay

Particulate Matter BART Determinations for US Steel – Minnesota Ore Operations, US Steel – Keetac, Hibbing Taconite, Arcelor Mittal USA, Northshore Mining- Silver Bay, and United Taconite LLC

The MPCA provided guidance to facilities performing a BART analysis. This guidance is available on the MPCA's web page.[156] EPA Region V staff, Federal Land Managers, and industry representatives of subject-to-BART facilities were given the opportunity to comment on the guidance prior to finalization. The guidance is based on Section IV of EPA's *Guidelines* [40 CFR Part 51, Appendix Y], though the *Guidelines* are not required to be applied at taconite facilities.

In making its BART determination for each facility, the MPCA evaluated whether each of the steps in the BART were conducted appropriately. The steps in a full BART analysis conducted by each facility consist of:

STEP 1—Identify All Available Retrofit Control Technologies

a. Existing controls and any other information pertinent to retrofit control equipment identification.

b. Available Retrofit Control Technologies; also identification of any available work practices, fuel changes, operational changes, and pollution prevention measures.

STEP 2— Eliminate Technically Infeasible Options

STEP 3— Evaluate Control Effectiveness of Remaining Control Technologies

STEP 4— Evaluate Impacts and Document the Results

Impact analysis part 1: Costs of compliance

Impact analysis part 2: Energy impacts

Impact analysis part 3: Non-air quality environmental impacts

Impact analysis part 4: Remaining useful life

STEP 5—Evaluate Visibility Impacts

STEP 6—Propose BART

A full BART analysis was conducted for SO_2 and NO_X at each of the BART-eligible pellet furnaces and a few units at certain facilities that were not able to undergo a streamlined BART-analysis. A BART-eligible emissions unit qualified for a streamlined BART analysis if one or more of the following conditions applied:

1. The unit emits only PM and is subject to the taconite MACT standard.
2. Sources of fugitive PM emissions that are subject to the taconite MACT standard.
3. Non-MACT units and fugitive sources emitting PM only that are already well-controlled, for example bentonite storage and handling,
4. Non-MACT units and fugitive sources emitting PM where modeling demonstrates negligible impact on visibility in a Class I area.[157]
5. Non-pellet furnace combustion units where modeling demonstrates negligible impact on visibility in a Class I area.
6. Emergency generators and fire pumps.

[156] http://www.pca.state.mn.us/publications/aq-sip2-09.pdf

[157] The method for visibility modeling and threshold for negligible impact (<0.05 deciview) are described in section 3F of each BART analysis. EPA Region V was informed of the streamlined BART analysis methods the MPCA agreed to.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : March 4, 2009

TO : AQD File No. 257
(Delta ID No. 13700062)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Nitrogen Oxides BART Determination for ArcelorMittal Steel Company

Note: Separate SO_2 and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
ArcelorMittal Steel USA 1 South Dearborn Street Chicago, IL 60603	ArcelorMittal Minorca Mine Inc. 5950 Old Highway 53 North Virginia, MN, St. Louis County
Contact: Ms. Jaime Baggenstoss,; Phone: (218) 749-5910 x283	

1.2 Description of the Facility

ArcelorMittal Minorca Mine Inc. (formerly Ispat Inland Mining Company) owns and operates a taconite pellet production plant. There are three main areas where emissions are created and these are the mine, tailings basin and pellet plant.

The major steps in taconite pellet production include taconite ore mining, crushing, grinding, concentrating, agglomerating, and indurating. The larger sources of air emissions at ArcelorMittal are from the indurating furnace operations and from mining activities, with lesser amounts from other processing operations and fugitive dust sources, including haul roads and the tailings basin.

ArcelorMittal's pellet plant has one Dravo indurating furnace. It burns a maximum of 370 MMBtu/hr of natural gas and is capable of handling 400 tons of pellets per hour.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The unit for which the MPCA must determine BART and establish a NO_X BART limit consistent with that determination is:

Emission Unit Name	EU Number[1]	Control Equipment & Stack Numbers[2]
Indurating Furnace	EU026	SV014, SV015, SV016, SV017

1 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.
2 The indurating furnace has no control equipment for NOX emissions.

2.3 The BART Analysis

ArcelorMittal's BART Analysis and Selection Process

ArcelorMittal submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 8, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-mittal.pdf.

Evaluation of Impacts

ArcelorMittal modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of ArcelorMittal's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	2.285	97
2003	2.457	90
2004	2.586	70
Combined (2002-2004)	2.381	257

The sulfur dioxide emissions from ArcelorMittal's pelletizing furnace are currently controlled by wet scrubbers installed primarily to remove particulate matter.

Identification of Available Retrofit Control Technologies

ArcelorMittal identified the following NO_X retrofit control technologies as available and applicable to pellet furnaces:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction

Elimination of Technically Infeasible Options

ArcelorMittal eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Low-NO_X Burners are not feasible since they are only feasible in pre-heat zone and ArcelorMittal has already installed Low-NO_X Burners in its pre-heat zone.[5] (Low NO_X burners in the indurating section of the

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3 The facility used the CALPUFF Modeling System required by the MPCA's BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.

4 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the ArcelorMittal.

5 As a result of a determination of Best Available Control Technology (BACT), the indurating furnace received an emissions limit of 1088 lb NO_X/hr for ArcelorMittal's indurating furnace in the early 1990's. The BACT

furnace would adversely affect pellet quality due to reduced flame temperature.) ArcelorMittal eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category. ArcelorMittal noted in its Analysis that the facility has already implemented several energy efficiency projects and that it will continue to evaluate and implement energy efficiency projects. Ported Kilns were eliminated by ArcelorMittal because they are applicable only to grate kiln furnaces not to the straight grate indurating furnaces that ArcelorMittal employs. ArcelorMittal eliminated Alternative Fuels because the environmental and economic benefits of such a change are uncertain and ArcelorMittal believes that this option is not mandated by U.S. EPA. Also, ArcelorMittal's permit currently limits its fuels to natural gas and fuel oil.

Selective Catalytic Reduction with conventional Reheat was the only technology considered by ArcelorMittal to be technically feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

The following table illustrates the NO_X emission reductions projected by ArcelorMittal with SCR.

Projected Annual NO_X Emission Reductions (tons per year)

NO_X Control Technology	Assumed Control Efficiency	Indurating Furnace (range)	Total
None (Baseline)[6]	--	520 – 1419	3639
Selective Catalytic Reduction w/ Reheat	80%	416 – 1135	2911

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

ArcelorMittal's estimates of the annualized pollution control cost of installing and operating the SCR is shown in the table below.

Pellet Furnace Projected NO_X Control Cost
(cost per ton of pollutant removed)

NO_X Control Technology	Indurating Furnace
Selective Catalytic Reduction w/ Reheat	$9,396[7] – $23,504 (varies by stack)

ArcelorMittal's BART Selection

In their BART submittal, ArcelorMittal indicated that traditional add-on controls would not be cost-effective and proposed BART as the low-NO_X burners already installed on the preheat section of the furnace. A BART emission limit of 1088 lb NO_X/hr (the sum of all four stacks), equivalent to the existing permit limit, was also proposed.

determination and the related permitting activities are described in the Technical Support Document for Air Emissions Permit No. 13700062-001.
6 The baseline emission levels are those provided by ArcelorMittal in its BART analysis.
7 This is the cost for SV017.

MPCA Review of ArcelorMittal's BART Analysis

The MPCA reviewed the BART analysis provided by ArcelorMittal and agrees with the selection of the technologies considered for the analysis as well as ArcelorMittal's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation Burners, Low-NO_X Burners, Ported Kilns and Alternative Fuels further in the report.[8] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage ArcelorMittal to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation in the BART Analysis of Energy Efficiency Projects is not feasible as ArcelorMittal does not identify a specific Energy Efficiency Project as a BART technology. The control efficiencies proposed for SCR with reheat appears to be reasonable.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in ArcelorMittal's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART.

The MPCA agrees with ArcelorMittal's proposal of the low-NO_X burners in the preheat section of the furnace as BART. In addition, the MPCA has also determined that BART is good combustion practices for the indurating furnace. However, the MPCA believes that neither ArcelorMittal nor the MPCA has sufficient operating parameter data or emissions data to be able to assess whether current combustion practices constitute "good" combustion practices nor does sufficient emissions data exist to establish a NO_X BART limit.

Prior to the submittal of ArcelorMittal's BART report, the MPCA encouraged the taconite facilities to consider the installation of NO_X Continuous Emission Monitoring Systems (CEMS) and the concurrent monitoring of operations as a control strategy. ArcelorMittal's BART submittal responds, stating that "[p]rocess optimization for NO_X reduction on an induration furnace is not a proven technology and is not commercially available as a control technology." Still, ArcelorMittal notes that the approach has been used in the electric utility industry to fine tune NO_X emissions from boilers.

From its experience with electric utilities, refineries, and other facilities, the MPCA notes that strategies to use CEMS to reduce NO_X have been successful. The MPCA believes that monitoring NO_X emissions with CEMS or other parametric monitoring at pelletizing furnaces will identify operating conditions under which NO_X emissions can be reduced. The MPCA also notes that NO_X reductions have occurred at another taconite facility after installing CEMS. While those reductions cannot be directly tied to operational changes identified with the aid of CEMS, this observation strongly suggests that using CEMS at pelletizing furnaces will help reduce NO_X through the feedback to the operator and plant management that a CEMS or predictive emission monitoring system provides. Operators can fine tune the operation since it responds to a number of variables under their control and the results of these adjustments can be seen with a CEMS. Plant management can analyze temporal differences in individual furnace

8 Although the MPCA agrees with ArcelorMittal that these emission reduction methods are not technically feasible, it does not agree with all aspects of ArcelorMittal's rationale.

operations and differences in emissions among similar furnaces to gain understanding of the factors that influence NO_X formation and apply that knowledge to lower emissions.

The MPCA has determined that continuous emission monitors or a comparable alternative emission measurement method combined with hourly process data can provide data that would be necessary in setting BART NO_X limits based on BART as good combustion practices, past installation of Low NO_X Burners in the preheat zone and the upcoming implementation of furnace energy efficiency projects in early 2008.

2.4 MPCA Determination of the BART Limit

Due to the lack of sufficient emissions data representing the range of operating conditions that influence emissions,[9] the MPCA is unable at this time to set an emission limit that corresponds to BART for ArcelorMittal's indurating furnace.

The following table represents the MPCA's NO_X BART determination for the pellet furnace at ArcelorMittal.

Pellet Furnace Line	**BART**	**Recommended BART Emission Limit**	**Compliance Schedule**[10]
Indurating Furnace (EU026)	Existing low-NO_X burners (in the furnace preheat section), good combustion practices and modifications to the furnace to improve energy efficiency in early 2008	To Be Determined (TBD) after gathering sufficient emissions and operating data	Draft Administrative Order requiring submittal of an alternative emission measurement method by February 22, 2009 was signed by ArcelorMittal.

The MPCA anticipates that the BART limit(s) will be established and incorporated into ArcelorMittal's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

9 The BART analysis was done based on two three-hour performance tests conducted prior to July 2008 for NO_X emissions from its indurating furnaces

10 The resulting emissions and operating parameter data will be used to establish a BART limit through an amendment to ArcelorMittal's Title V permit.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 8, 2009

TO : AQD File No. 257
(Delta ID No. 13700062)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Sulfur Dioxide BART Determination for for ArcelorMittal Steel Company

Note: Separate NO_X and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's SO_2 BART determination based on the technical review performed by MPCA staff. Public notice and comment and EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
Mittal Steel USA 1 South Dearborn Street Chicago, IL 60603	Mittal Steel USA – Minorca Mine Inc. 5950 Old Highway 53 North Virginia, MN St. Louis County
Contact: Jaime Bagenstoss; Phone (218) 749-5910 x283	

1.2 Description of the Facility

Mittal Steel USA – Minorca Mine Inc. (formerly Ispat Inland Mining Company) owns and operates a taconite pellet production plant. There are three main areas where emissions are created and these are the mine, tailings basin and pellet plant.

The major steps in taconite pellet production include taconite ore mining, crushing, grinding, concentrating, agglomerating, and indurating. The larger sources of air emissions at Mittal Steel are from the indurating furnace operations and from mining activities, with lesser amounts from other processing operations and fugitive dust sources, including haul roads and the tailings basin.

Mittal Steel's pellet plant has one Dravo indurating furnace. It burns a maximum of 370 MMBtu/hr of natural gas and is capable of handling up to 440 tons of pellets per hour.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The unit for which this determination of a BART Sulfur Dioxide Emission Limit has been completed is:

Emission Unit Name	EU Number[1]	Control Equipment and Stack Numbers
Indurating Furnace	EU026	CE014/SV014, CE015/SV015, CE016/SV016, CE017/SV017

Although the indurating furnace can burn both natural gas and fuel oil, natural gas is the primary fuel. Since natural gas is low in sulfur, the primary source of sulfur at this furnace is the iron ore used to form the green balls. Some additional sulfur may be present in additives also used in the green balls.

2.3 The BART Analysis

Mittal Steel's BART Analysis and Selection Process

Mittal Steel submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 8, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-mittal.pdf

Evaluation of Impacts

Mittal Steel modeled its impacts using BART modeling protocol required by the MPCA.[2] The following table shows a summary of Mittal Steel's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[3]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	2.285	97
2003	2.457	90
2004	2.586	70
Combined (2002-2004)	2.381	257

The sulfur dioxide emissions from Mittal Steel's pelletizing furnace are currently controlled by wet scrubbers installed primarily to remove particulate matter.

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1 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

2 The facility used the CALPUFF Modeling System required by the MPCA's *BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota*, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.

3 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the Mittal Steel.

Identification of Available Retrofit Control Technologies

Mittal Steel identified the following SO_2 retrofit control technologies:

- Wet Walled Electrostatic Precipitator (WWESP)
- Wet Scrubbing (High and Low Efficiency)
- Dry Sorbent Injection (Dry Scrubbing Lime/Limestone Injection)
- Spray Dryer Absorption (SDA)
- Energy Efficiency Projects
- Alternate Fuels

Elimination of Technically Infeasible Options

Mittal Steel eliminated Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Drying from consideration since they were technically infeasible. With Dry Sorbent Injection and Spray Dryer Absorption, the high moisture content of the exhaust would lead to saturation of the baghouse filter cake and plugging of the filters and the dust collection system. The company indicated that the potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no specific project has been envisioned, the company did not evaluate this option any further. Alternative Fuels were eliminated since Mittal Steel is prohibited from burning solids fuels and because natural gas is also a low-sulfur fuel. (Mittal Steel burns relatively small quantities of fuel oil.)

Evaluation of the Control Effectiveness of the Remaining Control Technologies

Mittal Steel estimated the control efficiency of WWESPs to be approximately 80 percent. A secondary wet scrubber was estimated to control roughly 60 percent of the SO_2 remaining after the existing scrubber. The following tables illustrate the SO_2 emission reductions projected by Mittal Steel with the technically feasible control technologies.

Annual SO_2 Emissions (tons per year)

	Total
Baseline SO_2 emissions[4]	179.2

Projected SO_2 Emission Reductions (tons per year)

SO_2 Control Technology	**Total**
WWESP	143.2
Secondary Wet Scrubber	107.6

[4] The baseline emission levels are those provided by Mittal Steel in its BART analysis.

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

Mittal Steel estimated the annualized pollution control cost of installing and operating WWESPs to be about $116,000 per ton of SO_2 removed. The cost of installing and operating a secondary wet scrubber was estimated to be about $83,000 per ton of SO_2 removed.

Mittal Steel's BART Selection

In its submittal, Mittal Steel indicated that add-on controls would not be cost-effective and proposed BART to be existing controls. Mittal Steel also states that the appropriate BART limit would be 540 lb/hr for its Indurating Furnace (270 MMBtu/hr at 2.0 lb/MMBtu).

MPCA Review of Mittal Steel's BART Analysis

The MPCA reviewed the BART analysis provided by Mittal Steel and agrees with the company's assessment of technical infeasibility for Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Drying.[5] The control efficiencies proposed for the remaining technologies appear to be reasonable.

"Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage Mittal Steel to implement projects that concurrently reduce energy consumption and sulfur dioxide, it does not identify a specific Energy Efficiency Project as a BART technology.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in Mittal Steel's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART and that the existing PM control (wet scrubber) is the technology that represents BART.

The current SO_2 limit in Mittal Steel's permit (and Mittal Steel's proposed limit) of 2.0 lb/MMBtu is not based on the performance of a wet scrubber; the MPCA must establish a BART limit that corresponds to the capabilities of the BART control technology. Therefore, the MPCA developed an alternate approach to establishing BART limits to the one supported by Mittal Steel. That analysis is provided below.

2.4 MPCA Determination of the BART Limit

Mittal Steel makes fully fluxed pellets using one straight grate furnace. There is only one performance test at Mittal Steel's straight grate furnace for which SO_2 emissions were determined from all four stacks. It was conducted on 6/17/1997 and a corresponding MPCA review letter was dated 8/12/1997. Another MPCA review letter, dated 5/15/1997, discussed a previous test, which was conducted on 6/29/1994, to provide SO_2 and other emissions from that stack. During both tests, Mittal Steel was burning natural gas.

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[5] Although the MPCA agrees with Mittal Steel that these emission reduction methods are not technically feasible, it does not agree with all aspects of Mittal Steel's rationale.

The following table presents the initial information from the MPCA review letters and a method of determining an emission limit given the small number of performance tests performed.

Stack test results and suggested SO_2 emission limit for Mittal Steel USA

Performance test conducted on 6/17/1997 (MPCA review letter dated 8/12/1997)					
Stack	A	B	C	D	Sum
SO_2, lb/hr	13.9	7.3	7.9	3.4	32.5
Heat input rate, million BTU/hr, based on 169,000 to 195,000 ft^3/hr of natural gas					183
Pellet production rate, LT/hr, based on 325 to 360 long ton/hr					342
Emission factor for emission inventory reporting purpose, EF_{EI}, lb SO_2/LT pellets					0.095
Ave (13.9; 7.3; 7.9; 3.4) = 8.13		Max – Min = 13.9 – 3.4 = 10.5		k* = (Max-Min)/Ave = 1.29	
Emission factor modified for limit setting purpose, k × EF_{EI}, lb SO_2/LT pellets					**0.123**
Resultant margin of compliance, calculated as (0.123 – 0.095) / 0.123					22.6%
Performance test conducted on 6/29/1994 (MPCA review letter dated 5/15/1997)					
Stack	A	B	C	D	Sum
SO_2, lb/hr	Not tested	Not tested	Not tested	0.89	Not available
Heat input rate, million BTU/hr					192
Pellet production rate, LT/hr					380

* This is a multiplier just intended to modify the emission factor so that it is more suitable for limit setting. This is a last resort for figuring out an emission limit. The preferred method is getting more stack tests conducted and analyzing test results statistically.

Additional information was received from Mittal Steel, with data from stack testing conducted in March 2008. This data consisted of 146 hourly data points, showing that SO_2 emissions averaged 0.112 lb/LT with a standard deviation of 0.034. Hourly values ranged from 0.036 to 0.212. Using statistical analysis techniques to estimate a year's worth of daily data based on these parameters, the MPCA determined that an SO_2 BART limit of 0.165 lb/LT is appropriate for this facility.

2.5 Conclusion

For the indurating furnace at Mittal Steel, the MPCA sets a BART limit at 0.165 lb SO_2/long ton of pellets fired (finished) that applies only when the company is burning natural gas. This limit applies as a 30-day rolling average. The limit will be incorporated into the requirements for Mittal Steel through an Air Emission Permit Amendment that the MPCA intends to issue in 2008.

Permit Conditions

In addition to creating the BART limit on SO_2, the "BART permit amendment" for Mittal Steel will add a number of conditions to the permit to ensure that the facility demonstrates compliance with the limit. The suggested permit language (refer to the Attachment) envisions that Mittal Steel will conduct annual performance tests (at least initially). Alternatively, Mittal Steel may install and operate a continuous emission monitor system (CEMS) to demonstrate compliance on a continuous basis.

If performance tests are chosen as the desired method of demonstrating direct compliance with the BART SO_2 limit, Mittal Steel will need to monitor certain parameters to show that the wet scrubber is operating as it was when it demonstrated compliance (during the performance test). The key parameters that will be monitored are the pressure drop across the scrubber, the water flow rate, and the pH of the water leaving the scrubber. Mittal Steel is already subject to the Taconite MACT (40 CFR 63 Subpart RRRRR), which also requires monitoring of the pressure drop across the scrubber and the water flow rate to assure good particulate control. To avoid duplication of requirements and potential confusion, the MPCA will add a BART citation to those monitoring requirements currently required by the MACT. A separate set of monitoring requirements will be added for pH, since it is now needed to ensure that the scrubber is functioning optimally to remove SO_2. The MPCA will determine the monitoring frequency for pH based on an analysis of the stability of the pH measurements from records that Mittal Steel will provide. If Mittal Steel decides to monitor SO_2 emissions with CEMS, the MPCA may adjust the SO_2 emission limit based on scrubber performance parameters (e.g., pH) and on the data collected from CEMS.

The permit amendment will also require Mittal Steel to monitor the concentration of sulfur in the filter cake (comprised of iron ore concentrate and some additives) used to form the green balls fed to the pelletizing furnace. Tracking the sulfur content of this material will allow Mittal Steel and the MPCA to gauge the relationship between stack emissions (as measured by a performance test or a CEMS) and the sulfur content of the raw materials and demonstrate that that operating conditions remain representative of those observed during testing. It will also allow for the assessment of the variability of the sulfur content of the materials entering the furnace.

ATTACHMENT

Draft SO_2 permit conditions for a taconite facility subject to BART while burning natural gas

What to do	Why do it
BART LIMIT	hdr
Sulfur dioxide: less than or equal to <ABCD> pounds per long ton taconite pellets while burning natural gas only.	Title I Condition: 40 CFR 51.308 & Minn. R. 7007.5000; Minn. R. 7007.0800, subp. 2
PERFORMANCE TESTING REQUIREMENTS	hdr
Conduct of performance tests. Performance tests shall be conducted under such conditions as the Commissioner specifies based on representative performance of the affected source.	Minn. R. 7007.0800, subp. 4
Initial BART SO2 performance test. During calendar year 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions.	Minn. R. 7007.0800, subp. 4
Annual BART SO2 performance tests. Each calendar year after 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions. The performance test shall be conducted between 10 months and 14 months after the previous BART SO2 performance test. If, after at least three successive annual tests, the emission rate measured by each performance testing is less than 90 percent of the stated BART limit, the Permittee may request through a permit amendment that the testing frequency follow the MPCA's stack testing frequency policy.	Minn. R. 7007.0800, subp. 4
MONITORING REQUIREMENTS	hdr
Raw Material Sulfur Concentration Monitoring: Once per week, the Permittee shall measure and record the sulfur concentration of the filter cake used to form the greenballs fed to the pelletizing furnace.	Minn. R. 7007.0800, subp. 4
POLLUTION CONTROL EQUIPMENT MONITORING REQUIREMENTS	hdr
The Permittee may request a permit amendment to install and operate a continuous emission monitoring system (CEMS) to directly measure SO2 emissions (for BART purposes) instead of complying with the monitoring requirements for the surrogate parameters (pressure drop across the wet scrubbers, liquid flow rate, and pH) listed below.	Minn. R. 7007.0800, subp. 4
The Permittee shall monitor scrubber performance for sulfur dioxide control by complying with the Taconite MACT monitoring for pressure drop across the wet scrubber and liquid flow rate.	Minn. R. 7007.0800, subp. 4
The Permittee shall also monitor the pH of the water exiting the scrubber. The Permittee shall <monitor pH continuously> <collect pH data at all required intervals> when a BART-affected source is operating except for monitoring malfunctions, associated repairs, and required quality assurance or control activities (including as applicable, calibration checks and required zero and span adjustments). The Permittee shall not use data recorded during monitoring malfunctions, associated repairs, and required quality assurance or control activities in data averages and calculations used to report emission or operating levels, or to fulfill a minimum data availability requirement. The Permittee shall use all the data collected during all other periods in assessing compliance. (A monitoring malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring failures that are caused in part by poor maintenance or careless operation are not considered malfunctions.)	Minn. R. 7007.0800, subp. 4

What to do	Why do it
Measure the pH of the scrubber water at least <TBD> with a pH meter. The frequency of measurement may be modified through a permit amendment that includes a demonstration that the pH is stable over a longer period of time.	Minn. R. 7007.0800, subp. 4
Establish site-specific pH operating limits according to the procedures in paragraphs (1) and (2). (1) Measure and record the pH every 15 minutes during each run of the sulfur dioxide performance test. (2) Calculate and record the pH for each individual test run. Operating limits are established as the lowest pH corresponding to any of the three test runs. (The runs must demonstrate compliance with the emission limit.)	Minn. R. 7007.0800, subp. 4
The Permittee may change the pH operating limits for the air pollution control device as long as the requirements in paragraphs (1) through (3), below, are met. (1) Submit a written notification to the Commissioner of the request to conduct a new performance test to revise the operating limit. (2) Conduct a performance test to demonstrate compliance with the applicable sulfur dioxide emission limitation. (3) Establish revised operating limits according to the applicable procedures to establish site-specific operating limits, above.	Minn. R. 7007.0800, subp. 4
RECORDKEEPING	hdr
The Permittee shall maintain electronic files of all information required by this part in a form suitable and readily available for expeditious inspection and review. The files should be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. Only the most recent two years of information must be kept on site.	Minn. R. 7007.0800, subp. 5
REPORTING	hdr
Deviations. The Permittee must report each instance in which an emission limitation was not met. This includes periods of startup, shutdown, and malfunction.	Minn. R. 7007.0800, subp. 5

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : March 4, 2009

TO : AQD File No. 541
(Delta ID No. 13700061)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Nitrogen Oxides BART Determination for Hibbing Taconite Company (HibTac)

Note: Separate SO_2 and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
P.O. Box 589 Hibbing, MN 55746	Highway 5 North, Fire Number 4590 Hibbing, MN 55746, St. Louis County
Contact: Ms. Andrea J. Hayden; Phone: (218) 262-6856	

1.2 Description of the Facility

Hibbing Taconite Company (HibTac) is a taconite (magnetite) ore mining and beneficiation facility located in Hibbing, Minnesota. HibTac is owned by ArcelorMittal, Cleveland-Cliffs, and US Steel; Cliffs Mining Company is the managing agent.

The major steps in taconite pellet production include taconite ore mining, crushing, grinding, concentrating, agglomerating, and indurating. The larger sources of air emissions at HibTac are from the mining activities and indurating furnace operations, with lesser amounts from other processing operations and fugitive dust sources, including haul roads and the tailings basin.

The facility was constructed in two phases. Phase I included two Dravo-Lurgi straight grate indurating furnaces. Construction of the phase began in 1974 and operation began in 1976. A third Dravo-Lurgi straight grate indurating furnace was added in Phase II. Construction of Phase II began in 1976, with operation beginning in 1979.

The three pellet indurating furnaces are functionally equivalent. The average production of the three furnaces is roughly equivalent. While the facility is capable of producing 9 million dry long tons (dlt) annually, it reached its maximum in 1988 when it produced in excess of 8.6 million dlt. HibTac's pelletizing furnaces are currently controlled by wet scrubbers primarily to remove particulate matter.

HibTac started operation in 1976 with the flexibility to use natural gas or fuel oil (all grades). All three furnaces started operation with fuel oil No. 6 (Bunker C) as the primary fuel and were then switched over to natural gas as the primary fuel during 1981. (In the recent past, the facility evaluated other fuels including wood and oat hulls.)

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which the MPCA must determine BART and establish a NO_X BART limit consistent with that determination include:

Emission Unit Name	EU Number[1]	Control Equipment[2] and Stack Numbers
Line 1 Pelletizing Furnace	EU020	SV021, SV022, SV023, SV024
Line 2 Pelletizing Furnace	EU021	SV025, SV026, SV027, SV028
Line 3 Pelletizing Furnace	EU022	SV029, SV030, SV031, SV032

Each of these units (i.e., the pelletizing furnaces) is a member of GP003. Other than units that qualify as insignificant activities, the three pellet furnaces are the only emission units NO_X at HibTac. A full BART analysis for NO_X was conducted for the three pelletizing furnaces.

2.3 The BART Analysis

Hibbing Taconite Company's BART Analysis and Selection Process

HibTac submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-hibbingtaconite.pdf.

Evaluation of Impacts

HibTac modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of HibTac's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	1.634	73
2003	1.638	64
2004	1.604	52
Combined (2002-2004)	1.609	189

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[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

[2] HibTac's control equipment for its indurating furnaces (wet scrubbers) does not reduce emissions of Nitrogen Oxides.

3 The facility used the CALPUFF Modeling System required by the MPCA's *BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota*, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

[4] The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the Hibbing Taconite Company.

Identification of Available Retrofit Control Technologies

HibTac identified the following NO_X retrofit control technologies as available and applicable to pellet furnaces:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction with Reheat

Elimination of Technically Infeasible Options

HibTac eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Low-NO_X Burners are not feasible since they are only feasible in pre-heat zone and HibTac does not use burners in the pre-heat zone. (Low NO_X burners in the indurating section of the furnace would adversely affect pellet quality due to reduced flame temperature.) HibTac eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category. HibTac noted in their Analysis that the facility has already implemented several energy efficiency projects[5] and that it will continue to evaluate and implement energy efficiency projects. Ported Kilns were eliminated by HibTac because they are applicable only to grate kiln furnaces not to the straight grate indurating furnaces that HibTac employs. HibTac eliminated Alternative Fuels because the environmental and economic benefits of such a change are uncertain and HibTac believes that this option is not mandated by U.S. EPA. Also, HibTac's permit currently limits its fuels to natural gas, fuel oil, and used oil.

Selective Catalytic Reduction with conventional Reheat was the only technology considered by HibTac to be technically feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

The following table illustrates the NO_X emission reductions projected by HibTac with SCR.

Projected Annual NO_X Emission Reductions (tons per year)

NO_X Control Technology	Assumed Control Efficiency	Line 1	Line 2	Line 3
None (Baseline)[6]	--	2,497.7	2,143.5	2,247.1
Selective Catalytic Reduction	80%	2,082.6	1,799.1	1,832.0

[5] HibTac altered the airflow to the two combustion chamber upper air inlet ducts on each furnace to allow for more efficient combustion by achieving more uniform air flow and eliminating the need to heat the atomizing air. Line 1, 2, and 3 modifications were completed in February 2006, June 2006, and fall 2005, respectively, resulting in a reduction of 12-20% in natural gas usage by each line.

[6] The baseline emission levels are those provided by HibTac in its BART analysis.

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

HibTac's estimates of the annualized pollution control cost of installing and operating the SCR are shown in the table below.

Pellet Furnace Projected NO_X Control Cost (cost per ton of pollutant removed)

NO_X Control Technology	Line 1	Line 2	Line 3
SCR w/ reheat	$20,478	$22,357	$22,208

Hibbing Taconite Company's BART Selection

In their BART submittal, HibTac indicated that traditional add-on controls would not be cost-effective and proposed BART as the energy efficiency projects recently implemented. BART limits would be established following stack testing. HibTac did not propose a specific schedule for BART implementation but stated it would be with the 5 year time frame required.

MPCA Review of Hibbing Taconite Company's BART Analysis

The MPCA reviewed the BART analysis provided by HibTac and agrees with the selection of the technologies considered for the analysis as well as HibTac's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation Burners, Low-NO_X Burners, Ported Kilns and Alternative Fuels further in the report.[7] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage HibTac to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation in the BART Analysis of Energy Efficiency Projects is not feasible as HibTac does not identify a specific Energy Efficiency Project as a BART technology. The control efficiencies proposed for SCR with reheat appears to be reasonable.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in HibTac's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART.

The MPCA agrees with HibTac's proposal of the furnace energy efficiency projects made in 2005 and 2006 as BART. In addition, the MPCA has also determined that BART is good combustion practices for the three pellet lines. However, the MPCA believes that neither HibTac nor the MPCA has sufficient operating parameter data or emissions data to be able to assess whether current combustion practices constitute "good" combustion practices nor does sufficient emissions data exist to establish a NO_X BART limit.

Prior to the submittal of HibTac's BART report, the MPCA encouraged the taconite facilities to consider the installation of NO_X CEMS and the concurrent monitoring of operations as a control strategy. HibTac's BART submittal responds, stating that "[p]rocess optimization for NO_X reduction on an induration furnace is not a proven technology and is not commercially available

[7] Although the MPCA agrees with HibTac that these emission reduction methods are not technically feasible, it does not agree with all aspects of HibTac's rationale.

as a control technology." Still, HibTac notes that the approach has been used in the electric utility industry to fine tune NO_X emissions from boilers.

From its experience with electric utilities, refineries, and other facilities, the MPCA notes that strategies to use CEMS to reduce NO_X have been successful. The MPCA believes that monitoring NO_X emissions with CEMS or other parametric monitoring at pelletizing furnaces will identify operating conditions under which NO_X emissions can be reduced. The MPCA also notes that NO_X reductions have occurred at another taconite facility after installing CEMS. While those reductions cannot be directly tied to operational changes identified with the aid of CEMS, this observation strongly suggests that using CEMS at pelletizing furnaces will help reduce NO_X through the feedback to the operator and plant management that a CEMS or predictive emission monitoring system provides. Operators can fine tune the operation since it responds to a number of variables under their control and the results of these adjustments can be seen with a CEMS. Plant management can analyze temporal differences in individual furnace operations and differences in emissions among similar furnaces to gain understanding of the factors that influence NO_X formation and apply that knowledge to lower emissions.

The MPCA has determined that continuous emission monitors or a comparable alternative emission measurement method combined with hourly process data can provide data that would be necessary in setting BART NO_X limits based on BART as good combustion practices and the past implementation of furnace energy efficiency projects.

2.4 MPCA Determination of the BART Limit

Due to the lack of sufficient emissions data representing the range of operating conditions that influence emissions[8], the MPCA is unable at this time to set an emission limit that corresponds to BART for HibTac's three pellet furnaces. In addition, HibTac recently made furnace modifications to the three lines, making previous emissions information no longer representative. It is difficult to quantify the amount of NO_X reductions on an ongoing basis from these furnace modifications from each furnace due to differences in the physical and operating characteristics of each furnace.[9]

[8] HibTac is not subject to any performance standards that regulate NO_X and does not have a NO_X limit in its current permit 13700061-002. In the past, three one-hour stack tests have been performed on each stack about once every five years.

[9] HibTac performed stack tests (three 1-hr runs) on each furnace following the energy-efficiency projects. HibTac tested Line 1 on May 11, 2007; Line 2 on May 2, 2007; and Line 3 on May 7, 2007. Compared to the most recent previous performance test on each furnace, these results indicated NO_X reductions of 44% (Line 1), 18% (Line 2), and 42% (Line 3) in the respective hourly emissions rate.

The following table represents the MPCA's NO_X BART determinations for the pellet furnaces at HibTac.

Pellet Furnace Line	**BART**	**Recommended BART Emission Limit**	**Compliance Schedule**[10]
Lines 1, 2, 3 (EU020, EU021, EU022)	Good combustion practices, Furnace Energy efficiency projects completed in 2005 and 2006	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order signed March 3, 2008 requires submittal of an alternative emission measurement method (comparable to CEMS) by March 31, 2008 for Line 2 and by June 30, 2008 for Lines 1 and 3

The MPCA anticipates that the BART limit(s) will be established and incorporated into HibTac's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

[10] The resulting emissions and operating parameter data from the alternative emission method will be used to establish a BART limit through an amendment to HibTac's Title V permit.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 8, 2009

TO : AQD File No. 541
(Delta ID No. 13700061)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Sulfur Dioxide BART Determination for Hibbing Taconite Company

Note: Separate NO_X and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's SO_2 BART determination based on the technical review performed by MPCA staff. Public notice and comment and EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
P.O. Box 589 Hibbing, MN 55746	Highway 5 North, Fire Number 4590 Hibbing, MN 55746, St. Louis County
Contact: Ms. Andrea J. Hayden; Phone: (218) 262-6856	

1.2 Description of the Facility

Hibbing Taconite Company (HTC), an unincorporated joint venture, is the owner and operator of a taconite (magnetite) ore mining and beneficiation facility located in Hibbing, Minnesota. Cliffs Mining Company is the managing agent.

The major steps in taconite pellet production include taconite ore mining, crushing, grinding, concentrating, agglomerating, and indurating. The larger sources of air emissions at HTC are from the mining activities and indurating furnace operations, with lesser amounts from other processing operations and fugitive dust sources, including haul roads and the tailings basin.

The facility was constructed in two phases. Phase I included two Dravo-Lurgi straight grate indurating furnaces. Construction of the phase began in 1974 and operation began in 1976. A third Dravo-Lurgi straight grate indurating furnace was added in Phase II. Construction of Phase II began in 1976, with operation beginning in 1979.

The three pellet indurating furnaces are functionally equivalent. The average production of the three furnaces is roughly equivalent. While the facility is capable of producing 9 million dry long tons (dlt) annually, it reached its maximum in 1988 when it produced in excess of 8.6 million dlt.

HTC started operation in 1976 with the flexibility to use natural gas or fuel oil (all grades). All three furnaces started operation with fuel oil No. 6 (Bunker C) as the primary fuel and were then switched over to natural gas as the primary fuel during 1981. (In the recent past, the facility evaluated other fuels including wood and oat hulls.)

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to

BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which this determination of BART Sulfur Dioxide Emission Limit has been completed are:

Emission Unit Name	EU Number[1]	Control Equipment and Stack Numbers
Line 1 Pelletizing Furnace	EU020	CE022/SV021, CE023/SV022, CE024/SV023, CE025/SV024
Line 2 Pelletizing Furnace	EU021	CE027/SV025, CE028/SV026, CE029/SV027, CE030/SV028
Line 3 Pelletizing Furnace	EU022	CE032/SV029, CE033/SV030, CE034/SV031, CE035/SV032

Although the indurating furnaces can burn both natural gas and fuel oil, natural gas is the primary fuel. Since natural gas is low in sulfur, the primary source of sulfur at these furnaces is the iron ore used to form the green balls. Some additional sulfur may be present in additives also used in the green balls.

Each of these units (i.e., the pelletizing furnaces) is a member of GP003.

2.3 The BART Analysis

Hibbing Taconite Company's BART Analysis and Selection Process

HTC submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-hibbingtaconite.pdf

Evaluation of Impacts

HTC modeled its impacts using BART modeling protocol required by the MPCA.[2] The following table shows a summary of HTC's Baseline Visibility Modeling Results.

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[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

[2] The facility used the CALPUFF Modeling System required by the MPCA's BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.

Impacts at the Boundary Waters Canoe Area Wilderness[3]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	1.634	73
2003	1.638	64
2004	1.604	52
Combined (2002-2004)	1.609	189

The sulfur dioxide emissions from HTC's pelletizing furnaces are currently controlled by wet scrubbers installed primarily to remove particulate matter.

Identification of Available Retrofit Control Technologies

HTC identified the following SO_2 retrofit control technologies:

- Wet Walled Electrostatic Precipitator (WWESP)
- Wet Scrubbing (High and Low Efficiency)
- Dry Sorbent Injection (Dry Scrubbing Lime/Limestone Injection)
- Spray Dryer Absorption (SDA)
- Energy Efficiency Projects
- Alternate Fuels
- Coal Processing

Elimination of Technically Infeasible Options

HTC eliminated Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Drying from consideration since they were technically infeasible. With Dry Sorbent Injection and Spray Dryer Absorption, the high moisture content of the exhaust would lead to saturation of the baghouse filter cake and plugging of the filters and the dust collection system. Alternative Fuels were eliminated since HTC is prohibited from burning solids fuels. Coal Drying is technically infeasible since HTC does not burn coal.

In addition, HTC has already implemented Energy Efficiency Projects. The company indicated that the potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no particular project has been envisioned, the company did not evaluate this option any further.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

HTC estimated the control efficiency of WWESPs to be approximately 80 percent. A secondary wet scrubber was estimated to control roughly 60 percent of the SO_2 remaining after the existing scrubber. HTC also expected that modifying the existing wet scrubber would control between 0 and 50 percent of the SO_2 currently emitted. The following tables illustrate the SO_2 emission reductions projected by HTC with the technically feasible control technologies.

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3 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the Hibbing Taconite Company.

Annual SO_2 Emissions (tons per year)

	Line 1	Line 2	Line 3	Total
Baseline SO_2 emissions[4]	202.2	179.5	188.1	569.8

Projected SO_2 Emission Reductions (tons per year)

SO_2 Control Technology	Line 1	Line 2	Line 3	Total
WWESP	161.8	143.6	150.5	455.9
Secondary Wet Scrubber	121.3	121.3	121.3	363.9
Modification of Wet Scrubber	0 – 101.1	0 – 101.1	0 – 101.1	0 – 303.3

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

HTC estimated the annualized pollution control cost of installing and operating WWESPs to be about $37,000 per ton of SO_2 removed. The cost of installing and operating a secondary wet scrubber was estimated to be between $57,000 and $67,000. No cost estimate was provided for modifications to the existing wet scrubber.

Hibbing Taconite Company's BART Selection

In its submittal, HTC indicated that add-on controls would not be cost-effective and that BART was determined to be existing controls. HTC also states that the appropriate BART limits would be 720 lb/day for Line 1; 1912 lb/day for Line 2; and 1032 lb/day for Line 3.

MPCA Review of Hibbing Taconite Company's BART Analysis

The MPCA reviewed the BART analysis provided by HTC and agrees with HTC's assessment of technical infeasibility for Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Processing.[5] The control efficiencies proposed for the remaining technologies appear to be reasonable.

"Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage HTC to implement projects that concurrently reduce energy consumption and sulfur dioxide, it does not identify a specific Energy Efficiency Project as a BART technology.

John Engesser of the Minnesota Department of Natural Resources noted that the concentration of sulfur dioxide in the waste gas entering HTC's scrubber is about 25 ppm while the concentration of the waste gas leaving the scrubber is about 6 ppm. The scrubber water leaving the scrubber still has a pH of 7 and contains 200 ppm bicarbonate alkalinity. This means that the sulfur dioxide scrubbing reaction is gas concentration limited, which also means that sulfur dioxide scrubbing efficiency will not be improved by adding chemicals to increase scrubber water alkalinity. The data also show that the installation of a recirculating lime scrubber will not

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4 The baseline emission levels are those provided by HTC in its BART analysis.

5 Although the MPCA agrees with HTC that these emission reduction methods are not technically feasible, it does not agree with all aspects of HTC's rationale.

improve scrubbing.[6] Based in part on this analysis, the MPCA does not require that the scrubber technology be improved.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in HTC's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART and that the existing PM control (wet scrubber) is the technology that represents BART.

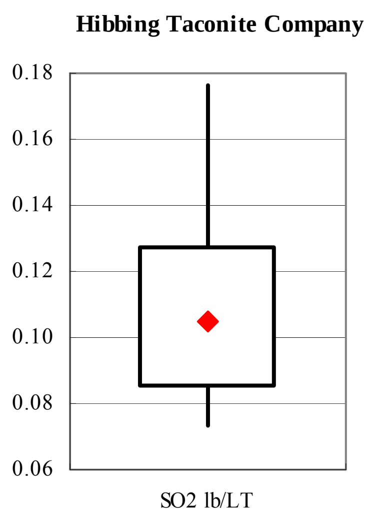
The current SO_2 limit in HTC's permit (4 lb/MMBtu) is not based on the performance of a wet scrubber; the MPCA must establish a BART limit that corresponds to the capabilities of the BART control technology. Also, HTC's proposed limits do not accurately reflect the recently-demonstrated capabilities of the control equipment identified as BART. Therefore, the MPCA developed an alternate approach to establishing BART limits to the one supported by HTC. That analysis is provided below.

2.4 MPCA Determination of the BART Limit

Indurating furnace stack SO_2 emissions [1]

Emissions, lb SO_2/LT pellets
0.073
0.082
0.176
0.087
0.105
0.113
0.141

Box-Whisker Plot ►



Theoretical normal distribution [2]

Upper prediction level:[3]	**0.207**
Upper confidence level:	0.145
(Arithmetic) Mean:	0.111
Lower confidence level:	0.077
Lower prediction level:	0.015

1. The emission data are taken from the seven stack tests in 1994 – 2005 for which, the furnaces fired with natural gas. SO_2 emission determined during the 1994 *residual oil fired* stack test is 0.197 lb/LT pellets.
2. Two-tail t-distribution with $\alpha = 0.05$ is used to calculate the prediction and confidence intervals, which are further described in the text of this write-up.
3. This is the emission limit selected by the MPCA for BART for a HTC indurating furnace.

For each indurating furnace at HTC, the MPCA sets a BART limit at the upper prediction level of 0.207 lb SO_2/long ton of pellets fired (finished).[7] This limit is a 30-day rolling average.

[6] This information is taken from a draft 2007 report entitled "Evaluation of Minnesota Taconite Wet Scrubbers at Minntac, Keewatin Taconite, Hibbing Taconite, and United Taconite," by John Engesser, P.E.

Because backup fuel, usually distillate fuel oil, is not used frequently and its sulfur content is decreasing, a different BART limit for oil-firing is not necessary.

The MPCA plans to issue an Air Emission Permit to Hibbing Taconite Company in 2008 to incorporate sulfur dioxide emission limits under the Best Available Retrofit Technology (BART) program (an element of the Minnesota's State Implementation Plan for Regional Haze).

Permit Conditions

In addition to creating the BART limit on SO_2, the "BART permit amendment" for HTC will add a number of conditions to the permit to ensure that the facility demonstrates compliance with the limit. The suggested permit language (refer to the Attachment) envisions that HTC will conduct annual performance tests (at least initially). Alternatively, HTC may install and operate continuous emission monitoring systems (CEMSs) to demonstrate compliance on a continuous basis.

If performance tests are chosen as the desired method of demonstrating direct compliance with the BART SO_2 limit, HTC will need to monitor certain parameters to show that the wet scrubber is operating as it was when it demonstrated compliance (during the performance test). The key parameters that will be monitored are the pressure drop across the scrubber, the water flow rate, and the pH of the water leaving the scrubber. HTC is already subject to the Taconite MACT (40 CFR 63 Subpart RRRRR), which also requires monitoring of the pressure drop across the scrubber and the water flow rate to assure good particulate control. To avoid duplication of requirements and potential confusion, the MPCA will add a BART citation to those monitoring requirements currently required by the MACT. A separate set of monitoring requirements will be added for pH, since it is now needed to ensure that the scrubber is working correctly to remove SO_2. The MPCA will determine the monitoring frequency for pH based on an analysis of the stability of the pH measurements from records that HTC will provide.

If HTC decides to monitor SO_2 emissions with CEMS, the MPCA may adjust the SO_2 emission limit based on scrubber performance parameters (e.g., pH) and on the data collected from CEMS.

The permit amendment will also require HTC to monitor the concentration of sulfur in the filter cake (comprised of iron ore concentrate and some additives) used to form the green balls fed to the pelletizing furnace. Tracking the sulfur content of this material will allow HTC and the MPCA to gauge the relationship between stack emissions (as measured by a performance test or a CEMS) and the sulfur content of the raw materials and demonstrate that that operating conditions remain representative of those observed during testing. It will also allow for the assessment of the variability of the sulfur content of the materials entering the furnace.

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[7] The upper prediction level is the preferred statistic to be used. As the name suggests, the prediction interval represents the range of values within which – based on the data collected so far and our desired confidence level – the next measurement is expected to fall. In contrast, the confidence interval represents the range of values within which the actual mean of the data set is expected to fall. Because we are interested in identifying a value under which future measurements will fall, the upper predictive level is the appropriate statistic to use in setting the limit.

ATTACHMENT

Draft SO_2 permit conditions for a taconite facility subject to BART while burning natural gas

What to do	Why do it
BART LIMIT	hdr
Sulfur dioxide: less than or equal to <ABCD> pounds per long ton taconite pellets while burning natural gas only.	Title I Condition: 40 CFR 51.308 & Minn. R. 7007.5000; Minn. R. 7007.0800, subp. 2
PERFORMANCE TESTING REQUIREMENTS	hdr
Conduct of performance tests. Performance tests shall be conducted under such conditions as the Commissioner specifies based on representative performance of the affected source.	Minn. R. 7007.0800, subp. 4
Initial BART SO2 performance test. During calendar year 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions.	Minn. R. 7007.0800, subp. 4
Annual BART SO2 performance tests. Each calendar year after 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions. The performance test shall be conducted between 10 months and 14 months after the previous BART SO2 performance test. If, after at least three successive annual tests, the emission rate measured by each performance testing is less than 90 percent of the stated BART limit, the Permittee may request through a permit amendment that the testing frequency follow the MPCA's stack testing frequency policy.	Minn. R. 7007.0800, subp. 4
MONITORING REQUIREMENTS	hdr
Raw Material Sulfur Concentration Monitoring: Once per week, the Permittee shall measure and record the sulfur concentration of the filter cake used to form the greenballs fed to the pelletizing furnace.	Minn. R. 7007.0800, subp. 4
POLLUTION CONTROL EQUIPMENT MONITORING REQUIREMENTS	hdr
The Permittee may request a permit amendment to install and operate a continuous emission monitoring system (CEMS) to directly measure SO2 emissions (for BART purposes) instead of complying with the monitoring requirements for the surrogate parameters (pressure drop across the wet scrubbers, liquid flow rate, and pH) listed below.	Minn. R. 7007.0800, subp. 4
The Permittee shall monitor scrubber performance for sulfur dioxide control by complying with the Taconite MACT monitoring for pressure drop across the wet scrubber and liquid flow rate.	Minn. R. 7007.0800, subp. 4
The Permittee shall also monitor the pH of the water exiting the scrubber. The Permittee shall <monitor pH continuously> <collect pH data at all required intervals> when a BART-affected source is operating except for monitoring malfunctions, associated repairs, and required quality assurance or control activities (including as applicable, calibration checks and required zero and span adjustments). The Permittee shall not use data recorded during monitoring malfunctions, associated repairs, and required quality assurance or control activities in data averages and calculations used to report emission or operating levels, or to fulfill a minimum data availability requirement. The Permittee shall use all the data collected during all other periods in assessing compliance. (A monitoring malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring failures that are caused in part by poor maintenance or careless operation are not considered malfunctions.)	Minn. R. 7007.0800, subp. 4

What to do	Why do it
Measure the pH of the scrubber water at least <TBD> with a pH meter. The frequency of measurement may be modified through a permit amendment that includes a demonstration that the pH is stable over a longer period of time.	Minn. R. 7007.0800, subp. 4
Establish site-specific pH operating limits according to the procedures in paragraphs (1) and (2). (1) Measure and record the pH every 15 minutes during each run of the sulfur dioxide performance test. (2) Calculate and record the pH for each individual test run. The operating limits are established as the lowest pH corresponding to any of the three test runs. (The runs must demonstrate compliance with the emission limit.)	Minn. R. 7007.0800, subp. 4
The Permittee may change the pH operating limits for the air pollution control device as long as the requirements in paragraphs (1) through (3), below, are met. (1) Submit a written notification to the Commissioner of the request to conduct a new performance test to revise the operating limit. (2) Conduct a performance test to demonstrate compliance with the applicable sulfur dioxide emission limitation. (3) Establish revised operating limits according to the applicable procedures to establish site-specific operating limits, above.	Minn. R. 7007.0800, subp. 4
RECORDKEEPING	hdr
The Permittee shall maintain electronic files of all information required by this part in a form suitable and readily available for expeditious inspection and review. The files should be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. Only the most recent two years of information must be kept on site.	Minn. R. 7007.0800, subp. 5
REPORTING	hdr
Deviations. The Permittee must report each instance in which an emission limitation was not met. This includes periods of startup, shutdown, and malfunction.	Minn. R. 7007.0800, subp. 5

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : January 31, 2008

TO : AQD File No. 62B
(Delta ID No. 13700063)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Nitrogen Oxides and Sulfur Dioxide BART Determination for US Steel – Keewatin Taconite's Pelletizing Furnace

Note: A separate BART determination for PM for the subject-to-BART emission units at this facility is contained in another memorandum to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X and SO_2 BART determinations based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
US Steel – Keewatin Taconite P.O. Box 217 Keewatin, Minnesota 55753-0217	1 Mine Road Keewatin, Minnesota 55753 St. Louis County
Contact: Ryan Siats; Phone: (218)778-8684	

1.2 Description of the Facility

US Steel owns and operates a taconite (iron ore) mine and processing plant in Keewatin, Minnesota. Taconite is a rock bearing from 15 to 30 percent magnetic iron particles (magnetite). The iron ore is mined in an open pit, and reduced in size by a series of crushers until it has a powdery consistency. Iron oxide concentrate is separated magnetically, while the remaining portion of the mined ore (tailings) is sent to a tailings disposal basin. Limestone and/or dolomite (fluxstone) is added to the concentrate and the mixture is formed into round "green balls" (pellets) in a balling drum. The green balls are heat hardened in an indurating process (agglomerator or grate-kiln) line, which consists of a traveling grate, a rotary kiln, and a horizontal rotary hearth (commonly called annular cooler). Finished taconite pellets are stored for transport to blast iron furnaces.

At its "Keetac" facility, US Steel operates one grate-kiln furnace (the "Phase II furnace;" EU030) constructed in 1976. The furnace is capable of processing 415 tons of pellets per hour with a heat input of 178.5 MMBtu/hr.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which the MPCA must determine BART and establish a NO_X and SO_2 BART limits consistent with that determination include:

Emission Unit Name	EU Number[1]	Control Equipment[2] and Stack Numbers
Phase II Grate-Kiln Pelletizing Furnace	EU030	CE110, CE111/SV051

The permit for the US Steel – Keetac facility allows the combustion of burn natural gas, distillate fuel oils, coal, and petroleum coke in the pelletizing furnace. Coal and natural gas are the primary fuels; coal is a significant source of sulfur. Another source of sulfur emissions from this furnace is the iron ore used to form the green balls, although this represents a smaller contribution than the sulfur in the solid fuels burned. Sulfur dioxide emissions are currently controlled by wet scrubbers.

2.3 The BART Analysis

Keewatin Taconite's BART Analysis and Selection Process

Keetac submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-keetac.pdf

Evaluation of Impacts

Keetac modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of Keetac's Baseline Visibility Modeling Results.

Impacts at Voyageurs National Park[4]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	1.372	49
2003	1.197	42
2004	1.008	31
Combined (2002-2004)	1.253	120

[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.
[2] Keetac's operates wet scrubbers to control particulate matter on its Phase II Furnace. The wet scrubbers also remove some SO_2 but do not reduce NO_X emissions.
[3] The facility used the CALPUFF Modeling System required by the MPCA's *BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota,* Final March 2006, modified as described in Appendix B of the facility's BART Analysis. http://www.pca.state.mn.us/publications/aq-sip2-05.pdf
[4] Voyageurs National Park is the Class I Area with the greatest impacts from emissions from the US Steel – Keetac facility. Results are shown for the entire facility.

2.3.1 SO_2 BART Analysis for Keewatin Taconite

Identification of Available Retrofit Control Technologies for SO_2

Keetac identified the following SO_2 retrofit control technologies as available and applicable to pellet furnaces:

- Wet Walled Electrostatic Precipitator (WWESP)
- Secondary Wet Scrubber
- Modifications to Existing Wet Scrubber
- Dry Sorbent Injection (Dry Scrubbing Lime/Limestone Injection)
- Spray Dryer Absorption (SDA)
- Energy Efficiency Projects
- Alternate Fuels
- Coal Processing

Elimination of Technically Infeasible Options for SO_2

In considering control options for sulfur dioxide, Keetac eliminated Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Processing from consideration since they were technically infeasible. With Dry Sorbent Injection and Spray Dryer Absorption, the high moisture content of the exhaust would lead to saturation of the baghouse filter cake and plugging of the filters and the dust collection system. The company indicated that the potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no particular project has been envisioned, the company did not evaluate this option any further. Alternative Fuels were eliminated due to the uncertainty of alternative fuel costs, the potential of replacing one visibility pollutant for another, and Keetac's belief that BART does not intend to mandate a fuel switch. Coal Processing requires a source of excess or of low pressure stream to remove water from the washed coal. There is no such heat source at Keetac so this option is technically infeasible.

In addition, Keetac has already implemented a number of Energy Efficiency Projects. The potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no particular project has been envisioned, the company decided not to evaluate this option any further.

Keetac evaluated modifying the existing scrubber to determine whether further SO_2 removal could be achieved. However, Keetac has recently installed new wet scrubbers to control SO_2 emissions. Since operation of the scrubber has been optimized, further improvement of the removal efficiency is not feasible and was not considered further in the report.

Evaluation of the Control Effectiveness of the Remaining Control Technologies for SO_2

Keetac evaluated WWESPs and Secondary Wet Scrubber as the two remaining retrofit technologies it deemed to be available and technically feasible. Keetac estimated the control efficiency of WWESPs to be approximately 80 percent. A secondary wet scrubber was estimated to control roughly 60 percent of the SO_2 remaining after the existing scrubber. The following table illustrates the SO_2 emission reductions projected by Keetac with the technically feasible control technologies.

Projected SO_2 Emission Reductions (tons per year)

SO_2 Control Technology	Phase II Furnace
Baseline emissions (existing scrubber)[5]	850.5
WWESP (after existing scrubber)	760.4
Secondary Wet Scrubber (after existing scrubber)	570.3

Evaluation of the Cost Effectiveness of the Remaining Control Technologies for SO_2

Keetac's estimates of the annualized pollution control cost of installing and operating the WWESP and Secondary Wet Scrubber are shown in the table below.

Pellet Furnace Projected SO_2 Control Cost
($ per ton of pollutant removed)

SO_2 Control Technology	Phase II Furnace
WWESP (after existing scrubber)	$15,165
Secondary Wet Scrubber (after existing scrubber)	$8,870

Keewatin Taconite's BART Selection for SO_2

In its submittal, Keetac proposed new wet scrubbers on its furnace. (These scrubbers began operating in 2005.) Keetac will maintain a minimum SO_2 removal efficiency of 34% (corresponding to a minimum pH of 6.5). Compliance will be demonstrated by continuous monitoring of the scrubber water pH.

MPCA Review of Keewatin Taconite's BART Analysis for SO_2

The MPCA reviewed the BART analysis provided by Keetac and agrees with Keetac's assessment of technical infeasibility for Dry Sorbent Injection, Spray Dryer Absorption, Alternate Fuels, and Coal Processing.[6]

The MPCA believes that the potential fuel reductions and the commensurate emission reductions associated with future Energy Efficiency projects cannot accurately be predicted without details, so it is appropriate not to evaluate this option any further. However, the MPCA will continue to encourage Keetac to implement projects that concurrently reduce energy consumption and sulfur dioxide.

The control efficiencies proposed for WWESP and a Secondary Wet Scrubber appear to be reasonable.

The MPCA examined the cost-effectiveness determination for WWESP. Although there were some discrepancies between the costs provided in Keetac's BART analysis and the costs

[5] The baseline emission levels are those provided by Keetac in its BART analysis.
[6] Although the MPCA agrees with Keewatin Taconite that these emission reduction methods are not technically feasible, it does not agree with all aspects of Keewatin Taconite's rationale.

identified by the MPCA, the differences were not significant enough to change the conclusion that a post-scrubber WWESP or additional wet scrubber would not be BART. This is also supported by a John Engesser of the Minnesota Department of Natural Resources, who reviewed the operation of the recirculating wet scrubber at Keetac. He noted that operation above a pH of 7.5 would cause scaling. He indicated that it appears Keetac is operating at near optimum sulfur dioxide scrubbing conditions.[7] Based in part on this analysis, the MPCA does not require that the scrubber technology be improved.

An SO_2 Continuous Emission Monitoring Systems (CEMS) will be required to gather data to establish the appropriate BART limit. The CEMS will also be used to determine continuous compliance with that limit. Through Administrative Orders by Consent, the MPCA has required other taconite facilities that use solid fuels with a higher sulfur content (coal) to install SO_2 Continuous Emission Monitoring Systems and to monitor parameters that are linked to scrubber performance.

2.3.2 NO_X BART Analysis for Keewatin Taconite

Identification of Available Retrofit Control Technologies for NO_X

Keetac identified the following NO_X retrofit control technologies as available and applicable to pellet furnaces:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction with Reheat

Elimination of Technically Infeasible Options for NO_X

Keetac eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Low-NO_X Burners are not feasible since they are only feasible in pre-heat zone and Keetac does not have a preheat zone. (Low NO_X burners in the indurating section of the furnace would adversely affect pellet quality due to reduced flame temperature.) The company indicated that the potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no particular project has been envisioned, the company did not evaluate this option any further.

Keetac eliminated Alternative Fuels because the furnace already uses solid fuels that result in lower flame temperature and, thus, lower NO_X emissions. Switching to another fuel such as

[7] This information is taken from a draft 2007 report entitled "Evaluation of Minnesota Taconite Wet Scrubbers at Minntac, Keewatin Taconite, Hibbing Taconite, and United Taconite," by John Engesser, P.E.

natural gas (which Keetac already is capable of using[8]) could exchange one visibility impairing pollutant for another (NO_X for SO_2). Keetac also believes that this option is not mandated by U.S. EPA.

Keetac identified Ported Kilns and Selective Catalytic Reduction with conventional Reheat as the only technologies that are technically feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies for NO_X

The following table illustrates the NO_X emission reductions projected by Keetac with SCR.

Projected Annual NO_X Emission Reductions

NO_X Control Technology	Assumed Control Efficiency	Phase II Furnace (tons per year)
None (Baseline)	--	4154.0
Selective Catalytic Reduction with reheat	80%	3323.2
Ported Kiln	5%	207.7

Evaluation of the Cost Effectiveness of the Remaining Control Technologies for NO_X

Keetac's estimates of the annualized pollution control cost of installing and operating SCR and Ported Kilns is shown in the table below.

Pellet Furnace Projected NO_X Control Cost
(cost per ton of pollutant removed)

NO_X Control Technology	Phase II Furnace
Selective Catalytic Reduction (w/ reheat)	$9,514
Ported Kiln	$2,938 – $6,032[9]

Keewatin Taconite's BART Selection for NO_X

In their BART submittal, Keetac eliminated SCR (with reheat) from consideration due to its high costs. Keetac indicated declined to identify the installation and operation of a Ported Kiln as BART since it would only control 5% of the NO_X emissions when the furnace was using natural gas as its fuel; there is no improvement in NO_X emissions when burning solid fuels.

Keetac proposes existing combustion controls and fuel blending as BART, with the installation of continuous emission monitoring systems (CEMS) to monitor NO_X emissions. The NO_X limit for the furnace will be based on at least twelve months of monitoring data.

[8] Keewatin Taconite's permit currently allows pulverized coal, petroleum coke, distillate fuel oil, and natural gas as fuels for the furnace.
[9] There is a discrepancy in the submittal from Keewatin Taconite. Chapter 7 ("Select BART") cites a control cost of $6,032, while Appendix A indicates that the cost is $2,938.

MPCA Review of Keewatin Taconite's BART Analysis for NO_X

The MPCA reviewed the BART analysis provided by Keetac and agrees with the selection of the technologies considered for the analysis as well as Keetac's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation Burners, Low-NO_X Burners and Alternative Fuels (for NO_X) further in the report.[10] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage Keetac to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation in the BART Analysis of Energy Efficiency Projects is not feasible as Keetac does not identify a specific Energy Efficiency Project as a BART technology. The control efficiencies proposed for SCR with reheat and for Ported Kilns appears to be reasonable.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in Keetac's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that SCR with reheat is economically infeasible as BART. Porting Keetac's furnace may be cost-effective when Keetac is burning natural gas; however, the MPCA recognizes that Keetac currently combusts coal as its preferred fuel (to reduce costs) and does not identify a Ported Kiln as BART.

The MPCA agrees with Keetac's proposal to install CEMS to monitor NO_X emissions and to set a limit based on those measurements after acquiring twelve months of emission data.

2.4 MPCA Determination of the SO_2 and NO_X BART Limits

The following table represents the MPCA's SO_2 and NO_X BART determinations for Keetac.

Pellet Furnace Line	BART	Recommended BART Emission Limit	Compliance Schedule
Phase II Pelletizing Furnace (EU030)	SO_2: Existing wet scrubber	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order dated Sept. 27, 2007 requires installation of SO_2 CEMS by Nov. 30, 2008
Phase II Pelletizing Furnace (EU030)	NO_X: Good combustion practices and fuel blending	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order dated Sept. 27, 2007 requires installation of NO_X CEMS by Nov. 30, 2008

The MPCA anticipates that the BART limit(s) will be established and incorporated into Keetac's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

[10] Although the MPCA agrees with Keewatin Taconite that these emission reduction methods are not technically feasible, it does not agree with all aspects of Keewatin Taconite's rationale.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : January 31, 2008

TO : AQD File No. 26A
(Delta ID No. 13700005)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Nitrogen Oxides BART Determination for U.S. Steel Corporation – Minnesota Ore Operations (Minntac)

Note: Separate SO_2 and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
U.S. Steel Corp. Minnesota Ore Operations P.O. Box 417 Mountain Iron, MN 55768	Minntac County Highway 102 Mountain Iron; St. Louis County
Contact: Chrissy Bartovich; Phone (218) 749-7364	

1.2 Description of the Facility

U.S. Steel – Minnesota Ore Operations owns and operates a taconite mine and processing facility, known as Minntac, at County Highway 102, on the Mesabi Range north of the City of Mountain Iron, St. Louis County, Minnesota.

Taconite is a rock bearing from 15 to 30 percent magnetic iron particles (magnetite). The iron ore is mined in an open pit, and reduced in size by a series of crushers until it has a powdery consistency. Iron oxide concentrate is separated magnetically, while the remaining portion of the mined ore (tailings) is sent to a tailings disposal basin. Limestone and/or dolomite (fluxstone) is added to the concentrate and the mixture is formed into round "green balls" (pellets) in a balling drum. The green balls are heat hardened in an indurating process (agglomerator or grate-kiln) line, which consists of a traveling grate, a rotary kiln, and a horizontal rotary hearth (commonly called annular cooler). Finished taconite pellets are stored for transport to blast iron furnaces.

Minntac operates five indurating furnaces (Lines 3, 4, 5, 6, and 7). Line 3 (Step I) began operation in 1967; Lines 4 and 5 (Step II) began operation in 1972; and Lines 6 and 7 (Step III) began operation in 1978. This memorandum examines the NO_X BART determinations for all five lines.

Minntac also operates four heating boilers that are subject to a full BART analysis. The facility's two Step I Heating Boilers (#1 and #2) are each rated at 104 MMBtu/hr and the two Step III Heating Boilers (#4 and #5) are rated at 153 MMBtu/hr. Each boiler is capable of burning natural gas and fuel oil.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which the MPCA must determine BART and establish a NO_X BART limit consistent with that determination include:

Emission Unit Name	EU Number[1]	Control Equipment[2] and Stack Numbers
Line 3 Indurating Furnace	EU225	SV103
Line 4 Indurating Furnace	EU261	SV118
Line 5 Indurating Furnace	EU282	SV127
Line 6 Indurating Furnace	EU315	SV144
Line 7 Indurating Furnace	EU334	SV151
Heating Boiler #1	EU001	SV001
Heating Boiler #2	EU002	SV002
Heating Boiler #4	EU010	SV004
Heating Boiler #5	EU011	SV005

The five pellet furnaces are the primary NO_X emission sources at Minntac. Other Minntac combustion sources include process heaters, emergency generators, boilers, air compressors and fire pumps. These non-pellet furnace sources are responsible for only a few percent of total actual NO_X emissions from the facility. In addition to the five pellet furnaces, a full BART analysis was conducted for four of the five utility plant heating boilers (EU001, EU002, EU004, and EU005).

2. 3 The BART Analysis

Minntac's BART Analysis and Selection Process

Minntac submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 8, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-minntac.pdf.

Evaluation of Impacts

Minntac modeled its impacts using BART modeling protocol required by the MPCA.[3]

[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.
[2] Minntac's control equipment for its indurating furnaces (wet scrubbers) does not reduce emissions of Nitrogen Oxides. Minntac's heating boilers are not controlled.
[3] The facility used the CALPUFF Modeling System required by the MPCA's BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.

The following table shows a summary of Minntac's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	5.508	177
2003	7.201	168
2004	5.962	160
Combined (2002-2004)	6.209	505

The nitrogen oxide emissions from Minntac's pellet furnaces do not have add-on pollution controls. Existing controls on the pellet furnaces include wet scrubbers primarily for particulate control.

Minntac performed an analysis of visibility impacts for the non-emergency, non-pellet furnace combustion sources to determine whether a full BART analysis was needed for these sources. The MPCA directed Minntac to consider existing operations for emergency generators and fire pumps as BART. For the remaining sources, Minntac conducted an analysis to determine if visibility impacts were negligible.

If the modeled emission sources (modeled as a group, not individually) resulted in a 98th percentile change in visibility of less than 0.05 deciviews[5] then the MPCA did not request Minntac to conduct a full BART analysis for those units and the existing operations were to be considered BART for those units. Based on the visibility modeling, all non-pellet furnace combustion sources except four of the five utility heating boilers did not need to undergo a full NO_X BART analysis. Table 3-1 of Minntac's BART analysis contains a summary of the emission units at the facility and the actions taken for each in the BART analysis.

[4] The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the US Steel – Minntac facility. The modeling results shown are based on the indurating furnaces burning all natural gas (rather than solid fuels).

[5] Given the large number of low-emitting process units such as small boilers and process heaters at taconite facilities, the MPCA allowed a streamlined BART approach. In this approach, the MPCA considered visibility impact to be negligible if the 98th percentile value of all low-emitting sources modeled together was less than 0.05 deciview (one-tenth of the threshold used to determine whether a source is subject-to-BART). The MPCA did not expect equipment such as emergency generators and fire pumps to be included in the modeling run. If the modeling showed this group of sources to have negligible visibility impact, then the other factors in the BART analysis, e.g. identification of available and applicable controls, cost effectiveness, etc. were not required to be performed as the MPCA does not expect application of controls if no visibility improvement will result from the installation of the controls.

Identification of Available Retrofit Control Technologies

Minntac identified the following NO_X retrofit control technologies as available:

Pellet Furnaces
- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction

Utility Plant Heating Boilers
- External Flue Gas Recirculation
- Low-NO_X Burners (LNB)
- LNB with Overfire Air
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Alternate Fuels
- Low Temperature Oxidation
- Selective Catalytic Reduction
- Regenerative SCR
- Selective Non-Catalytic Reduction

Elimination of Technically Infeasible Options

Pellet Furnaces

Minntac eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Minntac eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category. Minntac noted in their Analysis that the facility has already implemented several energy efficiency projects and that it will continue to evaluate and implement energy efficiency projects. Minntac eliminated Alternative Fuels because the environmental and economic benefits of such a change are uncertain and Minntac believes that this option is not mandated by U.S. EPA. The remaining technologies, considered by Minntac to be technically feasible, include:

1. SCR w/ reheat (All lines)
2. Low NO_X burners + Ported kilns (Lines 4 and 5)
3. Low NO_X burners (Pre-heat zone only for lines 4, 5 and 7 as low NO_X burners in the indurating section of the furnace would adversely affect pellet quality due to reduced flame temperature. Low NO_X burners were installed in the pre-heat zone of Line 6 in 2006. Line 3 does not use burners in the preheat section.)
4. Ported kilns (Lines 3, 4, and 5. Kilns on lines 6 and 7 are already ported.)

Utility Plant Heating Boilers

Minntac eliminated External Flue Gas Recirculation from consideration since it was technically infeasible for the boilers based on Minntac staff judgment that the existing fireboxes for the boilers would be unable to accommodate longer flame length to avoid flame impingement. Minntac eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category, but stated that Minntac will continue to evaluate and implement energy efficiency projects. Minntac eliminated Alternative Fuels because the environmental and economic benefits of such a change are uncertain, the limited fuel options available and the fact that natural gas is the typical fuel burned in the boilers. Minntac stated that they will continue to evaluate and implement alternative fuel usage as feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

The following tables illustrate the assumed control efficiencies and the projected NO_X emission reductions projected by Minntac with the technically feasible control technologies.

Pellet Furnace Projected NO_X Emission Reductions (Tons per year)

NO_X Control Technology	Assumed Control Efficiency	Line 3	Line 4	Line 5	Line 6	Line 7
None (Baseline)[6]	--	1,345	1,812	1,820	1,776	1,928
SCR w/ reheat	80%	1,076	1,450	1,456	1,421	1,542
Low NO_X burners +Ported kilns	15%	na	249	273	na	na
Low NO_X burners	10%	na	181	182	na	193
Ported kilns	5%	67	91	91	na	na

Utility Heating Boiler Projected NO_X Emission Reductions (Tons per year)

NO_X Control Technology	Assumed Control Efficiency	Boilers #1, #2, #4, #5	Total
None (Baseline)	--	13.8 - 14.8	56.7
Low Temperature Oxidation	90%	12.4 – 13.3	51.0
SCR	80%	11.0 – 11.8	45.4
Low NO_X burner / Flue gas recirc	75%	10.4 – 11.1	42.5
Regenerative SCR	70%	9.7 – 10.4	39.7
Low NO_X Burner/ Overfire Air	67%	9.2 – 9.9	38.0
Low NO_X Burner	50%	6.9 – 7.4	28.4
Selective Non-Catalytic Reduction	50%	6.9 – 7.4	28.4

[6] The baseline emission levels are those provided by Minntac in its BART analysis.

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

Minntac's estimates of the annualized pollution control cost of installing and operating the various control technologies are shown in the table below.

Pellet Furnace Projected NO_X Control Cost ($ per ton of pollutant removed)

NO_X Control Technology	Line 3	Line 4	Line 5	Line 6	Line 7
SCR w/ reheat	$18,135	$19,433	$19,347	$18,595	$17,129
Low NO_X burners & Ported kilns	na	$5,844	$5,974	na	na
Low NO_X burners	na	$768	$765	na	$588
Ported kilns	$5,076	$5,209	$5,186	na	na

Utility Heating Boiler Projected NO_X Control Cost

($ per ton of pollutant removed)

NO_X Control Technology	Range of Costs for Boilers #1, 2, 4 and 5
Low Temperature Oxidation	$23,668 – $27,713
SCR	$50,632 – $60,211
Low NO_X burner / Flue gas recirc	$15,558 – $20,299
Regenerative SCR	$22,879 – $30,710
Low NO_X Burner/ Overfire Air	$14,282 – $18,634
Low NO_X Burner	$6,653 – $8,646
Selective Non-Catalytic Reduction	$42,037 – $51,494

Minntac's BART Selection

Pellet Furnaces

In their BART submittal, Minntac indicated that traditional add-on controls would not be cost-effective and proposed BART as the following for each line:

- Line 3: Existing combustion controls and fuel blending. (The pre-heat zone does not use burners so low-NO_X burners are not an option)
- Line 4, Line 5, Line 7: Installation of low-NO_X burners on the pre-heat zone sections, existing controls and fuel blending.
- Line 6: Operation of low-NO_X burners on the pre-heat zone section (installed in April 2006), existing controls, and fuel blending.

Minntac stated that NO_X BART limits will be proposed 12 months after the installation of the low-NO_X burners to allow sufficient time for process and emissions monitoring using NO_X Continous Emission Monitoring Systems (CEMS) under a range of operating conditions. Minntac also proposed that compliance will be demonstrated using the NO_X CEMS and will be based on a 30-day rolling average.

Utility Plant Heating Boilers

Minntac proposed BART as no additional controls, revision of emission limits, or additional NO_X monitoring requirements for the four heating boilers because the cost of the controls evaluated were high and did not result in a significant improvement in the visibility modeling.

Minntac also stated that the actual visibility impact is small due to the relatively small size of the boilers and low hours of operation.

MPCA Review of Minntac's BART Analysis

Pellet Furnaces

The MPCA reviewed the BART analysis provided by Minntac and agrees with the selection of the technologies considered for the analysis as well as Minntac's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation Burners, and Alternative Fuels further in the report.[7] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage Minntac to implement projects that concurrently reduce energy consumption and NO_X, it does not identify a specific Energy Efficiency Project as a BART technology. The control efficiencies proposed for the remaining technologies appear to be reasonable.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in Minntac's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no add-on controls are required for BART.

The MPCA agrees with Minntac's proposal of low NO_X burners in the pre-heat zone and fuel blending as BART for Lines 4, 5, 6 and 7. Low NO_X burners were installed on Line 6 in 2006. Minntac plans to install Low NO_X burners on Line 7 in 2008, with Low NO_X burners to be installed on Line 4 and Line 5 by the end of 2009. The MPCA also agrees with Minntac's assessment that fuel blending, in part, represents BART for Line 3. Rather than Minntac's proposal of "existing combustion controls" as BART, the MPCA believes that "good combustion practices" is a term that better represents the MPCA's NO_X BART determination for all five pellet lines.

Prior to the submittal of Minntac's BART report, the MPCA encouraged the taconite facilities to consider the installation of NO_X CEMS and the concurrent monitoring of operations as a control strategy. Minntac's BART submittal responds, stating that it "has not yet identified specific operating parameters which can be controlled to reduce emissions without sacrificing unit efficiency or produce quality."

From its experience with electric utilities, refineries, and other facilities, the MPCA notes that strategies to use CEMS to reduce NO_X have been successful. The MPCA believes that monitoring NO_X emissions with CEMS or other parametric monitoring at pelletizing furnaces will identify operating conditions under which NO_X emissions can be reduced. The MPCA also notes that NO_X reductions occurred at the US Steel – Minntac facility after installing CEMS. While those reductions cannot be directly tied to operational changes identified with the aid of CEMS, this observation strongly suggests that using CEMS at pelletizing furnaces will help reduce NO_X through the feedback to the operator and plant management that a CEMS or predictive emission monitoring system provides. Operators can fine tune the operation since it

[7] Although the MPCA agrees with Minntac that these emission reduction methods are not technically feasible, it does not agree with all aspects of Minntac's rationale.

responds to a number of variables under their control and the results of these adjustments can be seen with a CEMS. Plant management can analyze temporal differences in individual furnace operations and differences in emissions among similar furnaces to gain understanding of the factors that influence NO_X formation and apply that knowledge to lower emissions.
The MPCA has determined that continuous emission monitors or a comparable alternative emission measurement method combined with hourly process data can provide data that would be necessary in setting BART NO_X limits based on BART as good combustion practices and the past implementation of furnace energy efficiency projects.

The MPCA has determined that continuous emission monitors combined with hourly process data can provide data that would be necessary in setting BART NO_X limits based on BART as good combustion practices, fuel blending and the operation of low-NO_X burners for Lines 4, 5, 6, and 7 and combustion controls and fuel blending for Line 3.

Utility Plant Heating Boilers
The MPCA reviewed the BART analysis provided by Minntac and agrees with the selection of the technologies considered for the utility plant heating boiler analysis as well as Minntac's decision to not evaluate External Flue Gas Recirculation, Energy Efficiency Projects and Alternative Fuels further in the report. The control efficiencies proposed for the remaining technologies appear to be reasonable.

Given the low actual emissions from each boiler (less than 20 tons per year of NO_X), the high cost of add-on controls, and the small visibility impact of these units; the MPCA has determined that BART for the utility heating plant boilers is the existing operations and fuels and compliance with the existing operating permit conditions and limits.

2.4 MPCA Determination of the BART Limit

Pellet Furnaces
Due to the lack of sufficient emissions data representing the range of operating conditions that influence emissions (less than 6 months of CEMS data for each of the lines), the MPCA is unable at this time to set an emission limit that corresponds to BART for Minntac's five pellet furnaces. In addition, Minntac will be installing Low NO_X burners on the pre-heat sections of Lines 4, 5 and 7 in 2008. It is difficult to quantify the amount of NO_X reductions from installing Low NO_X burners on just one section of the furnace due to differences in the physical and operating characteristics of each furnace. Minntac estimated that the Low NO_X burners installed in the preheat zone of Line 6 resulted in a 10 percent reduction in NO_X.

The following table represents the MPCA's NO_X BART determinations for the pellet furnaces at Minntac.

Pellet Furnace Line	**BART**	**Recommended BART Emission Limit**	**Compliance Schedule**[8]
Line 3 (EU225)	Good combustion practices, fuel blending	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order requires installation of NO_X CEMS by Nov. 30, 2008
Line 4 (EU261)	Good combustion practices, fuel blending, Low NO_X Burners in Pre-Heat Zone	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order requires installation of NO_X CEMS by Nov. 30, 2008 Low NO_X Burners to be installed in 2009
Line 5 (EU282)	Good combustion practices, fuel blending, Low NO_X Burners in Pre-Heat Zone	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order requires installation of NO_X CEMS by Nov. 30, 2008 Low NO_X Burners to be installed in 2009
Line 6 (EU315)	Good combustion practices, fuel blending, Low NO_X Burners in Pre-Heat Zone	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order requires installation of NO_X CEMS by Nov. 30, 2008 Low NO_X Burner on Preheat Zone installed April 2006
Line 7 (EU334)	Good combustion practices, fuel blending, Low NO_X Burners in Pre-Heat Zone	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order requires installation of NO_X CEMS by Nov. 30, 2008 Low NO_X Burners to be installed in 2008

The MPCA anticipates that the BART limit(s) will be established and incorporated into Minntac's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

8 The Administrative Order by Consent referred to in this column became effective on September 27, 2007. Minntac currently has NOx CEMS installed on all five lines but has not been required by their permit to operate the CEMS or submit the emissions data to the MPCA. Under the Order agreed to by Minntac, Minntac will provide hourly emissions data as well as operating parameter data in order to establish a BART limit based on good combustion practices that reflects the process modifications and installation of Low NOx burners in the preheat zone sections on Lines 4-7.

Utility Plant Heating Boilers

Minntac's current Title V permit (13700005 – 002) does not include NO_X emission limits for the utility plant heating boilers. Given the low actual emissions from each boiler and the small visibility impact of these units; the MPCA has determined that a NO_X limit for BART purposes does not need to be established. The permit's existing operational requirements, including fuels (natural gas with fuel oil as back-up) and compliance requirements are sufficient.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 8, 2009

TO : AQD File No. 26A
(Delta ID No. 13700005)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : <u>Sulfur Dioxide BART Determination for U.S. Steel Corporation – Minnesota Ore Operations (Minntac)</u>

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
U.S. Steel Corp. Minnesota Ore Operations P.O. Box 417 Mountain Iron, MN 55768	Minntac County Highway 102 Mountain Iron; St. Louis County
Contact: Chrissy Bartovich; Phone (218) 749-7364	

1.2 Description of the Facility

U.S. Steel – Minnesota Ore Operations (Minntac) owns and operates a taconite mine and processing facility, known as Minntac, at County Highway 102, on the Mesabi Range north of the City of Mountain Iron, St. Louis County, Minnesota.

Taconite is a rock bearing from 15 to 30 percent magnetic iron particles (magnetite). The iron ore is mined in an open pit, and reduced in size by a series of crushers until it has a powdery consistency. Iron oxide concentrate is separated magnetically, while the remaining portion of the mined ore (tailings) is sent to a tailings disposal basin. Limestone and/or dolomite (fluxstone) is added to the concentrate and the mixture is formed into round "green balls (pellets)" in a balling drum. The green balls are heat hardened in an indurating process (agglomerator or grate-kiln) line, which consists of a traveling grate, a rotary kiln, and a horizontal rotary hearth (commonly called annular cooler). Finished taconite pellets are stored for transport to blast iron furnaces.

Minntac operates five indurating furnaces (Lines 3, 4, 5, 6, and 7). Line 3 (Step I) began operation in 1967; Lines 4 and 5 (Step II) began operation in 1972; and Lines 6 and 7 (Step III) began operation in 1978. This memorandum examines the SO_2 BART determination for these five lines.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which these BART Sulfur Dioxide Emission Limit determinations have been completed are:

Emission Unit Name	EU Number[1]	Control Equipment and Stack Numbers
Line 3 Indurating Furnace	EU225	CE146/SV103
Line 4 Indurating Furnace	EU261	CE103/SV118
Line 5 Indurating Furnace	EU282	CE113/SV127
Line 6 Indurating Furnace	EU315	CE126/SV144
Line 7 Indurating Furnace	EU334	CE136/SV151

Lines 3, 4, and 5 can burn natural gas, wood, and fuel oil, but natural gas and wood are used most frequently. Since these fuels are low in sulfur, the primary source of sulfur in these furnaces is the iron ore used to form the green balls. Some additional sulfur may be present in additives also used in the green balls. In addition to natural gas, wood and fuel oil, coal is used in Lines 6 and 7.

2.3 The BART Analysis

Minntac's BART Analysis and Selection Process

Minntac submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 8, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-minntac.pdf

Evaluation of Impacts

Minntac modeled its impacts using BART modeling protocol required by the MPCA.[2] The following table shows a summary of Minntac's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[3]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	5.508	177
2003	7.201	168
2004	5.962	160
Combined (2002-2004)	6.209	505

1 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

2 The facility used the CALPUFF Modeling System required by the MPCA's BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.

3 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the US Steel – Minntac facility. The modeling results shown are based on the indurating furnaces burning all natural gas (rather than solid fuels).

The sulfur dioxide emissions from Minntac's pelletizing furnaces are currently controlled by wet scrubbers primarily to remove particulate matter.

Identification of Available Retrofit Control Technologies

Minntac identified the following SO_2 retrofit control technologies:

- Wet Walled Electrostatic Precipitator (WWESP)
- Wet Scrubbing (High and Low Efficiency)
- Dry Sorbent Injection (Dry Scrubbing Lime/Limestone Injection)
- Spray Dryer Absorption (SDA)
- Energy Efficiency Projects
- Alternate Fuels

Elimination of Technically Infeasible Options

Minntac eliminated Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Drying from consideration since they were technically infeasible. With Dry Sorbent Injection and Spray Dryer Absorption, the high moisture content of the exhaust would lead to saturation of the baghouse filter cake and plugging of the filters and the dust collection system. The use of Alternative Fuels requires switching a high-sulfur fuel for a lower-sulfur fuel. However, wood and natural gas are low in sulfur, so a fuel switch is unlikely to create significant reductions in sulfur dioxide emissions. Coal Drying requires a source of excess or of low pressure stream to remove water from the washed coal. There is no such heat source at Minntac so this option is technically infeasible.

In addition, Minntac has already implemented a number of Energy Efficiency Projects. The potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no particular project has been envisioned, the company decided not to evaluate this option any further.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

Minntac estimated the control efficiency of WWESPs to be approximately 80 percent. A secondary wet scrubber was estimated to control roughly 60 percent of the SO_2 remaining after the existing scrubber. The following table illustrates the SO_2 emission reductions projected by Minntac with the technically feasible control technologies.

Projected SO_2 Emission Reductions (tons per year)

SO_2 Control Technology	Line 3	Line 4	Line 5	Line	Line 7	Total
Baseline emissions[4]	329.4	447.5	447.5	544.8	544.8	2313.9
WWESP	263.5	358.0	358.0	435.9	435.9	1851.3
Secondary Wet Scrubber	197.6	268.5	268.5	326.9	326.9	1388.4

4 The baseline emission levels are those provided by Minntac in its BART analysis.

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

Minntac estimated the annualized pollution control cost of installing and operating WWESPs on Lines 3, 4, and 5 to be between $20,000 and $24,000 per ton of SO_2 removed. The cost of installing and operating a secondary wet scrubber on these lines was estimated to be between $14,000 and $16,000 per ton of SO_2 removed. The annualized cost of controlling SO_2 with WWESPs on Lines 6 and 7 was estimated to be roughly $18,000 per ton, compared to a cost of about $12,000 per ton for a secondary wet scrubber.

Minntac's BART Selection

In its submittal, Minntac indicated that add-on controls would not be cost-effective and that BART was determined to be existing controls. Minntac stated that the appropriate BART limit for Line 3 would be based on the results of performance testing. For Lines 4 and 5, Minntac proposed BART SO_2 emission limits of 182 lb/hr for each furnace. At Lines 6 and 7, emission limits of 284 lb SO_2/hr were proposed as BART.

MPCA Review of Minntac's BART Analysis

The MPCA reviewed the BART analysis provided by Minntac and agrees with Minntac's assessment of technical infeasibility for Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels and Coal Drying.[5] The control efficiencies proposed for the remaining technologies appear to be reasonable.

"Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage Minntac to implement projects that concurrently reduce energy consumption and sulfur dioxide, it does not identify a specific Energy Efficiency Project as a BART technology.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in Minntac's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART. However, the MPCA has developed an alternate approach to establishing BART limits than the one supported by Minntac.

2.4 MPCA Determination of the BART Limit

Minntac operates five agglomerator lines (grate-kiln), Lines 3 through 7. Line 3 waste gas stack had its air pollution control equipment upgraded in the summer of 2006. Lines 6 and 7 are now operated with a ported kiln and continue to focus on making fluxed pellets with coal (about 0.4% sulfur on a dry weight basis) providing more than half of the required heat input. Wood (about 0.02% sulfur on a dry weight basis) continues to be supplied to Lines 3, 4, and 5 to be co-fired with natural gas. Line 3 serves as a swing line to respond to product demands.

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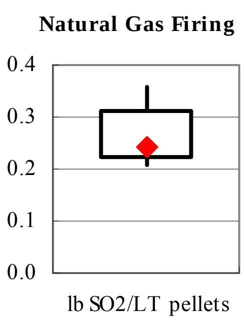
5 Although the MPCA agrees with Minntac that these emission reduction methods are not technically feasible, it does not agree with all aspects of Minntac's rationale.

Based on the data shown below, an SO_2 emission limit is suggested when the kiln is not fired with coal. Minntac has agreed to install SO_2 Continuous Emission Monitoring Systems (CEMS) on the waste gas stacks for Lines 3, 4, and 5; in addition, SO_2 CEMS and the collection of scrubber operating data are being required through an Administrative Order by Consent to provide more accurate emission data and scrubber operating parameter data for determination of a BART limit for only Lines 6 and 7 where a high sulfur fuel (coal) is burned.

Table 7. Stack test results and suggested SO_2 emission limit for non-coal firing at USS Minntac

Test No.	Performance test date	lb SO_2/LT pellets	Furnace and its production process description
1	9/5/2000	0.302	Line 7; pre-ported; gas-fired; fluxed pellet production
2	11/28/2000	0.356	Line 7; pre-ported; gas-fired; fluxed pellet production
3	2/20/2001	0.209	Line 7; pre-ported; gas-fired; fluxed pellet production
4	8/2/2001	0.231	Line 7; ported; gas-fired; fluxed pellet production
5	8/30/2001	0.243	Line 7; ported; gas-fired; fluxed pellet production
6	6/20/2002	0.209	Line 7; ported; gas-fired; no N_2 purge; fluxed pellet production
7	12/26/2006	0.322	Line 3; post-scrubber; gas-fired; fluxed pellet production
8	6/20/2002	0.208	Line 7; ported; gas-fired; N_2 purge; fluxed pellet production
9	4/8/2004	0.154	Line 6; post-ported; coal (57%)+gas fired; fluxed pellet prod.
10	4/6/2004	0.103	Line 4; wood (75%)+gas fired; acid pellet production
11	4/7/2004	0.509	Line 3; pre-scrubber; gas-fired; acid pellet production

Box-Whisker Plot for Test No. 1 – 7



Heat input rate, million BTU/hr

Theoretical normal distribution for Test Nos.1 – 7 at α = 0.05

Upper prediction level: **0.421** lb SO_2/LT pellets;[6]

Upper confidence level: 0.322 lb SO_2/LT pellets;

(Arithmetic) mean: 0.267 lb SO_2/LT pellets;

Lower confidence level: 0.213 lb SO_2/LT pellets;

Lower prediction level: 0.114 lb SO_2/LT pellets.

Other remarks

For Test No. 7, pH value of the scrubbing liquid is not reported. Test Nos. 6 and 8 were actually two sampling trains used at the same test. For Test No. 9, 57% of the heat input was from coal with 0.4% sulfur, but still resulting in a low lb SO_2/LT pellet value. It may be that Line 6 is just different from Line 7. Test Nos. 10 and 11 reflect SO_2 emissions from acid pellet production between wet scrubber control (Line 4) and no control (Line 3); sulfur from wood was on average 0.02% on a dry basis (moisture content at 3.8%).192

[6] The upper prediction level is the preferred statistic to be used. As the name suggests, the prediction interval represents the range of values within which – based on the data collected so far and our desired confidence level – the next measurement is expected to fall. In contrast, the confidence interval represents the range of values within which the actual mean of the data set is expected to fall.

Because we are interested in identifying a value under which future measurements will fall, the upper predictive level is the appropriate statistic to use in setting the limit.

2.5 Conclusion

Based on the analysis above, the MPCA will set a limit equivalent to 0.421 lb SO_2 per long ton of pellets produced for Lines 3, 4, and 5 when burning natural gas or wood.[7] US Steel has requested that the limit be expressed in lbs/hour. The MPCA has agreed and will set the following limits:

Line	SO_2 BART Limit in lbs/hr
3	116 lbs SO_2/hr
4	180 lbs SO_2/hr
5	180 lbs SO_2/hr

These limits are a 30-day rolling average.

The MPCA is requiring the collection of additional data before setting an SO_2 BART limit for the indurating furnaces on Lines 6 and 7.[8]

The MPCA will issue Minntac an Air Emission Permit incorporating sulfur dioxide emission limits under the Best Available Retrofit Technology (BART) program (an element of the Minnesota's State Implementation Plan for Regional Haze). The MPCA plans to incorporate these limits into Minntac's permit for lines 3, 4 and 5 along with the language in the Attachment (or with similar language) in 2008. The MPCA plans to incorporate limits into Minntac's permit for lines 6 and 7 about 2010 after the limits are approved into the Regional Haze SIP.

Permit Conditions

In addition to creating the BART limit on SO_2, the "BART permit amendment" for Minntac will add a number of conditions to the permit to ensure that the facility demonstrates compliance with the limit.

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7 Minntac informed the MPCA that it plans to install SO_2 CEMS on Lines 3, 4, and 5. When the installation and operation of the CEMS has been completed, the MPCA will use data collected from the CEMS to determine appropriate limits for Lines 3, 4, and 5; Minntac will then use the CEMS to demonstrate compliance with those limits.

This possibility is noted in the proposed permit language in the Attachment.

8 The MPCA and Minntac executed an Administrative Order by Consent on September 27, 2007 that requires collection of data for setting the limits on Lines 6 and 7.

ATTACHMENT

Draft SO_2 permit conditions for a taconite facility subject to BART
(while burning natural gas or wood)

What to do	Why do it
BART LIMIT	hdr
Sulfur dioxide: less than or equal to A.BCD pounds per hour while burning natural gas or wood only. <If the Permittee installs and operates a continuous SO2 emission monitor (CEM) on this furnace, the Permittee may apply for a permit amendment to change to the emission limit. Approval of the permit amendment will require the submittal of sufficient data collected by that CEM.>	Title I Condition: 40 CFR 51.308 & Minn. R. 7007.5000; Minn. R. 7007.0800, subp. 2
PERFORMANCE TESTING REQUIREMENTS	hdr
Conduct of performance tests. Performance tests shall be conducted under such conditions as the Commissioner specifies based on representative performance of the affected source.	Minn. R. 7007.0800, subp. 4
Initial BART SO2 performance test. During calendar year 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions.	Minn. R. 7007.0800, subp. 4
<Annual BART SO2 performance tests. Each calendar year after 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions. The performance test shall be conducted between 10 months and 14 months after the previous BART SO2 performance test.> *<If, after at least three successive annual tests, the emission rate measured by each performance testing is less than 90 percent of the stated BART limit, the Permittee may request through a permit amendment that the testing frequency follow the MPCA's stack testing frequency policy.>*	*Minn. R. 7007.0800, subp. 4*
MONITORING REQUIREMENTS	hdr
Raw Material Sulfur Concentration Monitoring: Once per week, the Permittee shall measure and record the sulfur concentration of the filter cake used to form the greenballs fed to the pelletizing furnace.	Minn. R. 7007.0800, subp. 4
POLLUTION CONTROL EQUIPMENT MONITORING REQUIREMENTS	hdr
The Permittee shall monitor scrubber performance for sulfur dioxide control by complying with the Taconite MACT monitoring for pressure drop across the wet scrubber and liquid flow rate.	Minn. R. 7007.0800, subp. 4
The Permittee shall also monitor the pH of the water exiting the scrubber. The Permittee shall <monitor pH continuously> <collect pH data at all required intervals> when a BART-affected source is operating except for monitoring malfunctions, associated repairs, and required quality assurance or control activities (including as applicable, calibration checks and required zero and span adjustments). The Permittee shall not use data recorded during monitoring malfunctions, associated repairs, and required quality assurance or control activities in data averages and calculations used to report emission or operating levels, or to fulfill a minimum data availability requirement. The Permittee shall use all the data collected during all other periods in assessing compliance. (A monitoring malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring failures that are caused in part by poor maintenance or careless operation are not considered malfunctions.)	Minn. R. 7007.0800, subp. 4
Measure the pH of the scrubber water at least <TBD> with a pH meter. The frequency of measurement may be modified through a permit amendment that includes a demonstration that the pH is stable over a longer period of time.	Minn. R. 7007.0800, subp. 4

What to do	Why do it
Establish site-specific pH operating limits according to the procedures in paragraphs (1) and (2). (1) Measure and record the pH every 15 minutes during each run of the sulfur dioxide performance test. (2) Calculate and record the pH for each individual test run. Operating limits are established as the lowest pH corresponding to any of the three test runs. (The runs must demonstrate compliance with the emission limit.)	Minn. R. 7007.0800, subp. 4
The Permittee may change the pH operating limits for the air pollution control device as long as the requirements in paragraphs (1) through (3), below, are met. (1) Submit a written notification to the Commissioner of the request to conduct a new performance test to revise the operating limit. (2) Conduct a performance test to demonstrate compliance with the applicable sulfur dioxide emission limitation. (3) Establish revised operating limits according to the applicable procedures to establish site-specific operating limits, above.	Minn. R. 7007.0800, subp. 4
RECORDKEEPING	hdr
The Permittee shall maintain electronic files of all information required by this part in a form suitable and readily available for expeditious inspection and review. The files should be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. Only the most recent two years of information must be kept on site.	Minn. R. 7007.0800, subp. 5
REPORTING	hdr
Deviations. The Permittee must report each instance in which an emission limitation was not met. This includes periods of startup, shutdown, and malfunction.	Minn. R. 7007.0800, subp. 5

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : March 4, 2009

TO : AQD File No. 27A
(Delta ID No. 07500003)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : <u>Nitrogen Oxides BART Determination for Northshore Mining Company's Taconite Operations</u>

Note: Separate SO_2 and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
Northshore Mining Company 10 Outer Drive Silver Bay, MN 55614	Northshore Mining Company 10 Outer Dr Silver Bay 55614 Lake County
Contact: Scott Gischia; Phone: (218) 226-6076	

1.2 Description of the Facility

Northshore Mining Company's ("Northshore") Silver Bay facility is located on the north shore of Lake Superior. It was the first taconite operation in Minnesota, originally built in the mid-1950s by Reserve Mining Company. Cleveland Cliffs, Incorporated purchased the facility from Cyprus Minerals in 1994; Cleveland Cliffs now owns and operates the facility.

Northshore has four indurating furnaces. Furnaces 11 and 12 began operating in 1963, a few years after Furnaces 5 and 6 started operation. However, Furnace 5 was shut down for several years; in 2006, Northshore received a Prevention of Significant Deterioration permit authorizing the restarting of Furnace 5.

Furnaces 11 and 12 were manufactured by Arthur G. McKee and are Northshore's largest indurating furnaces. They each burn a maximum of 150 MMBtu/hr of natural gas and are capable of processing 300 tons of pellets per hour.

Northshore also operates two process boilers that are subject to BART. Both process boilers were installed in 1965 and are rated at 79 MMBtu/hr. The boilers are capable of burning fuel oil and natural gas.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which the MPCA must determine BART and establish a NO_X BART limit consistent with that determination include:

Emission Unit Name	EU Number[1]	Control Equipment[2] and Stack Numbers
Indurating Furnace #11 – Hood Exhaust	EU100	SV101, SV102, SV103
Indurating Furnace #11 – Waste Gas	EU104	SV104, SV105
Indurating Furnace #12 – Hood Exhaust	EU110	SV111, SV112, SV113
Indurating Furnace #12 – Waste Gas	EU114	SV114, SV115
Process Boiler #1	EU003	SV003
Process Boiler #2	EU004	SV003

2.3 The BART Analysis

Northshore Mining Company's BART Analysis and Selection Process

Northshore submitted its *Analysis of Best Available Retrofit Technology (BART) for Furnaces 11 & 12 Lines and Process Boilers 1 & 2* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-northshore.pdf.

Evaluation of Impacts

Northshore modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of Northshore's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98^{th} Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	1.1	34
2003	1.1	34
2004	1.3	38
Combined (2002-2004)	1.1	106

1 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.
2 Northshore's control equipment for its indurating furnaces (wet-walled electrostatic precipitators) does not reduce emissions of Nitrogen Oxides.
3 The facility used the CALPUFF Modeling System required by the MPCA's BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.
4 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from Northshore's Silver Bay facility.

Identification of Available Retrofit Control Technologies – Furnaces

Northshore identified the following NO_X retrofit control technologies as available and applicable to pellet furnaces:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction with Reheat

Elimination of Technically Infeasible Options – Furnaces

Northshore eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Low-NO_X Burners are feasible only in a pre-heat zone; Northshore's furnace design does not include a separate pre-heat zone, so Low-NO_X Burners are infeasible for Northshore. Northshore eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category. The company has already implemented several energy efficiency projects and it will continue to evaluate and implement energy efficiency projects. Northshore's use of straight grate indurating furnaces makes the use of Ported Kilns infeasible, since they can be used only at grate-kiln furnaces. Northshore eliminated Alternative Fuels because the environmental and economic benefits of such a change are uncertain and Northshore believes that this option is not mandated by U.S. EPA. In addition, Northshore's furnace is currently incapable of handling solid fuels.

Selective Catalytic Reduction with conventional Reheat was the only technology considered by Northshore to be technically feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies – Furnaces

The following table illustrates the NO_X emission reductions projected by Northshore with SCR.

Projected Annual NO_X Emission Reductions (tons per year)

NO_X Control Technology	Assumed Control Efficiency	Furnace 11 Hood Exhaust	Furnace 11 Waste Gas	Furnace 12 Hood Exhaust	Furnace 12 Waste Gas
None (Baseline)[5]	--	112.4	273.7	109.9	267.7
Selective Catalytic Reduction	80%[6]	106.7	255.9	104.4	250.3

5 The baseline emission levels are those provided by Northshore in its BART analysis.
6 The values in this table were taken from Northshore's BART submittal. The removal efficiencies provided here (and in the report) exceed the 80% described in the report's text. This discrepancy does not alter the MPCA's BART determination.

Evaluation of the Cost Effectiveness of the Remaining Control Technologies – Furnaces

Northshore's estimates of the annualized pollution control cost of installing and operating the SCR is shown in the table below.

Pellet Furnace Projected NO_X Control Cost (cost per ton of pollutant removed)

NO_X Control Technology	Furnace 11 Hood Exhaust	Furnace 11 Waste Gas	Furnace 12 Hood Exhaust	Furnace 12 Waste Gas
SCR w/ reheat	$155,784	$46,771	$162,309	$61,107

Northshore Mining Company's BART Selection – Furnaces

In its BART submittal, Northshore indicated that add-on controls would not be cost-effective. It proposed that existing furnace design and permitted fuels to be BART, with a corresponding NO_X limit of 176 lb/hr for each furnace.

Identification of Available Retrofit Control Technologies – Process Boilers

Northshore identified the following NO_X retrofit control technologies as available and applicable to its process boilers:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Overfired Air
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Alternate Fuels
- Non-Selective Catalytic Reduction
- Selective Catalytic Reduction
- Regenerative SCR
- Selective Non-Catalytic Reduction

Elimination of Technically Infeasible Options – Process Boilers

Northshore found External Flue Gas Recirculation to be technically infeasible and eliminated it from further consideration because Northshore's process boilers lack the capability needed to controlled combustion conditions at the boiler tip. Overfired air was eliminated due to the small size of Northshore's process boilers and the number of burners. Northshore eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category. However, it has already implemented energy efficiency projects and it will continue to evaluate and implement energy efficiency projects. Northshore also rejected Alternate Fuels, as the process boilers burn distillate fuel oil and natural gas only; since those fuels have low nitrogen content, even a fuel alternative with no nitrogen content would provide little benefit. Northshore also believes that this option is not mandated by U.S. EPA and its boilers are incapable of handling solid fuels.

Northshore identified Low-NO_X Burners, Induced Flue Gas Recirculation Burners, Selective Catalytic Reduction, and Selective Non-Catalytic Reduction as the only technically feasible alternative from the list above. These technologies were then evaluative for cost-effectiveness.

Evaluation of the Control Effectiveness of the Remaining Control Technologies – Process Boilers

The following table illustrates the NO_X emission reductions projected by Northshore with the technically feasible technologies.

Projected Annual NO_X Emission Reductions (tons per year)

NO_X Control Technology	Assumed Control Efficiency	Process Boilers
None (Baseline)[7]	--	41.2
Selective Catalytic Reduction	90%	37.1
Low-NO_X Burners with Induced Flue Gas Recirculation Burners	75%	30.9
Low-NO_X Burners	50%	20.6
Selective Non-Catalytic Reduction	50%	20.6

Evaluation of the Cost Effectiveness of the Remaining Control Technologies – Furnaces

Northshore's estimates of the annualized pollution control cost of installing and operating the technically feasible technologies are shown in the table below.

Process Boiler - Projected Annualized NO_X Control Cost
(cost per ton of pollutant removed)

NO_X Control Technology	Process Boilers
Selective Catalytic Reduction	$30,160
Low-NO_X Burners with Induced Flue Gas Recirculation Burners	$10,675
Low-NO_X Burners	$723
Selective Non-Catalytic Reduction	$12,126

Northshore Mining Company's BART Selection – Process Boilers

In its submittal, Northshore proposed the existing design and permitted fuels as BART, noting that the control technologies evaluated in the BART analysis (e.g., low-NO_X burners, et al.) would not accomplish a meaningful improvement in visibility. Correspondingly, Northshore proposed a BART limit of 0.17 lb NO_X/MMBtu.

MPCA Review of Northshore Mining Company's BART Analysis

Indurating furnaces

The MPCA reviewed the BART analysis provided by Northshore for its indurating furnaces and agrees with the selection of the technologies considered for the analysis as well as Northshore's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation

7 The baseline emission levels are those provided by Northshore in its BART analysis.

Burners, Low-NO_X Burners, Ported Kilns and Alternative Fuels further in the report.[8] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage Northshore to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation in the BART Analysis of Energy Efficiency Projects is not feasible as Northshore does not identify a specific Energy Efficiency Project as a BART technology. The control efficiencies proposed for SCR with reheat appears to be reasonable.

The MPCA examined the cost-effectiveness determination and agrees with Northshore that add-on controls are not cost-effective. Although there were some discrepancies between the costs provided in Northshore's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART.

The MPCA's determined that BART is good combustion practices for the indurating furances. This determination does not conflict with Northshore's proposal of existing furnace design and permitted fuels, but adds an operating element. However, the MPCA believes that neither Northshore nor the MPCA has sufficient operating parameter data or emissions data to be able to assess whether current combustion practices constitute "good" combustion practices nor does sufficient emissions data exist to establish a NO_X BART limit.

Prior to the submittal of Northshore's BART report, the MPCA encouraged the taconite facilities to consider the installation of NO_X CEMS and the concurrent monitoring of operations as a control strategy. Northshore's BART submittal responds, stating that "[p]rocess optimization for NO_X reduction on an induration furnace is not a proven technology and is not commercially available as a control technology." Still, Northshore notes that the approach has been used in the electric utility industry to fine tune NO_X emissions from boilers.

From its experience with electric utilities, refineries, and other facilities, the MPCA notes that strategies to use CEMS to reduce NO_X have been successful. The MPCA believes that monitoring NO_X emissions with CEMS or other parametric monitoring at pelletizing furnaces will identify operating conditions under which NO_X emissions can be reduced. The MPCA also notes that NO_X reductions have occurred at another taconite facility after installing CEMS. While those reductions cannot be directly tied to operational changes identified with the aid of CEMS, this observation strongly suggests that using CEMS at pelletizing furnaces will help reduce NO_X through the feedback to the operator and plant management that a CEMS or predictive emission monitoring system provides. Operators can fine tune the operation since it responds to a number of variables under their control and the results of these adjustments can be seen with a CEMS. Plant management can analyze temporal differences in individual furnace operations and differences in emissions among similar furnaces to gain understanding of the factors that influence NO_X formation and apply that knowledge to lower emissions.

8 Although the MPCA agrees with Northshore that these emission reduction methods are not technically feasible, it does not agree with all aspects of Northshore's rationale.

The MPCA has determined that continuous emission monitors or a comparable alternative emission measurement method combined with hourly process data can provide data that would be necessary in setting BART NO_X limits based on BART as good combustion practices.

Process Boilers

The MPCA reviewed the BART analysis provided by Northshore for its process boilers and agrees with the selection of the technologies considered for the analysis. The MPCA agrees with the removal of Overfired Air, Energy Efficiency Projects,[9] and Alternate Fuels from the analysis due to technical infeasibility. However, the MPCA does not believe that Northshore provided sufficient information about External Flue Gas Recirculation to demonstrate that the technology is infeasible.

The MPCA agrees that Low-NO_X Burners, Induced Flue Gas Recirculation Burners, Selective Catalytic Reduction, and Selective Non-Catalytic Reduction are technically feasible alternatives and believes that Low-NO_X Burners are a cost-effective option for reducing NO_X. However, the goal of the BART program is to reduce visibility impacts; the effect of removing ~20 tons per year of NO_X from each process boiler will be imperceptible. Because of this, the MPCA agrees with Northshore's conclusion that the existing design and permitted fuels constitute BART and supports the proposed BART limit of 0.17 lb NO_X/MMBtu. This determination is valid despite the lack of information on External Flue Gas Recirculation.

2.4 MPCA Determination of the BART Limit

Due to the lack of sufficient emissions data representing the range of operating conditions that influence emissions,[10] the MPCA is unable at this time to set an emission limit that corresponds to BART for Northshore's pellet furnaces.

9 Although the MPCA will continue to encourage Northshore to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation is not feasible as no specific Energy Efficiency Project has been identified as a potential BART technology.

10 Northshore is not subject to any performance standards that regulate NOx and neither Furnace 11 nor Furnace 12 has a NOx limit in the facility's current permit 07500003-005. Performance tests are relatively infrequent, as two NOx stack tests were performed on Northshore's indurating furnaces in the last decade.

The following table represents the MPCA's NO_X BART determinations for the pellet furnaces at Northshore.

Pellet Furnace Line	**BART**	**Recommended BART Emission Limit**	**Compliance Schedule**[11]
Furnace 11 Hood Exhaust; Furnace 11 Waste Gas Stack; Furnace 12 Hood Exhaust; Furnace 12 Waste Gas Stack (EU100, EU104, EU110, EU114)	Good combustion practices	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order signed April 7, 2008 requires submittal of an alternative emission measurement method (comparable to CEMS) by June 30, 2008
Process Boilers #1 & #2	Existing design and permitted fuels	0.17 lb NO_X/MMBtu	Upon EPA approval of the RH SIP

The MPCA anticipates that the BART limit(s) will be established and incorporated into Northshore's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

11 The resulting emissions and operating parameter data will be used to establish a BART limit through an amendment to Northshore's Title V permit.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 8, 2009

TO : AQD File No. 27A
(Delta ID No. 07500003)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Sulfur Dioxide BART Determination for Northshore Mining Company's Taconite Operations

Note: Separate NO_X and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's SO_2 BART determination based on the technical review performed by MPCA staff. Public notice and comment and EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
Northshore Mining Company 10 Outer Drive Silver Bay, MN 55614	Northshore Mining Company 10 Outer Dr Silver Bay 55614 Lake County
Contact: Scott Gischia; Phone: (218) 226-6076	

1.2 Description of the Facility

Northshore Mining Company's ("Northshore") Silver Bay facility is located on the north shore of Lake Superior. It was the first taconite operation in Minnesota, originally built in the mid-1950s by Reserve Mining Company. Cleveland Cliffs, Incorporated purchased the facility from Cyprus Minerals in 1994.

Northshore's Furnaces 11 and 12 began operating in 1963, a few years after Furnaces 5 and 6 started operation. However, Furnace 5 was shut down for several years; in 2006, Northshore received a Prevention of Significant Deterioration permit authorizing the restarting of Furnace 5.

Furnaces 11 and 12 were manufactured by Arthur G. McKee and are Northshore's largest indurating furnaces. They each burn a maximum of 150 MMBtu/hr of natural gas and are capable of processing 300 tons of pellets per hour.

Northshore also operates two power boilers that are subject to BART. The BART determination for those units is not discussed in this memorandum.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which this determination of BART Sulfur Dioxide Emission Limit has been completed are:

Emission Unit Name	EU Number[1]	Control Equipment and Stack Numbers
Indurating Furnace #11 – Hood Exhaust	EU100	CE101/SV101, CE102/SV102, CE103/SV103
Indurating Furnace #11 – Waste Gas	EU104	CE104/SV104, CE105/SV105
Indurating Furnace #12 – Hood Exhaust	EU110	CE111/SV111, CE112/SV112, CE113/SV113
Indurating Furnace #12 – Waste Gas	EU114	CE114/SV114, CE115/SV115

Although the indurating furnaces can burn both natural gas and fuel oil, natural gas is the primary fuel. Since natural gas is low in sulfur, the primary source of sulfur at these furnaces is the iron ore used to form the green balls. Some additional sulfur may be present in additives also used in the green balls.

2.3 The BART Analysis

Northshore Mining Company's BART Analysis and Selection Process

Northshore submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-northshore.pdf.

Evaluation of Impacts

Northshore modeled its impacts using BART modeling protocol required by the MPCA.[2] The following table shows a summary of Northshore's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[3]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	1.1	34
2003	1.1	34
2004	1.3	38
Combined (2002-2004)	1.1	106

1 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

2 The facility used the CALPUFF Modeling System required by the MPCA's *BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota,* Final March 2006, modified as described in Appendix B of the facility's BART Analysis. See http://www.pca.state.mn.us/publications/aq-sip2-05.pdf.

3 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from Northshore's Silver Bay facility.

The sulfur dioxide emissions from Northshore's pelletizing furnaces are currently controlled by wet-walled electrostatic precipitators installed primarily to remove particulate matter.

Identification of Available Retrofit Control Technologies

Northshore identified the following SO_2 retrofit control technologies:

- Wet Walled Electrostatic Precipitator (WWESP)
- Wet Scrubbing (High and Low Efficiency)
- Dry Sorbent Injection (Dry Scrubbing Lime/Limestone Injection)
- Spray Dryer Absorption (SDA)
- Energy Efficiency Projects
- Alternate Fuels
- Coal Processing

Elimination of Technically Infeasible Options

Northshore eliminated Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Processing from consideration since they were technically infeasible. With Dry Sorbent Injection and Spray Dryer Absorption, the high moisture content of the exhaust would lead to saturation of the baghouse filter cake and plugging of the filters and the dust collection system. Alternative Fuels were eliminated since Northshore is already fueled by a low-sulfur fuel (natural gas); substitution of a different low-sulfur fuel would provide little, if any, benefit.

The company indicated that the potential fuel reductions and the commensurate emission reductions for future Energy Efficiency Projects cannot accurately be predicted without specific details; since no particular project has been envisioned, the company did not evaluate this option any further. Finally, Coal Processing is not a technically feasible option, since Northshore does not burn coal in Furnaces 11 and 12.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

The available, technically feasible retrofit technologies remaining to be examined are secondary WWESPs and Secondary Wet Scrubbers. Northshore estimated the control efficiency of a secondary WWESP to be approximately 80 percent. A secondary wet scrubber was estimated to control roughly 60 percent of the SO_2 remaining after the existing scrubber. The following tables illustrate the SO_2 emission reductions projected by Northshore with the technically feasible control technologies.

Annual SO_2 Emissions (tons per year)

	F11 - HE[4]	**F11 - WG**	**F12 - HE**	**F12 - WG**	**Total**
Baseline SO_2 emissions[5]	28.6	9.5	26.3	8.8	73.2

4 F11 is Furnace 11; F12 is Furnace 12. HE refers to a hood exhaust stack; WG identifies a waste gas stack.

5 The baseline emission levels are those provided by Northshore in its BART analysis.

Projected SO_2 Emission Reductions (tons per year)

SO_2 Control Technology	F11 - HE	F11 - WG	F12 - HE	F12 - WG	Total
Secondary WWESP	22.9	7.6	21.0	7.0	58.5
Secondary Wet Scrubber	17.2	6.7	15.8	5.3	45.0

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

Northshore estimated that the annualized pollution control cost of installing and operating secondary WWESPs ranged from roughly $180,000 to $540,000 per ton of SO_2 removed. The cost of installing and operating a secondary wet scrubber ranged from about $140,000 to around $420,000.

Northshore Mining Company's BART Selection

In its submittal, Northshore indicated that add-on controls would not be cost-effective and that BART was determined to be existing controls. Northshore also states that the appropriate BART limits would be 2.0 lb/MMBtu for its Indurating Furnace. This is equivalent to 300 lb/hr for each furnace based on a heat input rating of 150 MMBtu/hr.

MPCA Review of Northshore Mining Company's BART Analysis

The MPCA reviewed the BART analysis provided by Northshore and agrees with the selection of the technologies considered for the analysis as well as Northshore's assessment of technical infeasibility for Dry Sorbent Injection, Spray Dryer Absorption, Alternative Fuels, and Coal Processing.[6] The control efficiencies proposed for the remaining technologies appear to be reasonable.

"Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage Northshore to implement projects that concurrently reduce energy consumption and sulfur dioxide, it does not identify a specific Energy Efficiency Project as a BART technology.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in Northshore's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART and that the existing PM control (wet-walled electrostatic precipitors) is the technology that represents BART.

The current SO_2 limit in Northshore's permit (and the limit proposed by Northshore) is 2.0 lb/MMBtu. This limit is not based on the performance of a wet-walled electrostatic precipitator; the MPCA must establish a BART limit that corresponds to the capabilities of the BART control technology. Therefore, the MPCA developed an alternate approach to establishing BART limits to the one supported by Northshore. That analysis is provided below.

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6 Although the MPCA agrees with Northshore that these emission reduction methods are not technically feasible, it does not agree with all aspects of Northshore's rationale.

2.4 MPCA Determination of the BART Limit

Northshore uses straight grate furnaces. In May 1994, both waste gas stacks at Furnace 11 were tested for SO_2 emissions, and one hood exhaust stack and one waste gas stack at Furnace 12 were also tested for SO_2. In January 1995, one waste gas stack at Furnace 12 was again tested for SO_2. For these furnaces, a hood exhaust common header is connected to three (3) stacks to release gas collected from the furnace zones for green ball drying and finished pellet cooling; a waste gas common header is connected to two (2) stacks to release gas collected from the furnace combustion zones.

Results from the performance tests were analyzed to develop a SO_2 emission limit for Northshore, as shown step by step in the following table.

SO_2 Emission Limit*

1. Furnace 12: May 1994	Hood exhaust stacks	Waste gas stacks	Whole furnace
lb SO_2/hr	6.17	1.69	7.85
lb SO_2/LT pellets	0.0255	0.0070	0.0325
2. Furnace 11: May 1994	Stack 1104	Stack 1105	Waste gas stacks
lb SO_2/hr	1.16	2.43	3.58
lb SO_2/LT pellets	0.0056	0.0119	0.0175
3. F 12 Stack 1205: 1/95	Waste gas stacks	**4**. Waste gas stacks from the 3 tests	
lb SO_2/hr	1.53	lb SO_2/hr	lb SO_2/LT pellets
lb SO_2/LT pellets	0.0057	1.53	0.0057
5. With limited hood exhaust data, we can do:		1.69	0.0070
0.0255 × 1.73 = 0.0441;	Where 1.73 serves as	<u>3.58</u>	<u>0.0175</u>
a compliance margin.	UCL 1-tail,† 95% ►	4.19	0.0210
6. Furnace 11 or 12	Hood exhaust stacks	Waste gas stacks	Limit on Furnace
lb SO_2/LT pellets	0.0441	0.0210	0.0651

* As described in the text above this table, 1 hood exhaust stack and 1 waste gas stack were tested to give estimates for the 3 hood exhaust stacks and 2 waste gas stacks in Step **1** in this table. Both waste gas stacks were tested, but none of the hood exhaust stacks were, as reflected in Step **2**. One waste gas stack was tested in January 1995. The multiplier, 1.73, in Step **5** is so chosen as to make the resultant suggested limit to double the whole furnace value of 0.0325 lb SO_2/LT pellets to accommodate the natural variation of sulfur in taconite concentrate (for comparison, the ratio of suggested limit to the mean value for Hibbing Taconite is 1.86). To further validate the Furnace 12 value of 0.0325 lb SO_2/LT pellets in Step **1**, we derived the value of 0.0297 lb SO_2/LT pellets for Furnace 6 (an older furnace that is not required to implement BART) from one of the three stacks in a performance test conducted on October 10, 1995.

† =average(d21:d23)+tinv(0.1,rows(d21:d23)-1)*stdev(d21:d23)/sqrt(rows(d21:d23)) where cells d21:d23 hold the values of 1.53; 1.69; and 3.58. Note that 4.19 > 3.58.

For the indurating furnaces at Northshore Mining Company, the MPCA sets a BART limit of 0.0651 lb SO_2 per long ton of pellets fired (finished) that applies only when the company is burning natural gas. This limit is a 30-day rolling average. The limit will be incorporated into the requirements for Northshore Mining Company through an Air Emission Permit Amendment that the MPCA intends to issue in the near future.

Permit Conditions

In addition to creating the BART limit on SO_2, the "BART permit amendment" for Northshore will add a number of conditions to the permit to ensure that the facility demonstrates compliance with the limit. The suggested permit language (refer to the Attachment) envisions that Northshore will conduct annual performance tests (at least initially). Alternatively, Northshore may install and operate continuous emission monitoring systems (CEMSs) to demonstrate compliance on a continuous basis.

If performance tests are chosen as the desired method of demonstrating direct compliance with the BART SO_2 limit, Northshore will need to monitor certain parameters to show that the wet scrubber is operating as it was when it demonstrated compliance (during the performance test). The key parameters that will be monitored are the pressure drop across the scrubber, the water flow rate, and the pH of the water leaving the scrubber. Northshore is already subject to the Taconite MACT (40 CFR 63 Subpart RRRRR), which also requires monitoring of the pressure drop across the scrubber and the water flow rate to assure good particulate control. To avoid duplication of requirements and potential confusion, the MPCA will add a BART citation to those monitoring requirements currently required by the MACT. A separate set of monitoring requirements will be added for pH, since it is now needed to ensure that the scrubber is working correctly to remove SO_2. The MPCA will determine the monitoring frequency for pH based on an analysis of the stability of the pH measurements from records that Northshore will provide. If Northshore decides to monitor SO_2 emissions with CEMS, the MPCA may adjust the SO_2 emission limit based on scrubber performance parameters (e.g., pH) and on the data collected from CEMS.

The permit amendment will also require Northshore to monitor the concentration of sulfur in the filter cake (comprised of iron ore concentrate and some additives) used to form the green balls fed to the pelletizing furnace. Tracking the sulfur content of this material will allow Northshore and the MPCA to gauge the relationship between stack emissions (as measured by a performance test or a CEMS) and the sulfur content of the raw materials and demonstrate that that operating conditions remain representative of those observed during testing. It will also allow for the assessment of the variability of the sulfur content of the materials entering the furnace.

ATTACHMENT

Draft SO_2 permit conditions for a taconite facility subject to BART while burning natural gas

What to do	Why do it
BART LIMIT	hdr
Sulfur dioxide: less than or equal to <ABCD> pounds per long ton taconite pellets while burning natural gas only.	Title I Condition: 40 CFR 51.308 & Minn. R. 7007.5000; Minn. R. 7007.0800, subp. 2
PERFORMANCE TESTING REQUIREMENTS	hdr
Conduct of performance tests. Performance tests shall be conducted under such conditions as the Commissioner specifies based on representative performance of the affected source.	Minn. R. 7007.0800, subp. 4
Initial BART SO2 performance test. During calendar year 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions.	Minn. R. 7007.0800, subp. 4
Annual BART SO2 performance tests. Each calendar year after 2010, the Permittee shall conduct a performance test to demonstrate compliance with the BART limit for SO2 emissions. The performance test shall be conducted between 10 months and 14 months after the previous BART SO2 performance test. If, after at least three successive annual tests, the emission rate measured by each performance testing is less than 90 percent of the stated BART limit, the Permittee may request through a permit amendment that the testing frequency follow the MPCA's stack testing frequency policy.	Minn. R. 7007.0800, subp. 4
MONITORING REQUIREMENTS	hdr
Raw Material Sulfur Concentration Monitoring: Once per week, the Permittee shall measure and record the sulfur concentration of the filter cake used to form the greenballs fed to the pelletizing furnace.	Minn. R. 7007.0800, subp. 4
POLLUTION CONTROL EQUIPMENT MONITORING REQUIREMENTS	hdr
The Permittee may request a permit amendment to install and operate a continuous emission monitoring system (CEMS) to directly measure SO2 emissions (for BART purposes) instead of complying with the monitoring requirements for the surrogate parameters (pressure drop across the wet scrubbers, liquid flow rate, and pH) listed below.	Minn. R. 7007.0800, subp. 4
The Permittee shall monitor scrubber performance for sulfur dioxide control by complying with the Taconite MACT monitoring for pressure drop across the wet scrubber and liquid flow rate.	Minn. R. 7007.0800, subp. 4
The Permittee shall also monitor the pH of the water exiting the scrubber. The Permittee shall <monitor pH continuously> <collect pH data at all required intervals> when a BART-affected source is operating except for monitoring malfunctions, associated repairs, and required quality assurance or control activities (including as applicable, calibration checks and required zero and span adjustments). The Permittee shall not use data recorded during monitoring malfunctions, associated repairs, and required quality assurance or control activities in data averages and calculations used to report emission or operating levels, or to fulfill a minimum data availability requirement. The Permittee shall use all the data collected during all other periods in assessing compliance. (A monitoring malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring failures that are caused in part by poor maintenance or careless operation are not considered malfunctions.)	Minn. R. 7007.0800, subp. 4

What to do	Why do it
Measure the pH of the scrubber water at least <TBD> with a pH meter. The frequency of measurement may be modified through a permit amendment that includes a demonstration that the pH is stable over a longer period of time.	Minn. R. 7007.0800, subp. 4
Establish site-specific pH operating limits according to the procedures in paragraphs (1) and (2). (1) Measure and record the pH every 15 minutes during each run of the sulfur dioxide performance test. (2) Calculate and record the pH for each individual test run. The operating limits are established as the lowest pH corresponding to any of the three test runs. (The runs must demonstrate compliance with the emission limit.)	Minn. R. 7007.0800, subp. 4
The Permittee may change the pH operating limits for the air pollution control device as long as the requirements in paragraphs (1) through (3), below, are met. (1) Submit a written notification to the Commissioner of the request to conduct a new performance test to revise the operating limit. (2) Conduct a performance test to demonstrate compliance with the applicable sulfur dioxide emission limitation. (3) Establish revised operating limits according to the applicable procedures to establish site-specific operating limits, above.	Minn. R. 7007.0800, subp. 4
RECORDKEEPING	hdr
The Permittee shall maintain electronic files of all information required by this part in a form suitable and readily available for expeditious inspection and review. The files should be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, or record. Only the most recent two years of information must be kept on site.	Minn. R. 7007.0800, subp. 5
REPORTING	hdr
Deviations. The Permittee must report each instance in which an emission limitation was not met. This includes periods of startup, shutdown, and malfunction.	Minn. R. 7007.0800, subp. 5

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : March 4, 2009

TO : AQD File No. 869A
(Delta ID No. 13700113)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Nitrogen Oxides BART Determination for United Taconite LLC's Line 1 Indurating Furnace

Note: Separate SO_2 and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
United Taconite LLC – Fairlane Plant P.O. Box 180 Eveleth, Minnesota 55734-0180	Highway 16 Forbes, Minnesota 55738 St. Louis County
Contact: Jason Aagenes; Phone (218) 744-7803	

1.2 Description of the Facility

The United Taconite, LLC ("United Taconite") facility processes crude taconite ore into a pellet product with ore supplied from a rail-linked facility, United Taconite's Thunderbird Mine. Fine crushing and grinding of crude ore and magnetic separation processes produce a taconite concentrate, which is used to make pellets. Taconite pellets are thermally hardened in a grate-kiln indurating furnace. The finished product (fired pellets) is transferred by conveyors to storage bins for holding and loading into railcars.

This facility has two indurating Allis-Chalmers furnaces. Line 1 is the smaller of the two, with a rated throughput of 280 tons of pellets per hour and a heat input of 190 MMBtu per hour of natural gas. The newer line, Line 2, is rated at 672 tons per hour with a heat input from natural gas, coal, petroleum coke, and other fuels of 400 MMBtu per hour.

This analysis focuses on Line 1.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The unit for which this determination of a BART Sulfur Dioxide Emission Limit has been completed is:

Emission Unit Name	EU Number[1]	Control Equipment[2] and Stack Numbers
Line 1 Pellet Induration	EU040	SV046

1 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

2 United Taconite's control equipment for its indurating furnace (wet scrubbers) does not reduce emissions of Nitrogen Oxides.

2.3 The BART Analysis

United Taconite's BART Analysis and Selection Process

United Taconite submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-unitedtaconite.pdf.

Evaluation of Impacts

United Taconite modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of United Taconite's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	3.0	114
2003	3.5	115
2004	4.0	97
Combined (2002-2004)	3.4	326

The nitrogen oxide emissions from United Taconite's pelletizing furnace are currently uncontrolled.

Identification of Available Retrofit Control Technologies

United Taconite identified the following NO_X retrofit control technologies as available and applicable to pellet furnaces:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction with Reheat

Elimination of Technically Infeasible Options

United Taconite eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Low-NO_X Burners are feasible

3 The facility used the CALPUFF Modeling System required by the MPCA's BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

4 The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the United Taconite facility. Results are shown for the entire facility, not just Line 1, and reflect the emission levels after the installation of the heat recoup project on Line 1.

only in a pre-heat zone; United Taconite's furnace design does not include a separate pre-heat zone, so Low-NO_X Burners are infeasible for United Taconite. United Taconite eliminated Energy Efficiency Projects due to the difficulty of assigning a general potential emission reduction for this category. The company has already implemented several energy efficiency projects and it will continue to evaluate and implement energy efficiency projects. United Taconite's use of straight grate indurating furnaces makes the use of Ported Kilns infeasible, since they can be used only at grate-kiln furnaces. United Taconite eliminated Alternative Fuels because the environmental and economic benefits of such a change are uncertain and United Taconite believes that this option is not mandated by U.S. EPA. In addition, United Taconite's furnace is currently incapable of handling solid fuels.

Selective Catalytic Reduction with conventional Reheat was the only technology considered by United Taconite to be technically feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies

The following table illustrates the NO_X emission reductions projected by United Taconite with SCR.

Projected Annual NO_X Emission Reductions (tons per year)

NO_X Control Technology	Assumed Control Efficiency	Line 1
None (Baseline)[5]	--	2151.2
Selective Catalytic Reduction	80%	1751.5

Evaluation of the Cost Effectiveness of the Remaining Control Technologies

United Taconite's estimates of the annualized pollution control cost of installing and operating the SCR is shown in the table below.

Pellet Furnace Projected NO_X Control Cost (cost per ton of pollutant removed)

NO_X Control Technology	Line 1
SCR w/ reheat	$13,659

United Taconite's BART Selection

In their BART submittal, United Taconite indicated that add-on controls would not be cost-effective. It proposed that the already-completed heat recuperation project was BART. However, no NO_X emission limit was proposed; United Taconite claimed that heat recoup is integral to the process and, therefore, no limitation is required.

MPCA Review of United Taconite's BART Analysis

The MPCA reviewed the BART analysis provided by United Taconite and agrees with the selection of the technologies considered for the analysis as well as United Taconite's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation Burners, Low-

5 The baseline emission levels are those provided by United Taconite in its BART analysis.

NO_X Burners, Ported Kilns and Alternative Fuels further in the report.[6] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage United Taconite to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation in the BART Analysis of Energy Efficiency Projects is not feasible as United Taconite does not identify a specific Energy Efficiency Project as a BART technology. The control efficiencies proposed for SCR with reheat appears to be reasonable.

The MPCA examined the cost-effectiveness determination and agrees with United Taconite that add-on controls are not cost-effective. Although there were some discrepancies between the costs provided in United Taconite's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART.

The MPCA also agrees that the NO_X reductions from the heat recuperation project are needed for BART; however, the MPCA determined that, in addition to those NO_X reductions, BART is good combustion practices for the indurating furnaces. Currently, the MPCA and United Taconite lack sufficient operating parameter data or emissions data to assess whether current combustion practices constitute "good" combustion practices nor does sufficient emissions data exist to establish a NO_X BART limit.

Prior to the submittal of United Taconite's BART report, the MPCA encouraged the taconite facilities to consider the installation of NO_X CEMS and the concurrent monitoring of operations as a control strategy. United Taconite's BART submittal responds, stating that "[p]rocess optimization for NO_X reduction on an induration furnace is not a proven technology and is not commercially available as a control technology." Still, United Taconite notes that the approach has been used in the electric utility industry to fine tune NO_X emissions from boilers.

From its experience with electric utilities, refineries, and other facilities, the MPCA notes that strategies to use CEMS to reduce NO_X have been successful. The MPCA believes that monitoring NO_X emissions with CEMS or other parametric monitoring at pelletizing furnaces will identify operating conditions under which NO_X emissions can be reduced. The MPCA also notes that NO_X reductions have occurred at another taconite facility after installing CEMS. While those reductions cannot be directly tied to operational changes identified with the aid of CEMS, this observation strongly suggests that using CEMS at pelletizing furnaces will help reduce NO_X through the feedback to the operator and plant management that a CEMS or predictive emission monitoring system provides. Operators can fine tune the operation since it responds to a number of variables under their control and the results of these adjustments can be seen with a CEMS. Plant management can analyze temporal differences in individual furnace operations and differences in emissions among similar furnaces to gain understanding of the factors that influence NO_X formation and apply that knowledge to lower emissions.

6 Although the MPCA agrees with United Taconite that these emission reduction methods are not technically feasible, it does not agree with all aspects of United Taconite's rationale.

The MPCA has determined that continuous emission monitors or a comparable alternative emission measurement method combined with hourly process data can provide data that would be necessary in setting BART NO_X limits based on BART as good combustion practices.

2.4 MPCA Determination of the BART Limit

Due to the lack of sufficient emissions data representing the range of operating conditions that influence emissions,[7] the MPCA is unable at this time to set an emission limit that corresponds to BART for United Taconite's pellet furnaces.

The following table represents the MPCA's NO_X BART determinations for the pellet furnaces at United Taconite.

Pellet Furnace Line	BART	Recommended BART Emission Limit	Compliance Schedule[8]
Line 1	Good combustion practices; past heat recuperation project	To Be Determined (TBD) after gathering sufficient emissions and operating data	Administrative Order signed April 21, 2008 requires submittal of an alternative emission measurement method (comparable to CEMS) by March 31, 2008. Stip requires CEMS installed within 60 days of Line resuming operations.

The MPCA anticipates that the BART limit(s) will be established and incorporated into United Taconite's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

7 United Taconite Line 1 is not subject to any performance standards or individual limits that regulate NOx in the facility's current permit 13700113-005.
8 The resulting emissions and operating parameter data will be used to establish a BART limit through an amendment to United Taconite's Title V permit.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : March 4, 2009

TO : AQD File No. 869A
(Delta ID No. 13700113)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 296-8517

SUBJECT : Nitrogen Oxides BART Determination for United Taconite LLC's Line 2 Indurating Furnace

Note: Separate BART determinations for Line 1 (NO_X and SO_2), Line 2 SO_2, and PM for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's NO_X BART determinations based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
United Taconite LLC – Fairlane Plant P.O. Box 180 Eveleth, Minnesota 55734-0180	Highway 16 Forbes, Minnesota 55738 St. Louis County
Contact: Jason Aagenes; Phone (218) 744-7803	

1.2 Description of the Facility

The United Taconite, LLC ("United Taconite") facility, owned by Cleveland-Cliffs and Laiwu Steel and managed by Cliffs Mining Company, processes crude taconite ore into a pellet product with ore supplied from a rail-linked facility, United Taconite's Thunderbird Mine. Fine crushing and grinding of crude ore and magnetic separation processes produce a taconite concentrate, which is used to make pellets. Taconite pellets are thermally hardened in a grate-kiln indurating furnace. The finished product (fired pellets) is transferred by conveyors to storage bins for holding and loading into railcars.

This facility has two indurating Allis-Chalmers furnaces. Line 1 is the smaller of the two, with a rated throughput of 280 tons of pellets per hour and a heat input of 190 MMBtu per hour of natural gas. The newer line, Line 2, is rated at 672 tons per hour with a heat input from natural gas, coal, petroleum coke, and other fuels of 400 MMBtu per hour.

This analysis focuses on Line 2.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which the MPCA must determine BART and establish a NO_X BART limits consistent with that determination include:

Emission Unit Name	EU Number[1]	Control Equipment[2] and Stack Numbers
Line 2 Pellet Induration	EU042	SV048, SV049

Although the Line 2 indurating furnace can burn a variety of fuels (including natural gas, pulverized coal, a coal/petroleum coke blend, and distillate oil), petroleum coke and coal are the primary fuels. Other than units that qualify as insignificant activities, the two pellet furnaces are the only NO_X emission units at United Taconite. A full BART analysis for SO_2 and NO_X was conducted for the two pelletizing furnaces. This memorandum addresses only NO_X for Line 2.

2.3 The BART Analysis

United Taconite's BART Analysis and Selection Process

United Taconite submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. On October 25, 2007 United Taconite submitted a revised BART analysis for a secondary Wet Scrubber on the Line 2 pellet furnace. The BART analyses are available at: http://www.pca.state.mn.us/air/regionalhaze.html.

Evaluation of Impacts

United Taconite modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of United Taconite's Baseline Visibility Modeling Results.

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98th Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	3.0	114
2003	3.5	115
2004	4.0	97
Combined (2002-2004)	3.4	326

[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

[2] United Taconite operates wet scrubbers to remove particulate matter. These scrubbers also remove some SO_2 emissions but do not affect NO_X emissions.

3 The facility used the CALPUFF Modeling System required by the MPCA's *BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota*, Final March 2006, modified as described in Appendix B of the facility's BART Analysis. http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

[4] The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the United Taconite facility. Results are shown for the entire facility, not just Line 2, and reflect the emission levels after the installation of the heat recoup project on Line 1. The emission rates used in modeling was based on the most recent stack test approved by the MPCA. For SO_2, this test was performed in June 2004 and the emission rate was 632.2 lb/hour. (In January 2008 the MPCA learned of an engineering stack test conducted in April 2006 to determine whether the results of this test are valid. The SO_2 emission rate in the April 2006 test was 1010 lb/hour. The MPCA is evaluating whether the appropriate 24-hour emission rate was used in modeling.)

Identification of Available Retrofit Control Technologies for NO_X

United Taconite identified the following NO_X retrofit control technologies as available and applicable to pellet furnaces:

- External Flue Gas Recirculation
- Low-NO_X Burners
- Induced Flue Gas Recirculation Burners
- Energy Efficiency Projects
- Ported Kilns
- Alternate Fuels
- Selective Catalytic Reduction with Reheat

Elimination of Technically Infeasible Options for NO_X

United Taconite eliminated External Flue Gas Recirculation and Induced Flue Gas Recirculation Burners from consideration since they were technically infeasible for the specific application to pellet furnaces due to the high oxygen content of the flue gas. Low-NO_X Burners are not feasible since they are only feasible in pre-heat zone and United Taconite does not use burners in the pre-heat zone. (Low NO_X burners in the indurating section of the furnace would adversely affect pellet quality due to reduced flame temperature.) United Taconite eliminated Energy Efficiency Projects for Line 2 but provide no reason for their elimination. Ported Kilns were eliminated by United Taconite because although they are applicable to grate kiln furnaces such as Line 2 the technology vendor United Taconite contacted would not guarantee that ported kilns would reduce NO_X emissions due to the inability to control oxygen in the combustion zone. United Taconite eliminated Alternative Fuels because Line 2 already uses solid fuels that result in lower flame temperature and, thus, lower NO_X emissions. Switching to another fuel such as natural gas (which Line 2 already is capable of using[5]) could exchange one visibility pollutant for another (NO_X for SO_2). United Taconite also believes that this option is not mandated by U.S. EPA.

Selective Catalytic Reduction with conventional Reheat was the only technology considered by United Taconite to be technically feasible.

Evaluation of the Control Effectiveness of the Remaining Control Technologies for NO_X

The following table illustrates the NO_X emission reductions projected by United Taconite with SCR.

Projected Annual NO_X Emission Reductions

NO_X Control Technology	**Assumed Control Efficiency**	**Line 2 (tons per year)**
None (Baseline)	--	1,633.3 (solid fuels)* 8,164.5 (natural gas only)
Selective Catalytic Reduction with reheat	80%	1598.3 (solid fuels) 7975.8 (natural gas only)

[5] United Taconite's permit currently allows pulverized coal, a coal/(petroleum) coke blend, distillate oil, and natural gas as fuels for the Line 2 furnace.

* United Taconite uses primarily solid fuels.

Evaluation of the Cost Effectiveness of the Remaining Control Technologies for NO_X

United Taconite's estimates of the annualized pollution control cost of installing and operating the SCR is shown in the table below.

Pellet Furnace Projected NO_X Control Cost
(cost per ton of pollutant removed)

NO_X Control Technology	Line 2
SCR w/ reheat (solid fuels)	$22,017
SCR w/ reheat (natural gas)	$4,736

United Taconite's BART Selection for NO_X

In their BART submittal, United Taconite did not propose BART for Line 2.

MPCA Review of United Taconite's BART Analysis for NO_X

The MPCA reviewed the BART analysis provided by United Taconite and agrees with the selection of the technologies considered for the analysis as well as United Taconite's decision to not evaluate External Flue Gas Recirculation, Induced Flue Gas Recirculation Burners, Low-NO_X Burners and Alternative Fuels (for NO_X) further in the report.[6] "Energy Efficiency Projects" as a general category are difficult to assess. Although the MPCA will continue to encourage United Taconite to implement projects that concurrently reduce energy consumption and nitrogen oxides, the MPCA agrees that further evaluation in the BART Analysis of Energy Efficiency Projects is not feasible as United Taconite does not identify a specific Energy Efficiency Project as a BART technology. The control efficiency proposed for SCR with reheat appears to be reasonable. However, United Taconite fails to provide enough information on Ported Kilns for the MPCA to eliminate them from consideration.

The MPCA examined the cost-effectiveness determination. Although there were some discrepancies between the costs provided in United Taconite's BART analysis and the costs identified by the MPCA, the differences were not significant enough to change the conclusion that no additional controls are required for BART (provided that, after receiving additional information from United Taconite, the MPCA concurs that Ported Kilns are technically infeasible).

United Taconite did not propose BART for Line 2 and its Title V operating permit lacks a NO_x limit. If the MPCA concurs that Ported Kilns are technically infeasible, the MPCA will identify good combustion practices as BART for Line 2. However, the MPCA believes that neither

[6] Although the MPCA agrees with United Taconite that these emission reduction methods are not technically feasible, it does not agree with all aspects of United Taconite's rationale. One specific area of disagreement is in the manner in which United Taconite characterizes the intent of US EPA on alternate fuels for BART.

United Taconite nor the MPCA has sufficient operating parameter data or emissions data to be able to assess whether current combustion operations constitute "good" combustion practices; in addition, there is not sufficient emissions data to establish a NO_X BART limit. It is particularly difficult to set a limit at United Taconite where the solid fuel blend of petroleum coke and coal may vary on a weekly basis. The MPCA does not have any information about how the variations in solid fuel blends impact NO_X emissions.[7]

Prior to the submittal of United Taconite's BART report, the MPCA encouraged the taconite facilities to consider the installation of NO_X CEMS and the concurrent monitoring of operations as a control strategy. United Taconite's BART submittal responds, stating that "[t]here is no indication that further emission reductions would be achieved through process optimization, using NO_X CEMS or other parametric monitoring, as a control technology." Still, United Taconite notes that the approach has been used in the electric utility industry to fine tune NO_X emissions from boilers.

From its experience with electric utilities, refineries, and other facilities, the MPCA notes that strategies to use CEMS to reduce NO_X have been successful. The MPCA believes that monitoring NO_X emissions with CEMS at pelletizing furnaces will identify operating conditions under which NO_X emissions can be reduced. The MPCA believes that NO_X CEMS are most appropriate at United Taconite rather than parametric monitoring given the variation in fuel blends and the existing need for SO_2 CEMS. The MPCA also notes that NO_X reductions have occurred at the US Steel – Minntac facility after installing CEMS. While those reductions cannot be directly tied to operational changes identified with the aid of CEMS, this observation strongly suggests that using CEMS at pelletizing furnaces will help reduce NO_X through the feedback to the operator and plant management that a CEMS provides. Operators can fine tune the operation since it responds to a number of variables under their control and the results of these adjustments can be seen with a CEMS. Plant management can analyze temporal differences in individual furnace operations and differences in emissions among similar furnaces to gain understanding of the factors that influence NO_X formation and apply that knowledge to lower emissions.

The MPCA has determined that continuous emission monitors or a comparable alternative emission measurement method combined with hourly process data can provide data that would be needed to set BART NO_X limits based on BART as good combustion practices and any additional technologies determined to be BART.

2.4 MPCA Determination of the SO_2 and NO_X BART Limits

Additional data from United Taconite and additional analysis by the MPCA are needed to determine whether Alternative Fuels, a Secondary Scrubber, or a new Recirculating Scrubber represents BART for SO_2. Among the significant issues in performing the BART analysis is determining the appropriate value to use for baseline annual emissions as this can significantly affect the cost effectiveness. The appropriate value to use for baseline annual emissions is

[7] During the last ten years, United Taconite has performed four stack tests for NO_X at Line 2. In three of the tests, both stacks were tested. Given the differences in furnaces throughput and fuel composition, this quantity of data is insufficient to make conclusions about the response of NO_X emissions to different fuel blends.

currently under review as historic data relevant to SO_2 emissions was just received in January 2008. The MPCA is currently reviewing whether installation of a CEMS prior to BART determination is needed to establish baseline emission levels. An SO_2 Continuous Emission Monitoring Systems (CEMS) may be used to gather data to establish the appropriate BART limit. In addition, the cost of using lower sulfur fuel blends must be performed by the MPCA as United Taconite has opted not to provide this information to the MPCA. The MPCA expects to complete the BART analysis and its selection of the technology that represents BART for SO_2 by mid-2008.

Due to the lack of sufficient emissions data representing the range of operating conditions that influence emissions,[8] the MPCA is unable at this time to set a NO_X emission limit that corresponds to BART for United Taconite's Line 2. In addition, the MPCA must further evaluate whether United Taconite appropriately eliminated Ported Kilns from evaluation in their BART Analysis.

The following table represents the MPCA's NO_X BART determinations for Line 2 at United Taconite.

Pellet Furnace Line	**NO_X BART**	**Recommended NO_X BART Emission Limit**	**Compliance Schedule**
Lines 2 (EU042)	Good combustion practices; also, additional evaluation of Ported Kilns is needed	To Be Determined (TBD) after gathering sufficient emissions and operating data and additional analysis of Ported Kilns[9]	Determination of the appropriate enforceable document to require the installation of NO_X CEMS is currently in process

The MPCA anticipates that the BART limit(s) will be established and incorporated into United Taconite's Title V operating permit in 2010 after EPA approval of the MPCA's regional haze State Implementation Plan and collection of sufficient data are needed to establish a BART limit.

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8 United Taconite is not subject to any performance standards that regulate NO_X and does not have a NO_x limit in its current permit.

9 The MPCA is currently hampered in its efforts to set a BACT limit for NO_X emissions from United Taconite's Line 2 by the lack of data over the range of operating conditions and the resulting effects on NO_X emissions.

ATTACHMENT 1

December 14, 2007

Mr. Jason Aagenes
Section Manager, Environmental Affairs
United Taconite LLC
P.O. Box 180
Eveleth, Minnesota 55734

Re: Best Available Retrofit Technology (BART) Analysis for United Taconite Line 2

Dear Mr. Aagenes:

The Minnesota Pollution Control Agency (MPCA) reiterates its request for United Taconite to complete its Best Available Retrofit Technology (BART) analysis by submitting an analysis of the costs of blending fuels to lower sulfur dioxide (SO_2) emissions.

United Taconite originally agreed to the MPCA's request during a conference call on August 1, 2007. On November 1, 2007, however, United Taconite asserted that the MPCA could not require this analysis. On November 28, 2007, United Taconite shared with the MPCA a memorandum from the Environmental Law Group (ELG) regarding the MPCA's legal authority to require a modification of current fuel blending practices under BART. This memorandum focused on the MPCA's authority to require "fuel switching", although the MPCA has not requested United Taconite to change fuels and is currently requesting an analysis of the costs and other impacts associated with modifying current fuel blending practices. However, the MPCA also disagrees with the conclusions of the memorandum and presents its rationale for requiring the costs and other impacts analysis below.

United Taconite submitted an analysis for the BART-eligible emission units at its facility on September 7, 2006. In this document, United Taconite stated that a full BART analysis was conducted for NO_X and SO_2. The MPCA disagreed with United Taconite's assertion that the BART analysis was complete and responded with a request for an analysis of the fuel blending costs; the MPCA believes the BART analysis is incomplete without this evaluation. The MPCA has been in consultation with EPA Region V on this issue and EPA Region V agrees with the MPCA's interpretation.

The EPA's "Guidelines for BART Determinations under the Regional Haze Rules" [40 CFR Part 51, Appendix Y] indicates that the first step in a BART analysis is to identify available retrofit emission control technologies. EPA's BART Guidelines ***to States*** [FR 39164] (emphasis added) classifies three categories of potentially available retrofit control alternatives:

- Pollution prevention: use of inherently lower-emitting processes/practices, including the use of control techniques (e.g. low-NO_X burners) and work practices that prevent emissions and result in lower "production-specific" emissions (note that it is not our intent to direct States to switch fuel forms, e.g. from coal to gas),
- Use of (and where already in place, improvement in the performance of) add-on controls, such as scrubbers, fabric filters, thermal oxidizers and other devices that control and reduce emissions after they are produced, and
- Combinations of inherently lower-emitting processes and add-on controls.

In its BART analysis, United Taconite identified the following SO_2 reduction technologies as generally available to pellet furnaces:

- Wet scrubbing (high efficiency)
- Wet scrubbing (low efficiency)
- Wet walled electrostatic precipitator (WWESP)
- Dry sorbent injection
- Spray dryer absorption
- Alternative Fuels
- Energy efficiency projects

Step 2 of the BART analysis eliminates technically infeasible options. United Taconite eliminated dry sorbent injection and spray dryer absorption as technically infeasible technologies. United Taconite identified the use of alternative fuels and energy efficiency projects as technically feasible, but did not evaluate the costs associated with these options. United Taconite justified its failure to evaluate the costs associated with the use of alternative fuels and with energy efficiency projects stating that a BART analysis does not require analysis of such options. The company noted U.S. EPA's intent "for facilities to consider alternate fuels as an option, not to direct fuel choice" as its rationale for failing to conduct the cost analyses.

Please note that the BART Guidelines are written for States. The MPCA is responsible for interpreting and implementing them. It is clearly the State's decision as to what technologies are deemed available and should undergo further evaluation as to their cost effectiveness. Although EPA noted in its guidance that it did not intend to direct States to require a facility to switch fuel forms, the Guidelines do not require the State to exclude lower emitting fuels from a BART analysis, especially those already in use by a facility. The example provided in the guidance discusses a switch from coal to natural gas; through its selection of this example, EPA indicates that it is primarily concerned with a situation in which a facility is not already capable of burning an alternate fuel; in such a case, a replacement of or a significant modification to the boiler would be needed**.**

Furthermore, in EPA's discussion of BART limits for SO_2 from oil-fired units in the final BART Guidelines, EPA's economic analysis found that "switching to low sulfur fuel oil is a cost effective method in reducing SO_2 emission from oil fired units." [F.R. 39133] This example demonstrates that EPA did not intend that States exclude evaluation of alternate fuels in their BART analyses.

In addition to its authority to implement the BART rule, the MPCA has statutory authority to require information that it deems relevant to pollution or to the rules or provisions of its enabling legislation and to require the owner or operator of any emission facility to make a report or provide information that the agency may reasonably require. Minn. Stat. §§ 116.07, subd. 9; 116.091, subd. 1.

In furtherance of its obligation to create BART limits and to issue permits including the BART limits as well as such conditions as it will prescribe for the prevention of pollution and to ensure compliance with all applicable requirements, including the BART requirements, the MPCA has determined that it requires an analysis of different blends of United Taconite's existing Line 2 solid fuels and natural gas.

United Taconite currently co-fires a combination of solid fuels and natural gas in Line 2. The current mix includes about petroleum coke (5-7% sulfur), eastern coal and the remainder natural gas. United Taconite establishes the ratio of petroleum coke and coal to meet Minnesota's direct heating equipment SO_2 standard of 4 lb per MMBTU heat input. Burning a higher ratio of eastern coal and use of coal types with lower sulfur contents would reduce SO_2 emissions. Since Line 2 is capable of using a less-polluting fuel (i.e., using more coal to displace petroleum coke), United Taconite's circumstances differ substantially from the situation that EPA sought to discourage.

The MPCA disagrees with ELG's contention that it lacks the authority to require United Taconite to provide an analysis of blending existing fuels to emit less SO_2. Furthermore, the MPCA disagrees with ELG's characterization of changing the fuel ratios as "fuel switching;" United Taconite already changes its fuel ratios depending on the sulfur content of the petroleum coke and the coal it uses in its furnaces. The MPCA continues to expect United Taconite, as part of its BART analysis, to evaluate the cost and expected emission reductions of the various blends of fuels that Line 2 is currently capable of using. United Taconite's evaluation should assess the costs associated with SO_2 reductions from the current 4 lb/MMBTU to levels of 3 lb/MMBTU; 2 lb/MMBTU; 1 lb/MMBTU; 0.5 lb/MMBTU; and 0.25 lb/MMBTU. For each of these scenarios, United Taconite must identify the various the fuel blending specifications (i.e., coke/coal ratios) needed to reach these levels. The evaluation should follow the BART analysis guidelines and identify whether it is technically feasible to reach each level. In addition, other impacts such as potential increases in other pollutants should be

Mr. Jason Aagenes

identified as part of the analysis for each scenario. United Taconite may request that certain data for this analysis be classified as nonpublic under Minn. Stat. §§ 13.37, subd. 1(b) and 116.075.

The MPCA asks that you send this analysis within three weeks from the date of this letter. If the analysis is not received by this date, the MPCA will conduct its own analysis of the costs with generally available data on fuel costs and with the assumption that all fuel blends are technically feasible.

Sincerely,

Todd Biewen
Manager
Environmental Analysis and Outcomes Division

TB:ale

cc: Dick Cordes, MPCA
Mary Jean Fenske, MPCA
Ann Foss, MPCA
Jess Richards, MPCA

ATTACHMENT 2

Detailed Cost Analysis to Enhance Sulfur Dioxide Removal For Scrubbers Installed on Line 2 Taconite Grate Kiln at United Taconite LLC

July 30, 2007
Minnesota Pollution Control Agency

Basis for analysis

This cost analysis is based on the wet scrubber analysis prepared for the Minnesota Pollution Control Agency (MPCA) by the Minnesota Department of Natural Resources (MDNR). The results of this evaluation indicate that the United Taconite (UNITED TACONITE) Line 2 system is the only Minnesota taconite induration scrubber system installation where it is feasible to increase sulfur dioxide (SO_2) collection efficiency through process modifications or replacement of an existing scrubber. Scenarios reviewed in the MDNR analysis included: (1) the use of the reagents sodium hydroxide or sodium carbonate in scrubber water, (2) installing lime addition to the existing scrubber water recirculation system and (3) installation of a new re-circulating lime scrubber similar to the Keewatin Taconite scrubber system.

The scope of the scrubber retrofit project and cost estimate was prepared initially by STS Consultants (STS). MPCA reviewed the scope of the assumed project and the cost estimate, and made adjustments to the estimate in consultation with STS. This written documentation was completed by MPCA staff. United Taconite was consulted on this analysis but not all comments made by United Taconite were incorporated in this analysis.

Site Visit

STS inspected United Taconite's existing scrubber system in spring 2007 and evaluated its suitability for lime addition SO_2 control and availability of space to install a new retrofit lime scrubber system.

The results of the site visit are as follows:

<u>Existing Scrubber System</u>

The installed particulate scrubber system uses two identical parallel scrubber systems to control particulate exhaust emissions from the grate kiln. Each scrubber system has a dedicated "wet" ID fan discharging to a single system stack. Each scrubber system consists of two modified Ducon model "VVO'S" venturi throat scrubbers discharging tangentially, 180 degrees apart into a single cylindrical scrub water droplet separator or mist eliminator. Each Ducon venturi was initially installed with swing door or "bomb bay" style adjustable venturi throat. These bomb bay mechanisms have been replaced with venturi rods. The separator was initially designed to use redwood slat mist elimination blades or vanes which were replaced with 3 pass metal 316 stainless steel chevron vanes in the 1980's. These vanes are now being retrofitted with higher efficiency sinusoid style thermoplastic vanes.

Spent scrub water is treated in each system by a dedicated thickener. The overflow from the thickeners is returned to the scrubbers with the system make up water. Thickener underflow is sent back to the process for further recovery of iron. System scrub water blow down is used to control suspended solids in the scrub water to minimize abrasion wear in the scrubber.

Potential location for retrofit scrubber system
The existing system installation is very compact and does not permit the installation of any required intermediate system flue gas components such as mechanical collectors between the kiln and existing scrubbers. Moreover, the existing location does not have the area available for retrofitting a recirculation scrub water system. For the retrofit scrubber system cost analysis, an area just outside the West end of existing building in the location of the existing stack was assumed to be available for the new system installation.

Due to the environmental issues which will result from the use of sodium based reagents, costing for scenario (1) was not examined as a feasible alternative in this cost estimate. Scenario (2) was also not examined as a feasible alternative because the operating chemistry required for this system and the inherent design of the existing scrubbers will cause severe scrubber internal chemical scaling likely rendering the system inoperable. This estimate is for scenario (3), a new lime scrubber system.

Replace existing scrubber with a new recirculating lime scrubber system
The design basis for this recirculating lime scrubber system is similar to that of the Keewatin Taconite scrubber system and requires the use of a mechanical collector upstream of the scrubber to remove enough particulate from the gas stream to permit scrub water recirculation to conserve reagent (lime), prevent calcium scaling, and prevent abrasion wear from the recirculated collected particulate in the scrub water.

The cost analysis for this scenario assumes that a new scrubber system is installed in the area downstream of the kiln in the location presently taken by the existing scrubber system fan, scrubber and stack. The footprint requirements of this new system will require the existing building to be extended to the West in the area presently occupied by the existing system stack.

Retrofit system design data
Volume (total two scrubbers): 600,000 ACFM
Pressure (at scrubber inlet): 16” W. C.
Inlet flue gas temperature: 110 °F
SO_2 inlet: 140 ppm
Lime use: 608 lb/hr
SO_2 Collection efficiency: Approximately double existing rate @ 50%

Design
The scrubbing equipment required for the new system presented in the cost analysis is as follows:

- Mechanical Collector/multi tube cyclone
- Venturi Rod scrubbers (two for parallel operation required)
  - Materials of construction:
    - Monolithic lined carbon steel (vinyl ester)
    - AL 6XN alloy

        - Rubber lined internal components
        - Ultem plastic internal mist eliminator components
        - Ceramic lined internal components
        - Stellite scrub liquor nozzles

- System ID fans and motors (two required)
    - Kiln/mechanical collector/scrubber induced draft fan systems, single dry fan replacement for each of the wet fans 2A and 2B to provide additional pressure drop for mechanical collector and scrubber SO_2 scrubbing. Fans will be located downstream of the new mechanical collector.

- Ductwork
    - Carbon steel ductwork to connect kiln discharge to new mechanical collectors, mechanical collector discharge to new induced draft fan inlets and fan outlets to scrubber inlets. All ductwork insulated and lagged.
    - Lined carbon steel ductwork/stack breaching to connect scrubber discharges to stack. Carbon steel ductwork designed and fabricated to receive field installed monolithic vinyl ester lining for corrosion protection.

- Scrub water recirculation system
    - Monolithic vinyl ester lined recirculation tank
    - Warman rubber lined pumps, operating and standby; each scrubber system
    - Rubber lined recirculation piping
    - Alloy and rubber lined valves and specialties

- Scrubber mist eliminator wash tank system
    - Monolithic vinyl ester lined recirculation tank
    - Warman rubber lined pumps, operating and standby; each scrubber system
    - Rubber lined recirculation piping
    - Alloy and rubber lined valves and specialties

- Scrub liquor settling and treatment system
    - Cone thickener with filter press
    - Monolithic lined vessel and launders with rubber covered rake system

- Lime storage and feed system

- Instrumentation and controls including the following
    - Program logic control system
    - Nuclear densitometer
    - System RTD temperature elements
    - Differential pressure transmitters
    - Tank level sensors
    - Pressure sensors and transmitters

- System Stack
    - Carbon steel monolithic vinyl ester lined

- Lot structural steel and supports for scrubber system components

- Foundations

- Scrubber system building

It is assumed that this installation is planned to occur during major scheduled outages.

Capital and Annual Operating Costs

The system operating and installation costs are displayed on the attached spreadsheet.

This spreadsheet was prepared from a sample spreadsheet transmitted to STS from the MPCA for the purpose of this cost analysis with missing formulations input from the "EPA Air Pollution Control Cost Manual", sixth edition".

Estimates for pollution control equipment purchase and installation were computed using actual costs from recent system installations completed by STS on Grate Kiln particulate/ SO_2 scrubbing systems. This estimate reflects most current pricing, therefore is a reliable budgetary estimate (+/- 30%).

A retrofit contingency factor of 25% of total capital costs has been included. This contingency factor has been selected to account for construction items that must be included in the project costs, but were not called out in the spreadsheet provided by the MPCA. For example, the contingency factor includes site clearing and equipment tie-in, as well as some amount to account for unanticipated site conditions. Because many site-specific issues are already accounted for in this cost estimate, a 25% retrofit contingency factor is appropriate for this budgetary estimate.

Annual costs include required labor, chemical and energy purchase, maintenance supplies. The annual costs include a line item for lost ore due to landfilling of sludge generated from scrubber water treatment.

Capital and annualized costs for the SO_2 control alternatives are described below. The cost estimates for installing an additional (polishing) scrubber are included for comparison. These estimates where prepared by Barr Engineering for United Taconite's BART analysis submitted to the MPCA in September 2006. (See http://www.pca.state.mn.us/publications/bart-facility-unitedtaconite.pdf .)

The overall SO_2 control efficiency is estimated to be 50% for the new system. However, the existing particulate control system has an assumed SO_2 control efficiency of about 25%. Thus, a 33% control efficiency was assumed to reflect the additional removal achieved beyond baseline (the control efficiency currently being achieved). The replacement of the existing scrubber with a recirculating lime scrubber would not only improve the SO_2 removal efficiency but the PM_{10} removal efficiency as well. In the BART analysis performed by Barr, a polishing scrubber specifically designed to remove SO_2 is added after the existing particulate scrubber and a control efficiency of 60% beyond baseline is assumed.

	Total Capital Cost	Total Annual Operating Costs (no CR)	Total Annualized Cost	Tons SO2 Removed	Additional control (over current control)	Cost per Ton SO2 removed
Retrofit New Recirculating Lime Wet Venturi Scrubber (STS/MPCA)	$ 45,732,000	$ 1,228,102	7,107,434	1078	33%	$ 6,592
Install Polishing Scrubber (Barr)	$ 28,067,000	$ 1,896,070	$ 5,545,472	1650	60%	$ 3,361

Co-Benefits from New Recirculating Scrubber

Other pollutants are controlled to some extent with the installation of a recirculating scrubber. Based on performance at Keewatin Taconite, the MPCA estimates that installing a recirculating scrubber with lime treatment could lower total mercury emissions by 30% from Line 2.

ATTACHMENT 3

From: Fenske, Mary Jean
Sent: Tuesday, December 11, 2007 1:53 PM
To: 'Aagenes, Jason D.'
Cc: Cordes, Richard; Jackson, Anne; Jiang, Hongming; Richards, Jess; Biewen, Todd; Seltz, John; 'Beresford, Robert'
Subject: Revised United Taconite Line 2 BART analysis

Jason,
Here are my notes from our discussion on Nov. 1 regarding the revised BART analysis for United Taconite line 2 dated Oct. 25, 2007. In the notes, I have included our requests to modify specific parts of the the revised BART analysis. Please let me know when you will be able to respond. (Note, the previous request we've made regarding a cost analysis to blend the fuels to a lower SO2 content is not addressed as it is being handled as a separate issue.)
Thank you,
Mary Jean

Mary Jean Fenske, P.E.
Minnesota Pollution Control Agency
520 Lafayette Road N.
St. Paul, MN 55155
(651) 297-5472
e-mail: maryjean.fenske@pca.state.mn.us

Notes and Additional Follow-Up from Nov. 1, 2007 Meeting Regarding United Taconite Line 2 Revised BART Analysis

Attendees:
MPCA: Hongming Jiang, Jess Richards, Anne Jackson, Dick Cordes, Mary Jean Fenske
Cliffs: Jason Aagenes, Dave Skolasinski
Barr Engineering: Beth Havlik

United Taconite submitted a revised SO2 BART analysis for an additional scrubber on line 2. The original BART cost estimate for an additional scrubber (and other technologies) was submitted to the MPCA on Sept. 7, 2006. At the Nov. 1 meeting each of the revisions was discussed plus the baseline SO2 emissions.

Enhanced water treatment –
In its revised analysis, United Taconite assumed that a 10mg/l sulfate standard for wild rice needed to be met at the basin outlet and therefore included costs of reverse osmosis to treat the tailings basin seepage to meet this standard. This standard needs to be met where the wild rice germinates, not in the basin, and only when the wild rice is germinating. In addition, the MPCA does not believe the entire cost of water treatment should be assigned to the additional scrubber as the sulfate concentration in the basin has been increasing over time and the existing scrubber also is contributing to the sulfate concentration in the basin.

Request: The MPCA would like the costs of water treatment revised to meet a concentration that reflects what would be allowed under water quality standards for sulfate. The MPCA also requests that only a portion of the cost of the water treatment system be assigned to this project, not the entire amount, perhaps that proportion represented by sulfate loadings from the additional scrubber relative to all existing sulfate loadings plus the sulfate from the additional scrubber.

Economic Cost of Lost Production on Line 2 During Construction -
In its revised analysis, United Taconite assumed 8 weeks of production downtime due to construction and tie-in of an additional scrubber and assigned those costs to the project. The MPCA disagrees that these costs should be included in the cost evaluation for BART. The MPCA has reviewed other BART analyses performed by facilities in other states and has not found any examples where a facility has included these costs even in instances of substantial changes to control equipment.

Request: The MPCA would like the economic cost of lost production on Line 2 removed from the BART analysis.

Project Contingency Cost-
United Taconite revised the project contingency cost to 30%, from 5% in the original analysis. The MPCA believes the age of the estimate is more appropriate to the increase in contingency costs and since construction costs, such as steel, have increased substantially since the estimate was performed, the MPCA accepts this revision as reasonable.

SO2 Baseline Emissions Used in Cost Estimate
United Taconite did not revise the SO2 baseline emissions in the revised BART analysis. However, during the meeting, the basis for the use of the hourly and yearly SO2 emission rates used in the BART analysis was discussed.

Request: MPCA staff believes that the maximum 24-hr SO2 emission rate of 632.2 lb/hr used in the BART analysis is not appropriate as it does not reflect the maximum 24-hr emission rate. The rate of 632.2 lb/hr was determined based on a stack test conducted in June of 2004. A blend of coal and petroleum coke was burned in that stack test. The percent sulfur of the blend was 2.37 % on a dry basis. Since 2005, average monthly % S of the weekly coal/pet coke samples performed by United Taconite have ranged from 3.01 to 3.87 % S as United Taconite's current practice is to establish the ratio of petroleum coke and coal to meet Minnesota's direct heating equipment SO_2 standard of 4 lb per MMBTU heat input. Thus, the MPCA does not believe the lb/hr emission rate determined by stack testing reflects the actual maximum 24 hr emission rate since measured S content of the fuel blend is well above the S of the fuel when testing was conducted. The MPCA believes a more appropriate way to establish the maximum 24-hr emission rate would be as follows:

$$\frac{4 \text{ lb SO2}}{\text{MMBTU}} * \frac{260 \text{ MMBTU}}{\text{hr}} = 1040 \text{ lb/ hr}$$

Where:

260 MMBTU/hr represents the maximum heat input over a 24 hr period
4.0 lb/MMBTU represents United Taconite's current fuel blending practices, including the 15.4 % SO2 removal by the scrubber based on the most recent performance test

However, to further confirm this value of 1040 lb/hr is appropriate, the MPCA requests that United Taconite submit the daily solid fuel blend fraction records of coal, petroleum coke and coker pond fines from the day bin silos to EU042 for 2002 through 2006. These records are required by permit no. 13700113-004.

According to EPA's BART guidelines, the yearly baseline emissions should represent a realistic depiction of anticipated annual emissions for the facility. Thus, the MPCA does not believe it would be appropriate to multiply the maximum 24 hour emission rate by the maximum number of operating hours over a past 24-month period to determine annual baseline emissions. Instead, the MPCA believes that the assumption of the current practice (blending to meet the state direct heat heating rule, accounting for SO2 removal by the scrubber) at a typical heat input rate would be more appropriate. This results in annual baseline emissions greater than the 2750 tons used in the revised BART analysis submittal:

$$\frac{4\ \text{lb}\ SO_2}{\text{MMBTU}} * \frac{215\ \text{MMBTU}}{\text{hr}} * \frac{1\ \text{ton}}{2000\text{lb}} * 7827\ \text{hr} = 3366\ \text{ton/ year}$$

Where:

7827 hr represents the average line 2 operating hours for 2004 (7898 hr) and 2005 (7755 hr).
215 MMBTU/hr heat input reflects typical operation (please provide data if this assumption is incorrect)

The MPCA asks that this annual baseline value be used in the revised BART analysis, unless United Taconite is able to provide data to demonstrate that these assumptions are in error.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 26, 2009

TO : AQD File No. 869A
(Delta ID No. 13700113)

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

Anne M. Jackson, P.E.
Environmental Analysis and Outcomes
Division

PHONE : (651) 757-2291 (651)757-2460

SUBJECT : Sulfur Dioxide BART Determination for United Taconite LLC's Indurating Furnaces

Note: Separate NO_X and PM BART determinations for the subject-to-BART emission units at this facility are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's SO_2 BART determination based on the technical review performed by MPCA staff.

1. General Information

1.1 Applicant and Stationary Source Location:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
United Taconite LLC – Fairlane Plant P.O. Box 180 Eveleth, Minnesota 55734-0180	Highway 16 Forbes, Minnesota 55738 St. Louis County
Contact: Jason Aagenes; Phone (218) 744-7803	

1.2 Description of the Facility

The United Taconite, LLC ("United Taconite") facility processes crude taconite ore into a pellet product with ore supplied from a rail-linked facility, United Taconite's Thunderbird Mine. Fine crushing and grinding of crude ore and magnetic separation processes produce a taconite concentrate, which is used to make pellets. Taconite pellets are thermally hardened in a grate-kiln indurating furnace. The finished product (fired pellets) is transferred by conveyors to storage bins for holding and loading into railcars.

This facility has two indurating Allis-Chalmers furnaces. Line 1 is the smaller of the two, with a rated throughput of 280 tons of pellets per hour and a heat input of 190 MMBtu per hour of natural gas. The newer line, Line 2, is rated at 672 tons per hour with a heat input from natural gas, coal, petroleum coke, and other fuels of 400 MMBtu per hour.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

2.2 Affected Units

The units for which determinations of BART SO_2 emission limits have been completed are:

Emission Unit Name	EU Number[1]	Control Equipment and Stack Numbers
Line 1 Pellet Induration	EU040	CE056/SV046
Line 2 Pellet Induration	EU042	CE040/SV048, CE050/SV049

[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

The Line 1 indurating furnace can burn both natural gas and fuel oil, but natural gas is the primary fuel. Since natural gas is low in sulfur, the primary source of sulfur at this furnace is the iron ore used to form the green balls. Some additional sulfur may be present in additives also used in the green balls.

The Line 2 indurating furnace is permitted to burn pulverized coal, a coal/pet coke blend, distillate oil, and natural gas. It is primarily operated using a blend of coal and pet coke. Therefore, the primary source of sulfur at this furnace is the fuel, though the iron ore also contributes some sulfur to the waste gas.

2.3 The BART Analysis

United Taconite's BART Analysis and Selection Process

United Taconite submitted its *Analysis of Best Available Retrofit Technology (BART)* to the MPCA in a report dated September 7, 2006. This report is available at: http://www.pca.state.mn.us/publications/bart-facility-unitedtaconite.pdf. United Taconite submitted a revised cost estimate for the wet scrubber alternatives (letter from Jason Aagnes, United Taconite, dated October 25, 2007).

Analyses of two additional SO_2 control technologies not included in the submitted BART analysis were developed by the MPCA to supplement the revised BART analysis. The MPCA requested that United Taconite amend the BART analysis to include an additional control technology – a new recirculating particulate matter wet scrubber to replace existing equipment on Line 2 to achieve an overall SO_2 control efficiency of at least 60%. When United Taconite declined to provide such information, the MPCA contracted with STS Consultants to prepare the cost estimate. The final cost estimate was completed by the MPCA, and is dated July 30, 2007. The final cost estimate is attached.[2]

The MPCA also requested an analysis of alternative fuel blends (coal and petroleum coke) for Line 2 as an SO_2 control alternative. United Taconite declined to provide such analysis. As a result, the MPCA prepared separately its analysis of fuel blends. The MPCA's worksheet showing these calculations is appended to this memorandum.

Evaluation of Impacts

United Taconite modeled its impacts using BART modeling protocol required by the MPCA.[3] The following table shows a summary of United Taconite's Baseline Visibility Modeling Results, after installation of a heat recoup project on Line 1. This scenario represents visibility impacts when the facility is burning natural gas on both lines (that is, worst-case NOx emissions are modeled).

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[2] The estimate is partially based on the *Evaluation of Minnesota Taconite Wet Scrubbers at Minntac, Keewatin Taconite, Hibbing Taconite, and United Taconite* by John Engesser of the Minnesota DNR available at http://www.pca.state.mn.us/publications/regionalhaze-taconitescrubber.pdf.

[3] The facility used the CALPUFF Modeling System required by the MPCA's *BART Modeling Protocol to Determine Sources Subject to BART in the State of Minnesota,* Final March 2006, modified as described in Appendix B of the facility's BART Analysis. http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

Impacts at the Boundary Waters Canoe Area Wilderness[4]

Year	Modeled 98^{th} Percentile Value (deciviews)	Number of days > 0.5 deciview
2002	3.0	114
2003	3.4	115
2004	4.0	97
Combined (2002-2004)	3.4	326

2.4 MPCA Analysis to make a Determination of the BART Limit

In its BART analysis, United Taconite identified the following SO_2 retrofit control technologies as feasible technologies for both Lines 1 and 2:

- Wet Walled Electrostatic Precipitator (WWESP)
- Secondary Wet Scrubber
- Energy Efficiency projects
- Alternate Fuels

2.4.1 Line 1

The MPCA reviewed the BART analysis provided by United Taconite and agrees with United Taconite's assessment of technical infeasibility for dry sorbent injection, spray dryer absorption, energy efficiency projects and coal processing for Line 1.[5]

Performance tests were conducted at United Taconite's Line 1 waste gas stack on 11/21/1997, 12/28/2004, 5/3/2005 and 5/3/2006 with natural gas firing. The 1997 and 2004 tests were conducted before United Taconite's energy efficiency improvement project for the line which added heat recuperation to move part of the pellet cooler exhaust to the drying zone of the traveling grate; the 2005 and 2006 tests were done after the efficiency project. Since sulfur contribution from natural gas is very small, we can focus on sulfur contribution from the taconite ore/concentrate.

SO_2 limits for natural gas fired units are being set to reflect when the particulate matter scrubbers are optimized for SO_2 removal, not to direct a change in controls or inputs. Therefore, the MPCA has selected the predictive level as the statistical interval to be used in establishing the SO_2 emissions rate. As shown in the following table, the SO_2 emission limit for BART is 0.121 lb SO_2/LT pellets, which is the 2-tail, upper 95% predictive limit of the data set.

[4] The Boundary Waters Canoe Area Wilderness is the Class I Area with the greatest impacts from emissions from the United Taconite facility. Results are shown for the entire facility, not just Line 1, and reflect the emission levels after the installation of the heat recoup project on Line 1.
[5] Although the MPCA agrees with United Taconite that these emission reduction methods are not technically feasible, it does not agree with all aspects of United Taconite's rationale.

SO_2 Emission Limit Determination for Line 1 at United Taconite Stack

Test Date	Emission, lb SO_2/LT pellets	Theoretical Normal Distribution
		Upper Prediction level: 0.121 lb/LT
11/21/1997	0.0040	Upper confidence level of the mean: 0.070 lb/LT
12/28/2004	0.0644	(Arithmetic) Mean: 0.030
5/3/2005	0.0190	Lower confidence level: -0.011; reset to 0
5/3/2006	0.0307	Lower prediction level: -0.062 reset to 0

2.4.2 Line 2

The BART analysis submitted by United Taconite proposes existing controls for SO_2 as BART. The MPCA agrees with United Taconite's assessment of technical infeasibility for dry sorbent injection, spray dryer absorption, energy efficiency projects and coal processing for Line 2.[6] However, based on the MPCA's recalculation of baseline emissions and review of submitted materials, the MPCA has determined that reductions of SO_2 are cost-effective, and is not accepting United Taconite's proposal for BART for Line 2.

Baseline Emission Rates

United Taconite burns a blend of eastern coal and petroleum coke in Line 2. At the MPCA's request, United Taconite submitted additional information related to quantities of petroleum coke and coal burned in Line 2 in order to clarify for MPCA staff the sulfur content of the fuel blends and resulting SO_2 emissions.[7] Fuel blends are reported as "weekly averages" because daily fuel samples are combined and analyzed once per week. From 2003 to 2007 fuel blend sulfur content has ranged from 3.74 to 5.14%, increasing each year. When operating at a heat input rate of 260 MMBtu/hr, (the peak hourly heat input rate during April 2001 and June 2004 performance tests), peak actual hourly SO_2 emission rates are 1040 lbs/hr.

This recalculated SO_2 emissions rate is greater than 50% of the hourly SO_2 emission rates of 632 lbs/hr used in the 2006 BART analysis.

BART analysis guidance published by EPA states:

> The baseline emissions rate should represent a realistic depiction of anticipated annual emissions for the source. In general, for the existing sources subject to BART, you will estimate the anticipated annual emissions based upon actual emissions from a baseline period 70 FR 39167.

Because the submitted fuel data indicates to the MPCA that United Taconite routinely elects to blend coal and petroleum coke to operate such that emissions of SO_2 are very near or at the 4.0 lb/MMBtu SO_2 limit in its permit, the MPCA believes it is appropriate to consider the current SO_2 emission limit as the baseline for BART. The baseline emissions rate of 1037 lbs/hr is a realistic depiction of peak hourly emissions for the source, and will be used to assess the cost-effectiveness of control alternatives for SO_2. At this emissions rate, controlled total annual SO_2 emissions are about 3,900 tons. Uncontrolled SO_2 rates are estimated at 5,800 tons per year.

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[6] Although the MPCA agrees with United Taconite that these emission reduction methods are not technically feasible, it does not agree with all aspects of United Taconite's rationale.

[7] Aagenes, Jason. Electronic mail message "Re: Request for coal/coke fuel analysis data" dated March 15, 2007.

Control Technology Alternatives

The U.S. EPA has confirmed the MPCA's position that using a blend of fuel types already in use at the facility to lower sulfur content is not "fuel switching" and therefore should be evaluated; use of cleaner fuel blends is considered to be a BART technology.[8]

United Taconite describes Line 2 as being designed originally to use eastern coals and petroleum coke fuel blends. United Taconite reports they are unable to switch to lower heat content fuel blends (presumably western coal) because more fuel is needed, exceeding the capacity of the existing mill and coal handling equipment. Previous tests appeared to indicate that additional fuel handling, dust suppression and fire suppression equipment would be needed.[9] In addition, this shift would produce additional slagging within the furnace that in past tests has forced shutdowns. United Taconite did not offer a cost related to addressing slagging or installing the additional equipment.

However, shifting entirely away from eastern coals and/or petroleum coke does not appear necessary to achieve substantial SO_2 emissions. United Taconite has in the past used eastern coals with sulfur content less than 1% while having appropriate heat content, resulting in about a 30 percent decrease in SO_2 on a lb/MMBtu basis over current practice. Combining lower sulfur fuel blends with additional scrubbing is also technically feasible. The MPCA offers such an instance in the last alternative in the following table. If the sulfur content of the fuel blend is reduced by 30% and a polishing filter is included, an equivalent reduction in SO_2 is accomplished as if petroleum coke was eliminated entirely.

While United Taconite identified alternative fuels as a technically feasible control technology in the initial BART analysis, it did not evaluate the cost of the alternative. Because United Taconite did not provide the MPCA with an analysis of the costs related to this alternative, the MPCA undertook its own assessment of alternative fuel blends.

<u>Cost estimating procedure</u>

United Taconite provided capital and annual cost estimates for the installation of wet walled ESPs and an add-on wet scrubber in the 2006 analysis. The MPCA and STS Consultants prepared the cost estimate for the replacement scrubber.

The MPCA is investigating potential sulfate contamination of surface waters from discharges at United Taconite's existing operations. Because additional SO_2 scrubbing would likely exacerbate an existing sulfate problem, United Taconite amended its BART analysis by including sulfate removal by reverse osmosis for its wastewater. Other treatment methods are being investigated, but for cost estimating purposes, the RO is being included.

Control equipment costs were re-calculated by changing emission rates in the cost estimate worksheets provided in the original BART analysis.

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[8] Steve Rosenthal, U.S. Environmental Protection Agency Region V. April 9, 2008.
[9] Aagenes, Jason. Letter to Todd Biewen, Minnesota Pollution Control Agency, May 13, 2008.

Sulfur Dioxide Removal Alternatives for United Taconite Line 2

Control Technology	Uncontrolled SO_2 Emissions rate lb/MMBtu	Existing SO_2 Removal Efficiency	Additional Control (BART Analysis, App A)	lb/ MMBtu SO_2	Max hourly emission rate (total) lb/hr	Tons SO_2 Emitted	Tons SO_2 Removed	Total Annualized Cost	$/Ton SO_2 Removed
Existing scrubber	5.32	25%	N/A	3.99	1037	3,900			
WWESP	5.32	25%	80%	0.80	207	780	3,120	$20,291,473	$6,504
Polishing Scrubber	5.32	25%	60%	1.60	415	1,560	2,340	$9,166,715	$3,917
Replacement Scrubber	5.32	N/A	60%	2.13	553	2,080	1,820	$7,107,434	$3,905
Fuel Blend Changes	2.26	25%	N/A	1.70	442	1,660	2,240	$1,341,482	$599
Fuel Blending + Polishing Scrubber	2.26	25%	60%	0.68	176	663	3,237	$9,650,715	$2,981

The table above identifies the alternatives for controlling SO_2 and their associated emissions rate. It appears that all alternatives are cost effective. However, because compliance that relies on fuel blends would be accomplished without additional construction, thus be implemented more quickly, and avoids further degradation of water quality, the MPCA believes it is appropriate to base the BART determination on this consideration.

Visibility Improvement

The MPCA completed visibility modeling to show the impact of BART compared to the emissions from the facility modeled in the 2002 base year modeling. Two years of meteorology were modeled, 2002 and 2005. The results are shown below.

Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	59	44	-15	32	20	-12	8	1	-7
	2005	40	24	-16	22	11	-11	3	2	-1
	'02 & 05	99	68	-31	54	31	-23	11	3	-8
98th Percentile Δ dv	**2002**	3.0	1.7	-1.3	1.8	0.8	-0.9	0.6	0.3	-0.3
	2005	1.5	1.1	-0.4	1.0	0.7	-0.3	0.4	0.2	-0.2
	'02 & 05	3.1	1.9	**-1.2**	1.9	1.1	**-0.8**	0.6	0.3	**-0.3**

2.5 MPCA Determination of the BART SO_2 Limit

As described above, the MPCA has determined that the BART limit of 0.121 lb SO_2 per long ton of pellets is appropriate for United Taconite's Line 1 indurating furnace. Measurement of the limit will be through tracking fuel use and production. This limit is a 30-day rolling average.

The BART limit for Line 2 is 1.7 lb SO_2/MMBtu heat input. This SO_2 limit can be met through modifying fuel blends; however, it could also be accomplished through use of additional air pollution control equipment. This limit is a 30-day rolling average, using SO_2 flue gas monitors. The emissions limit can be met through fuel changes, additional air pollution control equipment, or a combination of both.

Following EPA approval of the MPCA's regional haze State Implementation Plan, at the next opportunity for permit amendment or reissuance the MPCA will add the citations to United Taconite's air quality permit that the above permit requirements also satisfy the MPCA's Best Available Retrofit Technology determinations for this unit.

2.6 BART Alternative

As indicated in the Regional Haze SIP, the MPCA's determination of a specific BART limit does not preclude facilities from proposing alternatives to BART as they work towards BART compliance. This section of the BART memo further elaborates what the MPCA would consider as acceptable BART alternatives, subject to EPA approval of Minnesota's Regional Haze SIP and BART determinations.

United Taconite may choose to propose a BART Alternative project that is equivalent or better than BART. The BART Alternative must result in equivalent or greater emissions reductions and visibility benefits from the facility when compared to the MPCA's BART determination.

Should United Taconite choose to propose a BART alternative, the proposal must include:

- A demonstration of equivalent or greater combined annual emission reductions of NO_X and SO_2 (in tpy) than that established in this BART determination;
- Appropriate visibility modeling demonstrating equivalent or greater visibility protection than the MPCA's BART determination; and
- A proposal for enforceable emission limitations, with appropriate and justified averaging periods and methods for evaluating compliance.

Since the facility would be proposing an alternative to MPCA's BART determination, visibility modeling should follow the MPCA's *Guidance for Facilities Conducting a BART Analysis*[10] and *Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject-to-BART in the State of Minnesota*,[11] using the most recent versions of any model or EPA guidance referenced in those documents. The modeling should compare the baseline, pre-control scenario

[10] http://www.pca.state.mn.us/publications/aq-sip2-09.pdf

[11] http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

to post-control scenarios representing the MPCA's BART determination and the BART alternative being proposed by the facility.

United Taconite may propose a BART alternative that covers multiple BART units or both BART and non-BART units at the facility in the same source category. A proposal covering BART and non-BART units must demonstrate greater emission reductions and more visibility improvement than MPCA's BART determination. The MPCA would evaluate this proposal in consultation with the Federal Land Managers and determine if it is an acceptable BART alternative. If the MPCA accepts the proposal as such, the resulting emission limits would be placed in the facility's permit and noted as BART emission limits. Ultimately, EPA approval of an enforceable document (such as a Title V permit) containing BART emission limits will be necessary.

<u>Appendix</u>

Detailed Cost Analysis to Enhance Sulfur Dioxide Removal For Scrubbers Installed on Line 2 Taconite Grate Kiln at United Taconite LLC

July 30, 2007
Minnesota Pollution Control Agency

Basis for analysis
This cost analysis is based on the wet scrubber analysis prepared for the Minnesota Pollution Control Agency (MPCA) by the Minnesota Department of Natural Resources (MDNR). The results of this evaluation indicate that the United Taconite (UTAC) Line 2 system is the only Minnesota taconite induration scrubber system installation where it is feasible to increase sulfur dioxide (SO_2) collection efficiency through process modifications or replacement of an existing scrubber. Scenarios reviewed in the MDNR analysis included: (1) the use of the reagents sodium hydroxide or sodium carbonate in scrubber water, (2) installing lime addition to the existing scrubber water recirculation system and (3) installation of a new re-circulating lime scrubber similar to the Keewatin Taconite scrubber system.

The scope of the scrubber retrofit project and cost estimate was prepared initially by STS Consultants (STS). MPCA reviewed the scope of the assumed project and the cost estimate, and made adjustments to the estimate in consultation with STS. This written documentation was completed by MPCA staff. United Taconite was consulted on this analysis but not all comments made by United Taconite were incorporated in this analysis.

Site Visit
STS inspected United Taconite's existing scrubber system in spring 2007 and evaluated its suitability for lime addition SO_2 control and availability of space to install a new retrofit lime scrubber system.

The results of the site visit are as follows:

<u>Existing Scrubber System</u>
The installed particulate scrubber system uses two identical parallel scrubber systems to control particulate exhaust emissions from the grate kiln. Each scrubber system has a dedicated "wet" ID fan discharging to a single system stack. Each scrubber system consists of two modified Ducon model "VVO'S" venturi throat scrubbers discharging tangentially, 180 degrees apart into a single cylindrical scrub water droplet separator or mist eliminator. Each Ducon venturi was initially installed with swing door or "bomb bay" style adjustable venturi throat. These bomb bay mechanisms have been replaced with venturi rods. The separator was initially designed to use redwood slat mist elimination blades or vanes which were replaced with 3 pass metal 316 stainless steel chevron vanes in the 1980's. These vanes are now being retrofitted with higher efficiency sinusoid style thermoplastic vanes.

Spent scrub water is treated in each system by a dedicated thickener. The overflow from the thickeners is returned to the scrubbers with the system make up water. Thickener underflow is sent back to the process for further recovery of iron. System scrub water blow down is used to control suspended solids in the scrub water to minimize abrasion wear in the scrubber.

Potential location for retrofit scrubber system
The existing system installation is very compact and does not permit the installation of any required intermediate system flue gas components such as mechanical collectors between the kiln and existing scrubbers. Moreover, the existing location does not have the area available for retrofitting a recirculation scrub water system. For the retrofit scrubber system cost analysis, an area just outside the West end of existing building in the location of the existing stack was assumed to be available for the new system installation.

Due to the environmental issues which will result from the use of sodium based reagents, costing for scenario (1) was not examined as a feasible alternative in this cost estimate. Scenario (2) was also not examined as a feasible alternative because the operating chemistry required for this system and the inherent design of the existing scrubbers will cause severe scrubber internal chemical scaling likely rendering the system inoperable. This estimate is for scenario (3), a new lime scrubber system.

Replace existing scrubber with a new recirculating lime scrubber system
The design basis for this recirculating lime scrubber system is similar to that of the Keewatin Taconite scrubber system and requires the use of a mechanical collector upstream of the scrubber to remove enough particulate from the gas stream to permit scrub water recirculation to conserve reagent (lime), prevent calcium scaling, and prevent abrasion wear from the recirculated collected particulate in the scrub water.

The cost analysis for this scenario assumes that a new scrubber system is installed in the area downstream of the kiln in the location presently taken by the existing scrubber system fan, scrubber and stack. The footprint requirements of this new system will require the existing building to be extended to the West in the area presently occupied by the existing system stack.

Retrofit system design data
Volume (total two scrubbers): 600,000 ACFM
Pressure (at scrubber inlet): 16” W. C.
Inlet flue gas temperature: 110 °F
SO_2 inlet: 140 ppm
Lime use: 608 lb/hr
SO_2 Collection efficiency: Approximately double existing rate @ 50%

Design
The scrubbing equipment required for the new system presented in the cost analysis is as follows:

- Mechanical Collector/multi tube cyclone
- Venturi Rod scrubbers (two for parallel operation required)
  - Materials of construction:
    - Monolithic lined carbon steel (vinyl ester)
    - AL 6XN alloy
    - Rubber lined internal components
    - Ultem plastic internal mist eliminator components
    - Ceramic lined internal components
    - Stellite scrub liquor nozzles

- System ID fans and motors (two required)
  - Kiln/mechanical collector/scrubber induced draft fan systems, single dry fan replacement for each of the wet fans 2A and 2B to provide additional pressure drop for mechanical collector and scrubber SO_2 scrubbing. Fans will be located downstream of the new mechanical collector.

  - Ductwork
    - Carbon steel ductwork to connect kiln discharge to new mechanical collectors, mechanical collector discharge to new induced draft fan inlets and fan outlets to scrubber inlets. All ductwork insulated and lagged.
    - Lined carbon steel ductwork/stack breaching to connect scrubber discharges to stack. Carbon steel ductwork designed and fabricated to receive field installed monolithic vinyl ester lining for corrosion protection.

  - Scrub water recirculation system
    - Monolithic vinyl ester lined recirculation tank
    - Warman rubber lined pumps, operating and standby; each scrubber system
    - Rubber lined recirculation piping
    - Alloy and rubber lined valves and specialties

  - Scrubber mist eliminator wash tank system
    - Monolithic vinyl ester lined recirculation tank
    - Warman rubber lined pumps, operating and standby; each scrubber system
    - Rubber lined recirculation piping
    - Alloy and rubber lined valves and specialties

  - Scrub liquor settling and treatment system
    - Cone thickener with filter press
    - Monolithic lined vessel and launders with rubber covered rake system

  - Lime storage and feed system

- Instrumentation and controls including the following
    - Program logic control system
    - Nuclear densitometer
    - System RTD temperature elements
    - Differential pressure transmitters
    - Tank level sensors
    - Pressure sensors and transmitters

- System Stack
    - Carbon steel monolithic vinyl ester lined

- Lot structural steel and supports for scrubber system components

- Foundations

- Scrubber system building

It is assumed that this installation is planned to occur during major scheduled outages.

Capital and Annual Operating Costs

The system operating and installation costs are displayed on the attached spreadsheet.

This spreadsheet was prepared from a sample spreadsheet transmitted to STS from the MPCA for the purpose of this cost analysis with missing formulations input from the "EPA Air Pollution Control Cost Manual", sixth edition".

Estimates for pollution control equipment purchase and installation were computed using actual costs from recent system installations completed by STS on Grate Kiln particulate/ SO_2 scrubbing systems. This estimate reflects most current pricing, therefore is a reliable budgetary estimate (+/- 30%).

A retrofit contingency factor of 25% of total capital costs has been included. This contingency factor has been selected to account for construction items that must be included in the project costs, but were not called out in the spreadsheet provided by the MPCA. For example, the contingency factor includes site clearing and equipment tie-in, as well as some amount to account for unanticipated site conditions. Because many site-specific issues are already accounted for in this cost estimate, a 25% retrofit contingency factor is appropriate for this budgetary estimate.

Annual costs include required labor, chemical and energy purchase, maintenance supplies. The annual costs include a line item for lost ore due to landfilling of sludge generated from scrubber water treatment.

Capital and annualized costs for the SO_2 control alternatives are described below. The cost estimates for installing an additional (polishing) scrubber are included for comparison. These estimates where prepared by Barr Engineering for Utac's BART analysis submitted to the

MPCA in September 2006. (See http://www.pca.state.mn.us/publications/bart-facility-unitedtaconite.pdf .)

The overall SO_2 control efficiency is estimated to be 50% for the new system. However, the existing particulate control system has an assumed SO_2 control efficiency of about 25%. Thus, a 33% control efficiency was assumed to reflect the additional removal achieved beyond baseline (the control efficiency currently being achieved). The replacement of the existing scrubber with a recirculating lime scrubber would not only improve the SO_2 removal efficiency but the PM_{10} removal efficiency as well. In the BART analysis performed by Barr, a polishing scrubber specifically designed to remove SO_2 is added after the existing particulate scrubber and a control efficiency of 60% beyond baseline is assumed.

	Total Capital Cost	Total Annual Operating Costs (no CR)	Total Annualized Cost	Tons SO2 Removed	Additional control (over current control)	Cost per Ton SO2 removed
Retrofit New Recirculating Lime Wet Venturi Scrubber (STS/MPCA)	$ 45,732,000	$ 1,228,102	7,107,434	1078	33%	$ 6,592
Install Polishing Scrubber (Barr)	$ 28,067,000	$ 1,896,070	$ 5,545,472	1650	60%	$ 3,361

Co-Benefits from New Recirculating Scrubber

Other pollutants are controlled to some extent with the installation of a recirculating scrubber. Based on performance at Keewatin Taconite, the MPCA estimates that installing a recirculating scrubber with lime treatment could lower total mercury emissions by 30% from Line 2.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : January 22, 2008

TO : AQD File No. 26A, 62B, 257, 541, 869A, 27A

FROM : Richard Cordes, P.E.
Senior Engineer
Metallic Mining Sector
Industrial Division

PHONE : (651) 757-2291

SUBJECT : Particulate Matter BART Determinations for US Steel Corporation – Minntac, US Steel - Keewatin Taconite, ArcelorMittal Minorca Mine Inc., Hibbing Taconite Company, United Taconite LLC, and Northshore Mining- Silver Bay

Note: Separate SO_2 and NO_X BART determinations for the subject-to-BART emission units at these facilities are contained in other memoranda to this file.

This memo was prepared to provide the documentation of the MPCA's PM BART determination based on the technical review performed by MPCA staff. Public notice and comment and EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Applicant and Stationary Source Locations:

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
U.S. Steel Corp. – Minntac P.O. Box 417 Mountain Iron, MN 55768	U.S. Steel Corp. – Minntac 8819 County Highway 102 Mountain Iron; St. Louis County
Contact: Chrissy Bartovich; Phone (218) 749-7364	

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
U.S. Steel – Keewatin Taconite P.O. Box 217 Keewatin, MN 55753-0217	U.S. Steel – Keewatin Taconite 1 Mine Road Keewatin; St. Louis County
Contact: Ryan Siats; Phone: (218)778-8684	

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
ArcelorMittal Minorca Mine Inc. P.O. Box 1 Virginia, MN 55792-0001	ArcelorMittal Minorca Mine Inc. 5950 Old Highway 53 N Virginia; St. Louis County
Contact: Jaime Bagenstoss; Phone (218) 749-5910 x283	

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
Hibbing Taconite Company P.O. Box 589 Hibbing, MN 55746-0589	Hibbing Taconite Company Highway 5 N Hibbing; St. Louis County
Contact: Andrea Hayden; Phone (218) 262-6856	

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
United Taconite LLC P.O. Box 180 Eveleth, MN 55734-0180	United Taconite LLC Highway 16 Forbes; St. Louis County
Contact: Jason Aagenes; Phone (218) 744-7803	

Applicant/Mailing Address	Stationary Source (SIC: **1011**)/Address
Northshore Mining Company 10 Outer Drive Silver Bay, MN 55614	Northshore Mining Company 10 Outer Drive Silver Bay, MN 55614
Contact: Scott Gischia; Phone (218) 226-6076	

1.2 Description of the PM Emissions and PM Regulation for the Taconite Industry in General

Taconite is a rock bearing from 15 to 30 percent magnetic iron particles (magnetite). The iron ore is mined in an open pit, and reduced in size by a series of crushers until it has a powdery consistency. Iron oxide concentrate is separated magnetically, while the remaining portion of the mined ore (tailings) is sent to a tailings disposal basin. Limestone and/or dolomite (fluxstone) is added to the concentrate and the mixture is formed into round "green balls" (pellets) in a balling drum. The green balls are heat hardened in an indurating process. Finished taconite pellets are stored for transport to blast iron furnaces.

Sources of particulate matter in the production of taconite pellets include emissions from ore crushing and handling emission units, ore dryer stacks, indurating furnace stacks, finished pellet handling emission units, pellet coolers, and fugitive dust emissions from stockpiles, material transfer points, plant roadways, tailings basin, pellet loading areas and yard areas.

EPA published the final rule ("National Emission Standards for Hazardous Air Pollutants for Taconite Iron Ore Processing") on October 30, 2003.[1] (See 68 FR 61867.) The promulgated Maximum Achievable Control Technology (MACT) rule established particulate matter emission limits from process stacks for both existing and new taconite iron ore facilities. The particulate matter emission limits are a surrogate for the air toxic emissions targeted by this rule. The requirements of the rule are based on the equipment and procedures in place at well-controlled taconite ore processing facilities. All vented emissions of particulate emissions are required to have some form of control except for the pellet coolers. The preamble to the final rule explains EPA's rationale for not requiring additional control of the pellet coolers.

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[1] The final rule, 40 CFR 63, subp. RRRRR can be found at http://www.epa.gov/ttn/atw/taconite/fr30oc03.pdf.

The final standards for fugitive dust sources are in the form of work practice and operating standards. Performance tests are also required at least twice during each 5-year permit term for a control device applied to indurating furnaces. Existing facilities were required to comply with the rule by October 30, 2006.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facilities identified in this Memorandum were found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

The MPCA published a proposed BART implementation strategy in the *State Register* on September 6, 2005. In the strategy the MPCA proposed to:

> "streamline the analysis of PM and VOC sources subject to MACT standards in a BART determination. The MPCA agrees with U.S. EPA's assertion that it is unlikely that states will identify controls more stringent than the MACT standards without incurring much higher costs. Therefore, the MPCA intends to rely on MACT standards to represent BART level of control for those visibility-impairing pollutants addressed by the MACT

> standard unless there are new technologies subsequent to the MACT standards, which would lead to cost-effective increases in the level of control. For example, if a BART-eligible emissions unit emits PM_{10} and NO_x and the unit is subject to a MACT limit for PM_{10}, then a full BART analysis need only address NO_x."

No adverse comment was received on this approach. The strategy and the MPCA's response to comments received on the strategy are available at: http://www.pca.state.mn.us/air/regionalhaze.html.

2.2 Affected Units

The BART-eligible units that emit PM and were eligible for a streamlined BART analysis are listed in Table 3-1 of each facility's BART analysis.[2]

2. 3 The BART Analysis and BART Determination

MPCA in its BART analysis guidance to the facilities stated it "will rely on MACT standards to represent BART level of control for those visibility impairing pollutants addressed by the MACT standard unless there are new technologies subsequent to the MACT standard, which would lead to cost-effective increases in the level of control.[3]" Since the MACT standard was established in 2003, the MPCA has determined the technology analysis is up-to-date. As a result, the MPCA has determined that BART will be equivalent to MACT for PM emitting sources.

The taconite MACT regulates PM emissions from Indurating Furnaces, Ore Crushing and Handling operations and from Finished Pellet Handling operations No further analysis was required by the MPCA to establish BART for units or process that emitted only PM.

The MACT standard also regulates fugitive sources of PM:

- Stockpiles (includes, but is not limited to, stockpiles of uncrushed ore, crushed ore, or finished pellets),
- Material Transfer Points,
- Plant Roadways,
- Tailings basins,
- Pellet loading areas, and
- Yard areas.

Control of emissions from these fugitive PM sources is maintained through a fugitive control plan, as required by the MACT standard. The fugitive control plans consist of monitoring, primary controls, and contingent measures to prevent or mitigate fugitive PM emissions. The controls and measures are site specific and are appropriate to seasonal and weather conditions. Since the MACT standard was established in 2003 and became effective in 2006, the technology analysis is up-to-date. Again, for the units subject to a MACT standard, BART is determined to be equivalent to MACT by the MPCA.

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2 The BART analyses for each of the six taconite facilities are available at http://www.pca.state.mn.us/air/regionalhaze.html.

3 The MPCA's BART Analysis Guidance (Attachment 2, March 2006, page 2) is available at http://www.pca.state.mn.us/air/regionalhaze.html.

Three of the six facilities have pellet coolers. Pellet cooler PM emissions are excluded from additional control under the MACT due to “the large size of the particles and the relatively low concentration of particle emissions.” (FR 77570) Given the physical characteristics of the particles and low concentration, the MPCA has determined that the pellet coolers have negligible impact on visibility and no additional analysis is necessary to establish BART. BART is existing limits and operational requirements for these units.

Some sources of PM emissions and sources of fugitive PM are not subject to a MACT standard, including units such as bentonite storage and handling, concentrate storage and handling, additive storage and handling, and coal or solid fuel storage and handling. Emissions from these sources are typically a few percent of total facility PM emissions. The point source emission units, such as bentonite storage, are typically controlled by either baghouses or scrubbers, which are technologies that achieve high levels of control for PM. Since these units already have control equipment for PM emissions, and since the PM emissions from these sources is small relative to the total PM emissions that are subject to the BART standard, the MPCA has determined that additional control of these sources would have minimal impact on visibility improvement in Class I areas. Therefore the MPCA has determined that existing operations represent BART and that the MPCA does not need to establish new BART emission limits for these units. The fugitive sources are addressed by each facility’s Title V fugitive control plan and therefore the existing fugitive control plan is BART for these sources.

2.4 MPCA Determination of the BART Limit

Following EPA approval of the MPCA’s regional haze State Implementation Plan, at the next opportunity for permit amendment or reissuance the MPCA will add the citations to each facility’s air quality permit that the existing PM limits for each BART-eligible unit (listed in Table 3-1 of each taconite facility BART analysis) also satisfy the MPCA’s Best Available Retrofit Technology determinations for these units.

Appendix 9.4: BART Determinations by MPCA – EGU

This Appendix contains the MPCA's BART determinations for subject-to-BART EGUs.

In initial BART work, the MPCA determined that CAIR substitutes for BART for EGU SO_2 and NO_X emissions. Beginning in 2009, CAIR caps emissions of SO_2 and NO_x from EGUs in many Eastern states. EPA has found that, as a whole, CAIR improves visibility more than implementing BART in states subject to the Clean Air Interstate Rule. If a state determines that CAIR substitutes for BART, then BART-eligible EGUs are not required to install, operate and maintain BART for NO_X and SO_2 control.

Prior to determining that CAIR substitutes for BART, the MPCA required BART analyses from several EGU sources. BART analyses were required for several reasons. First, although EPA determined that CAIR as a whole is better than BART for NO_X and SO_2, preliminary MPCA modeling predicted only slight improvement for Minnesota's Class I areas in 2018 as a result of implementing CAIR. In addition, EPA clarified that all BART-eligible EGUs, regardless of CAIR status, should submit a BART analysis if they are found by the state to be subject to BART. Even if a state determines that CAIR substitutes for BART, a BART determination is still needed for PM emissions.

Finally, during the Regional Haze SIP development process, there were ongoing legal challenges to both the CAIR rule as a whole and to Minnesota's inclusion in the CAIR region. Knowing it was possible that eventually CAIR would not apply to Minnesota, the MPCA requested BART analyses. Several commenters on the draft Regional Haze SIP felt that this legal uncertainty made it important for Minnesota to make BART determinations for EGUs. The MPCA has agreed with these commenters; in addition, EPA has issued a proposed rule to stay application of CAIR in Minnesota.

The MPCA has therefore proceeded with BART determinations for subject-to-BART EGUs.

BART Process

The MPCA requested BART analyses from BART-eligible EGUs that were found through modeling to be subject-to-BART. Facilities were directed that the BART analysis should include direct emissions of PM as well as emissions of SO_2 and NO_X, and that the BART analysis was requested to provide the MPCA with additional information about control costs and relative visibility improvement.

If an EGU was scheduled for future emissions reductions, a BART analysis was not requested by the MPCA if all of the following criteria were met:

- The MPCA had sufficient information about planned emission reductions at the time facilities were notified that they were subject to BART;
- Public Utility Commission (PUC) approvals for the reductions were in place; and
- The MPCA determined that planned emission reductions likely represented presumptive BART.

Throughout 2006 and 2007, the MPCA acquired more information from utilities on planned controls; these indicate high levels of emission reductions are planned.

The following table shows which of the BART-eligible EGUs the MPCA found to be subject-to-BART[158] and which facilities were requested to submit BART analyses. BART analyses were not requested for units where planned upgrades were known and underway.

[158] For more information about the modeling performed to determine subject-to-BART units, see Appendix 9.2

Table 9.4.1: Subject-to-BART EGUs

BART-Eligible Facility	Unit(s) Subject-to –BART?	BART Analysis Requested?	Comments
Cleveland Cliffs – Northshore Mining Silver Bay Power Boiler 2	Y	Y	
Minnesota Power Boswell 3	Y	N	MPCA had sufficient information about planned controls for NO_X, PM and SO_2
Minnesota Power Taconite Harbor 3	Y	Y (PM only)	MPCA had sufficient information about planned controls for SO_2 and NO_X
Xcel Energy Riverside 8	Y	N	MPCA had information about Xcel's plans to replace Boiler 8 with a natural gas fired unit
Xcel Energy– Sherburne County 1,2	Y	Y	
Ottertail Power- Hoot Lake 3	N	N	CALPUFF modeling performed by the MPCA showed Unit 3 did not cause or contribute to haze using a 0.5 deciview threshold
Rochester Public Utility- Silver Lake 3, 4	Y	N	MPCA had sufficient information about planned controls for NO_X and SO_2. CALPUFF modeling of units 3 and 4 together were marginally over the 0.5 deciview threshold.

The MPCA initially requested BART analyses from several sources to enable us to determine if PM limits should be established for subject-to-BART EGU. PM BART analyses were requested and received from three facilities that were found to be subject-to-BART:

Table 9.4.2: EGUs BART Proposals for PM

Facility	Existing PM controls	Proposed BART	Reasoning
Xcel – Sherburne County 1,2	Wet scrubber/ Wet ESP	Existing permit limits	No technology would significantly improve the particulate control from current levels. As $/ton pollutant controlled is $75-82,000/ton, no new controls proposed for PM10.
Minnesota Power - Taconite Harbor 3	Hot-side ESP	Retrofit to cold-side ESP at capital cost of $4 million (permitted at 0.3lb/MMBtu but emits at 10% of that)	Relative small total visibility impact (on order of 0.1 Δ dv from existing PM emissions vs. 1.5 Δ dv from unit)
Northshore - Boiler 2	Baghouse	0.6 lb/MMBtu (existing permit limit)	Additional PM controls are not economically justified ($60-80,000/ton PM10 removed) and provide negligible deciview reductions

Although Xcel's Allen S King facility and Minnesota Power's Boswell 3 were also potentially subject-to-BART based on their 2002 emissions, they were not asked to submit a BART analysis for PM since they are installing BACT-like PM controls. Rochester Public Utilities Silver Lake's units 3 and 4 were on the threshold of subject-to-BART applicability with all three visibility-impairing pollutants modeled, therefore no BART analysis for PM was requested. (In addition, an emission reduction project at Silver Lake's Unit 4 was permitted in September 2007.)

Most states and RPOs have looked at the visibility impact from the direct PM emissions and determined that a PM limit should be set only if visibility impact is above a certain threshold. Typically, the visibility impact from direct PM emissions is much less than that of the NO_X and SO_2 emissions.

MPCA staff performed an analysis of the impact of direct PM emissions from our potentially subject to BART facilities. Results are summarized in the following table.

Table 9.4.3: Visibility Impact of Direct PM Emissions

Facility	Maximum Δ dv 98th Percentile Impact at VNP from PM	Maximum Δ dv 98th Percentile Impact at BWCAW from PM
Sherco 1,2	0.039	0.047
MP- Tac Harbor 3	0.004	0.078
Northshore Boiler 2	0.160	0.160
Boswell 3	0.048	0.047
RPU Silver Lake 3, 4	0.004	0.005

Since the modeling shows that the direct PM emissions have negligible visibility impact (the 98th percentile change in impact is less than 0.2 deciview for all facilities) and the cost of the controls per ton of pollutant controlled as demonstrated in the PM BART analyses submitted is significant ($60,000/ton or greater) then an evaluation of these factors along with the remaining useful life, non-air and energy impacts does not justify establishing a BART PM limit.

In addition, all of these units have existing PM controls in place and three of the five facilities have plans to further upgrade their PM controls. Taconite Harbor unit 3 will be upgrading their PM controls as part of the voluntary emissions reduction project for the units at that facility.[159] Boswell 3 is installing BACT-like PM controls as part of its voluntary emission reduction project for that unit.[160] RPU will be replacing existing ESPs with fabric filters for PM control as part of an emission reduction project.

The remainder of this Appendix contains memoranda documenting the MPCA's BART determinations for the five EGUs.

[159] MPCA, *Minnesota Power's Arrowhead Regional Emissions Abatement (AERA) Project*.
[160] MPCA, *Minnesota Power's Boswell 3 Emissions Reduction Plan*.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 26, 2009

TO : AQD File No. 73B
(Delta ID No. 06100004)

FROM : Anne Jackson, P.E.
Environmental Analysis and Outcomes Division

PHONE : (651) 757-2460

SUBJECT : BART Determination for Minnesota Power Boswell Unit 3

This memo was prepared to provide the documentation of the MPCA's BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Stationary Source Location:

Mailing Address	Stationary Source (SIC: **4911**)/Address
30 W. Superior St. Duluth, MN 55802	Minnesota Power- Boswell Energy Center 1210 3rd Street North Cohasset, Itasca County, MN 55721-4763
Contact: Mr. Brandon Krogh (218) 723-3954	

1.2 Description of the Facility

The Boswell Energy Center (BEC) is an electric generating facility located adjacent to the Mississippi River in Cohasset, Minnesota. This electric power facility contains steam generating boilers; emergency generators; cooling towers; coal receiving, handling, and storage facilities; and ash handling and storage capabilities. The boilers are coal-fired and have a combined net generating capacity of approximately 1025 megawatts.

All operations and equipment within the facility boundary are established to: (1) provide electrical power for on and off-site utilization; (2) provide fuel for electrical power production or support activities; (3) monitor and control air pollutants generated from electrical power production; (4) handle waste energy, wastes, materials produced from the on-site operations; and (5) provide support activities.

Power generation occurs by steam generated from four boilers. Units No. 1, 2 and Unit 3 discharge emissions to the atmosphere through a common 700-foot stack (Stack 3). Under emergency and testing conditions, Units 1 and 2 can also discharge to a separate 250-foot stack (Stack 1). Unit 4 discharges air emissions from a 600-foot stack (Stack 4).

Units 1 and 2 are wall-fired; Units 3 and 4 are tangential fired. The primary fuel for the boilers is sub-bituminous coal. Boilers 1 through 4 can also combust petroleum-derived waste oils (generated within the Minnesota Power system), petroleum distillate solvents, oily sorbents, boiler cleaning agents (generated onsite), wastewater treatment plant sludge, and various oily materials.

The fuels used for emergency power generation are liquid propane and diesel fuel (distillate fuel oil). Distillate fuel oil is also used for startup on Boilers 1 through 4. Emergency electric power can provide energy to the boilers. They are fired by liquid propane and diesel fuel.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA.[1]

The MPCA requested BART analyses from BART-eligible EGUs that were found through modeling to be subject-to-BART. Facilities were directed that the BART analysis should include direct emissions of PM as well as emissions of SO_2 and NO_X, and that the BART analysis was requested to provide the MPCA with additional information about control costs and relative visibility improvement.

If an EGU was scheduled for future emissions reductions, a BART analysis was not requested by the MPCA if all of the following criteria were met:

- The MPCA had sufficient information about planned emission reductions at the time facilities were notified that they were subject to BART;
- Public Utility Commission (PUC) approvals for the reductions were in place; and

[1] See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.

- The MPCA determined that planned emission reductions likely represented presumptive BART emissions levels.

Throughout 2006 and 2007, the MPCA acquired more information from utilities on planned controls being undertaken voluntarily. These indicate high levels of emission reductions are planned, many of which meet the BART requirements. The MPCA will continue to evaluate post-BART strategies for all EGUs to meet reasonable progress goals.

2.2 Affected Units

One unit at the facility is subject to BART:

Table 1. Subject to BART Units

Emission Unit Name	EU Number[2]	Control Equipment and Stack Numbers
Power boiler 3	EU003	CE 012 Wet Scrubber - High Efficiency CE 019 Modified Furnace or Burner Design CE 020 Catalytic Reduction CE 021 Fabric Filter - High Temperature, i.e., T>250 Degrees F CE 022 Wet Limestone Injection SV003

2.3 The BART Analysis

The EPA's BART *Guidelines* assert that States may streamline the BART analysis in cases where the sources are subject to other Clean Air Act requirements, such as MACT standards, section 111(d) standards, or NSR/PSD determinations, particularly when the technology determinations under these programs are relatively recent.[3] The BART *Guidelines* also state that if a source has undergone "a major modification that resulted in the installation of controls, the State will take this into account during the review process and may find that the level of controls already in place are consistent with BART."[4]

As the MPCA began determining subject to BART sources, Minnesota Power was in the process of installing BACT-like controls for NO_X, SO_2, and PM on Unit 3 with construction beginning in 2007. The project consists of retrofitting Unit 3 with Low NO_X burners, over fire air and selective catalytic reduction for nitrogen oxides control; a baghouse filter for particulate and mercury control; and a wet flue gas desulfurization (FGD) for SO_2 control. Combustion controls will be installed and/or updated for CO control. Prior to the project, the only control equipment serving the boiler was a wet scrubber for particulate emissions. Startup of the new controls is planned for the first quarter of 2010.

In determining what controls to install, Minnesota Power evaluated several control technologies through a BACT analysis process.

For SO_2, a wet scrubber with alkali injection and dry scrubbing were identified as technically feasible controls.

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[2] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.
[3] 40 CFR 51, Appendix Y, IV.C.
[4] 40 CFR 51, Appendix Y, II.A.2

Table 1. SO_2 Control Options

Control Technology	Control Efficiency	Energy Impacts	Non-Air Quality Environmental Impacts
Wet Scrubber with Alkali Injection (FGD)	80 to 95%	Increased Electrical Power Usage	Reagent Handling and Increased Wastewater
Dry Scrubbing – Spray Dryer	73% - 94.5%	Increased Electrical Power Usage	Increased Solid Waste

Minnesota Power proposed a wet scrubbing system with an emission rate of 0.09 lbs/MMBtu as the appropriate BACT/BART controls. The proposed emission rate is equivalent to the lowest value found in the RBLC database at the time of the analysis and is lower than the lowest value found for a dry system.

For NO_X, Minnesota Power identified the following six control technologies as feasible:

Table 2. NO_X Control Options

Control Technology	Control Efficiency	Energy Impacts	Non-Air Quality Environmental Impacts
Selective Catalytic Reduction (SCR)	75 to 85%	Increased Electrical Power Usage	Catalyst Disposal and Reagent Handling
Selective Non-Catalytic Reduction (SNCR)	30 to 60%	Increased Electrical Power Usage	Reagent Handling
Low NO_x Burners	35 to 55%	Negligible	None
Over-Fire Air	20 to 30%	Negligible	None
Flue Gas Recirculation	15 to 30%	Negligible	None
Good Combustion Practice	10 to 20%	Negligible	None

Minnesota Power proposed a combination of in-boiler modifications (overfire air and low NO_x burners) and SCR with an emission rate of 0.07 lbs/MMBtu as BACT/BART. SCR is the highest ranking technology, and the proposed emission rate is very close to the lowest value in RBLC database for existing units at the time of the analysis (proposed value of 0.07 compared to 0.067 lbs/MMBtu).

For PM control, Minnesota Power identified the following available control technologies:

Table 3. PM/PM_{10} Control Options

Control Technology	Control Efficiency*	Energy Impacts	Non-Air Quality Environmental Impacts
Fabric Filters	>99%	Minimal Electrical Power Relative to ESPs	Increased Solid Waste
Dry Electrostatic Precipitators (ESPs)	95%	Increased Electrical Power Usage	Increased Solid Waste
Wet ESPs	95%	Increased Electrical Power Usage	Increased Wastewater
Wet Scrubbers	90%	Minimal Electrical Power Relative to ESPs	Increased Wastewater
Cyclones	30-80%	Minimal Relative to Others	Solid Waste is generated

Minnesota Power proposed a fabric filter as BACT/BART, with an emission limit of 0.014 lbs/MMBtu for filterable PM as an emission limit. The proposed emission rate is very close to the most comparable limit in the RBLC database for a unit where dry solid injection is planned (proposed value of 0.014 compared to 0.013 lbs/MMBtu).

The following table shows the controls installed along with the tons reduced, percent emission reduction, and resulting emission rate achieved and permitted for each of the installed controls, along with the cost-effectiveness of the controls.

Table 4. BACT/BART Controls Installed

Control Technology	Tons Reduced (tpy)	Emissions reduction (%)	Emission Rate (lbs/MMBtu)	Total Annualized Cost	$/Ton Pollutant Reduced
LNB/OFA/SCR for NOx Control	3,904	81%	$\leq$ 0.07	$12,497,622	$3,201
FGD for SO_2 Control	10,934	90%	$\leq$ 0.09	$17,933,022	$1,640
Fabric Filter for PM Control	2,525	93%	$\leq$ 0.014	$6,388,378	$2,530
PM_{10} Only	820	65%	$\leq$ 0.035	N/A	N/A

EPA's BART *Guidelines* assert that if a State finds that a BART source "has controls already in place which are the most stringent controls available" or "if a source commits to a BART determination that consist of the most stringent controls available" then it is not necessary to complete each of the steps in the BART analysis.[5] The emissions limits and control equipment that Minnesota Power has recently installed are consistent with Federal New Source Review Best Available Control Technology (BACT) requirements, and in all cases Minnesota Power chose the "top" technology available.

In addition, the NO_X limit of 0.07 lbs/MMBtu and the SO_2 limit of 0.09 lbs/MMBtu both exceed the presumptive BART limits for coal-burning tangential fired units established in the BART *Guidelines*.

The MPCA issued Air Emission Permit No. 06100004-003 on March 28, 2007 that allowed Unit 3 to be retrofitted with the controls shown above, and incorporating the corresponding emission limits. The total facility potential to emit pre and post-modification is shown below.

Table 5. Total Facility Potential to Emit Summary[6]

	PM tpy	PM10 tpy	SO2 tpy	NOx tpy	CO tpy	VOC tpy	Single HAP tpy	All HAPs tpy
EU003 boiler pre-modification	8817	1469	58780	5878	432	51.9	1037	1177
EU003 boiler post-modification	206	514	1322	1028	2204	51.8	1037	1177

Visibility Impacts

The MPCA completed visibility modeling to show the impact of BART compared to the emissions from the facility modeled in the 2002 base year modeling. Two years of meteorology were modeled, 2002 and 2005. The results are shown below in Table 6.

[5] 40 CFR 51, Appendix Y, IV.D.9.
[6] Potential-to-emit values as shown in the technical support document for permit no. 06100004-003.

Table 6. Overall (PM2.5) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	111	60	-51	86	58	-28	48	27	-21
	2005	86	47	-39	72	36	-36	51	26	-25
	'02 & 05	197	107	-90	158	94	-64	99	53	-46
98th Percentile Δ dv	**2002**	4.3	2.4	-1.9	4.4	2.7	-1.8	2.0	1.0	-1.0
	2005	3.5	1.9	-1.6	3.2	1.7	-1.5	1.8	0.9	-1.0
	'02 & 05	4.8	2.8	**-2.1**	4.8	2.8	**-2.0**	2.0	1.1	**-0.9**

2.4 MPCA Determination of the BART Limit

The MPCA has determined that the controls installed at Boswell Unit 3 are consistent with BART. The following limits represent the MPCA's determination of BART for Boiler 3.

Table 7. BART Emission Limits

NO_x Limit	**SO_2 Limit**	**PM_{10} Limit***
$\leq$ 0.07 lb/MMBtu (30 day rolling average)	$\leq$ 0.09 lb/MMBtu (30 day rolling average)	$\leq$0.035 lb/MMBtu

*PM_{10} limit includes filterable plus organic and inorganic condensibles.

Following EPA approval of the MPCA's regional haze State Implementation Plan, at the next opportunity for permit amendment or reissuance the MPCA will add the citations to Boswell's air quality permit that the above permit requirements also satisfy the MPCA's Best Available Retrofit Technology determination for this unit.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 5, 2009

TO : AQD File No. 27A
(Delta ID No. 07500003)

FROM : Anne M. Jackson, P.E.
Environmental Analysis and Outcomes Division

PHONE : (651) 757-2460

SUBJECT : BART Determination for Northshore Mining Silver Bay Power Plant

This memo was prepared to provide the documentation of the MPCA's BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Stationary Source Location:

Mailing Address	Stationary Source (SIC: 1011/4911) Address
Northshore Mining Company 10 Outer Drive Silver Bay, MN 55614	10 Outer Drive Silver Bay (Lake County), MN 55614
Contact: Scott Gischia Phone: (218) 226-6076	

1.2 Description of the Facility

Note: A separate BART determination for the subject-to-BART emission units that are part of the taconite ore processing operations is contained in another memorandum to this file.

Cliffs Natural Resources, Ltd. is the parent company of both Northshore Mining Company and Silver Bay Power Company. Northshore Mining Company operates a taconite processing plant at the Silver Bay facility; Silver Bay Power Company operates a power plant at the facility, which provides electricity both for the taconite processing operations and the grid. Cliffs Natural Resources, Northshore Mines and Silver Bay Power are co-permittees for Title V permit no. 07500003-004 for the Silver Bay facility.

The Silver Bay facility was originally built in the mid-1950s by Reserve Mining Company and was briefly owned by Cyprus Minerals from 1989 to 1994 (Northshore was purchased in 1994 by Cleveland Cliffs, Inc.). Northshore (Reserve Mining at the time) was the first taconite operator in Minnesota. The Silver Bay facility is located on the north shore of Lake Superior.
Of interest in the BART determination is the Silver Bay Power plant. (Northshore Mine's taconite processing facility is subject to a separate BART determination.) The Silver Bay Power plant has two boilers identified as Boiler 1 and Boiler 2. Boiler 1 has a wall-fired configuration with a maximum heat input rating of 517 MMBtu/hr heat input and about 35 megawatts output. Boiler 2 has a dry bottom, front-wall fired configuration with a maximum heat input rating of 765 MMBtu/hr and an output of 75 megawatts. Both units are permitted to fire natural gas and coal, and both use a fabric filter to control particulate matter (PM). NO_X emissions are controlled through good combustion practices. There are no post-combustion SO_2 controls. Auxiliary processes include coal piles and coal ash handling facilities.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas. On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations Under the Regional Haze Rule*" which provides direction for deciding which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility that may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA. (See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.)

The MPCA requested BART analyses from BART-eligible EGUs that were found through modeling to be subject-to-BART. Facilities were directed that the BART analysis should include primary emissions of PM as well as emissions of SO_2 and NO_X, and that the BART analysis was being requested to provide the MPCA with additional information about control costs and relative visibility improvement.

2.2 Affected Units

Boiler 2 at the facility is subject to BART as start-up for this unit was in 1963. Boiler 1 is not subject to BART because start-up of that unit was in 1959, prior to the BART-eligibility date.

Table 1. Silver Bay Power Company at Northshore Mines

Emission Unit	EU Number[1]/Stack Vent number	Control Equipment and Stack Numbers
Boiler 1	EU001/SV001	CE001 Fabric Filter – High Temperature, i.e., T>250 Degrees, F
Boiler 2	EU002/SV002	CE002 Fabric Filter – High Temperature, i.e., T>250 Degrees F

[1] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

2.3 The BART Analysis

Northshore Mining (NSM) was asked by the MPCA to perform a BART analysis for Silver Bay Power Boiler 2. A BART analysis dated September 28, 2006 for Boiler 2 was submitted to the MPCA by Northshore Mining.[2]

In September 2008, NSM was requested to review its 2006 submittal and update it as necessary, including adding the NO_X/SO_2 control technology ROFA/Rotamix by Nalco/Mobotec to the feasible control technologies. This material was provided to the MPCA in November 2008.

Northshore Mining proposed the following as BART for Boiler 2:

Table 2. Northshore Mines' Proposed BART Limits for Silver Bay Power Unit 2

Pollutant	Technology Representing BART	Expected Reduction From Baseline	BART Limit Proposed by Facility
NO_X	Low NO_X burner with overfire air	40%	0.52 lb/ MMBtu[3]
SO_2	Existing coal processing	0%	4.0 lb/ MMBtu[4]
PM	Existing fabric filter baghouses	0%	0.6 lb/ MMBtu[5]

During the course of the MPCA's review, NSM requested the MPCA to consider a biomass combustion proposal at both Boilers 1 and 2 as a control technology. NSM did not formally submit the proposal as an available retrofit option for BART consideration. However, through a series of information requests, the MPCA secured sufficient technical information describing the process and emission reductions in order to include biomass co-firing as a potentially applicable retrofit control alternative in the BART review. A description of the project is in Appendix B.

Because this facility has a total generating capacity less than 750 MW (total generating capacity is about 110 MW), the determination of BART does not require strict compliance with the BART *Guidelines* found in 40 CFR Part 51 Appendix Y. The MPCA has, however, used the guidelines in an advisory fashion and has given consideration to the factors required by the Clean Air Act in making its determination of BART:

(a) The cost of compliance;
(b) The energy and non-air quality environmental impacts of compliance;
(c) Any existing air pollution control technology already in place;
(d) The remaining useful life of the source, and
(e) The degree of visibility improvement which may reasonably be anticipated from the use of BART.

At no time has NSM provided an estimate of a shortened remaining useful life of either Boiler 1 or 2 that would weigh as a consideration in the BART determination process. The MPCA therefore has assumed

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[2] http://www.pca.state.mn.us/publications/bart-facility-northshoreminingsilverbay.pdf.

[3] Permit 07500003-004 does not include a NO_X limit for Unit 2.

[4] Note that permit 07500003-004 includes a more stringent SO_2 limit than that proposed as BART by the facility. The sulfur content of coal is restricted so that SO_2 emission from each power boiler does not exceed 2.5 lbs SO_2/million BTU on a 1-hour average, 2.0 lbs SO_2/million BTU on a 3-hour average, 1.8 lbs SO_2/million BTU on a 24-hour average, and 1.5 lbs SO_2/million BTU based on an annual average.

[5] Permit 07500003-004 includes this Title I Condition PM_{10} limit as well: Particulate Matter < 10 micron must be less than or equal to 0.046 grains/dry standard cubic foot.

in its technical, environmental and economic analyses a normal lifespan for air pollution control equipment and continued operation of the boilers.

Nitrogen Oxides Control

The September 2006 BART analysis and amendments of November 2008 assessed seven NO_X control technologies. The conclusion of the MPCA's review of technically feasible alternatives is as follows:

Table 3. NO_X Reduction Options for Silver Bay Power Boiler 2

Control Technology	Emissions Rate lb/MMBtu	Tons Reduced	Emissions reduction (%)	Total Annualized Cost	$/Ton NOx reduced
Baseline	0.67				
Low NO_X Burners	0.57	303	15%	$412,000	$1,390
Selective Non-Catalytic Reduction (SNCR)	0.50	505	25%	$1,559,000	$3,087
Low NO_X Burners w/overfire air	0.40	808	40%	$472,370	$596
LNB/OFA/SNCR	0.30	1111	55%	$1,584,000	$1,425
Selective Catalytic Reduction	0.13	1616	80%	$7,616,000	$4,712
Reburn/Low NO_X Burners/OFA	0.34	1010	50%	$8,354,400	$8,236

Selective catalytic reduction (SCR) was rejected by NSM due to cost. At this time, the MPCA will not require further assessment of SCR, believing that if future NO_X reductions are needed, the technology has not been eliminated as a technically feasible alternative with the selection today of any of the above technologies.

Additionally, the MPCA is unaware of coal-fired boilers commonly evaluating reburn as a BART technology for NO_X control. While technical literature identifies the technology, it does not appear to be a widely demonstrated application of NO_X control, apparently due to the high cost of the natural gas used to replace some of the coal already being burned.[6] NSM submitted a revised cost estimate (the initial cost estimate did not include a supplemental fuel), which the MPCA believes demonstrates this option to be uneconomical.

Sulfur Dioxide Control

In the September 2006 Bart Analysis, NSM proposed no control of SO_2 as BART. The MPCA believes there are feasible and cost-effective controls for the reduction of SO_2, and identified the following feasible SO_2 controls:

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[6] Srivastava, et. al.. "Nitrogen Oxides Emission Control Options for Coal-Fired Electric Utility Boilers" J. Air & Waste Manage. Assoc. 55:1367-1388.

Mann and Ruppel, "Scorecard on Reburning" NETL Conference on Reburning for NOx Control, May 2004. http://www.netl.doe.gov/publications/proceedings/04/NOx/posters/Reburning%20Scorecard.pdf

Table 4. Sulfur Dioxide Control Options for Silver Bay Power Boiler 2

Control Technology	Emissions Rate Lb/MMBtu	Tons Reduced	Emissions Reduced (%)	Total Annualized Cost	$/Ton SO_2 reduced
Baseline	0.60				
Wet Electrostatic Precipitator	0.12	1448	80%	$4,718,000	$3,260
Absorber	0.12	1448	80%	$7,079,000	$4,877
Dry Sorbent Injection/Baghouse	0.30	905	50%	$3,418,000	$3,778
Spray Dryer/Baghouse	0.06	1628	90%	$5,777,000	$3,547

Given the substantial difficulties likely in securing the necessary water discharge permits, the MPCA does not believe that the two alternatives that rely on water to remove SO_2 from the flue gases are reasonable BART technologies. Wet electrostatic precipitators (wet ESPs) and absorbers have substantial negative non-air quality environmental impacts as they would require expanded wastewater discharges into Lake Superior, an "outstanding resource value" water body with special protections. Securing permits for such a discharge would be exceedingly difficult and prolonged, calling into question whether such wet control devices could become operational during the BART timeline. Because dry controls without water treatment requirements are available to achieve equal or better results, without the same environmental and implementation drawbacks, the MPCA has eliminated wet controls from further evaluation.

Cost estimates provided by NSM for sulfur dioxide control were significantly higher than those provided to the MPCA by other electric generators with similarly sized boilers. Therefore, the MPCA conducted its own assessment of likely capital and operating costs related to SO_2 scrubbing. In addition to interviewing NSM and its engineering consultant, the MPCA surveyed three vendors that provide scrubbers and fabric filters to the power industry. Costs for dry sorbent injection and spray drying included in Table 4 are those developed by the MPCA. A discussion of the development of these cost estimates is provided in Appendix A. While none of the vendors visited the site to ascertain site specific factors that might affect a cost estimate, each vendor reported likely equipment costs significantly below equipment costs included in Cliffs' analysis. Each vendor volunteered equipment cost estimates from similar-sized projects recently purchased or installed. EPA's Cost Control Manual was relied on to generate the full project cost estimate. All costs are budgetary estimates, with an expected precision of +/- 30%.

Multi-pollutant Controls

Two options have been developed that can be described as multi-pollutant controls, that is, a single technology will address control of both NO_X and SO_2.

The MPCA requested NSM evaluate the installation of Nalco/Mobotec's Rotating Opposed Fire Air (ROFA) with Rotamix for controlling NO_X and SO_2 because the technology has been installed at three coal-fired units in Minnesota with successful results.

The Mobotec technology consists of the installation of five or six overfire air boxes within the boiler to deliver secondary combustion air in a controlled manner. ROFA is generally equivalent to overfire air in which a portion of the combustion air is withheld from the primary combustion zone and transferred to a higher elevation in the furnace. The reduced availability of oxygen in the primary zone leads to lesser NO_X formation. Combustion is completed in the OFA zone where temperatures are lower. The component called "Rotamix" is a selective noncatalytic reduction technique where urea is injected into the boiler. Sulfur dioxide removal is accomplished by including chemical injection ports with the boxes and injecting hydrated lime to react with the SO_2 that is formed with the sulfur in the coal is burned (furnace sorbent injection). The bound SO_2 reaction products, unreacted lime and flyash, are then captured downstream by the particulate control device.

The second multi-pollutant option is NSM's request to consider biomass combustion as an alternative to BART. Co-firing involves displacing some coal with biomass. Because of the near-absence of sulfur in biomass, SO_2 emissions are reduced proportionately with the increased use of biomass on a heat input basis. Concurrent with the use of biomass to replace coal is the need to replace burners with low NO_X burners and overfire air. Low NO_X burners are needed to feed enough fuel into the boiler, while additional combustion air from the overfire air will eliminate "sparklers", that is, extinguish any flaming biomass ash particles that might carry out of the boiler itself, thus maintaining the integrity of the fabric filters used for particulate matter control.

Rather than evaluating biomass as an alternative reduction to BART, the MPCA included biomass combustion in both units as one option to be considered as BART. The biomass proposal consists of co-firing biomass at both Units 1 and 2 at a rate of 20% or greater of total heat input. Achievable emission limits are described in Table 5.

Table 5. Multi-Pollutant Control Options At Silver Bay Power

Control Technology	NO_X Emissions Rate Lb/MMBtu	SO_2 Emissions Rate Lb/MMBtu	Total Tons Reduced	Total Tons Reduced, %	Total Annualized Costs	$/ton total Pollutant Reduced
Baseline						
Boiler 1	0.68	0.51				
Boiler 2	0.67	0.60				
ROFA/Rotamix/Furnace Sorbent Injection						
Boiler 2	0.40 (40% reduction)	0.30 (50% reduction)	1743 808 tpy NOx 905 tpy SO2	45%	$8,000,000	$3,948
Co-firing Biomass at 20% heat input in Units 1 and 2						
Boiler 1 Boiler 2	0.41 0.40 (40% reduction)	0.41 0.48 (20% reduction)	1981 1159 tpy NO_X 583 tpy SO_2	30%	$4,809,000	$2,761

In order to successfully feed biomass into the boiler, the biomass must be "processed to a fine product" prior to the introduction into the furnace for combustion. The proposal describes equipment needed to reduce biomass to less than 1/8-inch in size, and is based on wood, because that is the most readily available biomass fuel in the area of the plant.

The MPCA evaluated a biomass co-firing project that involves both units as BART for a number of reasons. First, it is appropriate to evaluate work practices that result in lower "production-specific emissions" within a BART analysis, and states are encouraged in EPA's BART guidance to consider "inherently lower-emitting processes/practices".[7] Secondly, BART guidance notes that there are situations "where a set of units within a fenceline constitutes the logical set to which controls would apply

[7] 70 FR 39164

and that set of units may or may not all be BART eligible. (For example, some units in that set may not have been constructed between 1962 and 1977.)"[8] Boiler 2 is BART-eligible. Boiler 1, having been constructed before 1962, is not. However, in this case it makes sense to include both boilers because fuel handling equipment to allow co-firing of biomass is shared across the boilers. In addition, both are coal-fired boilers of similar design and vintage, meaning that cost-effective control strategies under a program to achieve future "reasonable progress" reductions at Unit 1are likely to be similar.

In other utility BART determinations, the MPCA evaluated the reduction requirements for NO_X and SO_2 individually without regard to total cost of the project, primarily because the options do not rely on common devices. In this instance, the MPCA requested the facility owner evaluate a multipollutant control strategy (ROFA/Rotamix/FSI) while NSM itself requested that one be evaluated as a potential alternative to BART. The cost-effectiveness of using these technologies cannot easily be assessed for each pollutant alone because it is difficult to assign the costs of the common equipment that makes up the control strategy to one pollutant or another. The MPCA believes that these controls might best evaluated by considering the total amount of NO_X and SO_2 reduced.

If the MPCA were to rely on pollutant by pollutant reduction options, BART appears to be the use of Low NO_X burners and overfire air on Boiler 2 to achieve an emissions rate of 0.40 lb/MMBtu, and spray drying/fabric filters to achieve an SO_2 emissions rate of 0.06 lb/MMBtu, and is included in the cost-effectiveness analysis for control at Silver Bay Power Plant in Table 6. The total annualized cost of these controls, based on the MPCA's recalculation of spray drying, is shown in Table 6 below. The cost-effectiveness of this combined pollutant reduction is $2,634. This cost is nearly indistinguishable from the biomass co-firing proposal including low NO_X burners and overfire air (OFA) on Boiler 1.[9]

Table 6. Multi-pollutant control options at Silver Bay Power

Control Technology	NOx Emissions Rate lb/MMBtu	SO_2 Emissions Rate lb/MMBtu	Total Tons Reduced	Total Annualized Costs	$/ton total Pollutant Reduced
LNB/OFA and SD/FF					
Boiler 2	0.40 (40% reduction)	0.06 (90% reduction)	2437 tpy 808 tpy NOx 1,628 tpy SO2	$6,258,000	$2,568
Co-firing Biomass in Boilers 1 and 2					
Boiler 1 Boiler 2	0.41 0.40	0.41 0.48	1981 tpy 1159 tpy NOx 583 tpy SO2	$4,809,000	$2,761

<u>Particulate Matter 10 microns and smaller</u>

The MPCA has conducted an analysis of the impacts of direct PM emissions on visibility. For each EGU subject to BART, visibility impacts from PM are less than 0.20 dV. Because of the small impact from the PM emissions, the MPCA has determined that any additional control would not be cost effective, particularly when weighed against the small amount of visibility improvement and other environmental

[8] 70 FR 39164-39165

[9] MPCA modified the cost of spray drying based on interviews with air pollution control equipment vendors, and has described the estimates as "budgetary" as +/- 30%. This cost is being compared the cost of the biomass co-firing project where significantly more information was used to develop the scope and cost of the project. Hence, the MPCA concludes that the incremental difference is insignificant.

impacts.[10] Therefore, the MPCA has determined that each facility's existing controls and emission limits for PM are considered BART.

The MPCA has determined that the existing particulate matter control technology, fabric filter baghouses, represents BART. The current operating permit imposes a PM_{10} emissions limit of 0.046 gr/dscf. The MPCA believes that this is a more appropriate emissions limit reflecting BART for this unit because it regulates a larger portion of PM emissions currently exiting the unit and reflects the operations of a fabric filter. Northshore has already demonstrated compliance with this PM_{10} emissions limit. Therefore, the MPCA will amend the Title V permit for Northshore to include a citation that the current PM_{10} limit and compliance demonstration method also satisfies BART as the limit is reflective of the MPCA's determination of the existing baghouse technology proposed as BART by the facility. Compliance with these emission limits must be demonstrated by the date five years after EPA approves Minnesota's regional haze SIP.

Visibility Impacts

The MPCA completed visibility modeling to show the impact of BART compared to the actual emissions from the facility modeled in the 2002 base year modeling. Two years of meteorology were modeled, 2002 and 2005. The results are shown below in Table 7.

Table 7. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Difference**	**Base**	**BART**	**Difference**	**Base**	**BART**	**Difference**
Days > 0.5 dv	**2002**	77	72	-5	9	8	-1	20	15	-5
	2005	58	47	-11	9	6	-3	11	8	-3
	'02 & 05	135	119	-16	18	14	-4	31	23	-8
98th Percentile Δ dv	**2002**	4.0	3.8	-0.2	0.6	0.5	-0.1	0.9	0.7	-0.2
	2005	1.9	1.7	-0.3	0.5	0.5	-0.1	0.7	0.5	-0.1
	'02 & 05	4.0	3.8	**-0.2**	0.8	0.7	**-0.1**	1.3	1.0	**-0.2**

2.4 MPCA Determination of the BART Limit

MPCA is setting the BART limits for both boilers as described in Table 8 below. Each boiler must separately demonstrate compliance with the emission limits determined as BART for that boiler, unless the facility undertakes a BART Alternative as described in section 2.5, below.

[10] In its BART analysis, NSM evaluated three PM/PM10 control technologies: a polishing wet electrostatic precipitator, a dry electrostatic precipitator, and an additional baghouse. Estimated control costs ranged from $67,000 to $89,000 per ton of pollution controlled with little projected visibility improvement. Thus, the MPCA has determined that these available control technologies are not cost effective and the existing baghouse represents BART. The Clean Air Act directs the states to consider existing control technology in use at the source.

The following limits represent the MPCA's determination of BART for Silver Bay Power:

Table 8. BART Limits for Silver Bay Power

NO_x Limit	SO_2 Limit	PM_{10} Limit*
Boiler 1		
0.41 lb/MMBtu 30-day rolling average	0.41 lb/MMBtu 30-day rolling average	$\leq$0.046 gr/dscf (limit in existing permit)
Boiler 2		
0.40 lb/MMBtu 30-day rolling average	0.48 lb/MMBtu 30-day rolling average	$\leq$0.046 gr/dscf (limit in existing permit)

*PM_{10} limit includes filterable plus organic and inorganic condensibles.

Compliance with the NO_X and SO_2 limits will be through the use of CEMs. Compliance with the PM_{10} value will be through periodic performance testing.

Following EPA approval of the MPCA's regional haze State Implementation Plan, at the next opportunity for permit amendment or reissuance the MPCA will add the citations to Northshore's air quality permit that the above permit requirements satisfy the MPCA's Best Available Retrofit Technology determinations for Boilers 1 and 2.

2.5 <u>BART Alternative</u>

As indicated in the Regional Haze SIP, the MPCA's determination of a specific BART limit does not preclude facilities from proposing alternatives to BART as they work towards BART compliance. This section further elaborates what the MPCA would consider as acceptable BART alternatives, subject to EPA approval of Minnesota's Regional Haze SIP and BART determinations.
NSM may choose to propose a BART Alternative project that is equivalent or better than BART. The BART Alternative must result in equivalent or greater emissions reductions and visibility benefits from the facility when compared to the MPCA's BART determination.

Should NSM choose to propose a BART alternative, the proposal must include:

- A demonstration of equivalent or greater combined annual emission reductions of NO_X and SO_2 (in tpy) than that established in this BART determination;
- Appropriate visibility modeling demonstrating equivalent or greater visibility protection than the MPCA's BART determination; and
- A proposal for enforceable emission limitations, with appropriate and justified averaging periods and methods for evaluating compliance.

Since the facility would be proposing an alternative to MPCA's BART determination, visibility modeling should follow the MPCA's *Guidance for Facilities Conducting a BART Analysis*[11] and *Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject-to-BART in the State of Minnesota*,[12] using the most recent versions of any model or EPA guidance referenced in those documents. The modeling should compare the baseline, pre-control scenario to post-control scenarios representing the MPCA's BART determination and the BART alternative being proposed by the facility.

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[11] http://www.pca.state.mn.us/publications/aq-sip2-09.pdf

[12] http://www.pca.state.mn.us/publications/aq-sip2-05.pdf

NSM may propose a BART alternative that covers multiple BART units or both BART and non-BART units at the facility in the same source category. A proposal covering BART and non-BART units must demonstrate greater emission reductions and more visibility improvement than MPCA's BART determination. The MPCA would evaluate this proposal in consultation with the Federal Land Managers and determine if it is an acceptable BART alternative. If the MPCA accepts the proposal as such, the resulting emission limits would be placed in the facility's permit and noted as BART emission limits. Ultimately, EPA approval of an enforceable document (such as a Title V permit) containing BART emission limits will be necessary.

Appendix A: Assessing Cost Estimates at Northshore Mines Silver Bay Power Plant

Anne Jackson, P.E.
Environmental Analysis and Outcomes Division
Minnesota Pollution Control Agency

Northshore Mines submitted capital and annualized cost estimates for installation of air pollution controls at its coal-fired power boiler at Silver Bay in response to requirements by US EPA and the MPCA to consider retrofitting the boiler to meet regional haze improvements. Unit 2 is a 75 MW (net) generating unit currently controlled with a baghouse for particulate matter capture.

Total annualized cost estimates provided by Northshore are considerably higher than costs presented to the MPCA for similar projects at utility boilers in Minnesota. Due to the difference, the MPCA undertook a cost analysis of its own to ascertain if the costs provided by Northshore were reasonable estimates of expected project costs.

First, capital and annual costs were compared to two other Minnesota projects of nearly identical size: retrofitting Minnesota Power's Taconite Harbor Unit 3 with furnace sorbent injection and fabric filters to control acid gases and particulate matter, and the installation of spray drying/fabric filters at Rochester Public Utilities Unit 4 for control of the same pollutants. The comparison is as follows:

	MW (net)	Existing APCD	Control Technology Alternative	Expected SO2 removal eff.	Capital cost(1)	$/kW
Northshore Mines Silver Bay Unit 2	75	FF	SD/FF	90%	$100,000,000	$1333
Minnesota Power Taconite Harbor Unit 3	75	ESP	SD/FF	91%	$40,901,000	$545
Rochester Public Utility(2)	64	ESP	ROFA, SD/FF	85%	$37,000,000	$578

(1)Estimates provided to the MPCA with BART analyses. Budget-level estimates in 2008 dollars

(2)Capital cost includes installation of NOx control equipment. RPU project startup in early 2009.

Steps were taken to determine the appropriateness of all projects' cost estimates. First, the cost estimates for all three projects were compared to industry surveys of desulfurization projects. Second, air pollution control equipment vendors were contacted which provided quotes developed for recent projects of similar size. Third, the engineering firm that prepared the estimates was interviewed to understand the generation of the estimates and the source of cost data used. The results of this review are described.

Comparing FGD to a Recent Industry Survey

The cost of flue gas desulfurization can be measured against industry surveys. A survey was published in March 2009 of 49 flue gas desulfurization (FGD) projects that are scheduled for startup in the years 2008 through 2015. Plants less than 300 MW reported a "fully loaded" FGD system capital cost of $440/kw.[13] "Fully loaded" is defined as the cost of project design, new stack and ductwork, reagent preparation, absorber island costs, including waste disposal systems, site preparation, wastewater treatment (for wet

[13] Sharp, George. "Update: What's that Scrubber Going to Cost?" Power, Vol. 153, No. 3. March 2009. pp 64-66.

scrubbing systems), balance-of-plant costs, as well as other direct costs such as engineering and project management and associated boiler modifications and draft fans.

This survey does not include improvements to particulate matter capture. For a measure of expected fabric filter capital costs, the MPCA used EPA's cost calculator for electric generating units, CUECost. The estimate from CUECost resulted in a per kilowatt capital cost of $179/kW. Together, these costs result in a FGD/FF capital cost of $619/kW. The cost per kilowatt for the Minnesota Power Taconite Harbor unit is within 88% of the modified industry survey value. The cost per kilowatt of Rochester Public Utilities' project is within 93% of the modified survey estimate, while the NSM estimate is 215% of the modified survey estimate.

Equipment Vendor Estimates

Three vendors of scrubbing/fabric filter controls were interviewed.[14] They were asked for a budgetary estimate of scrubbing equipment to provide 90% SO_2 control. Equipment prices were provided based on recent project estimates prepared by the companies. The scope of the equipment included ductwork from the boiler to the stack, scrubbing units and fabric filters, instrumentation, sorbent injection equipment, air supply if necessary. Understanding that these estimates were for similar sized boilers but little was understood about site specific conditions, vendors characterized their estimates as within 30% of the likely true estimate.

The equipment estimates were used by the MPCA in generating three different capital and annual cost estimates. The estimates are attached to this summary. The capital costs for scrubbing and fabric filters range from $20 to $59 million, compared to the NSM of $100 million.

NSM BART Analysis Cost Estimates

The engineering consultant reported that the capital cost estimates were provided by NSM for use in preparing the initial BART determination. The consultant also relied on cost estimates prepared for other coal fired utilities, prepared by a different engineering consultant. NSM's consultant reported that no inquiries were made of equipment suppliers directly.

At no time during discussions with the engineering consultant or NSM itself did the issue of a site limitation arise where unique equipment or construction techniques might be needed, thus raising equipment or installation costs significantly.

Summary

Three means of testing the expected cost of the project: comparison to similar project in Minnesota, using industry surveys, and conversations with equipment vendors indicates that the cost estimates provided by NSM appear highly inflated, by one measure more than twice what the industry currently experiences for flue gas scrubbing.

[14] Alstom Power, Babcock Power, McGill Airclean. Personal communication. Separate notes available.

Capital and Operating Costs of Spray Drying for SO2 Controls at Silver Bay Power

		SD/FF Barr equip est applying the Xcel cost factors	SD/FF--vendor 1	SD/FF--vendor 2	duct sorbent/ff--vendor 3
Direct Costs					
Purchased equipment costs					
reagent feed: receiving, storage, grinding			$ 1,500,000	$ 1,500,000	700000
SO2 removal system: tanks, pumps					
spray dryers and fabric filter		$ 24,859,000	$ 12,000,000	$ 17,000,000	$ 2,500,000
initial FF bag inventory			inc		
carbon steel piping			$ 50,000	$ 50,000	
flue gas handling (ductwork)					
dampers					
New ID Fans			$ 700,000	$ 700,000	$ 700,000
ash handling systems			$ 1,000,000	$ 1,000,000	$ 1,000,000
instrumentation and controls	0.1	$ 2,485,900	inc	inc	inc
subtotal capital cost (CC)		$ 27,344,900	$ 15,250,000	$ 20,250,000	$ 4,900,000
taxes	0.065*CC	$ 1,777,419	$ 991,250	$ 1,316,250	$ 318,500
freight	.11*CC	$ 3,007,939	$ 1,677,500	$ 2,227,500	$ 539,000
total purchased equipment cost (PEC)	PEC	$ 32,130,258	$ 17,918,750	$ 23,793,750	$ 5,757,500
direct insta foundation and supports	0.15	$ 4,819,539	$ 2,687,813	$ 3,569,063	$ 863,625.00
handling and erection	0.1	$ 3,213,026	$ 1,791,875	$ 2,379,375	$ 575,750.00
electrical	0.05	$ 1,606,513	$ 895,938	$ 1,189,688	$ 287,875.00
Piping	0.015	$ 481,954	$ 268,781	$ 356,906	$ 86,362.50
insulation	0.05	$ 1,606,513	$ 895,938	$ 1,189,688	$ 287,875.00
Painting	0.005	$ 160,651	$ 89,594	$ 118,969	$ 28,787.50
Demolition	0.05	$ 1,606,513	$ 895,938	$ 1,189,688	$ 287,875.00
Relocation	0.01	$ 321,303	$ 179,188	$ 237,938	$ 57,575.00
total direct installation costs (DIC)	0.43	$ 13,816,011	$ 7,705,063	$ 10,231,313	2,475,725.00
		$ 500,000	$ 500,000	$ 500,000	$ 500,000
Site prep buildings Barr lump sum cost item		$ 4,800,000	$ 4,800,000	$ 4,800,000	$ 4,800,000
total direct costs(DC) =(PEC +DIC)	DC	$ 51,246,268	$ 30,923,813	$ 39,325,063	$ 13,533,225
Indirect Costs					
Engineering	0.05	$ 2,562,313	$ 1,546,191	$ 1,189,688	$ 287,875
Owner's cost	0.03	$ 1,537,388	$ 927,714	$ 1,179,752	$ 172,725
Construction and Field Expenses	0.05	$ 2,562,313	$ 1,546,191	$ 1,966,253	$ 287,875
Contractor Fees	0.05	$ 2,562,313	$ 1,546,191	$ 1,966,253	$ 287,875
Characterization Testing		$ 150,000	$ 150,000	$ 150,000	$ 150,000
Start up		$ 50,000	$ 50,000	$ 50,000	$ 50,000
performance test NA (CEMs)					
Subtotal indirect cost (IDC)		$ 9,424,328	$ 5,766,286	$ 6,501,946	$ 1,236,350
Contingencies	.20*(DC+IDC)	$ 12,134,119	$ 7,338,020	$ 9,165,402	$ 2,953,915
Total indirect cost (IC)		$ 21,558,448	$ 13,104,306	$ 15,667,347	$ 4,190,265
Allowance for funds used during construction (AFUDC)	.0814*(DC+IC)	$ 5,926,304	$ 3,583,889	$ 4,476,382	$ 1,442,692
Total Capital Investment = TD +IC +AFUDC		$ 78,731,020	$ 47,612,007	$ 59,468,792	$ 19,166,182
$/KW		$ 1,050	$ 635	$ 793	$ 256
Annual Cost					
Direct Annual Cost					
Fixed Annual Cost					
operating and support labor for SDAFF					$ 168
maintenance and support labor for SDAFF					$ 79
yearly emissions testing (not applicable; CEMs)					
total fixed annual costs					
Variable annual cost					
compressed air					$ 83
reagent for SDA					$ 456
byproduct disposal					$ 304
water					$ 14
electrical power					$ 260
filter bags replacement cost					$ 245
total variable annual cost					
total Annual cost=fixed + variable		$ 1,282,000	$ 1,282,000	$ 1,282,000	$ 1,609
Indirect annual cost					
capital recovery		$ 7,432,208	$ 4,494,573	$ 5,613,854	$ 1,809,288
total annual cost =indirect + capital recovery		$ 8,714,208	$ 5,776,573	$ 6,895,854	$ 3,418,288
tons SO2 reduced		1544.90	1544.90	1544.90	905.00
$/ton of SO2		$ 5,641	$ 3,739	$ 4,464	$ 3,777

Appendix B: Co-firing Biomass

Description of Control Option

With modifications to existing fuel handling equipment and boiler, boilers 1 and 2 would burn up to 20% by heat input of biomass fuel, most likely wood.

Three different technologies were evaluated for co-firing 20% biomass in boilers 1 and 2:

- 1% biomass can be ground in the existing pulverizers.
- 9% can be burned by adding new burners and installing overfire air on the sidewalls of the existing boiler
- 10% biomass can be burned through fuel inductors added to the existing burners.

When combined, all three technologies provide each boiler with the capacity to burn 20% biomass on a heat input basis.

In addition to the burner additions, additional fuel handling equipment must be installed. Fuel unloading and storage equipment, grinding and conveying equipment must be installed to provide the fuel to the boiler. Combustion controls must be modified to interface with the new equipment, the boilers modified to allow the fuel to be introduced and combusted properly, and other balance of plant modifications completed to allow the use of biomass.

Attachments:

Michael Mlinar, Cliff Natural Resources Letter to David Thornton, MPCA. April 8, 2009

Sargent and Lundy, Biomass Co-Firing Feasibility Study, Silver Bay Unit 2 April 16, 2009

> This report recommends that low NOx burners be used to feed sufficient quantities of biomass to the boiler to achieve the 20% heat input level, and that OFA is needed to quench ash in the combustion chamber. Therefore, it is assumed that the same modifications at Unit 1 (the non-BART eligible unit) are necessary to combust biomass, and that low NOx burners and OFA are a fundamental requirement of burning biomass in Unit 1 as well as Unit 2.

Scott Gischia, Cliffs Natural Resources, Electronic Communication to Anne Jackson, MPCA April 20, 2009 (2 Communications)

Scott Gischia, Cliffs Natural Resources, Electronic Communication to Anne Jackson, MPCA April 21, 2009.

Northshore Mining Company: Silver Bay Power Emissions Control. February 20, 2008. (A description of a biomass combustion proposal for Unit 1.)

CLIFFS

CLIFFS NATURAL RESOURCES
Northshore Mining Company
10 Outer Drive, Silver Bay, MN 55614
P 218 226 4125 F 218 226 6037 cliffsnaturalresources.com

April 8, 2009

Mr. David Thornton
Minnesota Pollution Control Agency
525 Lafayette Road North
St. Paul, MN 55155-4194

Re: Emissions Reduction Proposal: Silver Bay Power

Dear Mr. Thornton,

Silver Bay Power Company represents a unique situation in the power industry in Minnesota for BART. It faces challenges of a captive cost structure with the inability for rate recovery, one majority customer facing economic challenges, relatively low uncontrolled emissions rates and an uncertain regulatory landscape. Among these challenges, however, SBPC sees what may be a unique opportunity to implement an environmentally sustainable solution in the near future, and it is in that context that this emissions reduction proposal is submitted.

MPCA's March 3, 2009 memorandum suggests establishment of BART limits based on low-NOx burner and overfire air (LNB/OFA) technology for NOx at a control cost of $642/ton and dry sorbent injection with an additional baghouse for SO2 at a control cost of $7,305/ton. While SBPC agrees with MPCA's assessment for NOx, the control cost for SO2 appears significantly beyond the scope of BART. Further, as MPCA has requested additional in-depth engineering information regarding dry sorbent injection for Unit 2, the limited ductwork and consequently short in-duct residence time for sulfur conversion gives SBPC pause to realize that the SO2 control afforded by this technology is likely lower than originally anticipated in earlier BART submittals (i.e., earlier submittals represented best case assumptions). Lastly, SBPC does not agree with MPCA comparisons to other power plants in Minnesota for a host of reasons already discussed (difference in baselines, absence of ability to compare facilities under BART, differences in associated retrofit costs, etc.).

As you are aware, the environmental regulatory landscape, particularly for the energy sector, is changing rapidly on several fronts, even beyond the long-term Regional Haze program. Carbon legislation is imminent, EPA has announced its intention to re-issue a new version of CAIR by 2010, the Boiler MACT continues to be re-evaluated, CAMR will re-emerge in a new form, multipollutant legislation is being discussed, and so on. While this situation is similar for many utilities in Minnesota, SBPC's small size and captive cost structure will allow only very singular opportunities to implement significant emissions control equipment, and for that reason, SBPC needs to make precise, optimal decisions on its pollution control equipment. MPCA's initial recommendation of dry sorbent injection for sulfur control as BART will require installation and operation of costly equipment and more importantly, prevent the facility from pursuing options that may have greater environmental benefit.

For all these reasons, and per our discussions of last week, and prior submittals, it has become clear that the applicable BART for SBPC Unit 2 is limited to LNB/OFA. However, without re-iterating prior points, SBPC is pleased to provide an alternative emissions reduction proposal that seeks to provide significant reductions of NOx and SO2, a flexible solution that could provide multipollutant reductions, and potentially provide the ability to make further future reductions from Silver Bay Power, all in a more economically feasible manner.

Emissions Reduction Proposal:

SBPC has undertaken a comprehensive engineering review of options to combust significant levels of biomass at Silver Bay Power. Because no similar facilities could be located that utilize such a high percentage of heat input as biomass, several creative potential solutions have been considered. Preliminary engineering analyses by consultants from the power industry have thus far indicated that biomass combustion at 20% or greater of total heat input appears technically possible for Silver Bay Power. As noted above, SBPC agrees that Low-NOx burners and overfire air are the best approach for NOx reductions for this facility. With this in mind, Silver Bay Power is poised to commit to emissions reductions at levels consistent with the following:

- Low-NOx Burners / Overfire Air on Unit 2
    - 40% reduction in NOx from Unit 2 (751 tons per year) or an equivalent Unit 2 NOx emissions rate of 0.52 lb/mmbtu
- Biomass combustion on Unit 1 at 20% of total heat input
    - 20% reduction of SO2 from Unit 1 (195 tons per year) or an equivalent Unit 1 SO2 emissions rate of 0.41 lb/mmbtu
- Biomass combustion on Unit 2 at 20% of total heat input
    - 20% reduction of SO2 from Unit 2 (326 tons per year) or an equivalent Unit 2 SO2 emissions rate of 0.48 lb/mmbtu

While Silver Bay Power currently believes the above solution will provide the best long-term environmental benefit and value for the facility, the uncertainties that will materialize over the course of the next 2-3 years related to the technical feasibility, feedstock sourcing, and future regulatory drivers could require other reduction measures as a preferred option (such as low-NOx burners and overfire air on Unit 1, natural gas utilization, other new technologies, etc...). Accordingly, SBPC proposes to guarantee regional haze reductions of 1272 combined tons of SO2 and/or NOx from either or both of Unit 1 and 2. Please be aware that SBPC is optimistic that it will be technically feasible to utilize higher levels of biomass, but can only rationally commit to 20% utilization at this time. However, once the capital costs are spent to put the facilities in place, if higher levels are achievable, SBPC and Cliffs will have a business incentive to realize the benefits of increased biomass combustion.

This proposed alternative provides substantially similar regional haze reductions at far less capital and operating costs which are more in-line with economic feasibility thresholds under BART, all with the added environmental benefits that come with utilizing and demonstrating green renewable fuels. In comparison to MPCA's proposal—at what now appears to be an unlikely removal efficiency of 55% for dry sorbent injection—this proposal represents almost 80% of MPCA's proposed 1648 tons of combined NOx and SO2, or more realistically 88% of 1485 tons for MPCA's solution at 45% removal, and potentially as much as 96% of 1322 tons for MPCA's solution should the efficiency provide only 35% removal. Further, if Silver Bay Power is able to achieve higher biomass levels, the solution may actually exceed MPCA's solution for regional haze reductions. Additionally, the biomass solution provides the added environmental benefits of significant greenhouse gas reductions (200,000 tons) and mercury reductions achieved by displacement of coal—all for a significantly lower capital and operating cost than MPCA's proposal which greatly exceeds the BART economic feasibility determination.

Cost Comparison:

Item	Unit of Measure	Unit 2: LNB/OFA	Unit 2: Dry Sorbent Injection/Baghouse			Unit 1 and 2: Biomass		
			Low Efficiency	Med Efficiency	High Efficiency	20%	23%	26%
Capital Cost	$ 000's	$ 6,000	$ 43,800	$ 43,800	$ 43,800	$20,000 - $29,700	$20,000 - $29,700	$20,000 - $29,700
Annualized Operating Cost	$ 000's	$ 640	$ 6,670	$ 6,670	$ 6,670	$3,060 - $4,360	$3,060 - $4,360	$3,060 - $4,360
SO2 Reduction	%	---	35%	45%	55%	20%	23%	26%
	tpy	---	571	734	897	521	593	670
	$/ton	---	$ 11,681	$ 9,087	$ 7,436	$5,941 - $8,472	$5,159 - $7,358	$4,566 - $6,512
NOx Reduction	%	40%	---	---	---	---	---	---
	tpy	751	---	---	---	---	---	---
	$/ton	$ 642	---	---	---	---	---	---
CO2 Reduction	tpy	---	---	---	---	200,000	230,000	260,000
Hg Reduction	lb/yr	---	---	---	---	8	9	10

Note: The latest engineering proposal for biomass at Silver Bay Power was focused on technical feasibility and capital costs. While operating costs for Renewafuel are highly dependent on feedstock prices and availability along with other factors, SBP believes biomass fuel pricing will be equal or favorable to coal costs after future regulatory drivers such as mandatory carbon legislation are in place. The values presented in this table represent SBPC's best information at this time.

Proposed BART Limit:

Silver Bay Power proposes a BART limit to be inserted into the Title V operating permit as follows:

> The combined NOx + SO2 emissions from Silver Bay Power Units 1 and 2 are not to exceed 0.98 lb/mmbtu *(as compared to current combined baseline of 1.26 lb/mmbtu)*. Compliance with the limit will be demonstrated through use of SO2 and NOx CEMS on both EU 001 and EU 002.

A flexible limit that still commits the reductions discussed above is necessary given the notion that SBPC may be required to utilize different approaches to achieve these reductions depending on the feasibility of various reduction options and the outcome of the regulatory changes anticipated over the next few years. SBPC will gladly work with agency to develop individual limits that still maintain flexibility if deemed necessary.

Summary:

Silver Bay Power Company views this proposal as positive for both SBPC, the State of Minnesota and the environment for a number of reasons.

Substantially similar regional haze reductions can be effected through this alternative, and at a lower overall capital and operating cost than the dry sorbent injection sulfur control scenario alone. Additionally, greenhouse gas and mercury reductions provide significant added benefit, particularly in light of the growing national focus on these issues. Lastly, a biomass approach utilizes renewable fuels as a better energy solution and provides a superior approach to landfill use by eliminating the additional solids that would be generated by lime injection.

Perhaps more significantly from an environmental perspective, this proposal could put a substantial amount of biomass in play for Minnesota. Not only would this bring biomass combustion to Silver Bay specifically and establish new 'green' jobs in Minnesota, but would also create a stable foundation for biofuel in northern Minnesota and will demonstrate biomass feasibility which may be applicable at other power plants and/or coal burning combustion units. While Cliffs has a business interest in demonstrating biomass capabilities, that interest lies parallel with the interests of Minnesota and the environment and may provide for further multipollutant reductions.

This proposal provides substantially similar regional haze reductions at significantly lower costs. Dry sorbent injection capital and annualized operating costs are roughly 75% and 80% higher, respectively, than the midpoint of the projected cost of a biomass solution which demonstrates a cost of control that closer to economic feasibility thresholds under BART, all with the added environmental benefits that come with utilizing and demonstrating green renewable fuels. Thank you for the opportunity to work cooperatively toward a creative, sustainable solution. We look forward to discussing with you again at your earliest convenience.

Sincerely,

Michael P. Mlinar
Vice President / General Manager

Cc: Anne Jackson, MPCA
David Cartella, Cliffs Natural Resources
Scott Gischia, Northshore Mining

CLIFFS NATURAL RESOURCES
NORTHSHORE MINING COMPANY
SILVER BAY POWER COMPANY

BIOMASS CO-FIRING FEASIBILITY STUDY

SILVER BAY UNIT 2

SL-009890

FINAL REPORT

APRIL 16, 2009
PROJECT 11705-005

PREPARED BY

Sargent & Lundy LLC

55 East Monroe Street • Chicago, IL 60603 USA • 312-269-2000

LEGAL NOTICE

This report was prepared by Sargent & Lundy, L.L.C., hereinafter referred to as S&L, expressly for Cliffs Natural Resources Northshore Mining Company, hereinafter referred to as Northshore Mining. Neither S&L nor any person acting on its behalf (a) makes any warranty, express or implied, with respect to the use of any information or methods disclosed in this report or (b) assumes any liability with respect to the use of any information or methods disclosed in this report.

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CONTENTS

TABLES AND FIGURES

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ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Explanation
B&W	Babcock & Wilcox
Btu	British thermal unit
CFD modeling	computational fluid dynamic modeling
EPRI	Electric Power Research Institue
FD	forced draft
hr	hour
ID	induced draft
lb	pound
mmBtu	million British thermal unit
MW	megawatt
MWhr	megawatt-hour
Northshore Mining	Cliffs Natural Resources Northshore Mining Company
O&M	operation and maintenance
OEM	original-equipment manufacturer
OFA	overfire air
PC	pulverized coal
ppm	parts per million
PRB	Powder River Basin
RDF	refuse-derived fuel
S&L	Sargent & Lundy, L.L.C.

EXECUTIVE SUMMARY

On behalf of Cliffs Natural Resources Northshore Mining Company (Northshore Mining), Sargent & Lundy, L.L.C. (S&L) evaluated the technical feasibility of co-firing Renewafuel at Silver Bay Unit 2 up to 20% (heat input) with the current Powder River Basin (PRB) fuel burned.

S&L's technical evaluation indicated that with modifications to the existing fuel handling equipment and boiler, the unit can burn up to 20% (heat input) Renewafuel.

Three different equipment technologies were evaluated for Co-firing the 20% Renewafuel in the existing boiler:

- 1% Renewafuel can be ground in the existing pulverizers.
- 9% Renewafuel can be burned by adding new design burners and installing on the sidewalls of the existing boiler.
- 10% Renewafuel can be burned through fuel inductors added to the existing burners.

The technical evaluations of the three technologies indicate that all are feasible and proven technologies, and when combined are capable of burning Renewafuel at a 20% replacement for the PRB fuel.

1. INTRODUCTION

On behalf of Cliffs Natural Resources Northshore Mining Company, Sargent & Lundy, L.L.C. (S&L) evaluated the feasibility of co-firing Renewafuel at Silver Bay Unit 2 up to a heat input of 20%. S&L identified three different equipment technologies associated with co-firing deemed worthy of further evaluation for use on Silver Bay as described below.

- **Co-firing Renewafuel with the existing PRB fuel.**

The three equipment technologies involve using existing pulverizers, new separate burners, and inductors for adding Renewafuel to existing burners. The layout schematic is shown in Attachment A. This co-firing evaluation would require the following modifications for using 4.5% and 10% moisture Renewafuel.

- Existing pulverizers (B&W EL-64) were reviewed for their capability of grinding Renewafuel and found to be acceptable. S&L evaluated the impacts on the existing boiler combustion process to ensure complete combustion. Approximately 1% heat input from this method of combustion is assumed to be the maximum from industry experience. The introduction of the Renewafuel into the existing coal feed storage silos will be regulated by a separate conveyor from the Renewafuel unloading area. The conveyor will have a belt scale included for measuring the Renewafuel feed and for obtaining the proper feed rate of 1% of the total fuel to the pulverizer storage silo.
- Separate burners for combustion of processed Renewafuel were evaluated for impacts to the combustion processes, required boiler modifications, and risk to the existing boiler. Commercially available separate burners have been proven in wood-based biomass combustion in other co-fired boilers. An impact evaluation and conceptual design were developed to determine the technical feasibility. Based on the existing boiler design and industry experience, approximately 9% heat input can reasonably be introduced through this technology.
- Induction of processed Renewafuel into the existing pulverized coal transport lines and combusted with the PRB coal is a proven technology. An impact evaluation and conceptual design were developed to determine the feasibility and cost for installation. Based on the existing boiler design and industry experience, approximately 10% heat input can reasonably be introduced through this technology.
- Combustion impacts of burning Renewafuel in the existing boiler were evaluated due to the introduction of a higher volatile fuel (77% versus 32%) with the PRB in the same combustion zone. The Renewafuel will compete for the available oxygen and modifications will be required to the existing boiler.

– Renewafuel unloading, conveying, and processing equipment evaluations were conducted to determine the types of equipment for meeting the fuel quality requirements of the co-firing option. The pulverizer option would not require any fuel processing and the fuel would be introduced on the existing conveyor feed to the pulverizers. The remaining Renewafuel must be processed to a fine product prior to introduction into the furnace for combustion. There is an opportunity for reducing the costs of processing the Renewafuel for the co-firing option if the Renewafuel supplier can produce the final product in a much finer form to avoid the onsite hammer mill installation. Table 1-1 summarizes the fuel handling equipment additions and modifications.

Table 1-1. Equipment Summary

Cliffs Natural Resources Northshore Mining Company Silver Bay Unit 2	Base Case Existing Boiler PRB	Boiler Mods 80% PRB 20% Renewafuel
Renewafuel handling equipment		
Truck unloader w / scale		X
Rotary feeder		X
Surge bin		X
Pressure blower		X
Pneumatic conveyor to coals silos		X
Tipper pit		X
Stack out conveyor		X
Reclaim conveyors		X
Wood hog w / building		X
Pneumatic conveyor to surge bin at boiler		X
Existing Boiler - Modifications		
Biomass burners & Inductors		X
Fuel piping		X
Igniters system		X
blower system		X
Ovefire air system		X

2. APPROACH

S&L evaluated the current designs of Silver Bay Unit 2 to determine the feasibility of co-firing Renewafuel using the existing boiler equipment. The expected annual generation output was calculated from design maximum continuous rating (MCR), gross capacity, auxiliary power, net unit heat rate, and the capacity factor. This generation output and the heat rates were used to estimate the fuel consumption. This data then represented the current conditions and basis for all impact calculations. Table 2-1 summarizes the unit operational assumptions.

Table 2-1. Performance Assumptions

Parameter		Silverbay Unit 2
Gross Load	MW	75.0
Aux power	MW	5.8
Net Load	MW	69.2
Capacity factor	%	0.9
Annual generation	MWhr	549,540
Heat rate	Btu/kwh	10,500
NOx emission	Lb/mmBtu	0.67
SO2 Emission	Lb/mmBtu	0.55

Silver Bay Unit 2 currently burns 100% PRB fuel. The typical fuel used is Antelope Mine and the fuel characteristics used in the analysis were typical.

The Renewafuel characteristics will vary significantly depending on the source of the raw material used in producing the Renewafuel pellets. The four basic types of Renewafuel are (1) wood-based, (2) forest products/paper-based, (3) grain/cereal-based, and (4) grain-based. For this study S&L used the fuel characteristics of the wood-based product as supplied by Northshore Mining Company since it is the most readily available.

Further evaluation of the impacts of the other Renewafuel products should be conducted in the future if these will be used in major quantities. The significant risk is if the grain and grain/cereal-based products are burned due to the high levels of chlorine in those products. Chlorine levels >0.25% when burned in a traditional boiler will have a high probability of causing waterwall and superheater section corrosion, resulting in tube wall wastage.

2.1 IMPACT ASSESSMENT OF BURNING RENEWAFUEL

2.1.1 Plant Operational Impacts

Potential impacts on plant operations from the three options are:

- Fuel handling impacts on existing equipment.
- Boiler modifications required to combustion controls and boiler logic (protection), and changes to operational procedures and training.
- Additional truck traffic for delivery of the Renewafuel.

2.1.2 Combustion Impact Evaluation

To determine combustion risks, S&L researched public information on co-firing experience in the U.S. at boilers similar to Silver Bay Unit 2 for comparison purposes. Information from industry reports, Electric Power Research Institute (EPRI) publications, as well as input from boiler manufacturer (OEM) experiences was used in assessing the risks of co-firing Renewafuel and coal in the unit.

2.2 IMPACTS ON COAL CONSUMPTION

The reduction in coal when co-firing Renewafuel and coal was determined by substituting the Renewafuel weight into the overall calculation, with adjustments to the boiler efficiency.

The amount of coal used will be reduced commensurate to the amount of Renewafuel; however, the total fuel consumption will increase slightly due to the lower heat value of Renewafuel, thereby increasing overall fuel requirements as the Renewafuel burn increases.

2.3 MODIFICATION REQUIREMENTS

The modifications required to the coal handling and boiler are based on previous projects, S&L technical experience and vendor technical input. The scope included materials, equipment, labor, engineering, overheads, and contingency. The modification scope is as follows:

- Fuel unloading based on Renewafuel quantities.
- Fuel preparation based on Renewafuel quantities.

- Fuel storage capability for each option.
- Fuel conveying or piping from the preparation system to burners.
- Combustion control modifications for interface with new equipment.
- Modifications to the existing boiler for co-firing option.
- Electrical service for new equipment for each option.
- Forced draft (FD) fan, ash removal system, electrical modifications, structural support, and ducting/piping to existing boiler.

3. RENEWAFUEL HANDLING AND COMBUSTION TECHNOLOGIES

There are multiple types of Renewafuel available, all of varying quality and moisture levels. There are several combustion technologies available for co-firing these fuels in existing coal-fired boilers. S&L evaluated co-firing Renewafuel based on minimal amount of capital investment or modification to existing combustion equipment. This requires changes to the fuel handling, fuel preparation, and combustion equipment.

3.1 RENEWAFUEL HANDLING AND PREPARATION EQUIPMENT

Fuel handling and preparation modifications are required to unload process and convey the Renewafuel. The co-firing option requires multiple fuel paths and multiple combustion technologies.

These systems are discussed below.

3.1.1 Co-firing Fuel Delivery/Receiving, Unloading, and Preparation

3.1.1.1 Fuel Delivery/Receiving

The 1.5" x 2" cube Renewafuel will be delivered by rear dump trucks with a capacity of approximately 15-20 tons. The Renewafuel will be delivered by trucks to a tipping-style truck dumper into a receiving hopper. Refer to Attachment B for the co-firing fuel handling layout.

3.1.1.2 Fuel Unloading and Preparation

The Renewafuel will be fed from the receiving hopper by a drag-chain conveyor onto a belt conveyor, where it will be stacked-out to a covered pile with a capacity of approximately 300 tons. Mobile equipment will load the Renewafuel from the pile to an at-grade reclaim hopper. From the reclaim hopper, Renewafuel will be transported in two paths:

- By belt conveyor to a wood hog/crusher, where it will be reduced in size to less than 1/8" and transported pneumatically to the storage bin adjacent to the plant, where it will be blown into the main boiler through two new systems.

- By belt conveyor to the existing coal conveyor feeding the existing pulverizer storage silos. The Renewafuel will be ground with the coal and burned in the normal burner system.

3.2 EQUIPMENT TECHNOLOGIES

S&L researched the various technologies available for burning Renewafuel to achieve the 20% heat input levels. There are three different technologies that have been proven to be capable of meeting the needs for Silver Bay Unit 2. These are discussed below.

3.2.1 Co-firing Renewafuel in Existing Boiler

There are several methods for introducing Renewafuel into the existing boiler. Each method has been proven, but with limited quantities of Renewafuel. The total heat input will be 153.9 mmBtu/hr for the combined inputs or a Renewafuel feed rate of 20,950 lb/hr. Refer to Attachment A for a co-firing equipment schematic.

Renewafuel can be introduced into the coal feeding the existing pulverizers. B&W's EL-64 pulverizers design is capable of handling 1% Renewafuel. Pulverizer capacity will not be affected due to similar grindability characteristics as the coal; however industry experience indicates that wood fibers at quantities greater than 1% tend to foul the pulverizer grinding zone. Based on Renewafuel quality and moisture level, the EL-64 pulverizer potentially could grind up to 3% Renewafuel; however, for this study S&L used a conservative 1% value. Discussions with B&W and a review of other biomass pulverizer tests indicate that this is a reasonable assumption.

A summary scope for the pulverizer co-grinding scheme follows:

- Renewafuel fed into the existing coal stream through a new conveyor.
- Minimal capital investment required. Renewafuel unloading and grinding.
- Limited Renewafuel burn rate at 1% (1,047 lb/hr Renewafuel).
- Minimal risk to existing pulverizer capacity.
- Inspection and monitoring program for first two years - Monitoring of pulverizer differential to determine if plugging is occurring and inspection for accumulation of wood fibers during standard spring adjustment inspections.

Renewafuel can be introduced into the unit through new, specially designed low-NO_X burners (LNBs). The processed fuel will be pneumatically transported from the storage bin adjacent to the unit-side of the building and pneumatically conveyed into the new burners with a new blower system. There are several commercial sources of custom-designed burners, such as Coen, B&W, and FW. The new burners will be located on the side-walls and industry experience indicates that the heat input is limited to 9% total boiler heat input, or 69.3 mmBtu/hr. The Renewafuel volatiles are much higher than with the PRB, resulting in the Renewafuel consuming the oxygen before the PRB can completely burn. Co-firing Renewafuel with PRB coal in the furnace will require installation of an overfire air (OFA) system above the existing coal burners to ensure complete combustion of any wood particles. The installation of OFA may increase the combustion temperature in the furnace and increase the furnace exit gas temperature.

A summary scope for the separate burner scheme follows:

- Burner scope includes burners, boiler openings, burner piping, igniters, flame scanners, and isolation valves.
- OFA scope covers boiler panels, air injection ports, ductwork, computational fluid dynamic (CFD) modeling, and instrumentation.
- Four burners will be required to meet the 69.3 mmBtu/hr heat input requirements. Each burner typically operates at 17.3 mmBtu/hr.
- Pulverizer grinding requirements (through put) will be reduced by 20% due to the displaced PRB coal by the Renewafuel.
- FD fan impacts are minimal. The current ID fans have no margin remaining at 4.5% moisture and will be undersized by 3% at a Renewafuel moisture level of 10%. The work scope for the co-firing option include ID fan capacity upgrades.

The Renewafuel can also be introduced into the unit through new, specially designed burner line inductors. The processed fuel will be transported pneumatically from the storage bin adjacent to the unit-side of the building and conveyed pneumatically into the inductors with a new blower system. Industry experience indicates that the heat input is limited to about 10% total boiler heat input or 77 mmBtu/hr. Each inductor would be capable of introducing 15 mmBtu/hr of Renewafuel per line.

The heat input proposed from the inductors is 77 mmBtu/hr and will require a minimum of five inductors. To maintain balance combustion across the boiler it is recommended that six (6) new inductors will be located in six of the nine existing burner pipes.

A summary scope for the inductor scheme follows:

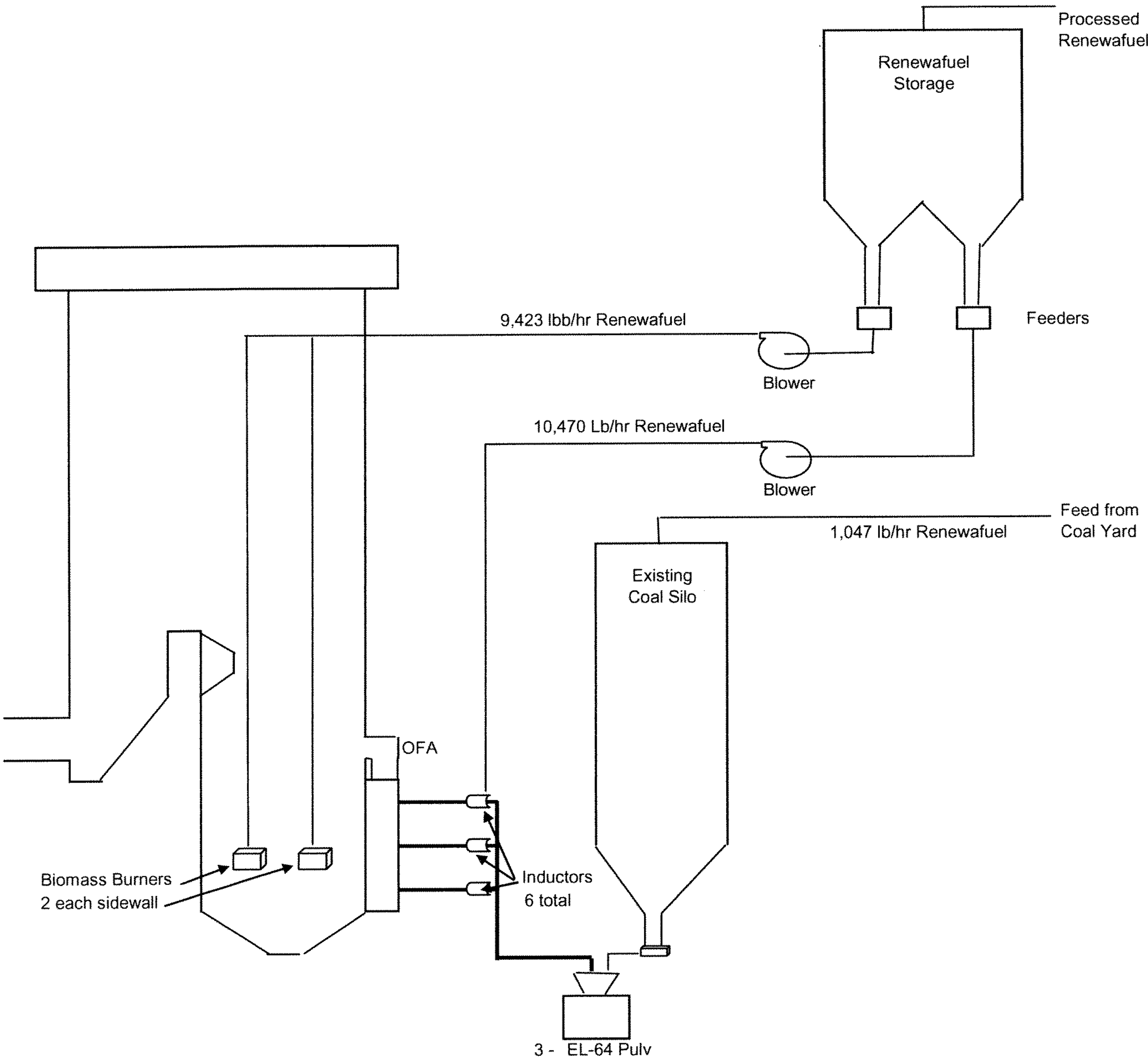
- Burner scope includes six inductors, burner piping, and isolation valves.
- Pulverizer grinding requirements will be reduced by 10% due to the displaced PRB coal.
- FD fan impacts are minimal. The current ID fans have no margin remaining at 4.5% moisture and will be undersized by 3% at 10% moisture. The cost estimates for the co-firing option included ID fan capacity upgrades.

4. RESULTS

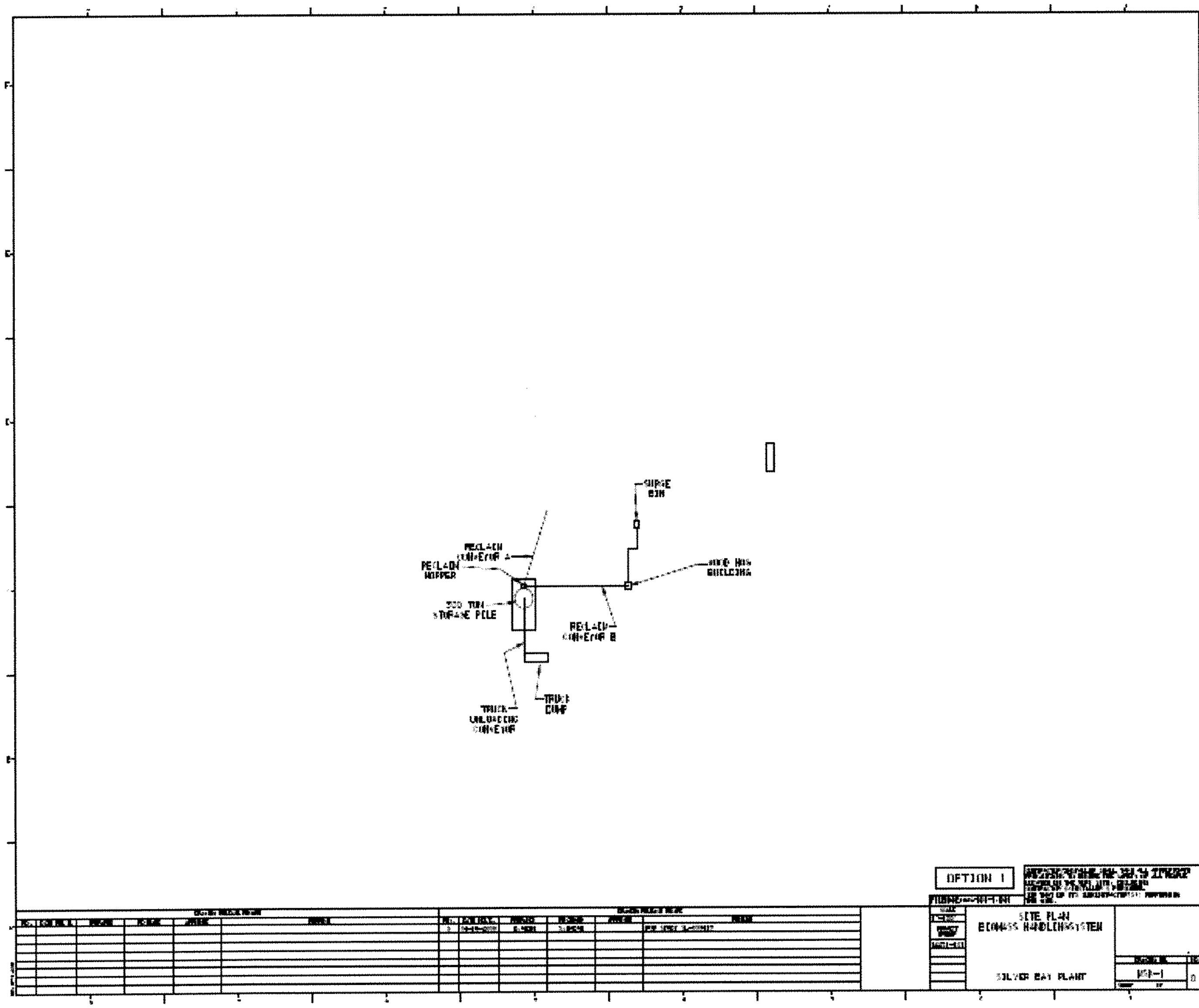
The technical evaluations of the three technologies indicate that all are feasible and proven technologies when combined are capable of burning Renewafuel at a 20% replacement for the PRB fuel.

5. ATTACHMENTS

Attachment A. Co-firing Equipment Schematic



Attachment B. Co-firing Option Fuel Handling Layout



Attachment C. Co-firing Option Fuel Handling equipment Additions

Silver Bay Option 1 3/17/09 rev Fuel handling equipment	
	Qty.
Truck Scale - Incoming	1
Truck Scale - Outgoing	1
Tipper	2
Reclaim Hopper with Drag Chain Bottom	1
Tipper pit	1
Stackout Conveyor	1
Telescopic Chute	1
Metal Detector	1
Magnetic Separator	1
Wood Hog Building	1
Disc Screen	1
Swing Hammer Hog	1
Scale	1
24" Reclaim Conveyor A	1
24" Reclaim Conveyor B	1
Pressure Blower	1
Pneumatic Conveyor Piping	1
Pneumatic Conveyor Rack	1
Surge Bin	1
Cover on storage pile (90ft x 90ft)	1

Attachment D. Boiler Co-firing Equipment List

Cliffs Natural Resources
Silver Bay Unit 2
Boiler Modifications Scope

Assumptions

Pulverizer - Feed 1% thru pulverizer			
Biomass input	1,047	Lb/hr	
Biomass HHV	7,350	But/lb	
Heat Input from Biomass	7.6	Btut/hr	
Suspension Burner system			
Biomass input	9,423	Lb/hr	
Biomass HHV	7,350	Btu/lb	
Heat Input from Biomass	69.3	Btu/hr	
Number of Burners @ 30mbtu/hr	2.3		
Number of Burners @ 30mbtu/hr	4		4 burners required for balnced heat input
Primary Air requirements	7,875	CFM	
Induction Burners system			
Biomass input	10,470	Lb/hr	
Biomass HHV	7,350	Btu/lb	
Heat Input from Biomass	77.0	Btu/hr	
Number of Burners @ 15mbtu/hr	5.13		
Number of Burners @ 15mbtu/hr	6		
Primary Air requirements	5,250	CFM	

Cost Estimates

	Quantity				
Suspension Burner System					
Burner assembly	4				
Burner boiler openings (4)	4				
Fuel piping system @ 4 - 6 inch	4				
Ignitor system	4				
Flame Scanner system	4				
Blower system @ 7,875 CFM	1				
Overfire air system addition	.				
Ductwork					
Separate fan system					
Boiler port installation					
Boiler CFD modeling					
I&C / Control logic changes					
Electrical changes					
Start up / Commissioning cost					
Total - Suspension Burner system					

	Quant				
Inductor system on existing burners					
Inductors at existing burner (6)	6				
Fuel piping system @ 4 - 6 inch					
Blower system @ 5,250 CFM					
I&C / Control logic changes					
Electrical changes					
Start Up / Commissioning					
Total - Inductor system					
Demolition / relocation allowance					
ID fan uprate allowance					
Subtotal - Material & Labor					
Fuel Handling / Preparation					

Attachment E. ID Fan Capacity Review

Sargent & Lundy

Calcs. For Silver Bay Unit 2		Calc. No		
ID fan flow calculations		Rev.	Date 3/12/09	
Safety Related	Non-Safety Related	Page 1 of 3		

Client Cliffs Natural Resources		Prepared by: Don Johnson	Date 3/12/09
Project Biomass Engineering study - Renewafuel		Reviewed by:	Date
Project No. 11705	Equip. No. 4	Approved by:	Date

ID fan design information

Buffalo Forge Fan @ 12/18/78

Size	1780 L-21 DWDI
Wheel diameter	95.0 inch
Outlet cone area	57.3 Sqft

Operating Conditions:

Speed	892 RPM
Gas temp	310 F
Gas density	0.0510 Lb/cuft
Barometric pressure	29.28 Hg "
Maximum Flow	170,000 CFM @310F
Fan pressure	27.5 H2O "

ID fan motor design information

Westinghouse Electric Motor

Horse Power	1250
Speed (variable)	890
Frame	6809L
Poles	8
Type	LLD
Voltage	2300 VAC
Phase	3
Insulation	Class B

Fan Capacity evaluation

Original boiler combustion gas flow

Fuel input	64,501 Lb/hr	Flue gas density	0.0489 Lb/cuft
Fuel input	757,892 Lb/hr	Flue gas Temp	298F
Lb flue gas per Lb fuel	11.75 Lb gas / Lb fuel	APH Leakage	10%

$$\text{Volumetric flow} = \frac{\text{Mass flow (Lb/hr)}}{\text{Density (Lb/cuft) X (60Min/hr)}}$$

$$= \frac{757{,}892 \text{ lb/hr}}{0.0489 \text{ Lb/cuft x 60 min/hr}}$$

= 258,314 CFM Total gas

Volumetric flow w/ Air Preheater leakage of 10%

= 258,314 CFM x 110%

= 284,145 CFM

ID Fan flow per fan

$$= \frac{284{,}145 \text{ CFM}}{2}$$

ID fan required = 142,072 CFM Maximum ID Fan capacity

Sargent & Lundy LLC	Calcs. For Silver Bay Unit 2		Calc. No	
	ID fan flow calculations		Rev.	Date 3/12/09
	Safety Related	Non-Safety Related	Page 3 of 3	

Client Cliffs Natural Resources		Prepared by: Don Johnson	Date 3/12/09
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ID fan motor design information

Westinghouse Electric Motor

Horse Power	1250
Speed (variable)	890
Frame	6809L
Poles	8
Type	LLD
Voltage	2300 VAC
Phase	3
Insulation	Class B

Original operating point (From Buffalo Forge Performance curve)

Flow 170,000 cfm @ 310F
HP 900 HP

Proposed operating condition (maximum flow demand @ external combustors)

Flow 174,712 CFM @310 F
HP 930 HP

Conclusions:

The ID fans are marginal at the present time based on the following:

The data from the plant indicates the inlet vanes are 100% open.
The calculated flows for the combustion gases indicate the ID fan demand will exceed the design flow.
The development of a solution will require additional information about the current condition of the fans.
An allowance was added to the costs for the options to perform fan upgrades.

The motor is adequate for the addition of the external combustors and the co firing options.

Attachment F. Pulverizer Capacity Review

B&W EL 64 Pulverizer		Original Design	Current operation PRB Fuel	Current operation Renewafuel	Co Firing Option PRB Fuel	Co Firing Option Renewafuel
Pulverizer Design	lb/hr	26,690	29,400		29,400	
Fuel heating value	Btu/lb	10,500	8,800		8,433	
Grindability	HGI	50	55		60	
Fineness thru 200 Mesh		70	70		70	
Correction factor @ Grindalility	%	1.0	1.1		1.1	
Primary Air Flow cfm @ 150F	cfm	13,400	13,400		13,400	
Pulverizer coal input						
Coal flow @ 69 MW net	lb/hr	64,600.0	86,229.0		69,962	20,941
Pulverizer requirements	Number	2.4	2.9		2.38	
Three pulverizers in service		21,525 lb/hr	28,750 lb/hr	98% capcity	23,320 lb/hr	79% capacity
Two pulverizers in service		Overload	Overload		Overload	

Neuschler, Catherine

From: Gischia, Scott [Scott.Gischia@cliffsnr.com]
Sent: Tuesday, April 21, 2009 2:30 PM
To: Jackson, Anne
Cc: Neuschler, Catherine; Cartella, David T.
Subject: RE: Biomass

Anne – please find the answers to your questions below.
-Scott

1. The SO2 reductions are calculated based on a percent change in sulfur emissions estimated by the S&L work. I applied this reduction – 20% in the case of a 20% coal replacement – to our baseline emissions (Unit 1 + Unit 2 SO2 emissions are 2576 tons per year from 2004-2007). As I reviewed the values in the April 8 letter, I see I had a slight miscalculation and the 521 tons of SO2 reductions reflected in the letter should be 515 tpy (2576*20%). Sorry for that error.

2. The April 8 proposal is based on combustion of biomass secured from wood sources in northern Minnesota, would could be processed by the Renewafuel process. There are no plans to utilize any of the grain or cereal feedstocks that were noted in the report.

From: Jackson, Anne [mailto:Anne.Jackson@state.mn.us]
Sent: Monday, April 20, 2009 2:19 PM
To: Gischia, Scott
Cc: Neuschler, Catherine
Subject: RE: Biomass

Thank you for providing this excerpt from the Sargent and Lundy report. It was very helpful.

Further clarification related to two aspects of the biomass proposal is needed to affirm certain claims in your April 8 letter. Scott, we have a phone call schedule for Wednesday morning; it would be very helpful to have this information available before our conversation so that we can come to a resolution very soon:

1. Please show the calculations for the 521 tons of SO2 reductions that would result from Biomass in Boilers 1 and 2, as shown in your April 8 letter.
2. In our phone conversation of April 13, David Cartella stated that this was a biomass proposal, not a Renewafuels proposal. However, the report is prepared based on the physical and fuel characteristics of Renewafuel, and makes reference to potentially requiring Renewafuels to be delivered to meet engineered fuel specifications. The report mentions that there are multiple types of Renewafuel available, all of varying quality and moisture levels. The report states that is considering wood based Renewafuels, and does not consider “grain or cereal” sources due to high chlorine levels in the fuel. Elsewhere the report points out that Renewafuel has a higher volatile content than PRB, thus will affect combustion conditions.

These are very specific requirements related to the use of biomass. Please confirm that indeed the considerations of this project apply to securing biomass from any wood source, and are not uniquely specific to the use of Renewafuels as a fuel. If this project is specific to Renewafuels, please provide a description of this fuel and how its attributes differ from wood generally available in Northern Minnesota.

If you need clarification, please call at 651-757-2460. I look forward to your reply!

-----Original Message-----
From: Gischia, Scott [mailto:Scott.Gischia@CliffsNR.com]
Sent: Friday, April 17, 2009 12:53 PM
To: Jackson, Anne
Subject: Biomass

Anne –

Sorry for the delay. Attached is a technical summary of biomass co-firing for Silver Bay Power Unit 2. I will call you shortly.

Scott

Neuschler, Catherine

From: Jackson, Anne
Sent: Monday, April 20, 2009 8:27 AM
To: Neuschler, Catherine
Subject: FW: Biomass

FYI

-----Original Message-----
From: Gischia, Scott [mailto:Scott.Gischia@cliffsnr.com]
Sent: Monday, April 20, 2009 8:21 AM
To: Jackson, Anne
Cc: Cartella, David T.
Subject: RE: Biomass

The cost ranges in the April proposal reflected modifications to support biomass for both Units 1 and 2.

From: Jackson, Anne [mailto:Anne.Jackson@state.mn.us]
Sent: Monday, April 20, 2009 8:11 AM
To: Gischia, Scott
Subject: RE: Biomass

Describe the scope of the cost estimates provided in the April letter—does it include work at both units? This report describes fuel storage, handling, feeding and modifications to the boiler. What is the scope of the costs related to both boilers?

-----Original Message-----
From: Gischia, Scott [mailto:Scott.Gischia@cliffsnr.com]
Sent: Monday, April 20, 2009 7:06 AM
To: Jackson, Anne
Subject: RE: Biomass

Good morning Anne –

There's no detailed work done for Unit 1, but there's no reason to believe that the findings of the Unit 2 work aren't equally applicable to Unit 1.

Scott

From: Jackson, Anne [mailto:Anne.Jackson@state.mn.us]
Sent: Friday, April 17, 2009 4:42 PM
To: Gischia, Scott
Subject: RE: Biomass

Is there a similar report for Unit 1? This addresses changes for Unit 2, yet the April proposal is for both Units 1 and 2.

-----Original Message-----
From: Gischia, Scott [mailto:Scott.Gischia@CliffsNR.com]
Sent: Friday, April 17, 2009 12:53 PM
To: Jackson, Anne
Subject: Biomass

Anne –

Sorry for the delay. Attached is a technical summary of biomass co-firing for Silver Bay Power Unit 2. I will call you shortly.

Scott

CLIFFS

Northshore Mining Company: Silver Bay Power Emissions Control

February 20, 2008

Background

Northshore Mining owns and operates Silver Bay Power (SBP), which utilizes the two electric generating units located at Northshore's facility in Silver Bay, Minnesota.

Unit 1 has a nameplate rating of 45MW and is primarily coal fired with natural gas or fuel oil as a backup fuel. The boiler utilizes a fabric filter baghouse for particulate matter control. Unit 1 is not BART-eligible.

Unit 2 has a nameplate rating of 75MW and is primarily coal fired with natural gas as a backup fuel. The boiler utilizes a fabric filter baghouse for particulate matter control. Unit 2 is BART-eligible and a BART analysis was performed for this unit. The BART analysis concluded that low-NOx burners and overfire air are the best available retrofit technology for this unit and prescribed a 40% NOx reduction from Unit 2.

A recent emissions summary from each unit is shown below in Table 1.

Table 1: Recent Years Emissions Summary

Unit 1		2004	2005	2006	Average
Sulfur Dioxide	tons	945	980	1025	983
Nitrogen Oxides	tons	1357	1347	1391	1365
Carbon Dioxide	tons	558586	547861	565759	557402
Unit 2		**2004**	**2005**	**2006**	**Average**
Sulfur Dioxide	tons	1769	1611	1529	1636
Nitrogen Oxides	tons	1948	1779	1642	1790
Carbon Dioxide	tons	775885	706375	670409	717556

Emissions Control Scenarios

Given the size and age of the units, as well as other business dynamics, Northshore is reluctant to invest capital for pollution control at Silver Bay Power—however, there may be two alternative scenarios where it makes sense for Northshore to not only meet the status quo option (BART controls on Unit 2 in 2012), but provide early installations of control on both units that will provide greater and earlier emission reductions. Accordingly, Northshore would like to propose for consideration, a different emissions control scenario whereby 1 of 2 alternatives will be implemented for the two electric generating units at Silver Bay Power Company that would result in a greater solution for the environment and be more amenable from the business perspective. The three scenarios are defined as follows, with a table at the end of this document outlining the timing and reductions associated with each option:

Scenario 1: Status Quo

For this scenario, nothing changes at Silver Bay Power from the current status of today. Unit 2 is BART-eligible and will require installation of technology at least as efficient as low-NOx burners in combination with overfire air to achieve a 40% reduction in NOx emissions, or 716 tons per year. This reduction will need to be achieved by the end of 2012. No modifications are made to Unit 1 in this scenario.

Scenario 2: Biomass Exploration / Implementation

In this scenario, Silver Bay Power would investigate the feasibility of burning biomass on Unit 2 at total fuel percentages in the 15-20% range. The potential benefits of burning biomass include reduction in carbon emissions, SO2 and mercury, along with possible reductions in particulate and nitrogen oxides. There are however, currently no known operating boilers similar to Unit 2 that utilize this significant a percent of biomass as fuel so a certain amount of risk is present in this scenario—along with a substantial capital investment for retrofit costs. A feasibility assessment for biomass burning would be completed by the end of 2009 with installation to occur by 2012 depending on the outcome of that assessment. A successful biomass installation would release Unit 2 from meeting the present BART requirements of a 40% reduction in NOx.

As part of this scenario, Silver Bay Power would install low-NOx burners in combination with overfire air on Unit 1 to achieve a 40% reduction in NOx from this unit. This installation would be completed by the end of 2010.

Any reductions in Regional Haze pollutants made beyond the total tons required to be reduced via BART (716 tons NOx per year on Unit 2) would be considered voluntary reductions by Silver Bay Power.

Scenario 3: Biomass Infeasible

In the event that the biomass option proves infeasible to install or operate, Silver Bay Power would install low-NOx burners in combination with overfire air on Unit 2 to achieve a 40% reduction in NOx from this unit, in addition to the previously installed pollution controls on Unit 1 in 2010. This installation would be completed by the end of 2013.

Any reductions in Regional Haze pollutants made beyond the total tons required to be reduced via BART (716 tons NOx per year on Unit 2) would be considered voluntary reductions by Silver Bay Power.

Table 2: Emissions Control Scenarios

	Scenario 1 **Status Quo**			Scenario 2 **Biomass Exploration/Implementation**			Scenario 3 **Biomass Infeasible**		
	% Reduction	Tons Reduced	Year of Reduction	% Reduction	Tons Reduced	Year of Reduction	% Reduction	Tons Reduced	Year of Reduction
Unit 1: Sulfur Dioxide	0%	0		0%	0		0%	0	
Unit 1: Nitrogen Oxides	0%	0	---	40%	546	2010	40%	546	2010
Unit 1: Carbon Dioxide	0%	0		0%	0		0%	0	
Unit 2: Sulfur Dioxide	0%	0		18%	295		0%	0	
Unit 2: Nitrogen Oxides	40%	716	2012	0%	0	2012	40%	716	2012
Unit 2: Carbon Dioxide	0%	0		20%	143511		0%	0	
SBP Overall: Sulfur Dioxide	0%	**0**		11%	**295**	**2012**	0%	**0**	
SBP Overall: Nitrogen Oxides	23%	**716**	**2012**	14%	**546**	**2010**	40%	**1262**	**2010/2012**
SBP Overall: Carbon Dioxide	0%	**0**		11%	**143511**		0%	**0**	

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 26, 2009

TO : AQD File No. 499A
(Delta ID No. 10900011)

FROM : Anne Jackson, P.E.
Principal Engineer
Environmental Analysis and Outcomes Division

PHONE : (651) 757-2460

SUBJECT : <u>BART Determination for Rochester Public Utilities – Silver Lake Plant; Units 3 and 4</u>

This memo was prepared to provide the documentation of the MPCA's BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Stationary Source Location:

Mailing Address	Stationary Source (SIC: **4911**)/Address
4000 East River Road Northeast Rochester, MN 55906	Rochester Public Utilities – Silver Lake 425 West Silver Lake Drive Northeast Rochester, MN
Contact: Mr. Joe Hensel (507) 280-1556	

1.2 Description of the Facility

Rochester Public Utilities (RPU) operates a bituminous coal and natural gas-fired steam-electric generating station known as the Silver Lake Plant (SLP) in Rochester, Olmsted County, Minnesota.

The SLP consists of four pulverized coal-fired, dry-bottom boilers that produce steam that is used both to generate electricity and sold off-site. The steam produced is sold to the Mayo Foundation, distributed via a high pressure steam line from the SLP to Mayo's Prospect Plant, where it is used to generate electricity via a stream turbine, with the waste heat used for building heating. The facility has a total nominal generating capacity of 100 megawatts gross, and the largest unit (Unit 4) has a capacity of around 60 megawatts. Unit 3 has a capacity of 24 megawatts. Units 3 and 4 were constructed in 1962 and 1969, respectively. Other emission sources include a natural-gas-fired steam heating boiler, coal handling and coal/ash storage facilities.

RPU-SLP is located in the Olmsted County/Rochester SO_2 and PM_{10} maintenance area and was deemed a culpable source in Rochester's SO_2 non-attainment, and the only culpable source in the area's PM_{10} non-attainment. This resulted in Title I SIP conditions being imposed, through the permit, on the SO_2 and PM_{10} emissions to ensure the area was able to attain the NAAQS.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA.[1] ()

The MPCA requested BART analyses from BART-eligible EGUs that were found through modeling to be subject-to-BART. Facilities were directed that the BART analysis should include direct emissions of PM as well as emissions of SO_2 and NO_X, and that the BART analysis was being requested to provide the MPCA with additional information about control costs and relative visibility improvement.

If an EGU was scheduled for future emissions reductions, a BART analysis was not requested by the MPCA if all of the following criteria were met:

- The MPCA had sufficient information about planned emission reductions at the time facilities were notified that they were subject to BART,
- Public Utility Commission (PUC) approvals for the reductions were in place; and
- The MPCA determined that planned emission reductions like represented presumptive BART emissions levels.

Throughout 2006 and 2007, the MPCA acquired more information from utilities on planned controls being undertaken voluntarily. These indicate high levels of emission reductions are planned, many of

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[1] See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.

which meet the BART requirements. The MPCA will continue to evaluate post-BART strategies for all EGUs to meet reasonable progress goals.

2.2 Affected Units

Two units at the SLP facility are subject to BART:

Table 1: Subject to BART Units

Emission Unit Name	EU Number[2]	Control Equipment and Stack Numbers
Boiler No. 3	EU003	CE 005 Centrifugal Collector – High Efficiency CE 006 Electrostatic Precipitator – High Efficiency SV002
Boiler No. 4	EU004	CE 007 Electrostatic Precipitator – High Efficiency CE 008 Spray Dryer Absorber (new) CE 009 Fabric Filter – Medium Temperature (new) SV003

2.3 The BART Analysis

RPU was not requested to submit a BART analysis for SLP Unit 4 because RPU was in the process of undertaking an air pollution control retrofit project for the targeted visibility pollutants (particulate matter, sulfur dioxide, and nitrogen oxides) that met the criteria listed above.

EPA's BART *Guidelines* state that if a source has undergone "a major modification that resulted in the installation of controls, the State will take this into account during the review process and may find that the level of controls already in place are consistent with BART." (40 CFR 51, Appendix Y, II.A.2)

Retrofit Control Technologies

Through 2003 to 2005, RPU evaluated several control technologies that could be used at the facility to reduce emissions.

In 2003, RPU reviewed potential controls for all units. For SO_2, this included wet scrubbers, dry scrubbers, lime injection, and lower-sulfur coal. For NO_X, this included low NO_X burners (LNB), selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and gas reburn. For particulate matter (PM), fabric filters, compact hybrid particulate collector (COHPAC), and electrostatic precipitators (ESPs) were looked at.

Some of these control options were then reviewed in more detail. The following table shows the controls screened for the BART-eligible units (Units 3 and 4). Note that these listings do not give consideration to site-specific factors that might preclude a particular technology at RPU.

2 The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

Table 2. Controls Screened for Units 3 and 4

Pollutant	Technology	Estimated Emission Rate (lb/MMBtu)	Potential Projected Emissions (tpy)	Reduction Cost, $/ton of Pollutant Removed
Unit 3				
NO_X	LNB + OFA	0.34	231	$68
NO_X	SCR	0.14	99	$1,703
SO_2	Spray Dryer Absorber + Fabric Filter	0.27	283	$2,566
SO_2	Wet Scrubber	0.13	92	$2,522
PM	Fabric Filter	0.015	10	$10,072
PM	COHPAC	0.015	10	$7,632
Unit 4				
NO_X	OFA + SNCR	0.21	337	$1,769
NO_X	SCR	0.06	92	$2,841
SO_2	Spray Dryer Absorber + Fabric Filter	0.37	594	$1,310
SO_2	Wet Scrubber	0.18	297	$1,232
PM	Fabric Filter	0.015	24	$2,304
PM	COHPAC	0.015	24	$1,761

In 2005, RPU completed a more detailed analysis for the subject-to-BART units. For SO_2 control, both wet and dry scrubbers were evaluated. For NO_X control, selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) were evaluated. RPU also looked at electrostatic precipitators and fabric filter/baghouse as potential controls for particulate matter.

Using the 2005 analysis, spray dryer absorbers, fabric filters, and an SNCR system were recommended as the best controls for these two units. Costs per ton of pollutant reduced were not estimated, but total costs of the project were estimated as follows:

Table 3. Cost of Chosen Controls

Unit	Generating Capacity (MW)	Installed Project Costs	Incremental Annual O & M Costs (high estimate)	Total Annualized Project Costs[3]	Annual Project Costs in $/MW
3	24	$17,000,000	$643,532	$2,007,656	$83,652
4	60	$21,300,000	$1,242,058	$2,951,225	$49,187

No adverse energy or non-air quality environmental impacts were identified for any of the screened technologies.

Because Unit 4 is larger than Unit 3, controls are more cost-effective at Unit 4. In addition, Unit 4 has much higher usage than Unit 3, therefore controls on Unit 4 are more likely to have an ongoing beneficial impact on visibility. As demonstrated in the MPCA's subject-to-BART modeling, Units 3 and 4 combined were found to be only "marginally" subject-to-BART. Unit 4 impacted visibility more than Unit 3 as Unit 4's 2002 SO_2 emissions were about four times those of Unit 3.

[3] Total annualized project costs were derived by the MPCA by determining an annual value of the installed project costs over 20 years at a 5% rate, and adding the annual O&M costs.

Given the likely small impact on visibility by Unit 3 emissions alone, and the higher cost of installing such controls, the MPCA has determined that the existing control equipment represents BART for this unit. As shown above, this includes multicyclones in series with electrostatic precipitators for PM_{10} control. There are permit limitations for SO_2 and PM_{10}; the unit is not subject to any site-specific NO_X emission limit or control requirement.

In 2006, after completing the analyses described above, RPU agreed to a settlement agreement, which resulted from the appeal of 2004 previous permit amendment.[4] MPCA is a party to the settlement agreement. The agreement requires additional pollution control equipment for SO_2, PM, and NO_X on Unit 4.

The settlement agreement recognizes that "operation of a conventional SCR system is not feasible at Silver Lake Plant Unit 4 due to the flue gas temperature and expected conversion of sulfur trioxide to ammonium sulfates and ammonium bisulfates." It then allowed RPU to use any combination of combustion and post-combustion technology to lower NO_X emission rates, requiring RPU to install and operate "a NO_X emission reduction system that is designed to achieve at least a 0.15 lbs/MMBtu emission rate for NO_X." RPU must commence operation of the equipment by July 1, 2009, "consistent with technological limitations, manufacturer's specifications, and good engineering and maintenance practices."

RPU has chosen to meet the requirements through installation of the combination of control technologies identified and recommended in the 2005 analysis. For NO_X control, RPU is installing the control technology known as 'Mobotec.' Mobotec is comprised of Rotating Opposed Fired Air ('ROFA') and Rotamix selective non-catalytic reduction (SNCR) with furnace urea injection. SO_2 controls consist of installing a spray-dryer absorber designed to achieve a 70 - 85% removal rate. To control PM, the existing ESP will be replaced by a fabric filter that includes a bag leak indicator.

The MPCA determined that the controls being installed at RPU are consistent with BART. The MPCA has determined that installation of the Mobotec system represents BART for NO_X on Unit 4. Initial operation of Mobotec has shown an emission rate of 0.25 lb/MMBtu is achievable on a 30-day rolling average basis. This meets the presumptive BART limit for this type of boiler. The MPCA has determined that installation of the spray dryer absorber represents BART for SO_2 on Unit 4. Although the initial costs at a screening level showed that wet scrubbing provided more emission reductions at a similar (or lower) cost effectiveness, the 2005 analysis recommended spray dryer absorbers due to a lower life cycle cost, driven primarily by a capital cost for dry scrubbing that is half the capital cost of wet scrubbing. The MPCA has determined that the new fabric filter installation represents BART for PM_{10} on Unit 4.

The MPCA issued permit no. 10900011-004 on September 7, 2007 that allows Unit 4 to be retrofitted with these additional controls. The following limits were incorporated into the requirements for Unit 4.[5]

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[4] This permit action, Air Emissions Permit No. 10900011-003, was for the Steam Line Project; the case leading to the settlement agreement was MCEA v. EPA, Docket number 05-1113 in the U.S. Court of Appeals for the Eighth Circuit.

[5] This permit can be found at: http://www.pca.state.mn.us/air/permits/issued/10900011-004-aqpermit.pdf

Table 4. Post-Project Permitted Emission Rates

NOx Limit (lb/MMBtu)	SO_2 Limit (lb/MMBtu)	PM_{10} Limit* (lb/MMBtu)
$\leq$ 0.46[6] (annual average)	$\leq$ 0.60 (1-hr, 3-hr, 24-hr block average)	$\leq$ 0.4

*PM_{10} limit includes filterable plus organic and inorganic condensibles.

The installation of the pollution control equipment on Unit 4 required a SIP revision and modeling to ensure that the SO_2 NAAQS are being maintained. Through the modeling, it was determined that, even with the installation of pollution controls on Unit 4, the facility models SO_2 non-attainment at a single elevated receptor in downtown Rochester. This resulted in the facility taking some lower SO_2 emission limits on Units 1 – 3 when more than one of those units is operating at a time. For the subject-to-BART Unit 3, the SO_2 emission limit when operating alone decreased, going from 3.20 lbs/hour to 2.30 lbs/hour. This new lower limit has been designated as the BART limit.

Table 5 shows the changes in visibility impairing pollutants that will result from the installation of these controls.

Table 5. Emission Changes from Project (based on Future Projected Actuals)

Pollutant	Limited PTE from Existing Facility (tpy)	Net Increase Attributable to proposed emission reduction project (tpy)	Limited PTE from Total Facility after Emission Reduction Project (tpy)
PM	3059.1	21.6	3080.7
PM10	2043.7	13.0	2056.7
SO2	7725.0	(1504)	6221.0
NOx	3175.0	(309.3)	2865.7

In addition, the Title V permit requires RPU to propose additional strategies to ensure modeled SO_2 attainment, which should result in decreased SO_2 emissions, ensuring additional progress in reducing this facility's visibility impact.

The MPCA completed visibility modeling to show the impact of BART compared to the actual emissions from the facility modeled in the 2002 base year modeling. Two years of meteorology were modeled, 2002 and 2005. The results are shown below in Table 6.

Table 6. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	0	0	0	0	0	0	0	0	0
	2005	0	0	0	0	0	0	0	0	0
	'02 & 05	0	0	0	0	0	0	0	0	0
98th Percentile Δ dv	**2002**	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
	2005	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0
	'02 & 05	0.2	0.1	**-0.1**	0.1	0.1	**-0.1**	0.1	0.1	**0.0**

[6] This emission limit is a result of Phase II of the Title IV acid rain program.

The modeled results show very little visibility improvement because the 2002 base year actual emissions modeled for this facility were very low, as shown below in Table 7. However, the MPCA believes that the BART determination and corresponding emission limit will serve to keep the facility emissions at this low level.

Table 7. Facility Emission 2001 – 2004

	2001	2002	2003	2004
NO_X	968	367	1323	1256
SO_2	2590	1137	3168	2590

2.4 MPCA Determination of the BART Limit

The following limits represent the MPCA's determination of BART for Boilers 3 and 4.

Table 8. BART Emissions Limits

	NO_x Limit (lb/MMBtu)	SO_2 Limit (lb/MMBtu)	PM_{10} Limit* (lb/MMBtu)
Unit 3	No limit	$\leq$ 2.30 (operating alone; 1-hr, 3-hr, 24-hr block average)	$\leq$0.4
Unit 4	$\leq$ 0.25 (30 day average)	$\leq$ 0.60 (1-hr, 3-hr, 24-hr block average)	$\leq$0.4

*PM_{10} limit includes filterable plus organic and inorganic condensibles.

Following EPA approval of the MPCA's Regional Haze State Implementation Plan, at the next opportunity for permit amendment or reissuance (likely when RPU proposes additional SO_2 controls) the MPCA will add the citations to RPU's air quality permit that the above permit requirements also satisfy the MPCA's Best Available Retrofit Technology determinations for these units.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 26, 2009

TO : AQD File No. 202C+Y
(Delta ID No. 14100004)

FROM : Anne Jackson, P.E.
Environmental Analysis and Outcomes Division

PHONE : (651) 757-2460

SUBJECT : BART Determination for Xcel Energy's Sherburne County Generating Plant (Sherco)

This memo was prepared to provide the documentation of the MPCA's BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Stationary Source Location:

Mailing Address	Stationary Source (SIC: **4911**)/Address
414 Nicollet Mall Minneapolis, MN 55401-1993	13999 Industrial Blvd. Becker, MN 55308
Contact: Rick Rosvold (612) 330-7879	

1.2 Description of the Facility

Xcel Energy's (Xcel) Sherburne County generating plant (Sherco) has a total plant electrical output rating of 2,255 MW, and also supplies steam to an off-site customer. Unit 1 (690 MW net, installed in 1976) and Unit 2 (683 MW net, installed in 1977) are tangentially fired and discharge emissions to the atmosphere through a common 650 foot stack. Unit 3 at the facility is a 900 MW, front and rear wall-fired boiler and discharges emissions through another 650 foot stack. Unit 1 and 2 each have a maximum rated heat input capacity of 7,111 MMBtu/hr while Unit 3 is rated at 8,840 MMBtu/hr. Steam for electric power generation is provided by all three boilers and approximately three percent of the steam from Unit 1 and 2 is supplied for off-site sale. Sub-bituminous coal is the primary fuel for all three power boilers. Distillate fuel oil is used as an ignition and warm up fuel.

Coal is brought to the facility via railcars and unloaded by physically flipping the railcar and dumping the coal into a hopper. From there it is transferred by conveyor to the coal barn, to the coal stacker in the coal berms area or to scraper loading for transportation to inactive storage. Coal going to the plant is first transferred to the crushers. Crushed coal is transferred to coal silos for temporary storage prior to pulverizing for combustion in Boilers 1, 2, and 3.

The air pollution control equipment for Units 1 and 2 consists primarily of spray towers (wet scrubbing) and high efficiency wet electrostatic precipitators to control particulate and sulfur dioxide (SO_2) emissions. In 2007 Xcel installed low NO_X burners, separated/close coupled overfire air systems, and a combustion optimization system for Unit 1. For Unit 2, Xcel installed a computer based combustion optimization system for the overfire air system in 2006. Unit 3 has a spray dryer absorber followed by a fabric filter.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations Under the Regional Haze Rule*", which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the *Guidelines*;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA.[1]

The MPCA requested BART analyses from BART-eligible EGUs that were found through modeling to be subject-to-BART. Facilities were directed that the BART analysis should include direct emissions of PM as well as emissions of SO_2 and NO_X, and that the BART analysis was being requested to provide the MPCA with additional information about control costs and relative visibility improvement.

2.2 Affected Units

Two units at the facility are subject to BART:

Table 1. Subject to BART Units at Sherburne County Generating Station

Emission Unit Name	EU Number[2]	Control Equipment and Stack Numbers
Unit No. 1	EU001	CE 038 Wet scrubber- high efficiency CE 047 Modified burner/ furnace CE 051 Electrostatic precipitator – high efficiency SV001
Unit No. 2	EU002	CE 039 Wet scrubber- high efficiency CE 040 Electrostatic precipitator – high efficiency CE 048 Modified burner/ furnace SV001

[1] See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.

[2] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

2.3 The BART Analysis

Because these units are located at a power plant greater than 750 MW, the BART *Guidelines* apply to the determination. The MPCA provided an annotated version of the *Guidelines* to affected facilities in 2006 which included the MPCA's interpretation of the *Guidelines* and specific instructions where necessary to complete a BART analysis.[3] Xcel's performed a BART analysis for Sherco Units 1 and 2 (dated October 27, 2006), and submitted that analysis to the MPCA.[4]

Available Retrofit Technologies

Xcel Energy identified the following potential NO_X controls:

- Combustion optimization (CC) system
- LNB with Separated overfire Air (SOFA) - Unit 1 only
- Mobotec ROFA & ROTAMIX
- NO_X Star & NO_X Star Plus
- Ecotube
- Induced flue gas recirculation (IFGR)
- Selective catalytic reduction (SCR)
- Selective non-catalytic reduction (SNCR)
- SCR/SNCR Hybrid (Cascade System)
- LoTOx
- Natural gas reburn (includes fuel lean gas reburn (FLGR) and amine-enhanced fuel lean gas reburn (AE-FLGR))

Rotamix, NO_X Star & NO_X Star Plus, Ecotube, IFGR, $LoTO_X$, and natural gas reburn were all eliminated from further consideration, due to technological infeasibility – namely that they have not been applied to units as large as Sherco, are not applicable to coal-fired units, or due to lack of access to a natural gas line. ROFA was not further analyzed due to its general similarity to OFA.

Xcel identified the following potential SO_2 controls:

- Wet flue gas desulfurization (FGD)
- Semi-dry FGD
- Dry FGD
- Furnace/Duct reagent injection
- Increase liquid to gas ratio (L/G) to existing scrubber
- DBA (or other organic acid additive) addition to existing scrubber
- Lime injection into existing scrubber
- Retrofit wet ESP with sparger tubes
- Retrofit existing FGD (installation of liquid distribution ring, installation of perforated trays, redesign spray header or nozzle configuration)

Furnace/duct reagent injection was eliminated from further consideration because it is impractical with an existing FGD system. Retrofitting the existing FGD system was also eliminated due to lack of physical space within the existing scrubbers.

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[3] http://www.pca.state.mn.us/publications/aq-sip2-09.pdf
[4] Available on the MPCA's website at: http://www.pca.state.mn.us/publications/bart-facility-xcelshercounit1.pdf.

Evaluation of Impacts of Technically Feasible Options

Xcel then identified the control effectiveness of the remaining feasible control technologies, along with the cost-effectiveness of installing and operating the relevant controls. Table 2 identifies the control and cost effectiveness of the remaining NO_X control technologies; Table 3 contains the same information for the SO_2 control technologies.

Evaluation of NO_X Controls

In the BART rulemaking, EPA promulgated "presumptive" emission limits which apply to units the size of Sherco Units 1 and 2. The presumptive NO_X rate for tangentially-fired subbituminous fired units is 0.15 lb/MMBtu. Xcel provided analysis of controls that would meet and exceed achieving this emissions rate. Because Unit 2 already has low NO_X burners in place while Unit 1 does not, the scope of the retrofit is slightly different for each unit.

Table 2. Control Effectiveness of Remaining Control Technologies for NO_X at Sherburne County

Technology	Emissions (lb/MMBtu)	Removal (tpy)	Total Capital Cost	Total Annualized Cost	Cost Effectiveness ($/ton)	Incremental Cost ($/ton)
Unit 1	***0.34***	***Baseline***				
Combustion Optimization System (CC)	0.28	1,600	$4,200,000	$485,000	$300	
New LNB, New Separated OFA (SOFA) System and CC	0.15	5,200	$19,000,000	$2,200,000	$430	
LNBs/SOFA/CC, and SNCR	0.14	5,400	$28,000,000	$5,300,000	$980	$15,500
LNBs/SOFA/CC and SNCR/SCR Hybrid (Cascade)	0.12	6,000	$66,000,000	$10,000,000	$1,700	$9,750
LNBs/SOFA/CC and SCR	0.08	7,100	$105,000,000	$18,000,000	$2,500	$8,300
Unit 2	***0.20***	***Baseline***				
Combustion Optimization System (CC)	0.15	1,400	$4,200,000	$490,000	$360	
CC and SNCR	0.14	1,600	$13,300,000	$3,500,000	$2,100	$15,050
CC and SNCR/SCR Hybrid (Cascade)	0.12	2,200	$51,900,000	$8,400,000	$3,900	$9,900
CC and SCR	0.08	3,300	$90,100,000	$15,000,000	$4,600	$7,600

In addition to the environmental impacts and costs, Xcel also described energy and non-air quality impacts, and conducted visibility modeling for its proposed option and the application of SCR in accordance with the MPCA's guidance. No energy or non-air quality impacts were identified as barriers to the use of any of the identified technologies.

Xcel's proposal for BART is to meet the presumptive BART emission limit at Unit 1 with new low NO_X burners (LNB), new separated overfire combustion air (SOFA) system and computer-aided combustion controls (CC). Xcel's proposal for BART at Unit 2 is to meet the presumptive limit with the use of combustion controls (CC). The selected option is highlighted in Table 2.

EPA promulgated presumptive NO_X emission rates in part to assist states in streamlining the BART determination process. The emission rates are based on the use of combustion controls and low NO_X burner systems, and were determined to be generally cost effective for all units. States have the option to assess the retrofitting of post-combustion NO_X controls (selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR)) to assess site-specific conditions.

Xcel provided an analysis of the installation of post combustion controls for NO_X. The MPCA reviewed the cost estimates, emission reduction calculations and made note of visibility modeling Xcel conducted related to the installation of SCRs.

Evaluation of SO_2 Controls

For units that have SO_2 controls achieving removal efficiencies of at least 50 percent, the BART *Guidelines* do not establish a presumptive SO_2 emissions rate, but recommend evaluating upgrades to existing systems. The *Guidelines* do not require removal and replacement of controls.

The existing wet scrubber/particulate matter controls at Sherco report a SO_2 control efficiency of 75%. Xcel evaluated options to improve overall SO_2 control efficiencies to levels ranging from 78% to 92%.

Xcel evaluated EPA's list of applicable suggested upgrades described in the *Guidelines*, and has proposed retrofitting the existing scrubbers with spargers and lime injection, resulting in a potential increase to 89% removal of SO_2 with an emissions rate of 0.12 lb/MMBtu. This emissions rate is more stringent than the presumptive BART SO_2 emissions rate of 0.15 lb/MMBtu established for EGUs currently lacking controls.

Table 3. Control Effectiveness of Remaining Control Technologies for SO_2

Technology	Emissions (lb/MMBtu)	Overall Removal Efficiency	Removal (tpy)	Total Capital Cost	Total Annualized Cost	Cost Effectiveness ($/ton)
Unit 1 Baseline	***0.27***	***75%***				
DBA Addition to Existing Scrubber	0.24	83%	830	$1030000	$260,000	$310
Increase L/G to Existing Scrubber	0.18	83%	2,500	$2300000	$350,000	$140
Lime Injection into Existing Scrubber	0.18	83%	2,500	$90,000	$500,000	$200
Retrofit Wet FGD with Sparger Tubes	0.14	87%	3,600	$3,600,000	$520,000	$140
Retrofit Wet FGD with Sparger Tubes with Lime Injection	0.12	89%	4,200	$3,700,000	$1,000,000	$240
New Semidry FGD	0.11	90%	4,400	$106,000,000	$22,000,000	$5,000
New Wet FGD	0.09	92%	5,000	$222,000,000	$37,000,000	$7,500
Unit 2 Baseline	***0.27***	***75%***				
DBA Addition to Existing Scrubber	0.24	83%	830	$1,000,000	$250,000	$300
Increase L/G ratio to Existing Scrubber	0.18	83%	2,500	$2,300,000	$350,000	$140
Lime Injection into Existing Scrubber	0.18	83%	2,500	$90,000	$480,000	$190
Retrofit Wet FGD with Sparger Tubes	0.14	87%	3,600	$3,600,000	$510,000	$140

Technology	Emissions (lb/MMBtu)	Overall Removal Efficiency	Removal (tpy)	Total Capital Cost	Total Annualized Cost	Cost Effectiveness ($/ton)
Retrofit Wet FGD with Sparger Tubes with Lime Injection	0.12	89%	4,200	$3,700,000	$990,000	$240
New Semidry FGD	0.11	90%	4,400	$106,100,000	$22,000,000	$4,900
New Wet FGD	0.09	92%	5,000	$222,200,000	$37,000,000	$7,400

Visibility Impacts

Xcel calculated the visibility improvement resulting from the proposed BART controls, compared to the next more stringent BART option likely to be considered. Modeling was conducted using BWCAW as the impacted Class I area, using meteorology from 2002 – 2004.

Table 5. Visibility Impacts

Pollutant	Controls	Total Annualized Cost	98th % dv	Days > 0.5 dv	Visibility Improvement	Cost $/dv
	Baseline		2.68			
NO_X	Unit 1: LNB/SOFA/CC Unit 2: CC	$2,700,000	2.11	227	0.57	$4,700,000
NO_X	Unit 1: LNB/SOFA/CC/SCR Unit 2: CC/SCR	$32,000,000	1.80	206	0.88	$36,000,000
SO_2	Sparger Tube Retrofit	$2,000,000	2.13	206	0.55	$3,600,000
SO_2	New wet FGD	$74,000,000	2.00	208	0.68	$108,000,000

Xcel also provided model results showing the overall impact of their proposed BART option at all three Class I areas impacted by Minnesota. This is shown in Table 6.[5]

Table 6. Visibility Impacts of BART at Three Class I areas

	2002		2003		2004		2002 - 2004	
	98th % dv	Days > 0.5 dv	98th % dv	Days > 0.5 dv	98th % dv	Days > 0.5 dv	98th % dv	Days > 0.5 dv
BWCAW Baseline	2.60	85	2.93	87	2.77	91	2.68	263
BWCAW BART	1.51	48	1.72	62	1.78	58	1.57	168
VNP Baseline	1.98	54	2.51	55	2.39	56	2.34	165
VNP BART	1.14	32	1.42	37	1.38	28	1.36	97
IR Baseline	1.69	50	2.04	52	1.95	57	1.79	159
IR BART	0.90	30	1.11	23	1.07	34	0.98	87

The MPCA completed visibility modeling to show the impact of BART compared to the actual emissions from the facility modeled in the 2002 base year modeling. Two years of meteorology were modeled, 2002 and 2005. The results are shown below in Table 7.

[5] This modeling was submitted with the 2006 BART analysis, but inadvertently the submittal only included results for the combined NO_X and SO_2 BART determinations on Isle Royale.

Table 7. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	74	58	-16	53	39	-14	42	30	-12
	2005	58	47	-11	59	37	-22	47	34	-13
	'02 & 05	132	105	-27	112	76	-36	89	64	-25
98th Percentile Δ dv	2002	2.5	1.9	-0.6	2.2	1.7	-0.5	1.4	1.0	-0.4
	2005	2.7	2.4	-0.3	1.5	1.3	-0.3	2.1	1.6	-0.4
	'02 & 05	3.2	2.7	**-0.5**	2.3	1.7	**-0.6**	2.4	1.7	**-0.7**

Cost and Other Considerations

In January 2007, Xcel submitted a notice of a voluntary proposed project at Sherco to the Minnesota Public Utilities Commission. This project included retrofitted SCRs, fabric filters and dry scrubbers on Units 1 and 2; this project was included in the potentially reasonable control measures modeling listed in Minnesota's Regional Haze SIP.[6] After additional study, Xcel concluded that SCRs are only marginally cost-effective, and removed them from the proposed project when the project was formally submitted to the MPCA and the PUC in September 2007 (PUC Docket No 07-02). The project as submitted included low NO_X burners and combustion controls along with the fabric filter/dry scrubber retrofit.

In the middle of 2008, Xcel reported to the MPCA that due to the softening economy, the likelihood of required CO_2 controls leading to the need for more aggressive SO_2 controls than currently available, and the growing quantity of wind-generated electricity making baseload coal plants run less frequently, Xcel was suspending the fabric filter/dry scrubber retrofit project. Instead, Xcel has committed to completing NO_X reduction projects on all three generating units as planned.

In September 2008, Xcel was requested to provide by November 2008 any updates to the 2006 BART analysis. In November, Xcel responded that construction costs as a whole have increased, estimating a 69% increase in the cost of building power plants since 2005.[7] This would particularly impact the costs of new equipment (semidry FGD, new wet FGD, new SNCR and new SCR) included in the BART analysis. Xcel also re-examined the costs of the dry FGD system, and concluded that costs would be at least double those presented in the BART analysis.[8] However, the cost of controls relative to one another has not changed, and the relevant factors of the BART analysis and proposed BART limits remain as originally proposed; therefore, Xcel did not change its proposal of BART technology.

2.2 MPCA Determination of the BART Limit

The MPCA has determined that the NO_X emissions limitation of 0.15 lb/MMBtu on a 30-day rolling average is BART for Sherco Units 1 and 2. The emission limits are achieved with low NO_X burners and overfire air at Sherco 1 and additional computerized combustion controls on Unit 2. The technology achieves the "presumptive BART" emissions rate, and does not prohibit or prevent the future installation of additional NO_X control technology if needed to achieve future reasonable progress requirements or other regulatory efforts.

[6] Minnesota Regional Haze SIP Modeling Technical Support Document, May 2009. p110.
[7] Xcel's original BART analysis was done on a 2005 cost basis.
[8] Detailed cost estimates were provided. They were done on a different basis and thus are not directly comparable to the costs shown in the BART analysis for other technologies.

As shown in Table 2, at this time SCRs are an order of magnitude more expensive than other NO_X controls. Xcel determined that implementing SCRs on these units would be $33 million (annualized) above the cost of proposed BART, and result in only 3,500 additional tons of NO_X removal. Getting only 1.5 times the pollutant reductions at greater than ten times the cost is not cost-effective for BART.

The MPCA has determined that the SO_2 emissions limitation of 0.12 lb/MMBtu on a 30-day rolling average is BART for Sherco Units 1 and 2. The emission limit is achieved with the installation of sparger tubes in the existing scrubbers and the injection of lime to lower the pH of the scrubbing system. Again, the technology achieves the "presumptive BART" emissions rate, and does not prohibit or prevent the future installation of any known additional SO_2 control technology.

The MPCA has determined that the existing particulate control represents BART, and will add a permit limit for PM_{10} of 0.09 lb/MMBtu.[9]

The 2018 regional scale modeling reflects the 2006 and 2007 combustion control upgrades to Units 1 and 2; the modeling of potentially reasonable future controls includes slightly higher controls on these units than required by this BART determination. The MPCA will include revised emission rates that reflect BART for the Five Year SIP assessment regional scale modeling.

The following limits represent the MPCA's determination of BART for Units 1 and 2.

Table 8. BART Emissions Limits

NO_X Limit	SO_2 Limit	PM_{10} Limit
0.15 lb/MMBtu on a 30-day rolling average	0.12 lb/MMBtu on a 30-day rolling average	0.09 lb/MMBtu

*PM_{10} limit includes filterable plus organic and inorganic condensibles.

Following EPA approval of the MPCA's Regional Haze State Implementation Plan, at the next opportunity for permit amendment or reissuance the MPCA will add the citations to Sherco's air quality permit that the above permit requirements satisfy the MPCA's Best Available Retrofit Technology determinations for these units.

9 In the draft SIP public-noticed February 25 through May 16, 2008, the MPCA described in error the existing permit limit for Units 1 and 2 as 0.03 lb/MMBtu.

DEPARTMENT : POLLUTION CONTROL AGENCY

STATE OF MINNESOTA

Office Memorandum

DATE : October 26, 2009

TO : AQD File No. 48A
(Delta ID No. 03100001)

FROM : Anne Jackson, P.E.
Environmental Analysis and Outcomes Division

PHONE : (651) 757-2460

SUBJECT : BART Determination for Minnesota Power Taconite Harbor Unit 3

This memo was prepared to provide the documentation of the MPCA's BART determination based on the technical review performed by MPCA staff. EPA's approval of the Regional Haze State Implementation Plan (SIP) for Minnesota is needed for the MPCA's BART determination to become effective.

1. General Information

1.1 Stationary Source Location:

Mailing Address	Stationary Source (SIC: **4911**)/Address
30 W. Superior St. Duluth, MN 55802	Minnesota Power- 8124 Highway 61 W Schroeder, MN 55613
Contact: Mr. Brandon Krogh (218) 723-3954	

1.2 Description of the Facility

Minnesota Power (Permittee) operates a coal-fired steam-electric generating station known as the Taconite Harbor Energy Center (THEC) at Taconite Harbor near Schroeder, Cook County, Minnesota. The facility and associated dock were built in the mid-1950s by Erie Mining Company to generate electricity as part of their taconite processing plant project in Hoyt Lakes. The dock received coal for the facility and shipped taconite pellets down lake. Many years later, all Erie Mining facilities were sold to LTV Steel Mining Company who hired Cleveland Cliffs as the operating agent. In the 1980s, the power plant was shut down for economic reasons and electricity needed for the Hoyt Lakes and dock operations was purchased from Minnesota Power. Then, once again due to changes in economics, in 1991 LTV decided to restart the power plant to resume production of electricity.

In early 2001, LTV went into bankruptcy and shut down all of its Minnesota facilities. Through the bankruptcy process, Minnesota Power purchased the facility in late 2001. In addition, a new company, Cliffs-Erie, LLC (now Cliffs Natural Resources) was formed that took ownership from LTV of the Taconite Harbor dock as well as the taconite processing facility in Hoyt Lakes. Minnesota Power returned the facility to service in 2002 and the dock is used to receive coal by ship for the facility. The taconite dock loadout operations have remained idle.

Because the facility and dock are located on contiguous property, the entire Taconite Harbor power plant and dock is considered a single source and the air permit lists Minnesota Power & Cliffs-Erie, LLC as co-permittees.

The three tangentially fired coal boilers (75 MW net each) at the facility produce steam that power turbines to generate electricity. The boilers were originally designed to operate on bituminous coal, but began burning subbituminous coal in the early 1990s They are permitted to burn either coal type.

Coal delivered by boat is unloaded and conveyed to a coal surge pile via a series of conveyors or transferred to a coal stockpile for long term storage for use during the non-shipping season. Coal is transferred directly from the coal surge pile by scraper or dozer to the boiler house building, pulverized, and fed into the boilers. Ash is pneumatically conveyed to the ash collection silo and then disposed of in a nearby ash landfill constructed by the Permittee in 2002. The boilers are equipped with distillate oil-fired igniters to facilitate coal combustion during boiler startup. The facility also contains a heating boiler, a cold start generator, and an emergency fire pump.

2. Regulatory and/or Statutory Basis

2.1 Overview of Visibility, Regional Haze, and Best Available Retrofit Technology Program

The U.S. EPA's 1999 Regional Haze Rule singles out certain older emission sources that have not been regulated under other provisions of the Clean Air Act for additional controls. The State of Minnesota is required to determine Best Available Retrofit Technology (BART) for these older sources that contribute to visibility impairment in Class I Areas to install Best Available Retrofit Technology (BART). On July 6, 2005, U.S. EPA published a revised final rule, including 40 CFR 51, Appendix Y "*Guidelines for BART Determinations* Under the Regional Haze Rule" which provides direction for determining which older sources may need to install BART and for determining BART. The State is required to determine BART for each source subject to BART based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable. The analysis must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts, any pollution control equipment in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from use of the technology.

To identify the BART-eligible emission units, MPCA used the following criteria:

- One, or more, emission(s) units at the facility fit within one of the twenty-six (26) categories listed in the Guidelines;
- The emission unit(s) were in existence on August 7, 1977 and began operation at some point on or after August 7, 1962; and
- The sum of the potential emissions from all emission unit(s) identified in the previous two bullets was greater than 250 tons per year of the visibility-impairing pollutants: sulfur dioxide (SO_2), nitrogen oxide (NO_x), and PM_{10}.

The MPCA performed source-specific analyses using the CALPUFF model to determine which sources cause or contribute to visibility impairment. In accordance with the *Guidelines*, a contribution threshold of 0.5 deciviews was used in determining those sources that are subject to BART. The facility identified in this Memorandum was found to be subject-to-BART by the MPCA.[1]

The MPCA requested BART analyses from BART-eligible EGUs that were found through modeling to be subject-to-BART. Facilities were directed that the BART analysis should include direct emissions of PM as well as emissions of SO_2 and NO_X, and that the BART analysis was being requested to provide the MPCA with additional information about control costs and relative visibility improvement.

[1] See http://www.pca.state.mn.us/air/regionalhaze.html for modeling results.

If an EGU was scheduled for future emissions reductions, a BART analysis was not requested by the MPCA if the following criteria were met:

- The MPCA had sufficient information about planned emission reductions at the time facilities were notified that they were subject to BART;
- Public Utility Commission (PUC) approvals for the reductions were in place; and
- The MPCA determined that planned emission reductions likely represented presumptive BART emissions levels.

Throughout 2006 and 2007, the MPCA acquired more information from utilities on planned controls being undertaken voluntarily. These indicate high levels of emission reductions are planned, many of which meet the BART requirements. The MPCA will continue to evaluate post-BART strategies for all EGUs to meet reasonable progress goals.

2.2 Affected Units

One unit at the facility is subject to BART:

Table 1. BART affected Unit at Taconite Harbor

Emission Unit Name	EU Number[2]	Control Equipment and Stack Numbers
Boiler No. 3	EU003	CE 003 Electrostatic Precipitator- High Efficiency SV003

2.3 The BART Analysis

Because this facility has a total generating capacity less than 750 MW (total generating capacity is about 110 MW), strict application of the BART *Guidelines* found in 40 CFR Part 51 Appendix Y is not required. The MPCA has, however, used the *Guidelines* in an advisory fashion and has given consideration to the factors required by the Clean Air Act in making its determination of BART:

(a) The cost of compliance;
(b) The energy and non-air quality environmental impacts of compliance;
(c) Any existing air pollution control technology already in place;
(d) The remaining useful life of the source, and
(e) The degree of visibility improvement which may reasonably be anticipated from the use of BART.

The MPCA requested Minnesota Power prepare a BART analysis for Unit 3. The analysis for NO_X, SO_2 and PM was submitted November 2008.

Pollution Control at the Facility

Minnesota Power has undertaken an emissions reduction project, referred to as the Arrowhead Regional Emissions Abatement (AREA) Project, which when completed will retrofit all three electric generating units at Taconite Harbor. Minnesota Power began the project by retrofitting Unit 2, which is not a BART eligible unit due to its construction date (1957). The MPCA issued Air Emission Permit No. 03100001-006 on January 8, 2007, which allows Unit 2 to be retrofitted with additional air pollution controls as a demonstration project. Minnesota Power intended to install similar controls at all three units at Taconite Harbor. As of the date of this determination, Units 1 and 2 have completed retrofits and are operating.

[2] The MPCA organizes conditions and illustrates associations in its permits using the Emission Unit (EU), Control Equipment (CE), and Stack/Vent (SV) numbers.

The operation of controls on these units provides valuable information for determining how controls would operate at Unit 3, as all three units are very similar.

The emissions reduction project at Units 1 and 2 involve the installation of Nalco-Mobotec's ROFA/Rotomix control system to reduction NO_X and SO_2. Additionally, Mobotec's "Minplus" injection system was installed to control mercury emissions. The project also involved modifying the electrostatic precipitators from "hot-side" to "cold-side".

Mobotec is comprised of Rotating Opposed Fired Air ('ROFA') and ROTAMIX selective non-catalytic reduction (SNCR) with furnace urea injection for NO_X control. In addition, the system includes a Furnace Sorbent Injection ('FSI') system for injection of a calcium alkaline reagent (limestone) for SO_2 control, and a system to inject a clay-based sorbent (MinPlus) to adsorb and chemically bind vaporized elemental mercury.

It was anticipated that the ROFA/Rotamix system would achieve the presumptive BART level of 0.15 lb/MMBtu. However, operation of the system throughout 2008 and 2009 demonstrated that actual efficiency of the NO_X control system is slightly less than anticipated, and average emissions are now around 0.17 lb/MMBtu. The system also did not achieve SO_2 removals as planned. It has proven necessary to operate the furnace sorbent injection system at a reduced lime injection rate in order to reliably meet the PM and PM_{10} limits with the existing ESP. These reduced injection rates have caused the facility to be unable to achieve the level of SO_2 expected by the pilot project.

Retrofit Control Technologies

Minnesota Power identified the following technical feasible retrofit control technology options for Unit 3:

NO_X Control
- Selective Catalytic Reduction (SCR)
- Mobotec's Rotating Opposed Fired Air (ROFA) and Rotamix technologies
- Mobotec's ROFA technology alone

Low NO_X burners were not considered due to their similarity to the ROFA system and lesser control efficiency.

SO_2 Control
- Wet Flue Gas Desulfurization (FGD) system using dry ground pulverized limestone
- Semi-Dry FGD system (lime spray dryer) using lime or hydrated lime
- Mobotec's Furnace Sorbent Injection (FSI) technology using hydrated lime

PM Control
- Existing hot-side electrostatic precipitator (ESP) in conjunction with a wet FGD
- Conversion of the hot-side ESP to a cold-side ESP in conjunction with Mobotec
- Fabric filter baghouse in conjunction with semi-dry FGD or Mobotec's FSI system

The BART *Guidelines* then call for an analysis of the control effectiveness of the technologies and impacts, including cost-effectiveness of these control technologies in terms of dollars per ton of pollutant removed.

Table 2 shows the resulting emission rates, tons removed, and cost-effectiveness of the SO_2 and NO_X control technologies identified above. Because some SO_2 control technologies affect PM loading, the SO_2 options analyzed below are shown paired with one of the PM control technologies identified above. The table shows only separate PM emission rates for the various combinations of SO_2 and PM controls.

Table 2. Proposed Emission Rates and Cost-Effectiveness of Feasible Technologies for Taconite Harbor Unit 3 BART

Control Technology	Post-BART emissions rate (lb/MMBtu) (annual basis)	Post-BART emissions rate (lb/MMBtu) (30-day rolling average)	Percent Reduction	Tons removed	Total Levelized Cost ($/yr)	Cost Effectiveness ($/ton)
NOx						
SCR	0.05		88%	1,100	$5,085,000	$4,600
ROFA/Rotamix	0.13		68%	840	$2,876,000	$3,400
ROFA	0.16	0.20	60%	750	$1,616,000	$2,200
SO_2						
Semi-dry FGD and new FF	0.08		89%	1,940	$9,689,000	$5,000
FSI and ESP conversion	0.42		40%	880	$1,109,000	$4,000
FSI and new FF[3]	0.42	0.40	55%		$1,868,000	$3,900
PM						
Fabric Filter with Semi-dry FGD	0.012	0.10	60%			
Fabric Filter with FSI	0.012	0.10	60%			
ESP Conversion with FSI	0.03		0%			

Because wet FGD provides a similar emission rate (0.06 lb/MMBtu) to semi-dry FGD along with a significantly higher cost for each ton of SO_2 removed, it was eliminated as a BART technology. Minnesota Power obtained preliminary estimates that showed that a wet FGD would be significantly more expensive than the control technologies shown in the table above. Further, wet FGD has higher energy costs for managing water in the scrubber and dewatering sludge. Sludge disposal presents an additional operational barrier in addition to the costs related to its disposal. The technology was appropriately rejected at Taconite Harbor.

Minnesota Power proposed that BART for Unit 3 is ROFA for NO_X control, while BART for SO_2 and PM is furnace sorbent injection with a new fabric filter.

During the public notice of the BART determinations, Minnesota Power commented that the effectiveness of the various technologies in its submitted BART analysis should be considered as demonstrating what is achievable on an annual basis and not reflective of an emissions rate that has a shorter averaging period. The BART *Guidelines* recommend the use of a short timeframe for emission limits, specifically a 30-day rolling average, so Minnesota Power proposed revised emission rates to reflect the shorter period.

Minnesota Power has revised the NO_X emissions limit to 0.20 lb/MMBtu, and provided NO_X emissions data from Units 1 and 2 showing the degree of variation experienced within a day and within 30 days with the use of ROFA/Rotamix. Additionally, the MPCA reviewed the 2008 and 2009 emissions data from

[3] In the analysis, the use of furnace sorbent injection (FSI) along with fabric filters was represented as achieving at least a 40% SO_2 removal rate. However, Minnesota Power explains in its selection of BART that with the use of a fabric filter, SO_2 removal rates should improve to 55%. This improvement in SO_2 controls results in an SO_2 emissions rate of 0.32 lb/mmbtu, resulting in a cost-effectiveness value of $ 3,900/ton.

EPA's Clean Air Markets Division for Taconite Harbor, and calculated the 30-day rolling average for each unit. The 30-day average at Unit 2 ranged from a low of 0.13 to a high of 0.20 lb/MMBtu, with individuals days ranging from 0.1 to 0.79 lb/MMBtu.

The MPCA also reviewed SO_2 data from Unit 2 for 2008 and 2009. FSI with the use of an ESP achieved a 30-day rolling average ranging from 0.29 to 0.53 lb/MMBtu. Minnesota Power has proposed a revised SO_2 emissions rate, going from 0.32 lb/MMBtu to 0.40 lb/MMBtu. This emissions rate is lower than the range achieved at Unit 2 as it reflects the additional 15% control of SO_2 expected with the addition of a fabric filter for particulate matter control, and the likelihood of a coal switch by Minnesota Power to one with lower sulfur content.[4]

Minnesota Power also requested a change in the PM_{10} limit from 0.012 lb/MMBtu to 0.10 lb/MMBtu. The 0.012 lb/MMBtu value reflects the filterable emissions rate the fabric filter is capable of achieving. Stack test measurements of condensable emissions at Unit 2 where ROFA/Rotomix and furnace sorbent injection is currently employed shows condensable PM emissions ranging fro 0.005 to 0.027 lb/MMBtu.[5] While the proposed PM_{10} limit of 0.10 lb/MMBtu is considerably higher than the sum of the filterable and condensable values (0.04 lb/MMBtu), the emissions rate is well below 0.3 lb/MMBtu, the PM10 limit the MPCA would have imposed in following its strategy for PM_{10} limits.

The MPCA does not view these changes as a change in the efficiency of the ability of the controls to capture or minimize pollutant emissions, but rather bounds the emission rate for the shorter time frame that BART requires. The MPCA is therefore not adjusting the removal effectiveness or the cost effectiveness of controls.

Visibility Impacts

Minnesota Power conducted visibility modeling in 2006 for Unit 3 assuming the implementation of the AREA plan described above.[6] At that time, the plan was to convert the hot-side ESP to a cold-side ESP. The modeling was being conducted to determine the impacts of improving particulate matter control by upgrading to a fabric filter.

Minnesota Power did not report visibility impacts by pollutant, and so visibility improvements in Table 3 below are reported for the entire project.

Table 3. Visibility Impacts from Application of NO_X, SO_2 and PM Controls at Taconite Harbor Unit 3[7]

Controls	Modeled emissions rate (AREA) lb/MMBtu			BART Limits lb/MMBtu			Days over 0.5 dv (BWCAW)	98^{th} % dv	Visibility Improvement
	SO_2	NO_X	PM_{10}	SO_2	NO_X	PM_{10}			
Baseline	0.667	0.402	0.141				163	1.499	
ROFARotamix/FSI/FF	0.273	0.15	0.097	0.40	0.20	0.10	53	0.689	0.81

[4] Minnesota Power has embarked on a campaign to identify appropriate coals with low sodium, as the current coal source will no longer be available. Potential suitable new coals will have lower sulfur content than the current coal.
[5] Brandon Krogh, Minnesota Power. Revised Draft of the Regional Haze State Implementation Plan Responses to Information Request. September 24, 2009.
[6] http://www.pca.state.mn.us/publications/g-16-01.pdf
[7] http://www.pca.state.mn.us/publications/bart-facility-mnpowertaconite.pdf

The results of this modeling cannot be precisely compared to the BART determination due to ROFA/Rotamix/FSI performance being slightly less than anticipated.   However, they do show that the user of controls similar to those imposed by BART will result in visibility improvement at BWCAW.

The MPCA completed visibility modeling to show the impact of BART compared to the emissions from the facility modeled in the 2002 base year modeling. Two years of meteorology were modeled, 2002 and 2005. The results are shown below in Table 4.

Table 4. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	94	90	-4	11	9	-2	30	27	-3
	2005	92	85	-7	11	8	-3	27	22	-5
	'02 & 05	186	175	-11	22	17	-5	57	49	-8
98th Percentile Δ dv	2002	9.2	8.3	-0.9	0.8	0.7	-0.1	2.2	1.9	-0.3
	2005	5.4	4.7	-0.7	0.8	0.6	-0.1	1.7	1.5	-0.2
	'02 & 05	9.2	8.8	**-0.4**	1.1	0.9	**-0.1**	2.4	2.1	**-0.3**

2.4 MPCA Determination of the BART Limit

Minnesota Power has proposed the use of Nalco-Mobotec ROFA system as BART for NO_X and furnace sorbent injection with installation of a new fabric filter as BART for SO_2 and PM_{10}.   The MPCA concurs.

Based on the review of emissions data from the use of this technology at sister units at Taconite Harbor, the MPCA is proposing the NOx BART emissions rate of 0.20 lb/MMBtu which will encompass the periods of highest NOx emissions rate during a 30-day period when using ROFA.   Similarly, the MPCA is proposing the SO_2 BART emissions rate of 0.40 lb/MMBtu on a 30-day rolling basis. The MPCA is proposing a PM_{10} limit of 0.10 lb/MMBtu.

The following limits represent the MPCA's determination of BART for Boiler 3, representing a 60% reduction in NO_X, a 55% reduction in SO_2, and a 60% reduction in PM_{10} from baseline conditions.

Table 5. BART Emission Limits

NO_x Limit	SO_2 Limit	PM_{10} Limit*
≤ 0.20 lb/MMBtu 30-day rolling average	≤ 0.40 lb/MMBtu 30-day rolling average	≤ 0. 0.10 lb/MMBtu

*PM_{10} limit includes filterable plus organic and inorganic condensibles.

CALPUFF modeling was not rerun for this source by the MPCA, however, the controlled emission rates are incorporated into the 2018 regional scale modeling performed.

Following EPA approval of the MPCA's regional haze State Implementation Plan, at the next opportunity for permit amendment or reissuance, the MPCA will add the citations to Taconite Harbor's air quality permit that the above permit requirements also satisfy the MPCA's Best Available Retrofit Technology determinations for this unit.

Appendix 9.5: BART Visibility Modeling

In response to comments on Minnesota's Revised Draft Regional Haze SIP, the MPCA conducted a supplementary analysis of visibility improvement expected due to the implementation of emission limits specified in the BART determinations.

BART determinations and associated emission limits are established for units at Minnesota Power-Boswell Energy Center, Minnesota Power-Taconite Harbor, Northshore Mining-Silver Bay, Rochester Public Utilities-Silver Lake, Xcel Energy-Sherburne Generating Plant and United Taconite-Fairlane Plant (see Figure 9.5.1, below). Specifically, the supplementary analysis attempts to estimate/address:

- The degree of visibility improvement in the Class I areas – Voyageurs, Boundary Waters and Isle Royale – associated with the controls/emission limits determined to be BART by the MPCA; and
- The relative importance of reducing NO_X verses SO_2 emissions.

The results of this analysis do not revisit which BART-eligible units are subject-to-BART. Subject-to-BART units were identified by the MPCA in the document *Results of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota* (see Appendix 9.2).

Figure 9.5.1. Facilities with BART Determinations Assessed

Modeling Methodology

The modeling was conducted with similar methodology as used in the overall SIP. This methodology is discussed in *Technical Support Document of the Minnesota State Implementation Plan for Regional Haze*.[161]

[161] http://www.pca.state.mn.us/publications/aq-sip2-13.pdf

The modeling system is composed of an atmospheric transport and chemistry model, also known as the "air quality model," an emissions model and a meteorological model. The emissions and meteorology models create inputs for use by the air quality model. The modeling system used in this assessment is the same used in the overall SIP and is made up of the following:

- Comprehensive Air Quality Model (CAMx). CAMx simulates atmospheric and surface processes affecting the transport, chemical transformation and deposition of air pollutants and their precursors. Some advantages of CAMx are two-way nesting, a subgrid scale plume-in-grid (PiG) module to treat the early dispersion and chemistry of point source plumes, a fast chemistry solver, and Particulate Source Apportionment Technology (PSAT), which tracks the original source of particulate species by geographic region and source category. CAMx is an Eulerian model that computes a numerical solution on a fixed grid. Minnesota used version 5.01, the most recent available model version.
- The Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5). MM5 output data is used in the emissions model and in the air quality model.
- Emissions Modeling System (EMS-2003). EMS-2003 generates hourly speciated emissions on a gridded basis for mobile, nonroad, area, point, natural (biogenic) and fires. The emissions are input to the air quality model.

Emissions

The base modeling for this analysis included all the emissions used in the 2002 base year, described fully in the technical support document. For power plants, the majority of the facilities specifically assessed in this analysis, the SO_2 and NO_X emissions were temporalized using heat input, in lb/MMBtu, from CEMs data to create temporal profiles with month-of-year, day-of-week, and hour-of-day variations by emissions unit. This approach results in variable emissions throughout the year.

BART guidance for subject-to-BART modeling requires a 24-hour maximum actual emission rate for the individual BART units. This ensures that on any given day during the modeled period, the maximum impact is assessed. The choice to use the actual emissions in the current analysis rather than 24-hour maximum emissions was made in the interest of time. This allowed the use of existing CAMx model output, which takes weeks of computation time to generate, and did not require the additional step of adjusting the temporalized emissions to reflect a 24-hour maximum actual value.

This document contains summary information for each facility assessed. Each facility summary contains Table A, specifying the annual 2002 actual emissions in tons for each facility with units for which a BART determination has been made. Emissions values are provided for NO_X, SO_2, $PM_{2.5}$ and PM_{10}.

The first values in the table are the total emissions from elevated stacks at the facility. Elevated stacks are defined as those with a plume rise of 50 meters or more as calculated by EMS-2003. Because elevated stacks are segregated out of the emissions files as individual point sources, they are eligible for PiG treatment and for determining individual source impacts with the PSAT tool in CAMx. The emissions for all the elevated stacks at each facility were tracked with the PSAT tool. For example, at Minnesota Power-Boswell Energy Center, 14,500 tons/year of NO_X and 21,200 tons/year of SO_2 were tracked in the modeling for the base scenario.

The second values in the table are the emissions for the BART unit stack. For example, Boswell Energy Center, Boiler #3 is a BART unit that emits 4,900 tons of NO_X and 13,300 tons of SO_2 through SV003.

The third value in the table provides the BART unit emissions as a percentage of the total facility emissions. For example, Boiler #3 comprises 34% of the NO_X and 63% of the SO_2 emitted from all elevated stacks at Boswell Energy Center.

The fourth values in the table are the emissions for the BART unit stack with BART controls applied. For example, Boswell Energy Center, Boiler #3 with BART controls applied emits 900 tons of NO_X and 1,300 tons of SO_2. As shown in the fifth value in the table, this reflects an 81% reduction in NO_X and 90% reduction in SO_2 due to the BART controls on Boiler #3. In the modeled BART scenario, the controlled emissions replace the base emissions for the BART-controlled unit. For example, at Minnesota Power-Boswell Energy Center, 10,500 (14,500 – 4,900 + 900) tons/year of NO_X and 9,200 (21,200 – 13,300 + 1,300) tons of SO_2 were tracked in the modeling for the BART scenario.

Each facility summary at the end of this document also contains a Figure entitled “Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling”. This graph depicts how the actual emissions for the BART unit in the base scenario compare to the 24-hour maximum emissions used in the subject-to-BART modeling. For Minnesota Power-Taconite Harbor, Northshore Mining-Silver Bay, and Rochester Public Utilities-Silver Lake, the actual emissions are at times significantly less than the 24-hour maximum value. This means that any visibility improvement shown in this document may be underestimated for the units with BART controls at these three facilities.

BART emission limits at Northshore Mining-Silver Bay are provided for both Power boilers #1 and #2 although only Power Boiler #2 is BART-eligible. While evaluating biomass co-firing as BART for unit #2, it became clear to the MPCA that much of the related handling and other equipment needed to enable biomass co-firing would be sized for both units. Thus, for this particular facility under circumstances of biomass co-firing, the MPCA deemed both units to be a “logical set” to which controls would apply.[162]

Modeling

As described above, the PSAT tool in CAMx was used in order to assess the visibility impact from individual facility point sources. The analysis applies PiG for all the Minnesota facilities with BART units for which a BART-determination with emission limits has been made. The overall domain is the same used in the SIP, the 36km “4rpos domain”, which encompasses an area of the United States and Canada extending east of a line dissecting the United States at the western-most tip of Texas. Concentrations generated from this larger domain feed into the 12km flexi-nested domain over Minnesota, which is the main focus of the visibility improvement analysis of BART controls. The grid domains are shown in Chapter 8 of the SIP.

A base scenario run was conducted with 2002 actual emissions, and a BART scenario run was conducted with 2002 actual emissions adjusted to reflect emission limits applied to units with BART determinations. Both 2002 and 2005 meteorology was used as these two years were readily available for regional scale modeling.

Modeling results were assessed at each 12km grid cell in the Class I areas within the modeling domain. There are 15 receptors in Voyageurs, 62 receptors in Boundary Waters and 15 receptors in Isle Royale.

[162] The BART guidelines at 40 CFR, Appendix Y state, “There may be situations where a specific set of units within a fenceline constitutes the logical set to which controls would apply and that set of units may or may not all be BART-eligible (For example, some units in that set may not have been constructed between 1962 and 1977).”

Visibility Assessment

The facilities assessed are located between about 30km (Minnesota Power-Taconite Harbor) and 420 km (Rochester Public Utilities-Silver Lake) from the nearest boundary of a Class I area. CAMx modeled contributions of the individual point sources to the receptors within the Class I area are output in micrograms per cubic meter ($\mu g/m^3$). These concentrations are further processed to develop visibility impacts.

Visibility impairment is characterized by a light extinction coefficient (B_{ext}), the attenuation of light per unit distance due to scattering and absorption by gases and particles in the atmosphere. The deciview (dv) is a translation of B_{ext} into terms of perceptible changes in visibility by a human observer, with a one to two dv difference being perceptible to a human observer.

The visibility impact from an individual source is too small to be directly assessed by the dv. Thus, visibility impact from individual sources can either be expressed in terms of light extinction, or it can be expressed in terms of a visibility change in deciviews related to natural background, as shown below.[163] The latter approach, which complies with the definition of "visibility impairment" in 40 CFR 51.301(x), was used in the subject-to-BART analysis and in this assessment.

$$\Delta dv = 10 \ln((B_{ext\text{-}background} + B_{ext\text{-}facility}) / B_{ext\text{-}background})$$

For this analysis, the $B_{ext\text{-}background}$ value is the natural conditions for the 20 percent best days at each Class I area. These values (Boundary Waters 14.08 Mm^{-1}, Voyageurs 15.32 Mm^{-1} and Isle Royale 14.51 Mm^{-1}) were obtained from VIEWS, the repository of data to support the Regional Haze Rule.

CAMx output was converted to $B_{ext\text{-}facility}$ using the new (or refined) IMPROVE algorithm. (Additional information on the IMPROVE algorithm can be found in Chapter 5.) The sulfate and nitrate mass were converted to ammonium sulfate and ammonium nitrate by multiplying by the ratio of the molecular weight of ammonium sulfate to sulfate, which is 1.375, and ammonium nitrate to nitrate, which is 1.29. The IMPROVE equation uses relative humidity correction factors (f(RH)), shown in Table 9.5.1,[164] applied to sulfate and nitrate concentrations.

$$\begin{aligned} b_{ext\text{-}facility} = \ & 2.2 * f_S(RH) * [\text{small sulfate}] + 4.8 * f_L(RH) * [\text{large sulfate}] \\ & + 2.4 * f_S(RH) * [\text{small nitrate}] + 5.1 * f_L(RH) * [\text{large nitrate}] \\ & + 2.8 * [\text{small organic mass}] + 6.1 * [\text{large organic mass}] \\ & + 10 * [\text{elemental carbon}] \\ & + 1 * [\text{fine soil}] \\ & + 1.7 * f_{SS}(RH) * [\text{sea salt}] \\ & + 0.6 * [\text{coarse mass}] \\ & + \text{Rayleigh scattering} \\ & + 0.33 * [\text{NO2 (ppb)}] \end{aligned}$$

where:
b_{ext} is the calculated total light extinction in inverse megameters
f_S(RH) is the relative humidity adjustment factor for small particles;
f_L(RH) is the relative humidity adjustment factor for large particles;
f_{SS}(RH) is the relative humidity adjustment factor for sea salt; and

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163 "Interagency Workgroup on Air Quality Modeling (IWAQM), Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts", December 1998.
164 Hand, et al. (March 2006)

The apportionment of the total concentration of sulfate, nitrate and organic compounds ("X") into the concentrations of the small and large size fractions is accomplished using the following equations:

$$[\text{large X}] = ([\text{total X}]/20\mu g/m^3) * [\text{total X}], \text{ for } [\text{total X}] < 20\ \mu g/m^3;$$

$$[\text{large X}] = [\text{total X}], \text{ for } [\text{total X}] \geq 20\ \mu g/m^3; \text{ and}$$

$$[\text{small X}] = [\text{total X}] - [\text{large X}]$$

Table 9.5.1. Monthly f_S(RH) and f_L(RH) values[165] for Boundary Waters and Voyageurs

Class I	f(RH)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Boundary Waters	f_S(RH)	3.24	2.84	2.99	2.64	2.93	3.21	3.44	3.67	3.80	3.07	3.50	3.49
	f_L(RH)	2.50	2.26	2.32	2.09	2.22	2.42	2.57	2.69	2.76	2.37	2.65	2.65
Voyageurs	f_S(RH)	3.16	2.77	2.82	2.59	2.65	3.28	3.25	3.48	3.66	3.02	3.37	3.32
	f_L(RH)	2.46	2.22	2.22	2.07	2.09	2.46	2.46	2.59	2.70	2.35	2.58	2.55
Isle Royale	f_S(RH)	3.45	2.90	3.13	2.85	2.80	3.29	3.76	4.05	4.16	3.36	3.86	3.80
	f_L(RH)	2.63	2.31	2.40	2.21	2.17	2.47	2.74	2.89	2.96	2.54	2.82	2.81

Results

Results of the analysis for all the visibility impairing components comprising primary and secondary formed fine particulate matter less than 2.5 µm in size ($PM_{2.5}$), are shown in Table B of each facility summary.

Both the 98th percentile Δdv change and the number of days 0.5 dv is exceeded are shown. Although the base (no controls) and the BART (with controls) values reflect the Δdv impact from all elevated stacks at the facility, the difference only reflects the change in Δdv due to emission limits on units with BART-determinations.

EPA BART *Guidelines* state that a source with a 98th percentile Δdv change greater than 0.5 dv is considered to "contribute" to regional haze visibility impairment. A value greater than 1.0 dv is considered to "cause" visibility impairment. Based on this criteria, the total actual 2002 emissions from all elevated stacks from each facility (except Rochester Public Utilities-Silver Lake) cause or contribute to visibility impairment to at least one of the Class I areas after controls are added to the BART unit.

However, the BART guidelines only apply the criteria to the BART unit, not all the elevated stacks at the facility. Recall that the percentage of the BART unit emissions to the total is provided in Table A of each facility summary. Only at the United Taconite-Fairlane Plant do emissions from the BART unit equal the emissions from all elevated stacks emitting in 2002.

In addition to visibility impairment results for $PM_{2.5}$, each facility summary contains separate results ranked for sulfate (Table C) and nitrate (Table D). This provides the relative importance of reducing NO_X verses SO_2 emissions. These results indicate that in general more visibility improvement is associated with control on SO_2 emissions than NO_X emissions. This makes sense for several reasons:

- At all BART units with BART-determination emission limits (except those at Northshore Mining-Silver Bay[166]), SO_2 emissions are higher than NO_X emissions;

[165] f_{SS}(RH) was excluded from this table because the IMPROVE equation was used to convert concentrations originating from facilities and they are not a source of sea salt.

- Ammonia preferentially reacts with SO_2 to form ammonium sulfate before reacting with NO_X to form ammonium nitrate;
- Ammonium nitrate forms in colder air temperatures while sulfate forms year-round (more so in warmer temperatures);
- Prevailing winds in the winter months typically are from the Northwest, while the facilities assessed are located South of the Class I areas; and
- There is scarce free ammonia in northeast Minnesota because of a lack of ammonia producing sources, and based on the limited monitoring data available[167] for the area.

The only source that did not include emission limits for both NO_X and SO_2 in its BART-determination is United Taconite-Fairlane Plant. Although there was an overall reduction in visibility impairment due to SO_2 emission controls, this was slightly counterbalanced by a slight increase in visibility impairment due to the lack of NO_X controls. It appears that in this case, the reduced levels of SO_2 allowed for more ammonia to become available to react with NO_X to form ammonium nitrate.

Individual facility summaries follow.

A comparison in methodology and results among the three individual facility visibility impact analyses conducted by Minnesota – Subject-to-BART, overall SIP, and the difference in visibility impact due to BART determinations with emission limits on BART units – can be found in Table 9.5.2. Table 9.5.3 contains the comparison of visibility impairment between the Subject-to-BART and the BART determinations with emission limits.

To obtain additional information about this analysis contact Margaret McCourtney at 651-757-2558 or margaret.mccourtney@state.mn.us

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[166] Improvement in visibility impairment is about the same for ammonium nitrate and ammonium sulfate, even though NO_X is controlled more than SO_2.
[167] "Ambient Gaseous Ammonia Monitoring at the Fernberg, MN Air Monitoring Site Using Passive Diffusion Samplers", April 2008.

Minnesota Power – Boswell Energy Center
(Facility ID 2706100004)
BART Unit: Boiler #3 (EU003)

Table A. Emissions

Actual 2002 Emissions in Tons Modeled					
Description	**Stack ID**	**NO_X**	**SO_2**	**PM_{25}**	**PM_{10}**
Facility Elevated Stack Total*		14,525	21,166	712	2,160
BART Unit Stack Total	SV003	4,911	13,280	3	1,283
BART Unit Stack Percent of Facility Total Emissions*		34%	63%	0%	59%
BART Unit Stack Total with BART Controls		933	1,328	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls		-81%	-90%		

*Facility total only accounts for emissions from elevated stacks. The criteria for elevated stacks is those with a plume rise of 50 meters or more as calculated by the emissions model.

Figure 1. Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling

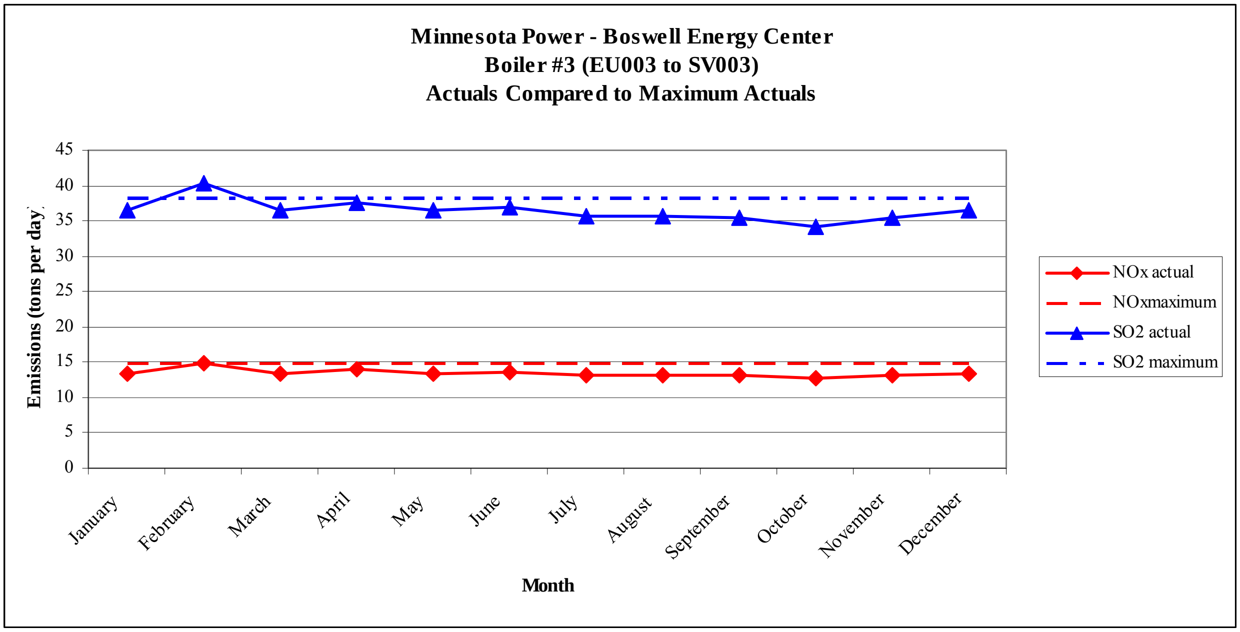


Table B. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	111	60	-51	86	58	-28	48	27	-21
	2005	86	47	-39	72	36	-36	51	26	-25
	'02 & 05	197	107	-90	158	94	-64	99	53	-46
98th Percentile Δ dv	**2002**	4.3	2.4	-1.9	4.4	2.7	-1.8	2.0	1.0	-1.0
	2005	3.5	1.9	-1.6	3.2	1.7	-1.5	1.8	0.9	-1.0
	'02 & 05	4.8	2.8	**-2.1**	4.8	2.8	**-2.0**	2.0	1.1	**-0.9**

Table C. Sulfate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

SO_4		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	97	53	-44	71	50	-21	46	25	-21
	2005	76	39	-37	59	34	-25	48	24	-24
	'02 & 05	173	92	-81	130	84	-46	94	49	-45
98th Percentile Δ dv	2002	4.1	2.2	-1.8	4.3	2.5	-1.8	1.9	0.9	-1.0
	2005	3.4	1.8	-1.6	3.2	1.7	-1.5	1.8	0.9	-1.0
	'02 & 05	4.7	2.5	**-2.2**	4.4	2.6	**-1.8**	2.0	1.1	**-1.0**

Table D. Nitrate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

NO_3		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	6	3	-3	3	2	-1	2	1	-1
	2005	10	7	-3	4	5	1	0	0	0
	'02 & 05	16	10	-6	7	7	0	2	1	-1
98th Percentile Δ dv	2002	0.4	0.3	-0.1	0.3	0.3	-0.1	0.2	0.2	-0.1
	2005	0.6	0.5	-0.2	0.4	0.3	-0.1	0.1	0.1	0.0
	'02 & 05	0.8	0.6	**-0.2**	0.5	0.4	**-0.1**	0.3	0.2	**-0.1**

Minnesota Power – Taconite Harbor
(Facility ID 2703100001)
BART Unit: Boiler #3 (EU003)

Table A. Emissions

Actual 2002 Emissions in Tons Modeled						
Description	Stack ID	NO_x	SO_2	PM_{25}	PM_{10}
Facility Elevated Stack Total*		2,307	3,108	136	38
BART Unit Stack Total	SV003	665	1,030	46	14
BART Unit Stack Percent of Facility Total Emissions*		29%	33%	34%	39%
BART Unit Stack Total with BART Controls		266	464	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls		-60%	-55%		

*Facility total only accounts for emissions from elevated stacks. The criteria for elevated stacks is those with a plume rise of 50 meters or more as calculated by the emissions model.

Figure 1. Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling

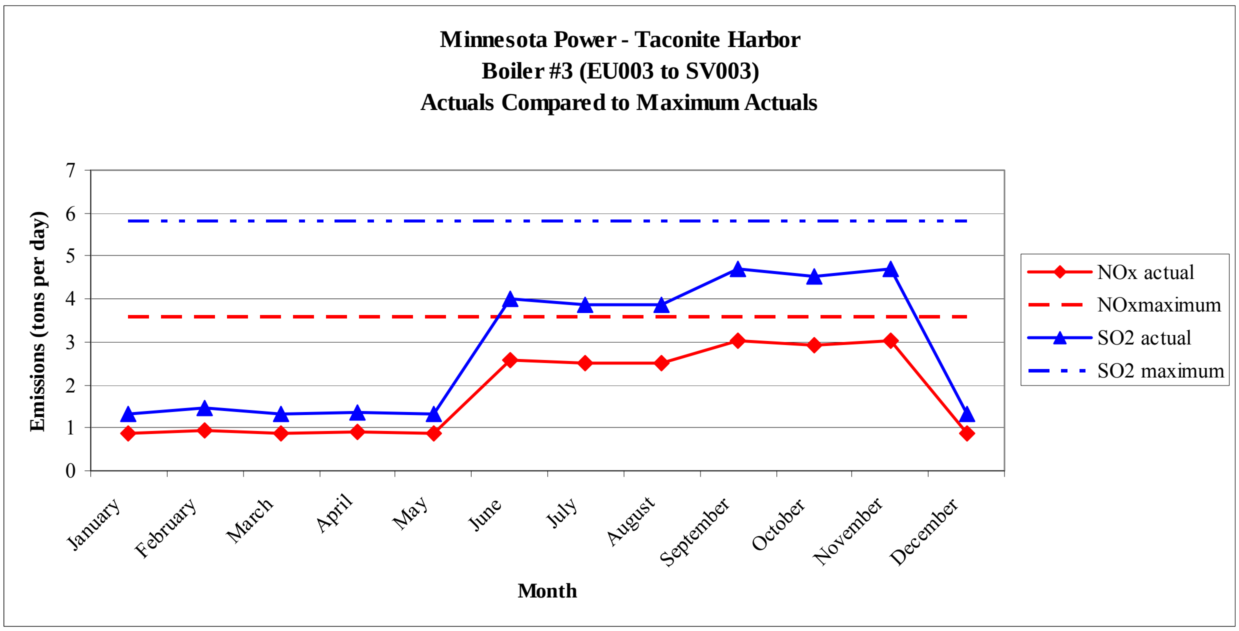


Table B. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	94	90	-4	11	9	-2	30	27	-3
	2005	92	85	-7	11	8	-3	27	22	-5
	'02 & 05	186	175	-11	22	17	-5	57	49	-8
98th Percentile Δ dv	2002	9.2	8.3	-0.9	0.8	0.7	-0.1	2.2	1.9	-0.3
	2005	5.4	4.7	-0.7	0.8	0.6	-0.1	1.7	1.5	-0.2
	'02 & 05	9.2	8.8	**-0.4**	1.1	0.9	**-0.1**	2.4	2.1	**-0.3**

Table C. Sulfate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

SO_4		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	88	85	-3	11	9	-2	30	27	-3
	2005	84	74	-10	10	8	-2	26	22	-4
	'02 & 05	172	159	-13	21	17	-4	56	49	-7
98th Percentile Δ dv	**2002**	9.0	8.2	-0.8	0.8	0.7	-0.1	2.2	1.9	-0.3
	2005	5.3	4.6	-0.7	0.8	0.6	-0.1	1.6	1.4	-0.2
	'02 & 05	9.1	8.7	**-0.4**	1.1	0.9	**-0.2**	2.4	2.1	**-0.3**

Table D. Nitrate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

NO_3		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	2	1	-1	0	0	0	0	0	0
	2005	2	1	-1	0	0	0	0	0	0
	'02 & 05	4	2	-2	0	0	0	0	0	0
98th Percentile Δ dv	**2002**	0.3	0.3	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	2005	0.3	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	'02 & 05	0.4	0.3	**-0.1**	0.0	0.0	**0.0**	0.1	0.1	**0.0**

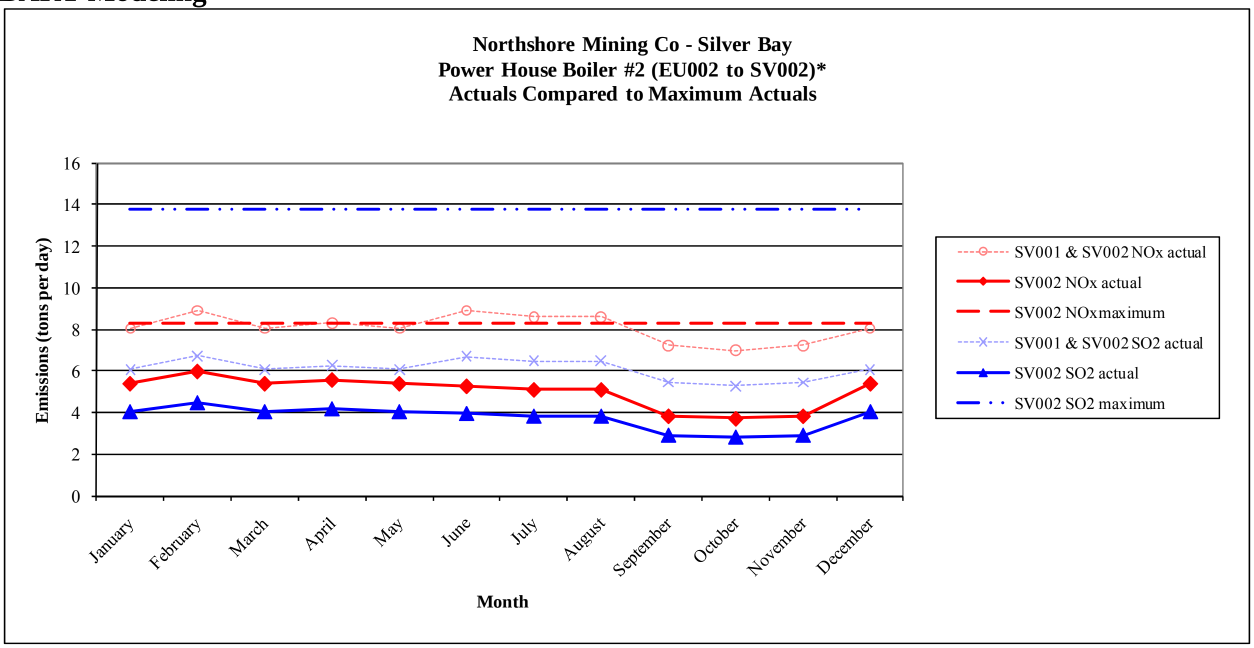
Northshore Mining – Silver Bay
(Facility ID 2707500003)
BART Unit: Power Boilers #1 & #2 (EU001 & EU002)[168]

Table A. Emissions

Actual 2002 Emissions in Tons Modeled						
Description	**Stack ID**	**NO_X**	**SO_2**	**PM_{25}**	**PM_{10}**
Facility Elevated Stack Total*		3,648	2,291	78	29
BART Unit Stack Total	SV001	1,126	851	0	11
BART Unit Stack Percent of Facility Total Emissions*	SV001	31%	37%	0%	38%
BART Unit Stack Total with BART Controls	SV001	676	681	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls	SV001	-40%	-20%		
BART Unit Stack Total	SV002	1,821	1,371	0	18
BART Unit Stack Percent of Facility Total Emissions*	SV002	50%	60%	0%	62%
BART Unit Stack Total with BART Controls	SV002	1,093	1,097	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls	SV002	-40%	-20%		

*Facility total only accounts for emissions from elevated stacks. The criteria for elevated stacks is those with a plume rise of 50 meters or more as calculated by the emissions model.

Figure 1. Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling



[168] Power Boiler #1 is not BART-eligible, but combined with subject-to-BART Power Boiler #2, constitutes a "logical set" as per 40 CFR, Appendix Y.

Table B. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	77	72	-5	9	8	-1	20	15	-5
	2005	58	47	-11	9	6	-3	11	8	-3
	'02 & 05	135	119	-16	18	14	-4	31	23	-8
98th Percentile Δ dv	2002	4.0	3.8	-0.2	0.6	0.5	-0.1	0.9	0.7	-0.2
	2005	1.9	1.7	-0.3	0.5	0.5	-0.1	0.7	0.5	-0.1
	'02 & 05	4.0	3.8	**-0.2**	0.8	0.7	**-0.1**	1.3	1.0	**-0.2**

Table C. Sulfate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

SO_4		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	69	64	-5	9	8	-1	19	15	-4
	2005	51	41	-10	7	4	-3	9	7	-2
	'02 & 05	120	105	-15	16	12	-4	28	22	-6
98th Percentile Δ dv	2002	3.4	3.4	0.0	0.6	0.5	-0.1	0.9	0.7	-0.2
	2005	1.9	1.7	-0.2	0.5	0.4	-0.1	0.6	0.5	-0.1
	'02 & 05	3.4	3.4	**0.0**	0.7	0.6	**-0.1**	1.3	1.0	**-0.3**

Table D. Nitrate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

NO_3		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	6	4	-2	0	0	0	0	0	0
	2005	5	2	-3	0	0	0	0	0	0
	'02 & 05	11	6	-5	0	0	0	0	0	0
98th Percentile Δ dv	2002	0.4	0.3	-0.1	0.0	0.0	0.0	0.2	0.1	0.0
	2005	0.4	0.3	-0.1	0.1	0.1	0.0	0.2	0.1	0.0
	'02 & 05	0.6	0.4	**-0.2**	0.1	0.1	**0.0**	0.2	0.2	**0.0**

Rochester Public Utilities – Silver Lake
(Facility ID 2710900011)
BART Unit: Boiler #4 (EU004)

Table A. Emissions

Actual 2002 Emissions in Tons Modeled						
Description	**Stack ID**	**NO_X**	**SO_2**	**PM_{25}**	**PM_{10}**
Facility Elevated Stack Total*		364	1,127	28	127
BART Unit Stack Total	SV003	192	873	11	117
BART Unit Stack Percent of Facility Total Emissions*		53%	77%	40%	92%
BART Unit Stack Total with BART Controls		104	262	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls		-46%	-70%		

*Facility total only accounts for emissions from elevated stacks. The criteria for elevated stacks is those with a plume rise of 50 meters or more as calculated by the emissions model.

Figure 1. Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling

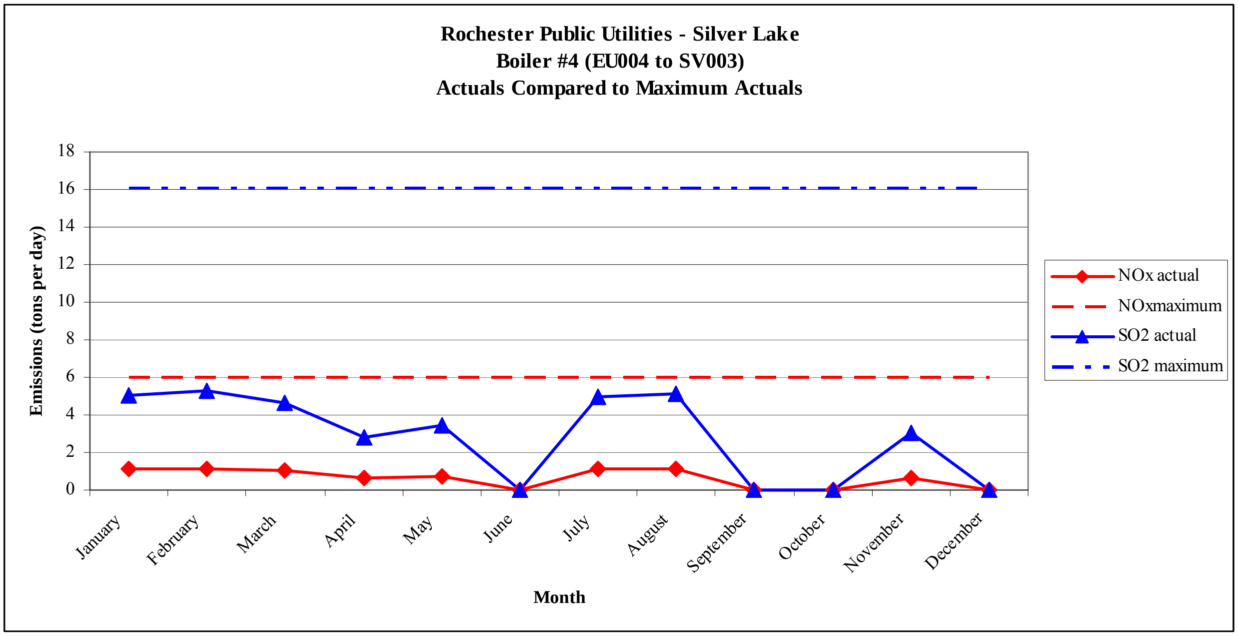


Table B. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Difference	Base	BART	Difference	Base	BART	Difference
Days > 0.5 dv	2002	0	0	0	0	0	0	0	0	0
	2005	0	0	0	0	0	0	0	0	0
	'02 & 05	0	0	0	0	0	0	0	0	0
98th Percentile Δ dv	2002	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.0	0.0
	2005	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.1	0.0
	'02 & 05	0.2	0.1	**-0.1**	0.1	0.1	**-0.1**	0.1	0.1	**0.0**

Table C. Sulfate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

SO_4		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	**2002**	0	0	0	0	0	0	0	0	0
	2005	0	0	0	0	0	0	0	0	0
	'02 & 05	0	0	0	0	0	0	0	0	0
98th Percentile Δ dv	**2002**	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
	2005	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
	'02 & 05	0.1	0.1	**-0.1**	0.1	0.1	**-0.1**	0.1	0.0	**-0.1**

Table D. Nitrate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

NO_3		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	**2002**	0	0	0	0	0	0	0	0	0
	2005	0	0	0	0	0	0	0	0	0
	'02 & 05	0	0	0	0	0	0	0	0	0
98th Percentile Δ dv	**2002**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	'02 & 05	0.1	0.1	**0.0**	0.0	0.0	**0.0**	0.0	0.1	**0.0**

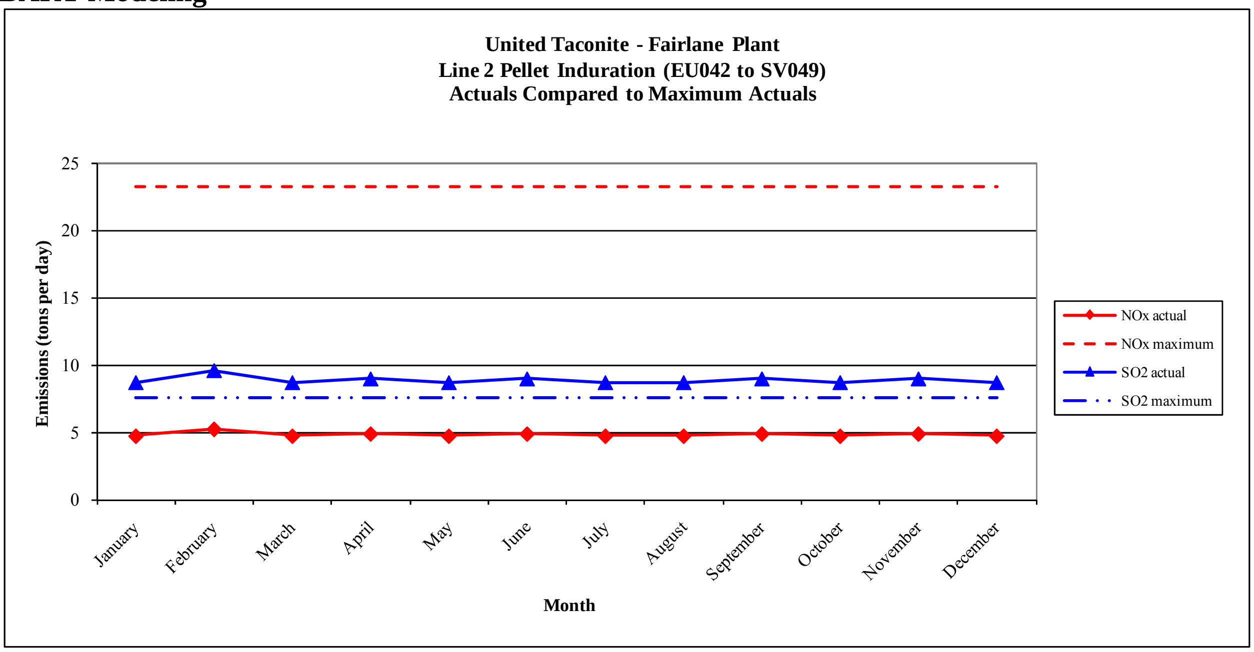
United Taconite – Fairlane Plant
(Facility ID 2713700113)
BART Unit: Line #2 Pellet Induration (EU042)

Table A. Emissions

Actual 2002 Emissions in Tons Modeled						
Description	**Stack ID**	**NO_X**	**SO_2**	**PM_{25}**	**PM_{10}**
Facility Elevated Stack Total*		1,765	3,222	183	473
BART Unit Stack Total	SV049	1,764	3,222	13	367
BART Unit Stack Percent of Facility Total Emissions*	SV049	100%	100%	7%	78%
BART Unit Stack Total with BART Controls	SV049	1,764	1,385	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls	SV049	0%	-57%	No Changes made due to BART Controls	

*Facility total only accounts for emissions from elevated stacks. The criteria for elevated stacks is those with a plume rise of 50 meters or more as calculated by the emissions model.

Figure 1. Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling[169]



[169] The SO_2 24-hour maximum actual emissions are less than the 24-hour actual in 2002 likely because the MPCA and the facility had different interpretations of significant digits in the emissions limit during this period.

Table B. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	59	44	-15	32	20	-12	8	1	-7
	2005	40	24	-16	22	11	-11	3	2	-1
	'02 & 05	99	68	-31	54	31	-23	11	3	-8
98th Percentile Δ dv	**2002**	3.0	1.7	-1.3	1.8	0.8	-0.9	0.6	0.3	-0.3
	2005	1.5	1.1	-0.4	1.0	0.7	-0.3	0.4	0.2	-0.2
	'02 & 05	3.1	1.9	**-1.2**	1.9	1.1	**-0.8**	0.6	0.3	**-0.3**

Table C. Sulfate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

SO_4		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	47	29	-18	29	17	-12	8	0	-8
	2005	32	15	-17	20	6	-14	3	0	-3
	'02 & 05	79	44	-35	49	23	-26	11	0	-11
98th Percentile Δ dv	**2002**	3.0	1.6	-1.4	1.7	0.8	-0.9	0.5	0.3	-0.3
	2005	1.4	0.7	-0.7	0.9	0.5	-0.4	0.4	0.2	-0.2
	'02 & 05	3.0	1.7	**-1.3**	1.9	1.0	**-0.9**	0.6	0.3	**-0.3**

Table D. Nitrate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

NO_3		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	**Met Year**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**	**Base**	**BART**	**Differ-ence**
Days > 0.5 dv	**2002**	5	8	3	0	1	1	0	0	0
	2005	7	11	4	1	4	3	0	1	1
	'02 & 05	12	19	7	1	5	4	0	1	1
98th Percentile Δ dv	**2002**	0.4	0.5	0.1	0.1	0.1	0.0	0.1	0.1	0.0
	2005	0.5	0.6	0.1	0.2	0.2	0.1	0.1	0.1	0.0
	'02 & 05	0.6	0.7	**0.2**	0.2	0.3	**0.1**	0.1	0.1	**0.0**

Xcel Energy – Sherburne Generating Plant
(Facility ID 2714100004)
BART Unit: Boiler #1 & #2 (EU001 & EU002)

Table A. Emissions

Actual 2002 Emissions in Tons Modeled						
Description	Stack ID	NO_X	SO_2	PM_{25}	PM_{10}
Facility Elevated Stack Total*		25,880	26,686	2,154	575
BART Unit Stack Total	SV001	14,372	14,762	1,306	555
BART Unit Stack Percent of Facility Total Emissions*		56%	55%	61%	96%
BART Unit Stack Total with BART Controls		8,048	6,495	No Changes made due to BART Controls	
BART Unit Stack Emission Reduction due to BART Controls		-44%	-56%		

*Facility total only accounts for emissions from elevated stacks. The criteria for elevated stacks is those with a plume rise of 50 meters or more as calculated by the emissions model.

Figure 1. Actual 2002 Emissions Compared to Maximum 24-hour Actuals used in Subject-to-BART Modeling

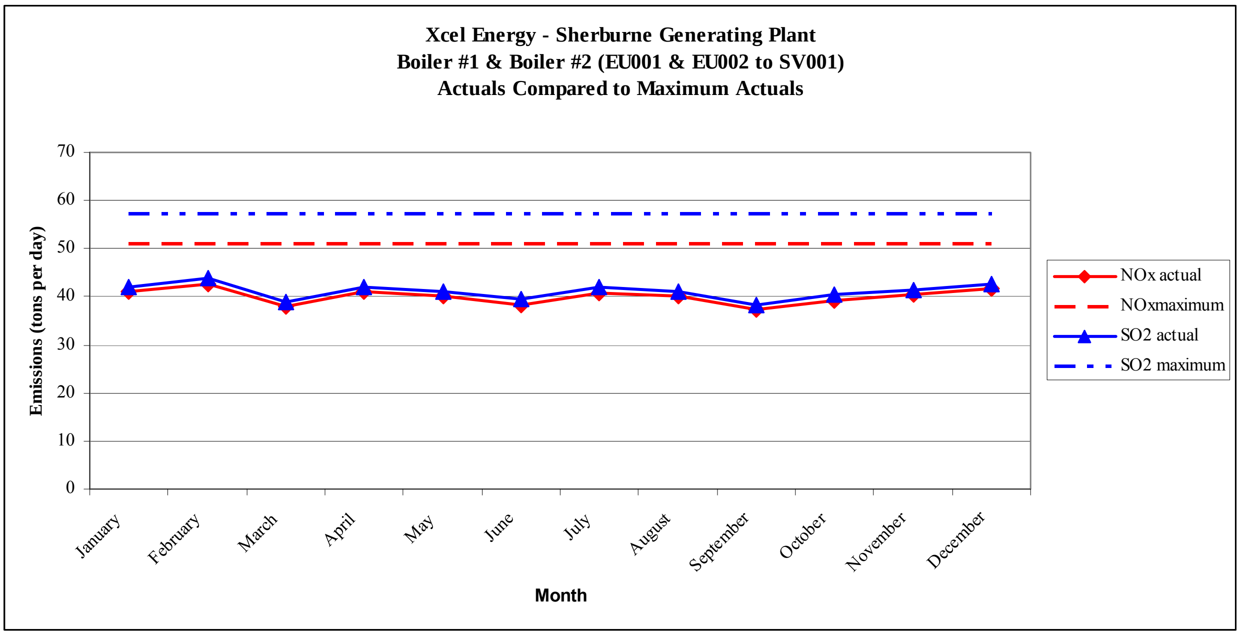


Table B. Overall ($PM_{2.5}$) Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

$PM_{2.5}$		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Differ-ence	Base	BART	Differ-ence	Base	BART	Differ-ence
Days > 0.5 dv	2002	74	58	-16	53	39	-14	42	30	-12
	2005	58	47	-11	59	37	-22	47	34	-13
	'02 & 05	132	105	-27	112	76	-36	89	64	-25
98th Percentile Δ dv	2002	2.5	1.9	-0.6	2.2	1.7	-0.5	1.4	1.0	-0.4
	2005	2.7	2.4	-0.3	1.5	1.3	-0.3	2.1	1.6	-0.4
	'02 & 05	3.2	2.7	**-0.5**	2.3	1.7	**-0.6**	2.4	1.7	**-0.7**

Table C. Sulfate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

SO_4		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Difference	Base	BART	Difference	Base	BART	Difference
Days > 0.5 dv	2002	57	45	-12	46	28	-18	26	18	-8
	2005	44	28	-16	37	23	-14	39	23	-16
	'02 & 05	101	73	-28	83	51	-32	65	41	-24
98th Percentile Δ dv	2002	2.2	1.6	-0.5	2.2	1.6	-0.5	1.2	0.9	-0.3
	2005	2.4	1.8	-0.6	1.3	1.0	-0.3	1.5	1.1	-0.4
	'02 & 05	2.9	2.1	**-0.8**	2.3	1.7	**-0.6**	1.9	1.4	**-0.5**

Table D. Nitrate Number of Days with Results > 0.5 dv and 98th Percentile Deciview Value

NO_3		Class I Area								
		Boundary Waters			Voyageurs			Isle Royale		
Parameter	Met Year	Base	BART	Difference	Base	BART	Difference	Base	BART	Difference
Days > 0.5 dv	2002	13	9	-4	9	7	-2	10	7	-3
	2005	17	16	-1	11	8	-3	7	5	-2
	'02 & 05	30	25	-5	20	15	-5	17	12	-5
98th Percentile Δ dv	2002	0.7	0.6	-0.1	0.6	0.5	-0.1	0.6	0.5	-0.1
	2005	1.2	1.1	-0.1	0.6	0.5	-0.1	0.4	0.3	-0.1
	'02 & 05	1.4	1.2	**-0.2**	1.0	0.8	**-0.2**	0.7	0.6	**-0.1**

Table 9.5.2. Comparison of Methodologies used in Subject-to-BART Modeling, RH SIP (Technical Support Document) and BART-Determination Visibility Impact Modeling.

Modeled Scenario:	**Subject-to-BART**	**RHSIP- Individual Source Contribution**	**BART-Determination** (current analysis)
Model:	CALPUFF	CAMx with PiG[170] + PSAT	CAMx with PiG[171] + PSAT
Emissions:	Maximum 24-hour actual emissions.	2002 actual (CEM data)	2002 actual (CEM data)
Source Contribution:	BART-eligible Units	All elevated stacks at facility	1. Base: All elevated stacks at facility; 2. BART: All elevated stacks at facility (with emission limits on BART units)
Meteorology:	2002-2004 CALMET derived 12km from 36km MM5	2002 CAMx flexi-nested 12 km from 36 km MM5	2002 + 2005 CAMx flexi-nested 12 km from 36 km MM5
Receptors:	BOWA – 856 VOYA – 366 ISLE – 966	BOWA – 8 VOYA – 2 ISLE – 1	BOWA – 62 VOYA – 15 ISLE – 15
Post Processing:	$\Delta dv = 10 \ln((B_{ext\text{-}background} + B_{ext\text{-}BART\text{-}eligible\ units})/ B_{ext\text{-}background})$ "Old" (prior to Oct 2005) IMPROVE algorithm Background as natural conditions for 20% best days	$B_{ext\text{-}facility}$ October 2005 IMPROVE algorithm	$\Delta dv = 10 \ln((B_{ext\text{-}background} + B_{ext\text{-}facility})/ B_{ext\text{-}background})$ October 2005 IMPROVE algorithm Background as natural conditions for 20% best days

170 PiG only for facilities located in Northeast Minnesota.
171 PiG on all facilities with BART-determinations with emission limits.

Table 9.5.3: Comparison of Subject-to-BART and BART Determination (basecase) Modeling Inputs and Results.

			Subject-to-BART Modeling Model: CALPUFF						BART Determination Modeling Model: CAMx						
Facility Name	Facility ID	Modeled	24-hr Max Actual Emissions (tons)	#Days Δdv => 0.5		98th percentile Δdv		Modeled	24-hr Actual Emissions BART-unit (tons)	#Days Δdv => 0.5			98th percentile Δdv		
				Boundary Waters (2002/ 2003/ 2004)	Voyageurs (2002/ 2003/ 2004)	Boundary Waters (2002/ 2003/ 2004)	Voyageurs (2002/ 2003/ 2004)			Boundary Waters (2002/ 2005)	Voyageurs (2002/ 2005)	Isle Royale (2002/ 2005	Boundary Waters (2002/ 2005)	Voyageurs (2002/ 2005)	Isle Royale (2002/ 2005
Minnesota Power-- Boswell Energy Center	2706100004	Boiler #3 (EU003)	SO_2: 38 NOx: 15	77 69 59	69 50 43	1.6 1.5 1.4	1.5 1.4 1.2	All Elev Stacks (BART = 34% NOx, 63% SO_2)	SO_2: 34-40 NOx: 13-15	111 86	86 72	48 51	4.3 3.5	4.4 3.2	2.0 1.8
Minnesota Power-- Taconite Harbor	2703100001	Boiler #3 (EU003)	SO_2: 6 NOx: 4	90 71 65	2 1 0	2.1 1.7 1.5	0.2 0.2 0.3	All Elev Stacks (BART = 29% NOx, 33% SO_2)	SO_2: 1-5 NOx: 1-3	94 92	11 11	30 27	9.2 5.4	0.8 0.8	2.2 1.7
Northshore Mining-- Silver Bay	2707500003	Power Boiler #2 (EU002)	SO_2: 14 NOx: 8	109 109 98	3 1 1	3.0 2.5 2.5	0.2 0.2 0.3	All Elev Stacks (BART = 81% NOx, 97% SO_2)	SO_2: 5-7 NOx: 6-10	77 58	9 9	20 11	4.0 1.9	0.6 0.5	0.9 0.7
Rochester Public Utilities-- Silver Lake	2710900011	Boiler #4 (EU004)	SO_2: 16 NOx: 6	1 8 8	1 3 6	0.4 0.6 0.5	0.3 0.4 0.4	All Elev Stacks (BART = 53% NOx, 77% SO_2)	SO_2: 0-5 NOx: 0-1	0 0	0 0	0 0	0.1 0.1	0.1 0.1	0.1 0.1
United Taconite-- Fairlane Plant	2713700113	Line #2 Pellet Induration (EU042)	SO_2: 8 NOx: 23	157 148 137	76 67 71	3.3 3.9 3.6	2.6 3.1 2.5	All Elev Stacks (BART = 100% NOx, 100% SO_2)	SO_2: 9-10 NOx: 5	59 40	32 22	8 3	3.0 1.5	1.8 1.0	0.6 0.4
Xcel-- Sherburne Generating Plant	2714100004	Boiler #1 & #2 (EU001 & EU002)	SO_2: 57 NOx: 51	72 78 80	46 48 46	2.2 2.3 1.8	1.5 2.0 1.9	All Elev Stacks (BART = 56% NOx, 55% SO_2)	SO_2: 33-44 NOx: 32-43	74 58	53 59	42 47	2.5 2.7	2.2 1.5	1.4 2.1

Appendix 9.6: Minnesota BART Rules

The MPCA completed rulemaking that makes BART an applicable requirement for stationary sources, and gave the MPCA the authority to request BART analyses and make BART determinations.

This language is codified in Minn. R. 7007.0100, Subp. 7, and Minn. R. 7007.5000. These two rules follow in their adopted form, certified by the Minnesota Revisor of Statutes.

The rule language became effective on November 26, 2007.

Office of the Revisor of Statutes

Cindy K. Maxwell
Senior Assistant Revisor
(651)296-0955 Fax (651)296-0569
cindy.maxwell@revisor.leg.state.mn.us

700 State Office Building
100 Rev. Dr. Martin Luther King Jr. Blvd.
St. Paul, MN 55155-1297
TTY 1-800-627-3529

RECEIVED
NOV 26 2007

November 20, 2007

Norma L. Coleman
Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155

RE: File No. 3650

Dear Ms. Coleman:

Enclosed for your files is a stripped copy of your rules as adopted. The copy shows the text of the rules with the stricken text deleted and the underscoring removed.

Very truly yours,

CKM LS

Cindy K. Maxwell

Office of Air Quality Planning and Standards, as amended, which is incorporated by reference and is available at the EPA Internet site www.epa.gov/ttnchiel/software/fire/index.html. Where more than one emission factor is listed, emission factor means the one approved by the commissioner using best engineering judgment and based on one or more of the considerations in item C, subitem (2). It is subject to frequent change.

C. (1) An emission factor developed or approved by the commissioner and derived from the following sources:

(a) other EPA publications including, but not limited to, Locating and Estimating documents, Control Technology Center documents, the preamble and background information documents for New Source Performance Standards or National Emission Standards for Hazardous Air Pollutants;

(b) EPA databases and computer programs;

(c) engineering publications;

(d) performance test data from the same or a similar emission unit at the same or a similar facility;

(e) manufacturer's performance tests; or

(f) emission data developed by the regulated party using the best engineering judgment criteria listed in subitem (2).

[For text of subitem (2), see M.R.]

[For text of subps 10b to 45, see M.R.]

7007.0100 DEFINITIONS.

[For text of subps 1 to 6, see M.R.]

Subp. 7. **Applicable requirement.** "Applicable requirement" means all the following as they apply to emissions units in a stationary source (including requirements that have been promulgated or approved by the EPA or the commissioner through rulemaking at the time of issuance but have future effective compliance dates):

[For text of items A to S, see M.R.]

T. any standard or other requirement of the acid deposition control rule under chapter 7021;

U. any standard or other requirement related to noise pollution under chapter 7030;

V. any standard or other requirement established under section 169A (Visibility Protection for Federal Class I Areas) or 169B (Visibility) of the act including emission limits established in the determination of best available retrofit technology; and

W. any standard or other requirement of the federal Clean Air Interstate Rule or a regulation adopted under it.

[For text of subps 7a to 9a, see M.R.]

Subp. 9b. **Environmental management system or EMS.** "Environmental management system" or "EMS" means an ongoing program of planning, implementing, reviewing, and improving the actions at a stationary source that the owner or operator takes to meet its environmental obligations and legal requirements, and to improve environmental performance, as measured by pollutants emitted or discharged, waste generated, or other objective measures. An EMS for a stationary source conforms to located in Minnesota shall be submitted to the commissioner.

7007.5000 BEST AVAILABLE RETROFIT TECHNOLOGY.

Subpart 1. **Incorporation by reference.** Code of Federal Regulations, title 40, part 51.301 (Definitions), as amended, is incorporated by reference. Appendix Y (Guidelines for Best Available Retrofit Technology (BART) Determinations Under the Regional Haze Rule) of Code of Federal Regulations, title 40, part 51, as amended, is incorporated by reference.

Subp. 2. **BART determination.** The owner or operator of a stationary source shall submit a best available retrofit technology (BART) analysis to the commissioner if the commissioner determines the stationary source is subject to BART according to Code of Federal Regulations, title 40, part 51, Appendix Y (Guidelines for BART Determinations Under the Regional Haze Rule). The owner or operator shall prepare the BART analysis according to section IV of Appendix Y of Code of Federal Regulations, title 40, part 51, as directed by the commissioner. The owner or operator of a stationary source shall submit the BART analysis 180 days after receipt of written notification by the commissioner that a BART analysis is required. The commissioner shall make the BART determination according to Appendix Y of Code of Federal Regulations, title 40, part 51.

Subp. 3. **BART implementation.** The owner of each BART-eligible source subject to BART shall install and operate BART no later than five years after the United States Environmental Protection Agency approval of Minnesota's regional haze state implementation plan. The owner or operator of each source subject to BART shall operate and maintain the control equipment or work practices required by this part and shall establish procedures to ensure such equipment or work practices are properly operated and maintained.

7011.0060 DEFINITIONS.

[For text of subps 1 to 3d, see M.R.]

Subp. 3e. **Hood.** "Hood" means a shaped inlet to a pollution control system that does not totally surround emissions from an emissions unit, that is designed, used, and maintained to capture and discharge the air emissions through ductwork to control equipment, and that conforms to the design and operating practices recommended in "Industrial Ventilation - A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists." This document is subject to frequent change. A spray booth can be a hood if it meets the definition in this subpart.

Subp. 4. **Listed control equipment.** "Listed control equipment" means the control equipment at a stationary source listed in part 7011.0070, subpart 1a, Table A.

[For text of subp 5, see M.R.]

7011.0061 INCORPORATION BY REFERENCE.

For the purpose of parts 7011.0060 to 7011.0080, the document, Industrial Ventilation - A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists (1984), 1300 Kemper Meadow Drive, Cincinnati, Ohio

Appendix 9.7: Administrative Orders

This Appendix consists of the following documents, which require installation of Continuous Emission Monitors or comparably accurate measures of emission levels from the taconite facilities.

Administrative Order by Consent – U.S. Steel, MinnTac

Administrative Order by Consent – U.S. Steel, Keewatin Taconite

Administrative Order by Consent – Hibbing Taconite

Administrative Order by Consent – Northshore Mining

Administrative Order by Consent – United Taconite

Administrative Order by Consent – Arcelor Mittal

STATE OF MINNESOTA
Minnesota Pollution Control Agency

In the Matter of:
United States Steel Corporation
Minntac

ADMINISTRATIVE ORDER BY CONSENT

The Commissioner of the Minnesota Pollution Control Agency (MPCA) and United States Steel Corporation, Minntac (Minntac) enter into this Administrative Order by Consent (Order) pursuant to Minn. Stat. §116.07, subd. 9 (2006). Minntac has reviewed the terms of this Order and, by its signature below, agrees to comply with it.

FINDINGS OF FACT

BACKGROUND

1. On July 6, 2005, the U.S. Environmental Protection Agency (U.S. EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas [70 Fed. Reg. 39103]. This rule is commonly known as the "Regional Haze Rule" [40 CFR §§ 51.300 -51.309].

2. The Regional Haze Rule (Rule) requires that Minnesota establish and achieve visibility goals for each of its Class I areas by 2018. The Rule regulates the emission of pollutants that contribute to regional haze. The MPCA has determined that the key pollutants are particulate matter (PM, measured as PM_{10}), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

3. The Rule contains provisions to regulate certain older stationary sources of these emissions that have not been regulated under other portions of the Clean Air Act. Those older sources that could contribute to visibility impairment in Class I areas will be subject to Best Available Retrofit Technology (BART) limits and may be required to install BART. The Regional Haze Rule includes Appendix Y to 40 CFR part 51 "Guidelines for BART Determinations Under the Regional Haze Rule" that provides direction to states on which sources may need to install BART and how to determine BART. The U.S. EPA expected the states to rely on control demonstrations and retrofits at existing facilities to determine BART, but there have been few such retrofits in the taconite industry.

4. The BART requirements are one part of the State's regional haze long term strategy; as an additional portion of the long term strategy, the MPCA plans to require research into new emission control technologies and pollution prevention practices by the taconite industry during the first half of the first implementation period. The reasonable progress factors for these sources will be reassessed in the State Implementation Plan (SIP) Report and Adequacy Determination, due to U.S. EPA in 2013. The Rule requires that by December 17, 2007, Minnesota must submit a Regional Haze (SIP) to the U.S. EPA that identifies the older sources that cause or contribute to visibility impairment in its Class I areas. The Regional Haze SIP submittal must also include a schedule for implementation

of BART and other control measures. The schedule will include dates by which the MPCA will establish BART limits for specific units at BART-eligible sources and dates by which facility owners or operators will demonstrate compliance with the limits.

5. To satisfy the Rule, the MPCA must determine what constitutes BART for each BART-eligible unit and must establish emission limits consistent with its determination of BART. BART limits must take into consideration the technology available, the costs of compliance, the energy and the nonair quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. Section 302(k) of the Clean Air Act requires emission limits such as BART be met on a continuous basis.
6. Most emission units at taconite facilities are BART eligible. This Order governs BART as it applies to the pellet furnaces only.

7. With regard to PM, the MPCA intends to propose to the U.S. EPA that the existing taconite Maximum Achievable Control Technology (MACT) standard will satisfy BART as it applies to BART-eligible units at taconite facilities [40 CFR, part 63, subpart RRRRR]. Therefore, the MPCA will not establish separate BART PM limits for BART-eligible units at taconite facilities.

8. The MPCA must however, establish SO_2 and NO_x limits for each pellet furnace consistent with BART as BART is identified for each furnace.

9. Minn. Stat. § 116.07, subd. 9(b) authorizes the MPCA to require the owner or operator of an emissions facility to install, use, and maintain monitoring equipment in a manner as the MPCA shall prescribe. Minn. Rule 7017.1006 authorizes the commissioner of the MPCA to order installation and operation of a CEMS, if other methods of measurement or calculation do not provide adequate information on the level or variation of emissions to assure compliance with a compliance document or applicable requirement.

10. Pursuant to Minn. R. 7017.1006, the MPCA finds that that the existing data shows that the level of SO_2 emissions from taconite facilities burning coal and petroleum coke, and of NO_x emissions from the facilities, demonstrates that the taconite industry is a major contributor to NO_x and SO_2 emissions in the State. The MPCA also finds that existing information from stack testing shows wide variation in these emissions. Due to the level of NO_x and SO_2 emissions from the industry and the proximity of the facilities to Class I areas, the MPCA finds that the variability in emissions is an important concern. The MPCA also finds poor correlation between operating conditions and SO_2 and NO_x emissions and thus, cannot establish emission limits or determine a method to assure continuing compliance with the limits. The MPCA finds that more complete emissions data is necessary to establish appropriate emission limits for and assure continuing compliance with the Regional Haze Rule.

THE MINNTAC FACILITY

11. United States Steel Corporation, Minntac, produces taconite pellets at its facility (herein referred to as "Minntac") located near Mt. Iron, Minnesota. In March 2006, the MPCA determined that Minntac includes units that are subject to BART. *See* RESULTS of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota at http://www.pca.state.mn.us/publications/aq-sip2-07.pdf.

12. Minntac has five pellet furnaces, identified in Air Emission Permit No. 13700005-003 as Lines 3, 4, 5, 6, and 7 (Groups (GP) GP009, GP010, and GP011), that are BART-eligible for SO_2 and NO_x and for which a BART analysis was performed.

13. Minntac proposed existing design and controls (wet scrubbers) as BART for SO_2 and proposed existing combustion controls and fuel blending as BART for NO_x emissions for all furnace lines plus the installation of low NO_x burners on the pre-heat sections of Lines 4, 5, and 7. Minntac proposed that existing NO_x Continuous Emission Monitor Systems (CEMS) would be used to establish the BART NO_x limit and to determine compliance with the limit, once established.

14. The MPCA must determine what constitutes BART and establish BART limits for NO_x and SO_2 from BART units [40 CFR § 51.308(e)].

15. The parties agree that Minntac will install, maintain, and operate SO_2 CEMS on each of Lines 6 and 7, GP011, which utilize coal for fuel. The parties agree that the MPCA will develop SO_2 emission limits based on sufficient CEMS data, to reflect a variety of fuel blends, as well as operating and control equipment conditions. The parties further agree that the MPCA will establish the BART limits for SO_2 through an amendment to the Minntac air emissions operating permit, which will be incorporated into Minnesota's SIP.

16. The parties agree that Minntac will continue to maintain and operate NO_x CEMS on each of Lines 3, 4, 5, 6, and 7. The parties agree that MPCA will develop NO_x emission limits based on sufficient CEMS data to reflect a variety of fuel blends, as well as operating and control equipment conditions. The parties further agree that the MPCA will establish the BART limits for NO_x through an amendment to the Minntac air emissions operating permit, which will be incorporated into Minnesota's SIP.

17. Once a limit is established in a permit, the MPCA must ensure compliance on a continuous basis with the SO_2 and NO_x emission limits. Data from continuing operation of Minntac's SO_2 CEMS will be used to ensure continuous compliance with SO_2 limits on the coal-fired Lines 6 and 7 (Lines 3, 4, and 5 are fired with very low sulfur fuels). Data from continuing operation of Minntac's NO_x CEMS will be used to ensure continuous compliance with NO_x limits on Lines 3, 4, 5, 6, and 7.

18. The parties agree, and the MPCA hereby finds that methods other than CEMS for measuring SO_2 from pellet furnaces Lines 6 and 7 at Minntac do not provide adequate data on the variation of emissions to establish BART limits or to demonstrate compliance with the limits. The parties also agree and the MPCA hereby finds that methods other than CEMS for measuring NO_x from the pellet furnace Lines 3, 4, 5, 6, and 7 at Minntac do not provide adequate data on the variation of emissions to establish BART limits or to demonstrate compliance with the limits. Further, the MPCA finds SO_2 and NO_x CEMS are technically feasible at taconite facilities.

ORDER

NOW, THEREFORE, IT IS ORDERED AND AGREED:

19. Within 60 days of the effective date of this Order, Minntac shall submit a Plan to the MPCA. The Plan shall provide a schedule for installation of CEMS for measuring SO_2 from Lines 6 and 7, such that each CEMS is installed and certification test results that report certification are submitted to the MPCA no later than November 30, 2008. The Plan shall provide a schedule for continuing operation of CEMS for measuring NO_x from Lines 3, 4, 5, 6, and 7. The Plan shall also include an explanation of the specific method(s) to be used, frequency of measurement, location of measurement, and units of measurement for each parameter required to be reported by paragraph 22 below.

20. Minntac shall conform to the CEMS requirements specified in Minn. R. chs. 7017.1002, 7017.1030, 7017.1035, 7017.1040, 7017.1060, 7017.1070, 7017.1080, 7017.1090, 7017.1110, subps. 2(B) and 2(C), 7017.1120, subps. 1, 2 and 3, 7017.1130, 7017.1140, 7017.1150, 7017.1160 subps. 2 and 3, 7017.1170 and 7017.1180.

21. Once installed, Minntac shall continuously operate the CEMS under this Order until the requirement to operate CEMS is made an enforceable condition of Minntac's air emissions operating permit.

22. Quarterly Emissions/Parameter Reports: Minntac shall report all NO_x emissions and SO_2 emissions to the MPCA. All data points collected by a CEMS shall be used to calculate individual hourly emission averages. Each Report shall include hourly data for the heat input, pellet type, pellet production rate, fuel used, combustion zone temperature, stack gas flow rate, pH of the water entering and leaving the scrubber, total volume of the water entering the scrubber, and the units for each of the parameters. Emissions shall be reported in pounds per hour, on an hourly and a 30 day rolling average basis. The Quarterly Report shall indicate all measured periods of emissions as well as periods of monitor downtime. The Report shall be provided in an electronic unprotected spreadsheet format that will be provided by the MPCA. A certification statement clearly indicating the submittal to which it applies and signed by a responsible official, pursuant to part 7007.0500, subpart 3 shall be mailed or delivered to the agency, postmarked or received within fifteen calendar days of the electronic mail or computer disk submittal of the

spreadsheet. Each Report for SO_2 CEMS is due 30 days after the end of each calendar quarter following the first CEMS Certification Test performed after the effective date of this Order until the MPCA notifies Minntac that it has sufficient information to establish a BART limit. Each Report for NO_x CEMS is due 30 days after the end of each calendar quarter following the effective date of this Order until the MPCA notifies Minntac that it has sufficient information to establish a BART limit. Upon notification by the MPCA, Minntac may apply to the MPCA for a reduction in the reporting requirements under this item (22).

23. Minntac shall submit all hourly NO_x CEMS data in pounds per hour, heat input data, pellet production rate, and fuel usage data for the period from November 1, 2006 to the start of the first quarterly report period required under this Order. The data shall be submitted within 60 days of the effective date of this Order.

24. This Order by Consent is not transferable or assignable to any person without the express written approval of the MPCA.

25. The MPCA staff may grant extensions to the deadlines established herein for reasons beyond the reasonable control of Minntac. Minntac must make a written request for an extension at least ten (10) days prior to the deadline.

26. This Order is effective upon the date that it is signed by the MPCA Commissioner or his designee. This Order shall remain in effect until terms and conditions for the ongoing use and maintenance of the required CEMS become an enforceable part of Minntac's air emissions permit.

RESERVATION OF AUTHORITY

Nothing in this Order shall prevent the MPCA from taking action to enforce the requirements of this Order, or from requiring additional action by the Regulated Party if necessary to ensure compliance with the Regional Haze Rule and other MPCA Rules and statutes.

IT IS SO ORDERED.

George F. Babcoke	James L. Warner, P.E.
Vice President – Plant Operations	Director
United States Steel Corporation	Industrial Division
Minntac	Minnesota Pollution Control Agency
Dated: 9/14/2007	Dated: 9/27/07

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STATE OF MINNESOTA
Minnesota Pollution Control Agency

In the Matter of: **United States Steel Corporation** **Keewatin Taconite, Inc.**	**ADMINISTRATIVE ORDER BY CONSENT**

The Commissioner of the Minnesota Pollution Control Agency (MPCA) and United States Steel Corporation, Keewatin Taconite, Inc. (Keewatin) enter into this Administrative Order by Consent (Order) pursuant to Minn. Stat. §116.07, subd. 9 (2006). Keewatin has reviewed the terms of this Order and, by its signature below, agrees to comply with it.

FINDINGS OF FACT

BACKGROUND

1. On July 6, 2005, the U.S. Environmental Protection Agency (U.S. EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas [70 Fed. Reg. 39103]. This rule is commonly known as the "Regional Haze Rule" [40 CFR §§ 51.300 -51.309].

2. The Regional Haze Rule (Rule) requires that Minnesota establish and achieve visibility goals for each of its Class I areas by 2018. The Rule regulates the emission of pollutants that contribute to regional haze. The MPCA has determined that the key pollutants are particulate matter (PM, measured as PM_{10}), sulfur dioxide (SO_2), and nitrogen oxides (NO_X).

3. The Rule contains provisions to regulate certain older stationary sources of these emissions that have not been regulated under other portions of the Clean Air Act. Those older sources that could contribute to visibility impairment in Class I areas will be subject to Best Available Retrofit Technology (BART) limits and may be required to install BART. The Regional Haze Rule includes, Appendix Y to 40 CFR part 51 "Guidelines for BART Determinations Under the Regional Haze Rule," that provides direction to states on which sources may need to install BART and how to determine BART. U.S. EPA expected the states to rely on control demonstrations and retrofits at existing facilities to determine BART, but there have been few such retrofits in the taconite industry.

4. The BART requirements are one part of the State's regional haze long term strategy; as an additional portion of the long term strategy, the MPCA plans to require research into new emission control technologies and pollution prevention practices by the taconite industry during the first half of the first implementation period. The reasonable progress factors for these sources will be reassessed in the State Implementation Plan (SIP) Report and Adequacy Determination, due to U. S. EPA in 2013. The Rule requires that by December 17, 2007, Minnesota must submit a Regional Haze SIP to U.S. EPA that identifies the older sources that cause or contribute to visibility impairment in its Class I areas. The Regional Haze SIP submittal must also include a schedule for implementation

of BART and other control measures. The schedule will include dates by which the MPCA will establish BART limits for specific units at BART-eligible sources and dates by which facility owners or operators will demonstrate compliance with the limits.

5. To satisfy the Rule, the MPCA must determine what constitutes BART for each BART-eligible unit and must establish emission limits consistent with its determination of BART. BART limits must take into consideration the technology available, the costs of compliance, the energy and the nonair quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. Section 302(k) of the Clean Air Act requires emission limits such as BART be met on a continuous basis.
6. Most emission units at taconite facilities are BART eligible. This Administrative Order governs BART as it applies to the pellet furnaces only.
7. With regard to PM, the MPCA intends to propose to the U.S. EPA that the existing taconite Maximum Achievable Control Technology (MACT) standard will satisfy BART as it applies to BART-eligible units at taconite facilities [40 CFR, part 63, subpart RRRRR]. Therefore, the MPCA will not establish separate BART PM limits for BART-eligible units at taconite facilities.
8. The MPCA must however, establish SO_2 and NO_X limits for each pellet furnace consistent with BART, as BART is identified for each furnace.
9. Minn. Stat. § 116.07, subd. 9(b) authorizes the MPCA to require the owner or operator of an emissions facility to install, use, and maintain monitoring equipment, in a manner as the MPCA shall prescribe. Minn. Rule 7017.1006 authorizes the commissioner of the MPCA to order installation and operation of a CEMS, if other methods of measurement or calculation do not provide adequate information on the level or variation of emissions to assure compliance with a compliance document or applicable requirement.
10. Pursuant to Minn. R. 7017.1006, the MPCA finds that the existing data shows that the level of SO_2 emissions from taconite facilities burning coal and petroleum coke, and of NO_X emissions from the facilities, demonstrates that the taconite industry is a major contributor to NO_X and SO_2 emissions in the State. The MPCA also finds that existing information from stack testing shows wide variation in these emissions. Due to the level of NO_X and SO_2 emissions from the industry and the proximity of the facilities to Class I areas, the MPCA finds that the variability in emissions is an important concern. The MPCA also finds poor correlation between operating conditions and SO_2 and NO_X emissions and thus, cannot establish emission limits or determine a method to assure continuing compliance with the limits. The MPCA finds that more complete emissions data is necessary to establish appropriate emission limits for and assure continuing compliance with the Regional Haze Rule.

THE KEEWATIN TACONITE FACILITY

11. United States Steel Corporation, Keewatin Taconite, produces taconite pellets at its facility (herein referred to as "Keewatin") located near Keewatin, Minnesota. In March 2006, the MPCA determined that Keewatin includes units that are subject to BART. *See* RESULTS of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota at http://www.pca.state.mn.us/publications/aq-sip2-07.pdf.

12. Keewatin has one pellet furnace, identified as Emission Unit (EU) 030 in Air Emissions Permit No. 13700063-003, that is BART-eligible for SO_2 and NO_X and for which a BART analysis was performed.

13. Keewatin proposed existing design and controls (recirculating wet scrubbers installed in 2005) as BART for SO_2 and proposed existing combustion controls and fuel blending as BART for NO_X emissions. Keewatin proposed a NO_X Continuous Emission Monitor System (CEMS) to establish the BART NO_X limit and to determine compliance with the limit, once established.

14. The MPCA must determine what constitutes BART and establish BART limits for SO_2 and NO_X from BART units [40 CFR § 51.308(e)].

15. The parties agree that Keewatin will install, maintain, and operate a SO_2 CEMS and a NO_X CEMS on EU030. The parties agree that the MPCA will develop SO_2 and NO_X emission limits based on sufficient CEMS data to reflect a variety of fuel blends, as well as operating and control equipment conditions. The parties further agree that the MPCA will establish the BART limits for SO_2 and NO_X through an amendment to the Keewatin air emissions operating permit, which will be incorporated into Minnesota's SIP.

16. Once a limit is established in a permit, the MPCA must ensure compliance on a continuous basis with the SO_2 and NO_X emission limits. Data from continuing operation of Keewatin's SO_2 CEMS and NO_X CEMS will be used to ensure continuous compliance.

17. The parties agree, and the MPCA hereby finds that methods other than CEMS for measuring SO_2 and NO_X from pellet furnace EU030 at Keewatin do not provide adequate data on the variation of emissions to establish BART limits or to demonstrate compliance with the limits. Further, the MPCA finds SO_2 and NO_X CEMS are technically feasible at taconite facilities.

ORDER

NOW, THEREFORE, IT IS ORDERED AND AGREED:

18. Within 60 days of the effective date of this Order, Keewatin shall submit a Plan to the MPCA. The Plan shall provide a schedule for installation of one SO_2 and one NO_X CEMS for pellet furnace EU030, such that each CEMS is installed and certification test results that report certification are submitted to the MPCA no later than November 30, 2008. The Plan shall also include an explanation of the specific method(s) to be used, frequency of measurement, location of measurement, and units of measurement for each parameter required to be reported by paragraph 21 below.

19. Keewatin shall conform to the CEMS requirements specified in Minn. R. chs. 7017.1002, 7017.1030, 7017.1035, 7017.1040, 7017.1060, 7017.1070, 7017.1080, 7017.1090, 7017.1110, subps. 2(B) and 2(C), 7017.1120, subps. 1, 2 and 3, 7017.1130, 7017.1140, 7017.1150, 7017.1160 subps. 2 and 3, 7017.1170 and 7017.1180.

20. Once installed, Keewatin shall continuously operate the CEMS under this Order until the requirement to operate CEMS is made an enforceable condition of Keewatin's air emissions operating permit.

21. Quarterly Emissions/Parameter Reports: Keewatin shall report all NOx emissions and SO_2 emissions to the MPCA. All data points collected by a CEMS shall be used to calculate individual hourly emission averages. Each Report shall include hourly data for the heat input, pellet type, pellet production rate, fuel used, combustion zone temperature, stack gas flow rate, pH of the water entering and leaving the scrubber, total volume of the water entering the scrubber, and the units for each of the parameters. Emissions shall be reported in pounds per hour, on an hourly and a 30 day rolling average basis. The Quarterly Report shall indicate all measured periods of emissions as well as periods of monitor downtime. The Report shall be provided in an electronic unprotected spreadsheet format that will be provided by the MPCA. A certification statement clearly indicating the submittal to which it applies and signed by a responsible official, pursuant to part 7007.0500, subp. 3 shall be mailed or delivered to the agency, postmarked or received within fifteen (15) calendar days of the electronic mail or computer disk submittal of the spreadsheet. Each Report for SO_2 CEMS is due 30 days after the end of each calendar quarter following the first CEMS Certification Test performed after the effective date of this Order until the MPCA notifies Keewatin that it has sufficient information to establish a BART limit. Each Report for NO_X CEMS is due 30 days after the end of each calendar quarter following the first CEMS Certification Test performed after the effective date of this Order until the MPCA notifies Keewatin that it has sufficient information to establish a BART limit. Upon notification by the MPCA, Keewatin may apply to the MPCA for a reduction in the reporting requirements under this item (21).

22. This Order by Consent is not transferable or assignable to any person without the express written approval of the MPCA.

23. The MPCA staff may grant extensions to the deadlines established herein for reasons beyond the reasonable control of Keewatin. Keewatin must make a written request for an extension at least ten (10) calendar days prior to the deadline.

24. This Order is effective upon the date that it is signed by the MPCA Commissioner or his designee. This Order shall remain in effect until terms and conditions for the ongoing use and maintenance of the required CEMS become an enforceable part of Keewatin's air emissions permit.

RESERVATION OF AUTHORITY

Nothing in this Order shall prevent the MPCA from taking action to enforce the requirements of this Order, or from requiring additional action by the Regulated Party if necessary to ensure compliance with the Regional Haze rule and other MPCA rules and statutes.

IT IS SO ORDERED.

George F. Babcoke
Vice President - Plant Operations
United States Steel Corporation
Keewatin Taconite, Inc

Dated: 9/14/2007

James L. Warner, P.E.
Director
Industrial Division
Minnesota Pollution Control Agency

Dated: 9/27/07

STATE OF MINNESOTA
Minnesota Pollution Control Agency

In the Matter of:	**ADMINISTRATIVE ORDER**
Hibbing Taconite Company	**BY CONSENT**

The Commissioner of the Minnesota Pollution Control Agency (MPCA) and Hibbing Taconite Company (Hibtac) enter into this Administrative Order by Consent (Order) pursuant to Minn. Stat. §116.07, subd. 9 (2006). Hibtac has reviewed the terms of this Order and, by its signature below, agrees to comply with it.

FINDINGS OF FACT

BACKGROUND

1. On July 6, 2005, the U.S. Environmental Protection Agency (U.S. EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas [70 Fed. Reg. 39103]. This rule is commonly known as the "Regional Haze Rule" [40 CFR §§ 51.300 -51.309].

2. The Regional Haze Rule (Rule) requires that Minnesota establish and achieve visibility goals for each of its Class I areas by 2018. The Rule regulates the emission of pollutants that contribute to regional haze. The MPCA has determined that the key pollutants are particulate matter (PM, measured as PM_{10}), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

3. The Rule regulates certain stationary sources that could contribute to visibility impairment in Class I areas and requires Best Available Retrofit Technology (BART) limits for these sources.

4. The Rule requires that by December 17, 2007, Minnesota must submit a Regional Haze State Implementation Plan (SIP) to U.S. EPA that identifies the older sources that cause or contribute to visibility impairment in its Class I areas. The Regional Haze SIP submittal must also include a schedule for implementation of BART and other control measures. The schedule will include dates by which the MPCA will establish BART limits for specific units at BART-eligible sources and dates by which facility owners or operators will demonstrate compliance with the limits.

5. To satisfy the Rule, the MPCA must determine what constitutes BART for each BART-eligible unit and must establish emission limits consistent with its determination of BART. BART limits must take into consideration the technology available, the costs of compliance, the energy and the non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility, which may reasonably be anticipated to result from the use of such technology.

THE HIBBING TACONITE COMPANY FACILITY

6. Hibtac produces taconite pellets at its facility (herein referred to as "Facility") located near Hibbing, Minnesota. In March 2006, the MPCA determined that Hibtac's Facility includes units that are subject to BART. *See* RESULTS of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota at http://www.pca.state.mn.us/publications/aq-sip2-07.pdf.

7. Hibtac has three pellet furnaces, identified as Emission Unit EU020, EU021, and EU022 in Air Emissions Permit No. 13700061-002, that are BART-eligible for SO_2 and NO_x and for which a BART analysis was performed. Each furnace has four stack vents. Exhaust from the furnaces is vented primarily through two ducts: the hood exhaust that handles the drying and recirculated cooling gases, and the windbox exhaust that handles the preheat, firing, and after-firing gases. The windbox exhaust flows through a multiclone, and then is combined with the hood exhaust stream in a common header, which is subsequently divided into four streams leading to four separate venturi rod scrubbers. The stack vents associated with each furnace are identified as follows: EU020 (SV021-024), EU021 (SV025-028), and EU022 (EU029-032).

8. Hibtac agrees to undertake the testing and analyses set forth below to provide the MPCA with data to determine whether an Alternative NO_x Emissions Measurement Method is approvable by the MPCA and agrees to implement the Alternative Method, if it is approved by the MPCA.

ORDER

NOW, THEREFORE, IT IS ORDERED AND AGREED:

Plan Submittal.

9. Within 30 days of the effective date of this Order, Hibtac shall submit a Plan to the MPCA. The Plan shall provide a schedule describing in detail the steps Hibtac will take to gather and analyze data that would constitute the basis of an Alternative Method such that an Alternative Method proposal is submitted to the MPCA no later than March 31, 2008, for Line 2 and June 30, 2008, for Lines 1 and 3. The Plan must include the testing and analysis methods described in this Order. Any proposed testing shall comply with the requirements of Minn. R. 7017.2020, subp. 2, 7017.2030, 7017.2035, and 7017.2040.

Alternative Method Proposal.

10. By March 31, 2008, Hibtac must submit to the MPCA for approval an Alternative Method proposal for Line 2. By June 30, 2008, Hibtac must submit to the MPCA for approval an Alternative Method proposal for Lines 1 and 3. Hibtac shall collect data by conducting continuous testing of each furnace using Method 7E for a period of time sufficient to gather a minimum of 150 one-hour data points under the range of operating parameters that influence NO_X emissions. The range of each operating parameter during testing should be representative of the furnace's range for that parameter in the 12 months previous to testing. The operating parameters and their ranges shall be submitted to the MPCA as part of the testing plan. All stacks for each furnace shall be tested simultaneously.

The Alternative Method proposal shall contain:

a. The data points recorded during emissions testing conducted for these parameters at a minimum: ferrous iron content of the feed materials, pellet type, production rate, heat input, stack gas flow rate, and combustion zone temperature. Data for other parameters shall be submitted if Hibtac determines they are relevant to NO_X formation. If the MPCA determines that any further parameters that are currently measured are relevant to NO_x formation, those parameters shall be added to the list of operating parameters recorded and submitted.

b. Hibtac shall submit all results of the testing to the MPCA. If Hibtac believes that any data resulting from the testing is not valid, Hibtac shall include an explanation of why it believes the data is not valid with the test report and test data. All data shall be provided in an unlocked electronic spreadsheet.

c. Hibtac shall analyze the calculated hourly NO_X concentration for each furnace weighted by stack flow rate and determine the relative variability index (RVI) for the data set. The variability of the stack-flow weighted NO_X concentration for each furnace will be quantified by a RVI, which is defined by the MPCA as the ratio of the width of a 95 percent prediction interval to the center of the interval. The stack-flow weighted NO_X concentration for each hourly data point shall be calculated as follows:

$$[NOx]_{F,j} = \frac{\sum_{i=1}^{4} [NOx]_{i,j}\ flow_{i,j}}{\sum_{i=1}^{4} flow_{i,j}}$$

Where:
$[NOx]_{Fj}$ is the flow-weighted concentration, ppmvd, at the j^{th} hour, j = 1, 2, ..., 150 or higher;
$[NOx]_{ij}$ is the measured concentration, ppmvd, of the i^{th} stack at the j^{th} hour, i = 1 to 4;
$flow_{i,j}$ is the measured gas flow rate in dscfm of the i^{th} stack at the j^{th} hour, i = 1 to 4.

If the RVI for the $[NO_X]_{Fj}$ data is less than or equal to 0.20, then variability will be considered to be "low". If the relative variability is greater than 0.20, then variability will be considered to be "high".

d. If the RVI for the data is high, then Hibtac may evaluate whether operating parameters (predictors) can be used to predict NO_X concentration for each stack, from which hourly mass rate emissions in pounds per hour can be calculated using hourly stack gas flow rate measurement. The MPCA will accept a multiple regression-based predictive equation for each stack for NO_X emission calculation, if: 1) the residual standard deviation of the random differences between the actual measured concentration and the regression equation predicted value divided by the average NO_X concentration is less than or equal to 0.09 at the midpoint of the predicted concentration; 2) the predictors used in the regression equations incorporate, either directly or by proxy, significant plant parameters that could affect the NO_X concentration; and 3) the leverage is not large, as determined by the MPCA (leverage is a measure used by statisticians to identify the extent to which the predictors are extrapolations). All supporting calculations and data used in developing the predictive equation shall be provided to the MPCA.

e. A description of and schedule for quality assurance and quality control methods by which Hibtac will ensure the continuing validity of the data collected for RVI determination or for the calibration of the predictive equation. The description shall include at a minimum: annual extended method 7E emissions testing with justification for the proposed duration of testing, and the quarterly submittal of relevant hourly operating parameters to demonstrate that operating conditions continue to be 1) within the range of the data collected during testing under Part 10, if the RVI is low or 2) within the range of data collected during calibration testing of a predictive equation, if the RVI is high. If the RVI is high and a predictive equation is used, Hibtac shall provide a protocol consistent with U.S. EPA's monitoring protocol for an industrial furnace Predictive Emission Monitoring System. The protocol is available at: http://www.epa.gov/ttn/emc/cem/furnace.pdf.

f. A schedule for installation and certification of permanent stack gas flow monitors such that installation and certification occurs no later than November 30, 2008.

g. If the RVI is high and a predictive equation is used, a schedule for installation of a readout in the pellet furnace operator control room with the predicted hourly NO_X emissions such that installation occurs no later than November 30, 2008.

11. The MPCA will either approve or disapprove the use of an Alternative Method by August 31, 2008.

12. If the MPCA approves an Alternative Method, then Hibtac shall:

    a. Report to the MPCA all emissions and operating parameter data at rates and averaging periods, as provided in the approved Alternative Method. The Report shall be provided in an electronic unprotected spreadsheet format that will be provided by the MPCA. Hibtac shall submit with each Report a written certification consistent with the certification required by Minn. R. 7017.1120, subp. 4. Data collection for the Report must begin no later than November 30, 2008. Each Report is due 30 days after the end of each calendar quarter following November 30, 2008.

    b. Conduct all approved measurement and reporting requirements until a BART limit and compliance demonstration requirements are made an enforceable condition of Hibtac's air emissions operating permit.

    c. The MPCA reserves its authority to revoke the approval of the Alternative Method should approval be granted, if any of the conditions on which the MPCA relied to grant approval changes. Any revocation shall be made in writing. Should the MPCA revoke its approval, the MPCA may exercise all its authorities to implement the Regional Haze rule, including BART.

General.

13. This Order by Consent is not transferable or assignable to any person without the express written approval of the MPCA.

14. The MPCA staff may grant extensions to the deadlines established herein for reasons beyond the reasonable control of Hibtac. Hibtac must make a written request for an extension at least 10 calendar days prior to the deadline.

15. This Order is effective upon the date that it is signed by the MPCA Commissioner or his designee. This Order shall remain in effect until appropriate BART-related terms and conditions of this Order become an enforceable part of Hibtac's air emissions permit. The MPCA may terminate the Order if MPCA does not approve an Alternative Method.

16. The terms of this Order may be amended by the written agreement of the parties.

RESERVATION OF AUTHORITY

Nothing in this Order shall prevent the MPCA from taking action to enforce the requirements of this Order, or from requiring additional action by the Regulated Party if necessary to ensure compliance with the Regional Haze rule and other MPCA rules and statutes.

IT IS SO ORDERED.

Edward M. LaTendresse
General Manager
Hibbing Taconite Company

Dated: 2/25/08

James L. Warner, P.E.
Director
Industrial Division
Minnesota Pollution Control Agency

Dated: 3/3/08

Minnesota Pollution Control Agency

520 Lafayette Road North | St. Paul, MN 55155-4194 | 651-296-6300 | 800-675-3843 | 651-282-5332 TTY | www.pca.state.mn.us

June 8, 2009

Mr. Andrew S. McDowell
Section Manager – Environmental
Hibbing Taconite Company
4950 County Highway 5 North, PO Box 589
Hibbing, MN 55746-0589

Dear Mr. McDowell:

On May 5, 2009, Hibbing Taconite (Regulated Party) submitted a written request to the Minnesota Pollution Control Agency (MPCA) requesting an extension of deadlines regarding installation of stack gas flowmeters. The Administrative Order by Consent (AO) required permanent stack gas flow meters to be installed and certified no later than November 30, 2008. On November 17, 2008, the MPCA granted approval of Hibbing Taconite's request to move this deadline to May 31, 2009.

In the letter of May 5, Hibbing Taconite requested that the deadline for certification be changed to May 31, 2010, due to the fact that the three furnace lines are currently idled. Line two is scheduled to be idled until September 2009, and Lines one and three are scheduled to be idled until January 2010.

In further discussions the Regulated Party explained that initial test probes showed evidence of substantial chemical and abrasive damage after only two months of use, and that further testing of probes would be conducted once Line two returns to operation. Once appropriate probes are chosen, manufacturing of permanent probes takes four months.

Therefore, the MPCA grants an extension of the schedule for certification of stack gas flowmeters for Line two until March 1, 2010. Certification of stack gas flowmeters for Lines one and three is to occur to within 60 days of the reactivation of each operating line.

Thank you for your cooperation in this matter.

Sincerely,

Jeff J. Smith
Division Director
Industrial Division

JJS:jab

cc: [redacted]MPCA, St. Paul
Chris Nelson, MPCA, St. Paul
AQD File #541

STATE OF MINNESOTA
Minnesota Pollution Control Agency

In the Matter of:	**ADMINISTRATIVE ORDER**
Northshore Mining Company – Silver Bay	**BY CONSENT**

This Administrative Order by Consent (Order) is issued by the Commissioner of the Minnesota Pollution Control Agency (MPCA) and Northshore Mining Company- Silver Bay (Regulated Party) pursuant to Minn. Stat. §116.07, subd. 9 (2006). The Regulated Party has reviewed the terms of this Order and, by its signature below, agrees to comply with it.

FINDINGS OF FACT

BACKGROUND

1. On July 6, 2005, the U.S. Environmental Protection Agency (EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas [70 Fed. Reg. 39103]. This rule is commonly known as the "Regional Haze Rule" [40 CFR §§ 51.300 -51.309].

2. The Regional Haze Rule (Rule) requires that Minnesota establish and achieve visibility goals for each of its Class I areas by 2018. The Rule regulates the emission of pollutants that contribute to regional haze. The MPCA has determined that the key pollutants are particulate matter (PM, measured as PM_{10}), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

3. The Rule regulates certain stationary sources that could contribute to visibility impairment in Class I areas and requires Best Available Retrofit Technology (BART) limits for these sources.

4. The Rule requires that by December 17, 2007, Minnesota must submit a Regional Haze State Implementation Plan (SIP) to the EPA that identifies the older sources that cause or contribute to visibility impairment in its Class I areas. The Regional Haze SIP submittal must also include a schedule for implementation of BART and other control measures. The schedule will include dates by which the MPCA will establish BART limits for specific units at BART-eligible sources and dates by which facility owners or operators will demonstrate compliance with the limits.

5. To satisfy the Rule, the MPCA must determine what constitutes BART for each BART-eligible unit and must establish emission limits consistent with its determination of BART. BART limits must take into consideration the technology available, the costs of compliance, the energy and the non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

6. The Regulated Party produces taconite pellets at its facility (herein referred to as "Facility") located in Silver Bay, Minnesota. In March 2006, the MPCA determined that the Regulated Party's Facility includes units that are subject to BART. See *RESULTS of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota* at http://www.pca.state.mn.us/publications/aq-sip2-07.pdf.

7. The Regulated Party has two pellet furnaces, identified as Emission Unit EU100 (Furnace 11 Hood Exhaust), EU104 (Furnace 11 Waste Gas), EU110 (Furnace 12 Hood Exhaust), and EU114 (Furnace 12 Waste Gas) in Air Emission Permit No. 07500003-003, that are BART-eligible for SO_2 and NO_x and for which a BART analysis was performed. The stack vents associated with each emission unit are identified as follows: EU100 (SV101-103), EU104 (SV104-105), EU110 (SV111-113), and EU114 (SV114-115).

8. The Regulated Party agrees to undertake the testing and analyses set forth below, to provide the MPCA with data to determine whether an Alternative NO_x Emissions Measurement Method is approvable by the MPCA, and agrees to implement the Alternative Method, if it is approved by the MPCA.

ORDER

NOW, THEREFORE, IT IS ORDERED AND AGREED:

Plan Submittal.

9. Within 30 days of the effective date of this Order, the Regulated Party shall submit a Plan to the MPCA. The Plan shall provide a schedule describing in detail the steps the Regulated Party will take to gather and analyze data that would constitute the basis of an Alternative Method such that an Alternative Method proposal is submitted to the MPCA no later than June 30, 2008, for Lines 11 and 12. The Plan must include the testing and analysis methods described in this Order. Any proposed testing shall comply with the requirements of Minn. R. 7017.2020, subp. 2, 7017.2030, 7017.2035, and 7017.2040.

Alternative Method Proposal.

10. By June 30, 2008, the Regulated Party must submit to the MPCA for approval an Alternative Method proposal for Lines 11 and 12. The Regulated Party shall collect data by conducting continuous testing of each furnace using Method 7E for a period of time sufficient to gather a minimum of 150 one-hour data points under the range of operating parameters that influence NO_x emissions. The range of each operating parameter during testing should be representative of the furnace's range for that parameter in the 12 months previous to testing. The operating parameters and their ranges shall be submitted to the MPCA as part of the testing plan. All stacks for each furnace shall be tested simultaneously.

The Alternative Method proposal shall contain:

a. The data points recorded during emissions testing conducted for these parameters at a minimum: ferrous iron content of the feed materials, pellet type, production rate, heat input, stack gas flow rate, and combustion zone temperature. Data for other parameters shall be submitted if the Regulated Party determines they are relevant to NO_x formation. If the MPCA determines that any further parameters that are currently measured are relevant to NO_x formation, those parameters shall be added to the list of operating parameters recorded and submitted.

b. The Regulated Party shall submit all results of the testing to the MPCA. If the Regulated Party believes that any data resulting from the testing is not valid, the Regulated Party shall include an explanation of why it believes the data is not valid with the test report and test data. All data shall be provided in an unlocked electronic spreadsheet.

c. The Regulated Party shall analyze the calculated hourly NO_x concentration for each furnace weighted by stack flow rate and determine the relative variability index (RVI) for the data set. The variability of the stack-flow weighted NO_x concentration for each furnace will be quantified by a RVI defined by the MPCA as the ratio of the width of a 95 percent prediction interval to the center of the interval. The stack-flow weighted NO_x concentration for each hourly data point shall be calculated as follows:

$$[NOx]_{F,j} = \frac{\sum_{i=1}^{4} [NOx]_{i,j}\ flow_{i,j}}{\sum_{i=1}^{4} flow_{i,j}}$$

Where:
$[NO_x]_{F,j}$ is the flow-weighted concentration, ppmvd, at the j^{th} hour, j = 1, 2, ..., 150 or higher;
$[NO_x]_{i,j}$ is the measured concentration, ppmvd, of the i^{th} stack at the j^{th} hour, i = 1 to 4;
$flow_{i,j}$ is the measured gas flow rate in dscfm of the i^{th} stack at the j^{th} hour, i = 1 to 4.

If the RVI for the $[NO_x]_{F,j}$ data is less than or equal to 0.20, then variability will be considered to be "low". If the relative variability is greater than 0.20, then variability will be considered to be "high".

d. If the RVI for the data is high, then the Regulated Party may evaluate whether operating parameters (predictors) can be used to predict NO_x concentration for each stack, from which hourly mass rate emissions in pound per hour can be calculated using hourly stack gas flow rate measurement. The MPCA will accept a multiple regression-based predictive equation for each stack for NO_x emission calculation, if: 1) the residual standard deviation of the random differences between the actual measured concentration and the regression equation predicted value divided by the average NO_x concentration is less than or equal to 0.09 at the midpoint of the predicted concentration; 2) the predictors used in the regression equations incorporate, either directly or by proxy, significant plant parameters that could affect the NO_x concentration; and 3) the leverage is not large as determined by the MPCA (leverage is a measure used by statisticians to identify the extent to which the predictors are extrapolations). All supporting calculations and data used in developing the predictive equation shall be provided to the MPCA.

e. A description of and schedule for quality assurance and quality control methods by which the Regulated Party will ensure the continuing validity of the data collected for RVI determination or for the calibration of the predictive equation. The description shall include at a minimum: annual extended method 7E emissions testing with justification for the proposed duration of testing, and the quarterly submittal of relevant hourly operating parameters to demonstrate that operating conditions continue to be 1) within the range of the data collected during testing under part ten if the RVI is low or 2) within the range of data collected during calibration testing of a predictive equation if the RVI is high. If the RVI is high and a predictive equation is used, the Regulated Party shall provide a protocol consistent with the EPA's monitoring protocol for an industrial furnace Predictive Emission Monitoring System. The protocol is available at: http://www.epa.gov/ttn/emc/cem/furnace.pdf.

f. A schedule for installation and certification of permanent stack gas flow monitors such that installation and certification occurs no later than November 30, 2008.

g. If the RVI is high and a predictive equation is used, a schedule for installation of a readout in the pellet furnace operator control room with the predicted hourly NO_x emissions such that installation occurs no later than November 30, 2008.

11. The MPCA will either approve or disapprove the use of an Alternative Method by August 31, 2008.

12. If the MPCA approves an Alternative Method, then the Regulated Party shall:

a. Report to the MPCA all emissions and operating parameter data at rates and averaging periods as provided in the approved Alternative Method. The Report shall be provided in an electronic unprotected spreadsheet format that will be provided by the MPCA. The Regulated Party shall submit with each Report, a written certification consistent with the certification required by Minn. R. 7017.1120, subp. 4. Data collection for the Report must begin no later than November 30, 2008. Each Report is due 30 days after the end of each calendar quarter following November 30, 2008.

b. Conduct all approved measurement and reporting requirements, until a BART limit and compliance demonstration requirements are made an enforceable condition of the Regulated Party's air emissions operating permit.

c. The MPCA reserves its authority to revoke the approval of the Alternative Method, should approval be granted, if any of the conditions on which the MPCA relied to grant approval changes. Any revocation shall be made in writing. Should the MPCA revoke its approval, the MPCA may exercise all its authorities to implement the Regional Haze rule, including BART.

General.

13. This Order by Consent is not transferable or assignable to any person without the express written approval of the MPCA.

14. The MPCA staff may grant extensions to the deadlines established herein for reasons beyond the reasonable control of the Regulated Party. The Regulated Party must make a written request for an extension at least ten calendar days prior to the deadline.

15. This Order is effective upon the date that it is signed by the MPCA Commissioner or his designee. This Order shall remain in effect until appropriate BART-related terms and conditions of this Order become an enforceable part of the Regulated Party's air emissions permit.

16. The terms of this Order may be amended by the written agreement of the parties.

RESERVATION OF AUTHORITY

Nothing in this Order shall prevent the MPCA from taking action to enforce the requirements of this Order, or from requiring additional action by the Regulated Party if necessary to ensure compliance with the Regional Haze rule and other MPCA rules and statutes.

This Order is effective upon the date that it is signed by the MPCA Commissioner or their designee.

IT IS SO ORDERED.

Mike Mlinar, Vice President/General Manager
Northshore Mining Company

Dated: 3/28/08

James L. Warner, P.E.
Division Director
Industrial Division
Minnesota Pollution Control Agency

Dated: 4/7/08

Minnesota Pollution Control Agency

520 Lafayette Road North | St. Paul, MN 55155-4194 | 651-296-6300 | 800-657-3864 | 651-282-5332 TTY | www.pca.state.mn.us

December 2, 2008

Mr. Scott A. Gischia, Section Manager – Environmental Services
Northshore Mining Company
10 Outer Drive
Silver Bay, MN 55614

RE: April 7, 2008, Administrative Order by Consent – Extension of Schedule

Dear Mr. Gischia:

On November 19, 2008, Northshore Mining Company (Regulated Party) submitted a written request to the Minnesota Pollution Control Agency (MPCA) requesting the extension for flowmeter certification testing until May 31, 2009, (a six month extension). The Regulated Party's letter explained that a physical inspection of the ten recently delivered flowmeters for Furnaces 11 and 12 shows that they were improperly sized for existing mounting flanges installed in anticipation of delivery. New, properly sized flowmeters have now been ordered that are compatible with existing installation configuration. They have an extensive lead time for manufacture and deliver. All other wiring and conduit runs have been completed to expedite installation upon delivery of the new flowmeters. The Administrative Order by Consent required installation and certification of these flowmeters by November 30, 2008.

This letter hereby approves the extension of schedule for certification of the 10 flowmeters for Furnaces 11 and 12 from the original deadline of November 30, 2008, to May 31, 2009.

Thank you for your cooperation in this matter.

Sincerely,

Jeff J. Smith
Division Director
Industrial Division

JJS/BB:rrh

cc: Ann Foss, MPCA, St. Paul
Catherine Neuschler, MPCA, St. Paul
Chris Nelson, MPCA, St. Paul
Dick Cordes, MPCA, St. Paul
Bob Beresford, MPCA, Duluth
AQD File No. 27A

STATE OF MINNESOTA
Minnesota Pollution Control Agency

In the Matter of:
UNITED TACONITE, LLC

AMENDED ADMINISTRATIVE ORDER BY CONSENT

The Commissioner of the Minnesota Pollution Control Agency (MPCA) and **United Taconite, LLC (Regulated Party)** enter into this Administrative Order by Consent (Order) pursuant to Minn. Stat. §116.07, subd. 9 (2006). Regulated Party has reviewed the terms of this Order and, by its signature below, agrees to comply with it.

FINDINGS OF FACT

BACKGROUND

1. On July 6, 2005, the U.S. Environmental Protection Agency (U.S. EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas [70 Fed. Reg. 39103]. This rule is commonly known as the "Regional Haze Rule" [40 CFR §§ 51.300 -51.309].

2. The Regional Haze Rule (Rule) requires that Minnesota establish and achieve visibility goals for each of its Class I areas by 2018. The Rule regulates the emission of pollutants that contribute to regional haze. The MPCA has determined that the key pollutants are particulate matter (PM, measured as PM_{10}), sulfur dioxide (SO_2), and nitrogen oxides (NO_x).

3. The Rule regulates certain stationary sources that could contribute to visibility impairment in Class I areas and requires Best Available Retrofit Technology (BART) limits for these sources.

4. The Rule requires that Minnesota must submit a Regional Haze SIP to U.S. EPA that identifies the older sources that cause or contribute to visibility impairment in its Class I areas. The Regional Haze SIP submittal must also include a schedule for implementation of BART and other control measures. The schedule will include dates by which the MPCA will establish BART limits for specific units at BART-eligible sources and dates by which facility owners or operators will demonstrate compliance with the limits.

5. To satisfy the Rule, the MPCA must determine what constitutes BART for each BART-eligible unit and must establish emission limits consistent with its determination of BART. BART limits must take into consideration the technology available, the costs of compliance, the energy and the non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life

of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

THE UNITED TACONITE FACILITY

6. The Regulated Party produces taconite pellets at its facility (herein referred to as "Facility") located near Forbes, Minnesota. In March 2006, the MPCA determined that Regulated Party's Facility includes units that are subject to BART. *See* RESULTS of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota at http://www.pca.state.mn.us/publications/aq-sip2-07.pdf.

7. The Regulated Party has two pellet furnaces, identified as Emission Unit EU040 and EU042 in Air Emissions Permit No. 13700113 - 004, which are BART-eligible for SO_2 and NO_x and for which a BART analysis was performed. Furnace EU040 (Line 1) has one stack vent identified as SV046; furnace EU042 (Line 2) has two stack vents, identified as SV048 and SV049.

8. The parties agree that the Regulated Party will install, maintain, and operate NOx CEMS on each of Line 1 and 2.

9. The parties agree that the MPCA will develop NOx emission limits based on sufficient CEMS data, to reflect a variety of fuel blends, as well as operating and control equipment conditions. The parties further agree that the MPCA will establish BART limits for NOx through an amendment to the Regulated Party's air emissions operating permit, which will be incorporated into Minnesota's SIP.

10. Once a limit is established in a permit, the MPCA must ensure compliance on a continuous basis with the NOx emission limits. Data from continuing operation of the Regulated Party's NOx CEMS will be used to ensure continuous compliance with NOx limits.

ORDER

NOW, THEREFORE, IT IS ORDERED AND AGREED:

CEMS Installation and Operation

11. By October 1, 2009, the Regulated Party shall complete the CEMS certification tests for Line 2 (EU042, SV048 and SV049). The Regulated Party shall complete the CEMS certification tests for Line 1 (EU040, SV046) within 60 days of the restart of the currently idled Line 1.

12. Within 60 days of the effective date of this Order, the Regulated Party shall submit a Plan to the MPCA. The Plan shall provide a schedule for continuing operation of CEMS for measuring NOx from Lines 1 and 2. The Plan shall also include an explanation of the

specific method(s) to be used, frequency of measurement, location of measurement, and units of measurement for each parameter required to be reported by paragraph 15 below.

13. The Regulated Party shall conform to the CEMS requirements specified in Minn. R. chs. 7017.1002, 7017.1030, 7017.1035, 7017.1040, 7017.1060, 7017.1070, 7017.1080, 7017.1090, 7017.1110, subps. 2(B) and 2(C), 7017.1120, subps. 1, 2 and 3, 7017.1130, 7017.1140, 7017.1150, 7017.1160 subps. 2 and 3, 7017.1170 and 7017.1180.

14. After CEMS certification, the Regulated Party shall continuously operate the CEMS under this Order until the requirement to operate CEMS is made an enforceable condition of the Regulated Party's air emissions operating permit.

15. Quarterly Emissions/Parameter Reports: the Regulated Party shall report all NO_x emissions to the MPCA. All data points collected by a CEMS shall be used to calculate individual hourly emission averages. Each Report shall include hourly data for the heat input, pellet production rate, fuel used, stack gas flow rate, and the units for each of the parameters. Emissions shall be reported in pounds per hour, on an hourly and a 30 day rolling average basis (recalculated daily). The Quarterly Report shall indicate all measured periods of emissions as well as periods of monitor downtime. The Report shall be provided in an electronic unprotected spreadsheet format that will be provided by the MPCA. A certification statement clearly indicating the submittal to which it applies and signed by a responsible official, pursuant to part 7007.0500, subpart 3 shall be mailed or delivered to the agency, postmarked or received within fifteen calendar days of the electronic mail or computer disk submittal of the spreadsheet. Each Report for NO_x CEMS is due 30 days after the end of each calendar quarter following the effective date of this Order until the MPCA notifies the Regulated Party that it has sufficient information to establish a BART limit. Upon notification by the MPCA, the Regulated Party may apply to the MPCA for a reduction in the reporting requirements under this item.

General

16. This Order by Consent is not transferable or assignable to any person without the express written approval of the MPCA.

17. The MPCA staff may grant extensions to the deadlines established herein for reasons beyond the reasonable control of the Regulated Party. the Regulated Party must make a written request for an extension at least 10 calendar days prior to the deadline.

18. This Order is effective upon the date that it is signed by the MPCA Commissioner or his designee. The April 21, 2008 Administrative Order by Consent agreed to by the MPCA and the Regulated Party is terminated upon issuance of this Order.

19. This Order shall remain in effect until BART-related terms and conditions of this Order become an enforceable part of the Regulated Party's air emissions permit.

20. The terms of this Order may be amended by the written agreement of the parties.

RESERVATION OF AUTHORITY

Nothing in this Order shall prevent the MPCA from taking action to enforce the requirements of this Order, or from requiring additional action by the Regulated Party if necessary to ensure compliance with the Regional Haze rule and other MPCA rules and statutes.

IT IS SO ORDERED.

John Tuomi, General Manager
United Taconite, LLC

Dated: 5/7/09.

Jeff J. Smith
Director
Industrial Division
Minnesota Pollution Control Agency

Dated: 5/18/09

November 5, 2009

Mr. Jason Aagenes
Manager, Minnesota and Canadian Environmental Affairs
United Taconite, LLC
County Highway 16
P.O. Box 180
Eveleth, MN 55734

RE: May 18, 2009, Amended Administrative Order by Consent – Extension for Certification of Continuous Emission Monitoring Systems

Dear Mr. Aagenes:

On September 23, 2009, United Taconite (Regulated Party) submitted a written request to the Minnesota Pollution Control Agency (MPCA) for an extension of deadlines regarding certification of flow monitors and SO_2/NO_X Continuous Emission Monitoring Systems (CEMS) on Line 1 (EU040, SV046) and Line 2 (EU042, SV048 and SV049) at the United Taconite facility.

Part 11 of the Amended Administrative Order by Consent required the certification tests for the CEMS on Line 2 to be complete by October 1, 2009, and the certification of the Line 1 CEMS to be complete 60 days after the restart of the currently idled Line 1.

On October 13, 2009, the MPCA sent a letter to United Taconite extending the deadline for these CEMS certification tests, which are also required under part 8.b of the March 2, 2009, Stipulation Agreement with United Taconite. The revised deadlines set forth in that letter are hereby also approved for the Amended Administrative Order by Consent.

The new deadline under Part 11 of the Amended Administrative Order by Consent for completion of Line 2 CEMS and flow monitor certification is June 1, 2010, for one of the two waste gas stacks on Line 2. The new deadline for CEMS and flow monitor certification on the second Line 2 waste gas stack and flow monitor, and for the Line 1 waste gas stack and flow monitor, is 60 days after the June 1, 2010, deadline for the first Line 2 CEMS and flow monitor certification, or August 1, 2010.

Please contact Catherine Neuschler with any questions, at 651-757-2607.

Sincerely,

Jeff J. Smith
Division Director
Industrial Division

JS/CN:sth

cc: Catherine Neuschler, MPCA, St. Paul
AQD File #869A

STATE OF MINNESOTA
Minnesota Pollution Control Agency

In the Matter of:
ARCELORMITTAL --
MINORCA MINE INC.

ADMINISTRATIVE ORDER BY CONSENT

The Commissioner of the Minnesota Pollution Control Agency (MPCA) and ArcelorMittal - Minorca Mine Inc. (Regulated Party) enter into this Administrative Order by Consent (Order) pursuant to Minn. Stat. §116.07, subd. 9 (2006). The Regulated Party has reviewed the terms of this Order and, by its signature below, agrees to comply with it.

FINDINGS OF FACT

BACKGROUND

1. On July 6, 2005, the U.S. Environmental Protection Agency (EPA) published regulations to address visibility impairment in our nation's largest national parks and wilderness ("Class I") areas [70 Fed. Reg. 39103]. This rule is commonly known as the "Regional Haze Rule" [40 CFR §§ 51.300-51.309].
2. The Regional Haze Rule (Rule) requires that Minnesota establish and achieve visibility goals for each of its Class I areas by 2018. The Rule regulates the emission of pollutants that contribute to regional haze. The MPCA has determined that the key pollutants are particulate matter [PM, measured as PM less than ten microns in size (PM_{10})], sulfur dioxide (SO_2), and nitrogen oxides (NO_x).
3. The Rule regulates certain stationary sources that could contribute to visibility impairment in Class I areas and requires Best Available Retrofit Technology (BART) limits for these sources.
4. The Rule requires that Minnesota submit a Regional Haze State Implementation Plan (SIP) to the EPA that identifies the older sources that cause or contribute to visibility impairment in its Class I areas. The Regional Haze SIP submittal must also include a schedule for implementation of BART and other control measures. The schedule will include dates by which the MPCA will establish BART limits for specific units at BART-eligible sources and dates by which facility owners or operators will demonstrate compliance with the limits.
5. To satisfy the Rule, the MPCA must determine what constitutes BART for each BART-eligible unit and must establish emission limits consistent with its determination of BART. BART limits must take into consideration the technology available, the costs of compliance, the energy and the non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

THE ARCELORMITTAL FACILITY

6. The Regulated Party produces taconite pellets at its facility (herein referred to as "Facility") located near Virginia, Minnesota. In March 2006, the MPCA determined that the Regulated

Party's Facility includes units that are subject to BART. *See* RESULTS of Best Available Retrofit Technology (BART) Modeling to Determine Sources Subject-to-BART in the State of Minnesota at http://proteus.pca.state.mn.us/publications/aq-sip2-07.pdf.

7. The Regulated Party has one pellet furnace, identified as Emission Unit EU026 in Air Emissions Permit No. 13700062-002, that is BART-eligible for SO_2 and NO_x and for which a BART analysis was performed. This furnace has 4 stack vents. The stack vents associated with the furnace are identified as SV014, SV015, SV016, and SV017.

8. The Regulated Party agrees to undertake the testing and analysis set forth below to provide the MPCA with data to determine whether an Alternative NO_x Emissions Measurement Method is approvable by the MPCA and agrees to implement the Alternative Method if it is approved by the MPCA.

ORDER

NOW, THEREFORE, IT IS ORDERED AND AGREED:

Plan Submittal.

9. The Regulated Party shall submit to the MPCA a Plan that shall describe in detail the steps the Regulated Party has taken or will take to gather and analyze data that would constitute the basis of an Alternative Method such that an initial Alternative Method proposal for its pellet furnace is submitted to the MPCA no later than 30 days after the effective date of this Order. The Plan must include the testing and analysis methods described in this Order. Any proposed testing shall comply with the requirements of Minn. R. 7017.2020, subp. 2, 7017.2030, 7017.2035, and 7017.2040.

Alternative Method Proposal.

10. Within 30 days of the effective date of this Order, the Regulated Party must submit to the MPCA for approval an Alternative Method proposal for its pellet furnace. The Regulated Party shall collect data by conducting continuous testing of each furnace using Method 7E for a period of time sufficient to gather a minimum of 150 one-hour data points under the range of operating parameters that influence NO_x emissions. The range of each operating parameter during testing should be representative of the furnace's operating range for the parameter in the 12 months previous to testing. The operating parameters and their ranges shall be submitted to the MPCA as part of the testing plan. All stacks for each furnace shall be tested simultaneously.

    The Alternative Method proposal shall contain:

    a) The hourly average data points recorded during emissions testing conducted for these parameters at a minimum: ferrous iron content of the feed materials, pellet type, production rate, heat input, stack gas flow rate, and combustion zone temperature. Data for other parameters shall be submitted if the Regulated Party determines they are relevant to NO_x formation. If the MPCA determines that any further parameters that are currently measured are relevant to NO_x formation, those parameters shall be added to the list of operating parameters recorded and submitted.

b) The Regulated Party shall submit all results of the Alternative Method testing to the MPCA. If the Regulated Party believes that any data resulting from the testing is not valid, the Regulated Party shall include an explanation of why it believes the data is not valid with the test report and test data. The MPCA shall determine if such data is valid consistent with methods reported in the current peer-reviewed literature. All data shall be provided in an unlocked electronic spreadsheet.

c) The Régulated Party shall analyze the calculated hourly NO_x concentration for each furnace weighted by stack flow rate and determine the relative variability index (RVI) for the valid data set. The variability of the stack-flow weighted NO_x concentration for each furnace will be quantified by RVI, defined by the MPCA as the ratio of the width of a 95 percent prediction interval to the center of the interval. The stack-flow weighted NO_x concentration for each hourly data point shall be calculated as follows.

$$[NOx]_{F,j} = \frac{\sum_{i=1}^{4} [NOx]_{i,j}\ flow_{i,j}}{\sum_{i=1}^{4} flow_{i,j}}$$

Where:

$[NO_x]_{Fj}$ is the flow-weighted concentration, ppmvd, at the j^{th} hour, j = 1, 2. … 150 or higher;

$[NO_x]_{Fj}$ is the measured concentration, ppmvd, of the i^{th} stack at the j^{th} hour, i = 1 to 4;

flow $_{Fj}$ is the measured gas flow rate in dscfm of the i^{th} stack at the j^{th} hour, i = 1 to 4.

If the RVI for the $[NO_x]_{Fj}$ data is less than or equal to 0.20, then variability will be considered to be "low". If the relative variability is greater than 0.20, then variability will be considered to be "high."

d) If the RVI for the data is high, then the Regulated Party may submit a schedule to evaluate whether operating parameters (predictors) can be used to predict NO_x concentration for each stack, from which hourly mass rate emissions in pounds per hour can be calculated using hourly stack gas flow rate measurements. The MPCA will accept a multiple regression-based predictive equation for each stack for NO_x emission calculation, if: 1) the residual standard deviation of the random differences between the actual measured concentration and the regression equation predicted value divided by the average NO_x concentration is less than or equal to 0.09 at the midpoint of the predicted concentration; 2) the predictors used in the regression equations incorporate, either directly or by proxy, significant plant parameters that could affect the NO_x concentration; and 3) the leverage is not large as determined by the MPCA (leverage is a measure used by statisticians to identify the extent to which the predictors are extrapolations). All supporting calculations and data used in developing the predictive equation shall be provided to the MPCA by May 1, 2009.

e) A description of and schedule for quality assurance and quality control methods by which the Regulated Party will ensure the continuing validity of the data collected for RVI determination or for the calibration of the predictive equation. If the RVI is low, the description shall include at a minimum: confirmation of the NO_x emission factor by a standard three-hour stack test once every two years and the quarterly submittal of relevant hourly average operating parameters to demonstrate that operating conditions continue to be within the range established using operating parameter data collected during testing under part 10. If the RVI is high, the description shall include at a minimum: annual method 7E emissions testing with justification for the proposed duration of testing, and the quarterly submittal of relevant hourly operating parameters to demonstrate that operating conditions continue to be within the range established using operating parameter data collected during calibration testing of a predictive equation. If the RVI is high and a predictive equation is used, the Regulated Party shall provide a protocol consistent with EPA's monitoring protocol for an industrial furnace Predictive Emission Monitoring System. The protocol is available at: http://www.epa.gov/ttn/emc/cem/furnace.pdf.

f) If the RVI is high and a predictive equation is used, a schedule for installation of a readout in the pellet furnace operator control room with the predicted hourly NO_x emissions and any other equipment used to monitor relevant operating parameters such that installations occurs within 60 days after MPCA approves the predictive equation Alternative Method.

11. The MPCA will either approve or disapprove the use of an Alternative Method within 30 days after the Alternative Method proposal and supporting data are submitted.

12. If the MPCA approves an Alternative Method, then the Regulated Party shall:

a) Report to the MPCA all emissions and operating parameter data at rates and averaging periods as provided in the MPCA approval. The Report shall be provided in an electronic unprotected spreadsheet format that will be provided by the MPCA. The Regulated Party shall submit with each Report a written certification consistent with the certification required by Minn. R. 7017.1120, subp. 4. Data collection for the Report must begin no later than 60 days after MPCA approval. Each Report is due 30 days after the end of each calendar quarter.

b) Conduct all approved measurement and reporting requirements until a BART limit and compliance demonstration requirements are made an enforceable condition of the Regulated Party's air emissions operating permit.

c) Should the MPCA approve the Alternative Method and should any of the conditions on which the MPCA relied to grant approval change, the parties agree that this Order may be terminated. Any revocation of approval of the Alternative Method of termination of this Order shall be made in writing. Should the MPCA revoke its approval, the MPCA may exercise all its authorities to implement the Regional Haze rule, including BART.

General.

13. This Order by Consent is not transferable or assignable to any person without the express written approval of the MPCA.

14. The Parties to this Order may grant extensions to the deadlines established herein by mutual written consent.
15. This Order is effective upon the date that it is signed by the MPCA Commissioner or his designee. This Order shall remain in effect until BART-related terms and conditions of this Order become an enforceable part of the Regulated Party's air emissions permit.
16. The terms of this Order may be amended by the written agreement of the parties.

RESERVATION OF AUTHORITY

Nothing in this Order shall prevent the MPCA from taking action to enforce the requirements of this Order, or from requiring additional action by the Regulated Party if necessary to ensure compliance with the Regional Haze rule and other MPCA rules and statutes.

IT IS SO ORDERED.

ARCELORMITTAL - MINORCA MINE INC.	**STATE OF MINNESOTA POLLUTION CONTROL AGENCY**
Jonathan Holmes	Jeff J. Smith
Jonathan Holmes Vice President/Operations Managers ArcelorMittal Minorca Mine Inc.	Jeff J. Smith Division Director Industrial Division
Dated: 1/9/09	Dated: 1-22-09

Appendix 10.1: Contribution Assessment Analysis

This appendix contains technical information to support Minnesota's designation of Illinois, Iowa, Minnesota, Missouri, North Dakota, and Wisconsin as the states that impact visibility at BWCAW and VNP, as well as Minnesota's assertion that it does not contribute significantly to any Class I area outside of Minnesota, except for Isle Royale National Park in Michigan.

Table 10.1.1: MRPO Estimated Contributions to Light Extinction – Percentages[172]

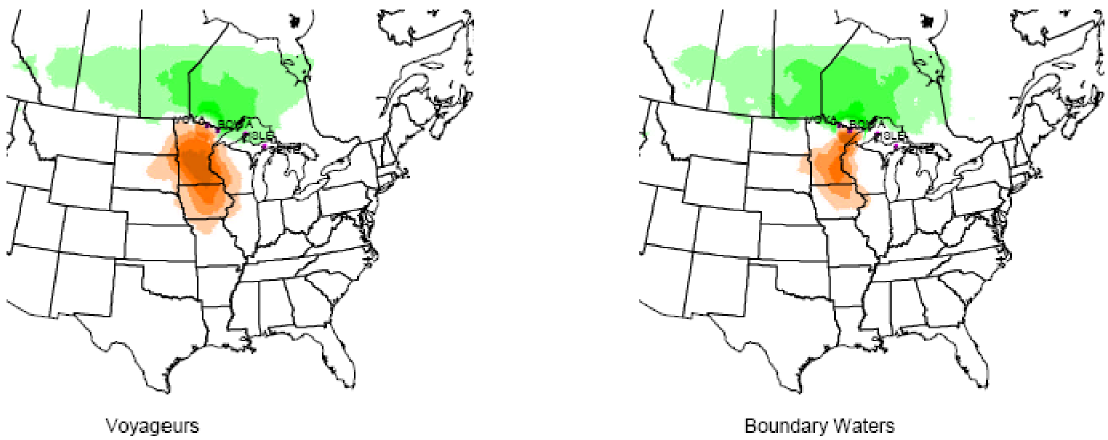
		Boundary Waters Extinction			Voyageurs Extinction			Seney Extinction		
		Best	All Days	Worst	Best	All Days	Worst	Best	All Days	Worst
US	Alabama		0.03						0.20	0.39
	Arkansas		0.30	0.40		0.10	0.19		1.54	2.93
	Florida								0.09	0.17
	Georgia								0.21	0.39
	Illinois		1.68	2.74		0.50	1.22		4.99	7.43
	Indiana		0.57	1.18					1.67	2.17
	Iowa		5.14	7.44		6.12	10.24		5.27	5.66
	Kentucky								1.14	2.18
	Louisiana		0.12	0.23		0.03	0.06		0.78	1.23
	Massachusetts								0.01	
	Michigan	0.78	1.17	0.66	0.27	1.22	1.57	14.51	13.68	14.68
	Minnesota	22.04	34.75	37.63	20.96	34.60	36.88	1.46	5.41	3.79
	Mississippi		0.06						0.62	1.04
	Missouri		2.17	3.26		1.02	0.30		2.42	3.17
	New Hampshire								0.02	
	New York								0.07	0.10
	North Carolina		0.09						0.19	0.36
	North Dakota	1.21	5.13	5.91	1.59	6.51	7.11		1.26	0.64
	Ohio		0.19	0.23				0.07	1.61	2.80
	Pennsylvania							0.49	0.15	0.26
	South Carolina								0.21	0.39
	South Dakota	0.45	3.06	4.38		4.08	6.93		1.13	1.12
	Tennessee		0.01						0.47	0.85
	Vermont								0.02	
	Virginia		0.03						0.17	0.33
	West Virginia		0.05						0.54	1.02
	Wisconsin	1.31	7.86	10.06		5.50	9.66	0.26	10.63	8.44
	Western States	1.10	4.31	5.74		7.05	9.53		5.80	5.90
Canada	Manitoba	9.95	7.45	3.71	17.65	10.35	6.04	3.77	2.37	0.77
	Ontario	47.52	15.96	8.92	49.56	13.59	4.98	50.97	12.86	7.66
	Quebec	1.77	0.15		0.21	0.01		0.97	0.93	0.41
	Other Provinces	2.27	3.73	2.46	6.05	6.29	2.35	0.86	1.72	2.28
Other (over water, etc.)		11.61	6.02	5.05	3.72	3.05	2.94	26.65	21.86	21.44
Total		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[172] MRPO, 2007a, pp 15 – 16.

Table 10.1.1 documents each state's percent contribution to visibility impairment in Minnesota's two Class I areas during part of the baseline period and some preceding years (1997 – 2001), based on back trajectory analyses done by MRPO. The contributing states are among the highest contributors to Minnesota's Class I areas in this analysis of the baseline period as well as the 2018 PSAT predictions.

Figure 10.1.1, below, is a visual representation of back trajectories for Minnesota's Class I areas on the 20% worst days from 2000 - 2003, showing the impact of the various states. Orange areas are where the air is <u>most</u> likely to come from on poor air quality days, and the green areas are where the air is <u>least</u> likely to come from on poor air quality days. Darker areas indicate higher probabilities.

Figure 10.1.1: Back Trajectories for Light Extinction, 20% Worst Days[173]



The map below, Figure 10.1.2, shows the AOIs for BWCAW and VNP for both nitrate and sulfate, with emissions from areas within the innermost circle (Level 1 AOI) having the greatest impact. In general, the nitrogen comes largely from the west of the Class I areas, while the sulfur and other particles come largely from the south. These graphical AOIs, constructed for CENRAP, compare favorably with the percentages and the light extinction back trajectories shown earlier.

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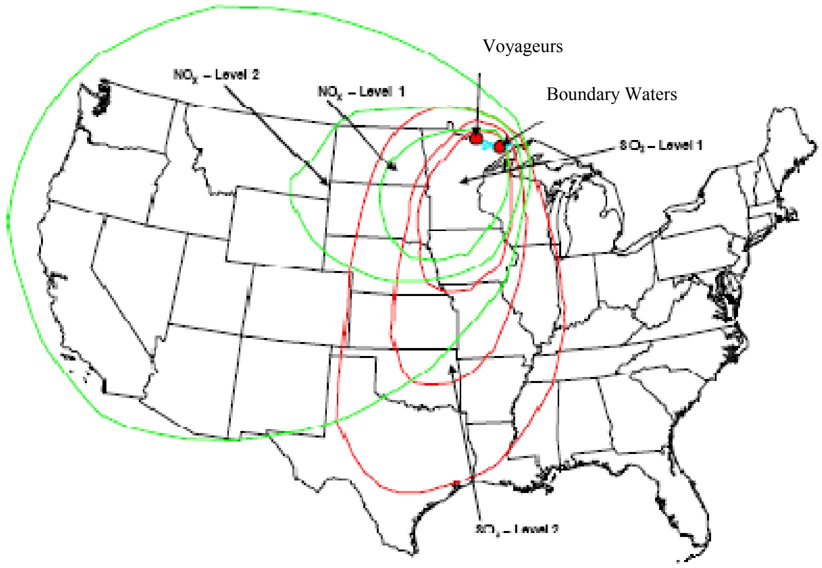
[173] MRPO, 2007a, pp 17 – 18.

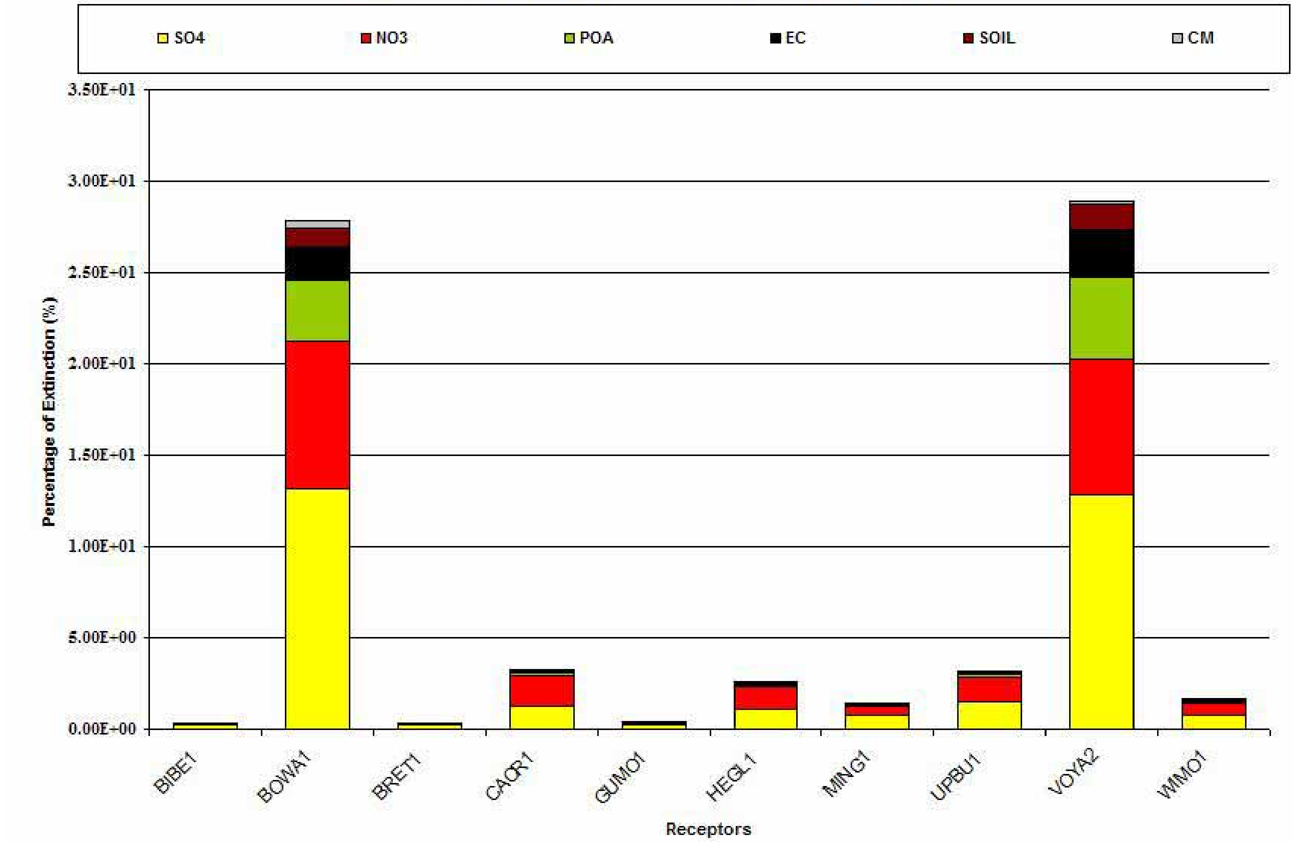
Figure 10.1.2: AOIs for Minnesota's Class I areas[174]



The AOIs and other CENRAP work serve to corroborate Minnesota's conclusions, largely drawn from MRPO work, about the key states that impact Minnesota's Class I area and the other Class I areas that Minnesota impacts. The following graphs were drawn from CENRAP's PSAT visualization tool dated July 18, 2007. Figure 10.1.3, of modeled light extinction on the 2018 worst 20% days at CENRAP Class I areas shows that Minnesota only contributes more than 5% of the light extinction at BWCAW and VNP, not at any other CENRAP Class I areas.

[174] Stella, G.M et al. *CENRAP Regional Haze Control Strategy Analysis Plan*.

Figure 10.1.3: CENRAP PSAT 2018 Modeled W20% Days Light Extinction from Minnesota (Percentage)



The following two graphs further support Minnesota's determination of the key contributing states, showing which states and source categories contribute to light extinction at BWCAW and VNP. Although in some cases the percentage impacts predicted by CENRAP are slightly lower than those predicted by the MRPO PSAT analysis (Iowa, Missouri), the identified states remain the higher contributors. The contributing states also do not change much between 2002 and 2018.

Figure 10.1.4: CENRAP PSAT 2018 Modeled W20% Days Light Extinction at BWCAW by Source Region (Percentage, Total 71.21)

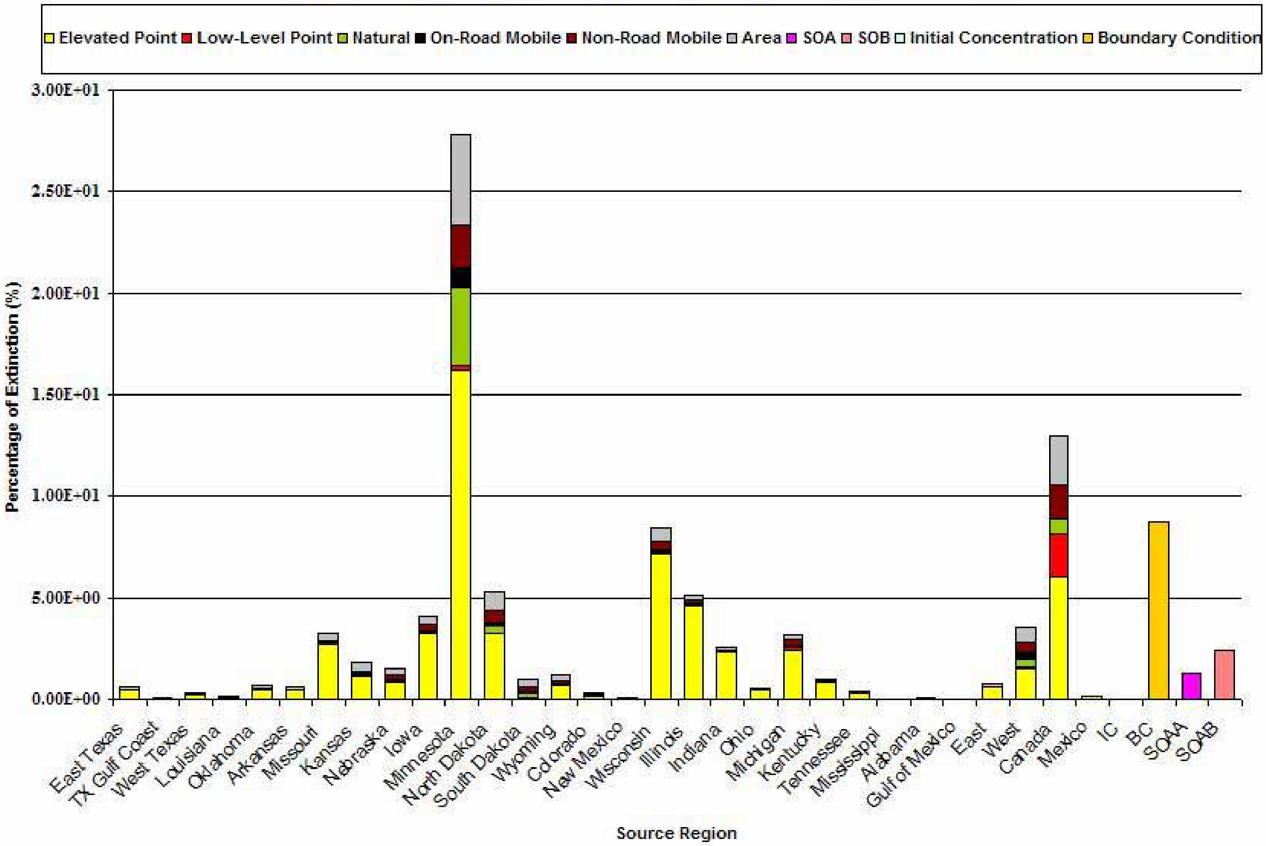
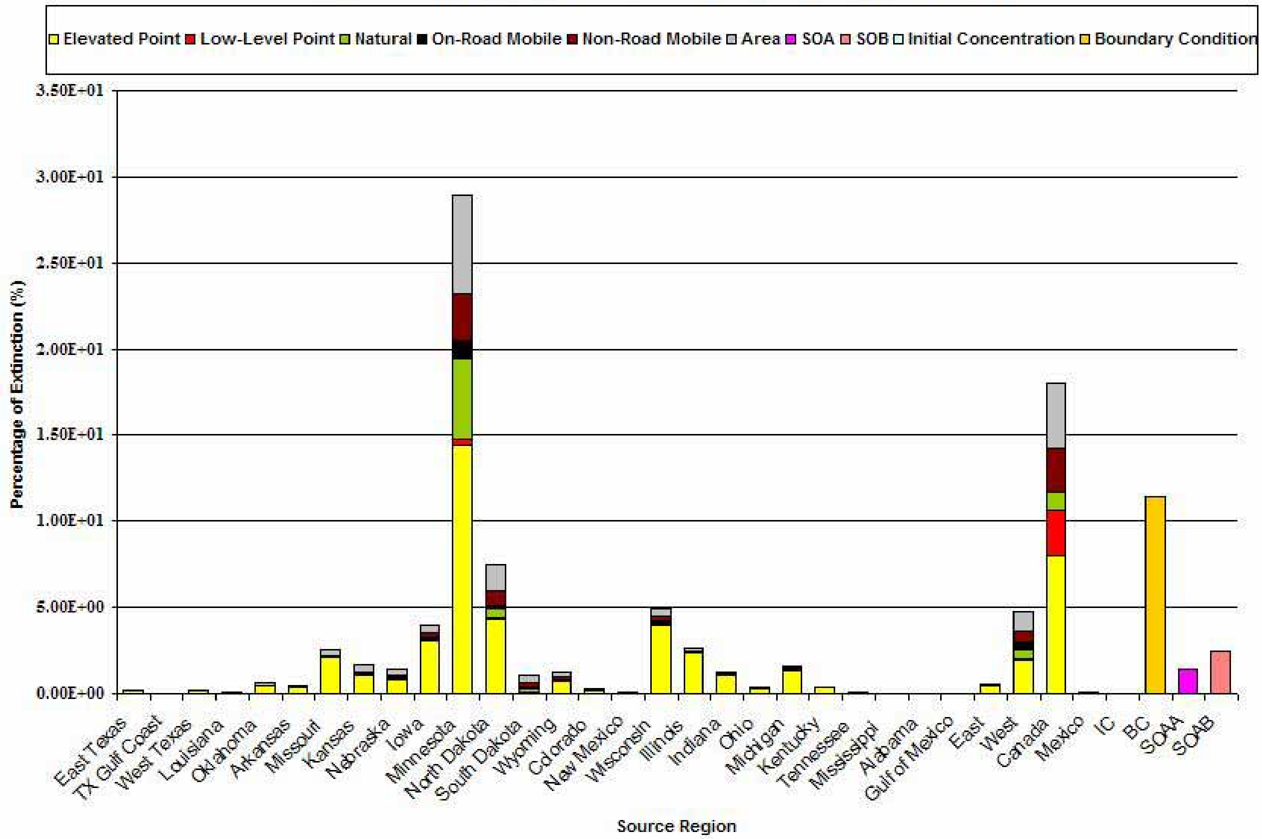


Figure 10.1.5: CENRAP PSAT 2018 Modeled W20% Days Light Extinction at VNP by Source Region (Percentage, Total 62.27)



Appendix 10.2: Minnesota Statute 216B.1692[175]

216B.1692 EMISSIONS-REDUCTION RIDER.

Subdivision 1. Qualifying projects. Projects that may be approved for the emissions reduction-rate rider allowed in this section must:

(1) be installed on existing large electric generating power plants, as defined in section 216B.2421, subdivision 2, clause (1), that are located in the state and that are currently not subject to emissions limitations for new power plants under the federal Clean Air Act;

(2) not increase the capacity of the existing electric generating power plant more than ten percent or more than 100 megawatts, whichever is greater; and

(3) result in the existing plant either:

(i) complying with applicable new source review standards under the federal Clean Air Act; or

(ii) emitting air contaminants at levels substantially lower than allowed for new facilities by the applicable new source performance standards under the federal Clean Air Act; or

(iii) reducing emissions from current levels at a unit to the lowest cost-effective level when, due to the age or condition of the generating unit, the public utility demonstrates that it would not be cost-effective to reduce emissions to the levels in item (i) or (ii).

Subd. 2. Proposal submission. A public utility that intends to submit a proposal for an emissions-reduction rider under this section must submit to the commission, the department, the Pollution Control Agency, and interested parties its plans for emissions-reduction projects at its generating facilities. This submission must be made at least 60 days in advance of a petition for a rider and shall include:

(1) the priority order of emissions-reduction projects the utility plans to pursue at its generating facilities;

(2) the planned schedule for implementation;

(3) the analysis and considerations relied on by the public utility to develop that priority ranking;

(4) the alternative emissions-reduction projects considered, including but not limited to applications of the best available control technology and repowering with natural gas, and reasons for not pursuing them;

(5) the emissions reductions expected to be achieved by the projects and their relation to applicable standards for new facilities under the federal Clean Air Act; and

(6) the general rationale and conclusions of the public utility in determining the priority ranking.

Subd. 3. Filing petition to recover project costs.

[175] This text is provided merely for the reader's information and is not intended to be incorporated into Minnesota's SIP.

(a) A public utility may petition the commission for approval of an emissions-reduction rider to recover the costs of a qualifying emissions-reduction project outside of a general rate case proceeding under section 216B.16.

In its filing, the public utility shall provide:

(1) a description of the planned emissions-reduction project;

(2) the activities involved in the project;

(3) a schedule for implementation;

(4) any analysis provided to the Pollution Control Agency regarding the project;

(5) an assessment of alternatives to the project, including costs, environmental impact, and operational issues;

(6) the proposed method of cost recovery;

(7) any proposed recovery above cost; and

(8) the projected emissions reductions from the project.

(b) Nothing in this section precludes a public utility or interested party from seeking commission guidelines for emissions-reduction rider filings; however, commission guidelines are not required as a prerequisite to a public utility-initiated filing.

Subd. 4. Environmental assessment. The Pollution Control Agency shall evaluate the public utility's emissions-reduction project filing and provide the commission with:

(1) verification that the emissions-reduction project qualifies under subdivision 1;

(2) a description of the projected environmental benefits of the proposed project; and

(3) its assessment of the appropriateness of the proposed project.

Subd. 5. Proposal approval.

(a) After receiving the Pollution Control Agency's environmental assessment, the commission shall allow opportunity for written and oral comment on the proposed emissions reduction-rate rider proposal. The commission must assess the costs of an emissions-reduction project on a stand-alone basis and may approve, modify, or reject the proposed emissions-reduction rider. In making its determination, the commission shall consider whether the project, proposed cost recovery, and any proposed recovery above cost appropriately achieves environmental benefits without unreasonable consumer costs.

(b) The commission may approve a rider that:

(1) allows the utility to recover costs of qualifying emissions-reduction projects net of revenues attributable to the project;

(2) allows an appropriate return on investment associated with qualifying emissions-reduction projects at the level established in the public utility's last general rate case;

(3) allocates project costs appropriately between wholesale and retail customers;

(4) provides a mechanism for recovery above cost, if necessary to improve the overall economics of the qualifying projects to ensure implementation;

(5) recovers costs from retail customer classes in proportion to class energy consumption; and

(6) terminates recovery once the costs of qualifying projects have been fully recovered.

(c) The commission must not approve an emissions-reduction project and its associated rate rider if:

(1) the emissions-reduction project is needed to comply with new state or federal air quality standards; or

(2) the emissions-reduction project is required as a corrective action as part of any state or federal enforcement action.

(d) The commission may not include any costs of a proposed project in the emissions-reduction rider that are not directly allocable to reduction of emissions.

Subd. 6. Implementation. Within 60 days of a final commission order, the public utility shall notify the commission and the Pollution Control Agency whether it will proceed with the project. Nothing in this section commits a public utility to implementing a proposed emissions-reduction project if the proposed project or terms of the emissions-reduction rider have been either modified or rejected by the commission. A public utility implementing a project under this section will not be required for a period of eight years after installation to undertake additional investments to comply with a new state requirement regarding pollutants addressed by the project at the project generating facility. This section does not affect requirements of federal law. The term of the rider shall extend for the period approved by the commission regardless of any subsequent state or federal requirement affecting any pollutant addressed by the approved emissions-reduction project and regardless of the sunset date in subdivision 8.

Subd. 7. Evaluation and report. By January 15, 2005, the commission, in consultation with the commissioner of commerce and commissioner of the Pollution Control Agency, shall report to the legislature:

(1) the number of participating public utilities and qualifying projects proposed and approved under this section;

(2) the total cost of each project and any associated incentives;

(3) the reduction in air emissions achieved;

(4) rate impacts of the cost recovery mechanisms; and

(5) an assessment of the effectiveness of the cost recovery mechanism in accomplishing power plant emissions reductions in excess of those required by law.

Subd. 8. Sunset. This section is effective until December 31, 2013, and applies to plans, projects, and riders approved before that date and modifications made to them after that date.

Appendix 10.3: EGU Air Emission Permits

These are the locations of various Air Emission Permits that have been issued to EGUs in Minnesota for emission reductions projects. These Air Emission Permits are not, at this time, being submitted for inclusion into the SIP.

- Minnesota Power, Boswell – Unit 3
  http://www.pca.state.mn.us/air/permits/issued/06100004-003-aqpermit.pdf
- Minnesota Power, Laskin – Units 1,2
  http://www.pca.state.mn.us/air/permits/issued/13700013-005-aqpermit.pdf
- Minnesota Power, Taconite Harbor – Units 1,2,3
  http://www.pca.state.mn.us/air/permits/issued/03100001-006-aqpermit.pdf
- Ottertail Power, Hoot Lake – Units 2,3
  Title V Reissuance in Process
- Rochester Public Utilities, Silver Lake Plant – Unit 4
  http://www.pca.state.mn.us/air/permits/issued/10900011-004-aqpermit.pdf
- Xcel Energy, Allen S. King Plant – Unit 1
  http://www.pca.state.mn.us/air/permits/issued/16300005-007-aqpermit.pdf
- Xcel Energy, High Bridge – Units 1,2,3
  http://www.pca.state.mn.us/air/permits/issued/12300012-005-aqpermit.pdf
- Xcel Energy, Riverside – Units 6,7,8
  http://www.pca.state.mn.us/air/permits/issued/05300015-004-aqpermit.pdf

Appendix 10.4: Concept Plan for Addressing Major Point Sources in Northeastern Minnesota

Vision and Goal

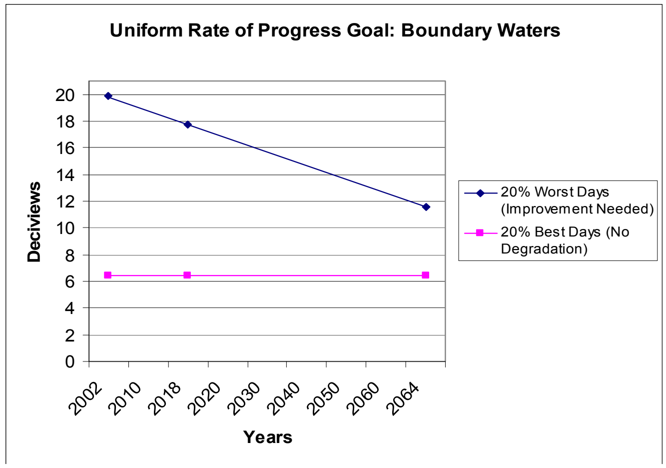
- To ensure that Minnesota is doing its share towards visibility improvement
- To improve the process of addressing visibility impairment from new and expanding sources near Class I areas
- To prepare a regional haze State Implementation Plan (SIP) for 2008-2018 that meets federal requirements

Principles

1. Major point sources of SO_2 and NO_x located in NE Minnesota contribute to visibility impairment and other environmental impacts at Voyageurs National Park, Boundary Waters Canoe Area Wilderness and Isle Royale National Park. Although reductions in Minnesota emissions alone cannot solve the problem, contributing sectors need to undertake measures necessary to obtain their share of the emission reductions needed to meet the visibility goals.
2. Under the Long-term Strategy (LTS) requirements of the Regional Haze Rule, the MPCA commits to reducing overall emissions of SO_2 and NO_x from major point sources in the region during the first implementation period (2008 – 2018), using the statutory four factors to analyze available control strategies.
3. The MPCA commits to reducing the uncertainty surrounding actual emissions from existing sources in the region, as this uncertainty, coupled with the potential for new sources, will make it difficult to determine whether sources in the region are providing an appropriate share of progress toward the 2018 visibility goal.
4. The MPCA commits to develop a Regional Haze State Implementation Plan (SIP) that spurs development of innovative emission control strategies in source sectors that currently are uncontrolled or under-controlled.
5. FLMs agencies agree that if effective emission management strategies are in place, an improved review of the impacts of new source emissions on visibility, based primarily on a review of emissions control technology and the status of the emission target, would be implemented under the new source permitting process for this geographic region.

Background

- The Regional Haze Rule requires states to reduce haze in the Class I areas (national parks and wildernesses) with an ultimate goal of no man-made visibility impairment by 2064
    - States must submit SIPs that show how they will obtain reductions of haze-causing emissions
- This graph shows one way of measuring progress towards the visibility goal laid out in the rule



- Federal programs and voluntary projects will result in emission reductions from these significant contributors:
  - Federal mobile source programs
    - Projected 50% reduction in nitrogen oxides (NO_X) and 80% in sulfur dioxide (SO_2).[176]
  - Major Sources (> 100 tons of emissions annually)
    - Projected 35% reduction in combined NO_X and SO_2 emissions in Minnesota by 2018
    - Projected reductions from sources outside NE Minnesota are greater than those in the region.
      - MPCA projects annual reductions of about 45% from Minnesota sources outside the Northeast region by 2012 (primarily due to reductions by Xcel and other utilities).
      - MPCA projects annual emissions reductions of about 20% from sources in NE Minnesota by 2012 (primarily due to reductions by Minnesota Power).
- Modeling done to date projects that Minnesota's Class I areas will not achieve the uniform rate of progress ("glide path") for visibility improvement needed by 2018.
  - Meeting the goal requires about a 25% improvement in visibility, corresponding to a higher percentage decrease in emissions.
  - Reductions from Minnesota sources alone cannot achieve the uniform rate of progress.
    - Like acid rain, many haze-causing emissions come from outside Minnesota, though local sources have more impact.
    - The Rule requires that each state impacting a Class I area include all measures necessary to obtain its share of the emission reductions needed to meet the visibility goals.
- Concerns have been raised by Federal Land Managers (FLMs) and others about the impact of new and existing sources in NE Minnesota on visibility in the Class I areas – due to both proximity and high emissions.
- Review of source-specific visibility impacts during permitting of new and expanding sources has required considerable resources on the part of the facility, MPCA, FLMs, and other parties involved in the process.

[176] Data source: Midwest Regional Planning Organization, Base K inventory, summer day estimate

Concepts for Implementation

1. Define region, major point sources, and pollutants of interest

- Pollutants to be tracked: Emissions of SO_2 and NO_x

  Rationale: These are precursor emissions to ammonium sulfate and ammonium nitrate, the principal anthropogenic contributors to visibility impairment in the BWCAW and Voyageurs. Levels of other visibility impairing pollutants (organic carbon, coarse matter, and sea salt) are at or below EPA's estimated natural background. Elemental carbon is above natural background but is a much smaller contributor relative to ammonium sulfate or ammonium nitrate.

- Geographic area for closer tracking of major point source emissions of SO_2 and NO_x.
  - County basis: St. Louis, Lake, Cook, Carlton, Itasca and Koochiching counties

  Rationale: The major point sources in the northeast are geographically isolated relative to major point sources in the rest of the state. Since local sources have greater impact on visibility, FLMs agencies are especially concerned about new and expanding sources in these six counties. Because of their proximity, the 2002 modeled visibility impact from the top-emitting point sources in this region is nearly twice that of the top-emitting Minnesota point sources outside this region. In addition, significant emissions reductions from most of the top-emitting sources outside this region will take place prior to 2012.

- Size of major point sources to be tracked
  - Existing sources with actual emissions in 2002 greater than 100 tpy of either NO_x or SO_2
  - New sources built after 2002 with a PTE greater than 100 tpy of either NO_x or SO_2

  Rationale: 100 tpy is the threshold for PSD applicability. In 2002, 19 facilities in the six northeastern counties had actual emissions above this threshold, accounting for 98.6 % of the NO_x emissions from all point sources in these counties and 99.6% of the SO_2 emissions. (These 19 facilities are listed at the end of this document.)

2. Determine an emissions reduction "target" for overall combined emissions of SO_2 and NO_x from tracked sources in this region for 2018 plus a "check-in" target for 2012.

- Suggested targets are a 20% by 2012 and 30% by 2018 reduction in region-wide NO_X and SO_2 emissions from the universe of tracked sources. The uniform rate of progress for visibility improvement was used to determine the percentage reduction in emissions needed.
- Suggested targets are based on emission levels consistent with the state and overall region doing its fair share towards obtaining the 2018 uniform rate of progress visibility goals.
- Emission reductions will be determined compared to the 2002 baseline emissions inventory used for the regional haze SIP.

Rationale: Although the goal is visibility improvement, visibility is difficult to assess in a short time period. The emission target is based on the NO_x and SO_2 emissions needed for Minnesota sources to do their share in meeting the 2018 uniform rate of progress visibility goal. Known control projects in the region are projected to result in reductions close to the 2012 target. The MPCA believes additional cost effective pollution prevention and control approaches are available that, if implemented, would allow the region to meet or exceed the 2018 target.

3. **Increase emissions certainty and track emissions**
   - Use the MPCA's point source criteria emission inventory to track emissions from these sources, and have a more precise inventory in place for tracked facilities for 2011 emission inventory.(Emissions for a given inventory year are available by the end of the following year.)
     - Potential emissions from complete permit applications by sources that have yet to submit their first emission inventory will be used in forecasting whether emissions targets will be met.
   - Evaluate emission estimation methods used by each facility and, where needed, develop methods for more accurately determining actual emissions.
   - Based on new information, determine how accurately 2002 emissions estimates reflected actual emissions and if 2002 emissions estimates in the baseline inventory need to be adjusted.
   - The MPCA will provide on their website actual and forecasted emissions for the region updated on an annual basis, along with the most recent monitored visibility conditions.

   Rationale: The MPCA criteria pollutant emissions inventory is an existing process that is used to track point source emissions and it is reasonable to use it for this purpose as well. Accurate emissions data is especially important for large sources for both assessing visibility impact and tracking emissions relative to the target. Potential emissions from permit applications are the emissions that consume increment in the PSD process. Providing annual emissions data and forecasts from tracked facilities will make the process more transparent for parties interested in the status of progress towards the 2012 and 2018 goals.

4. **Implement procedures for researching feasibility of new emission control technologies and pollution prevention practices.**
   - Expand coverage of Continuous Emission Monitors (CEMs) or a comparable emissions estimation method to taconite facilities in order to establish baseline data to set and establish compliance with BART limits. This data is also needed to determine the effectiveness of future emission control strategies.
     - MPCA must set BART emission limits for the taconite facilities.[177] However, because of the lack of research into NO_X and SO_2 control strategies for this industry, BART limits are likely to show no or minimal additional controls at most facilities. In addition, in many cases insufficient data exists to establish a BART emissions limit.
     - MPCA will issue an enforceable document by <September> 2007, requiring installation and operation of CEMs or a demonstration that another method is comparable. This shall take place by <November> 2008.
     - BART limits will be set in the 2010 timeframe after needed emissions data is gathered.
     - More accurate data will be used to provide a comparison to emission data when controls are pilot-tested or installed.
   - Each facility that is potentially uncontrolled or under-controlled will be required to investigate control technologies and pollution prevention practices through pilot tests or other mechanisms, and report to MPCA on feasible strategies.

[177] The indurating furnaces are the highest emitters of NO_X and SO_2 at each the six taconite plants. All indurating furnaces are subject to BART except for a few smaller furnaces at Northshore Mining that are outside the eligibility window.

- Based on the BART analysis submittals, the MPCA has determined that research on additional pollution prevention and/or control options for taconite indurating furnaces should take place.
- The MPCA will do a preliminary cost analysis of feasible pollution prevention and control options for large units at other facilities to evaluate whether any further analysis by those facilities is warranted to further refine cost estimates.
- Facilities identified as needing additional analysis will have from 2008 – 2011 to investigate the feasibility and cost effectiveness of emission reduction strategies that could be applied in 2012 – 2018 if needed. This could be implemented through an order or negotiated schedule of compliance.
- MPCA encourages these facilities to work together and will assist them in finding ways to do so.

Rationale: While all taconite facilities were subject to BART, there is little in the way of past retrofits or new plants to rely upon in determining BART for NO_x and SO_2. Research is needed by the industry to better understand the technical feasibility of various controls and pollution prevention practices. Control options for the other facilities (EGUs and forest products) are better understood and the MPCA believes sufficient information exists that engineering analyses by these facilities would suffice, should they be needed.

5. Review potential control measures to determine which control strategies or pollution prevention measures are reasonable

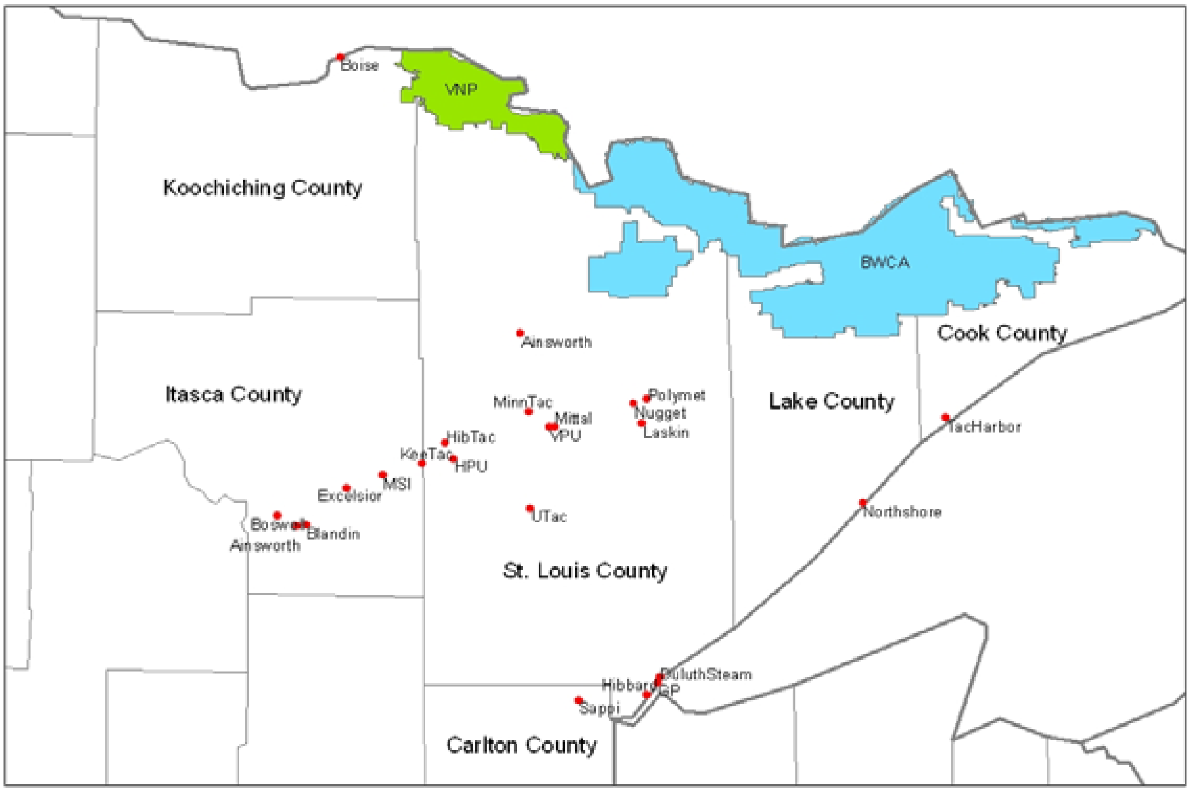
- All potential control strategies would be analyzed using the four factors (cost of compliance, time necessary for compliance, energy and non-air environmental impacts, and the source's remaining useful life) and considering a fifth and sixth factors: the visibility impact (degree of visibility improvement that would result from controls) and the emission target.
- MPCA will do a BART-like review of control technologies for <u>taconite</u> facilities based on the research conducted and the report submitted to MPCA.
  - The MPCA would require implementation of control strategies found reasonable considering the six factors; if cost-effective controls are found, these may be implemented regardless of whether the emission target is being met. The emission target, along with visibility improvement and the other factors, will influence the cost level considered to be cost-effective.
- If the emission target is not being met, MPCA would review emission reductions available from other (non-taconite) sources and require reasonable control strategies, evaluated on the same six factors mentioned previously. Implementation of reasonable controls could be required through a state rule, an order or the facility's Title V permit.

Rationale: The regional haze rule requires control strategies to be evaluated based on the four factors, along with the visibility improvement resulting from the control strategies (visibility improvement will be influenced by the level of emissions and emission reductions and a facility's distance from impacted Class I areas.) States should implement control measures found to be reasonable under these factors. Because this plan includes an emission target, the progress towards meeting that target will become a sixth factor considered in determining which control strategies are reasonable.

6. **Set procedures for assuring progress in meeting emission reduction goals as part of the SIP Report and Adequacy Determination (2013) by comparing 2012 emissions with the targets**
    - In the 2013 SIP report, MPCA will evaluate the progress towards meeting the emission reduction target and the reasonable progress goal for visibility. The following information will be considered:
        - The degree to which emissions are over or under the 2012 target.
        - Plans for emissions reductions from control upgrades or emission increases from newly permitted sources (in 2013-2018) that will determine if the 2018 target will be met.
        - The trend in ammonium nitrate and sulfate concentrations and visibility measured by monitors for BWCAW, Voyageurs, and Isle Royale.
        - Predicted visibility improvement in 2018 at Class I receptors as determined by modeling performed for the 2012 SIP Report.
        - The availability of cost-effective control measures.
    - If the 2012 emissions target is **not met**, then the MPCA will consult with the FLMs, tribes and interested parties, and determine what actions are needed to meet the 2018 emissions target considering the previous information. Actions that could be deemed appropriate include:
        - Assessing availability of cost-effective emission reductions based on information gathered under item 4 above.
        - Requiring individual facilities to propose and implement some kind of available retrofit technology (using information gathered from 2008-2012).
        - Encouraging voluntary implementation of control measures.
        - Continuing to track emissions and emission reduction projects and, establish a year for next check-in, e.g. 2015 or 2018.
    - If the **2012** target is **met**, assess permit applications approved and under review to project whether 2018 targets will be met. If it appears that the **2018** emission target will **not be met**, the state will follow the procedures as described under the previous bullet.
    - If the **2012** target is **met** in 2012 and projected to be **met** in **2018**, the state will continue to track emissions through 2018.
    - If **all emissions targets are met** in 2018, the state will review the necessity of further emissions budget reductions as appropriate to meet "reasonable progress."
7. **Once targets are set as part of the 2007 SIP, implement a "memorandum of understanding" between the MPCA, on behalf of the state of Minnesota, and FLMs on air quality related value analysis parameters for major new stationary sources applying for permits in the defined area**
    - Review of new sources would focus on application of best available control technology and a calculation of total existing and projected emissions in the area compared to the emission target.
    - In the 2012 SIP Report and in the 2018 SIP, the impact of all sources existing at that time, as well as any new or projected new sources will be modeled in a sub-regional scale model to determine if visibility improvement is tracking with projections.
    - Local impacts (within 50 km) would still need to be addressed on a case-by-case basis for the possible impact of plume blight.

Rationale: The state is required to address new sources under the Regional Haze Rule. While the FLMs have guidance for dealing with visibility impacts on an individual sources basis, it is burdensome for all involved. Addressing visibility impacts from all sources in the region as a whole will ensure better overall improvement and protection of visibility in the Class I areas. Once the major elements of the concept plan are established, a formal Memorandum Of Understanding would be needed to make the agreement enforceable.

Northeast Minnesota - Potential & Existing Air Sources



2002 Emissions Inventory – FACILITIES > 100 tons/year	SECTOR	CITY	COUNTY	NOx (tons)	SO2 (tons)	SO2+NOx (tons)
Minnesota Power Inc - Boswell	Power	Cohasset	Itasca	14528	21170	35698
US Steel Corp - Minntac	Taconite	Mountain Iron	St. Louis	14924	1946	16870
Hibbing Taconite Co	Taconite	Hibbing	St. Louis	6203	593	6795
US Steel - Keewatin Taconite	Taconite	Keewatin	St. Louis	6049	704	6753
Northshore Mining Co - Silver Bay	Power/ Taconite	Silver Bay	Lake	3649	2291	5940
Minnesota Power - Taconite Harbor	Power	Schroeder	Cook	2309	3112	5422
United Taconite LLC - Fairlane Plant	Taconite	Forbes	St. Louis	1771	3222	4994
Minnesota Power Inc - Laskin	Power	Aurora	St. Louis	2176	1608	3784
Mittal Mining Co	Taconite	Virginia	St. Louis	3254	155	3409
Sappi Cloquet LLC	Forest	Cloquet	Carlton	1196	190	1386
Boise White Paper LLC - Intl Falls	Forest	International Falls	Koochiching	846	68	914
Virginia Dept of Public Utilities	Power	Virginia	St. Louis	327	386	713
Duluth Steam Cooperative Assoc.	Power	Duluth	St. Louis	329	285	615
Minnesota Power Inc - ML Hibbard	Power	Duluth	St. Louis	414	132	546
Hibbing Public Utilities	Power	Hibbing	St. Louis	283	257	539
Blandin Paper/Rapids Energy Center	Forest	Grand Rapids	Itasca	416	44	460
Georgia-Pacific - Duluth Hardboard	Forest	Duluth	St. Louis	68	307	374
Ainsworth Engineered LLC-Cook	Forest	Cook	St. Louis	224	20	244
Ainsworth Engineered LLC - GR	Forest	Grand Rapids	Itasca	105	2	106
Totals				**59,071**	**36,491**	**95,562**

Establishing the 30% Emission Reduction Target for 2018

The 30% reduction target established in the NE Minnesota concept plan is based on the uniform rate of progress (URP, also called glide path) laid out in the haze rule. The glide path shows the yearly improvement needed between 2004 and 2064 to get to natural conditions in 2064, and is presented in deciviews.

Many RPOs and states have determined from technical analyses that much of their visibility impairment is caused by sources beyond the state's control - sources like organic carbon from wildfires, wind blown dust, or international transport of emissions. In order to try to determine reasonable progress without the impact of non-controllable sources, "species-specific" glide slopes are created. This involves changing the deciview glide path to a glide path for light extinction, and then separating out the different types of particles based on how they contribute to the overall light extinction. In order to focus solely on controllable impacts, we removed the effects of emissions from outside Minnesota, those emissions that are difficult to control, and emissions that are at predicted natural conditions. This amounted to about 75% of all emissions.

The focus was on the glide path for ammonium sulfate and ammonium nitrate, as these particles are caused by SO_2 and NO_X, pollutants with established controls. The percent decrease in light extinction due to these particles needed to achieve the 2018 visibility goal was calculated, and then it was assumed that the extinction coefficient changed in direct proportion to the change in emissions from the region. Since light extinction from these particles needs to decrease by about 30% to reach the glide path, the target is a 30% reduction in emissions.[178]

Note that changing the percentage of impacts found to be uncontrollable did not make a major difference in the percent reductions needed to meet the glide path. It should also be noted that the approach does not consider modeling of individual sources, but treats all emissions in Minnesota as though they have equal potential to cause impacts. It also does not explicitly account for differing mass extinction efficiencies of NO, NO_2 and SO_2.

The following pages show calculations that further illustrate how the 30% reduction target was derived.

Average Contribution to Light Extinction by Each Component Under Current and Natural Conditions on the 20% Haziest Days in Voyageurs (b_{ext} in Mm^{-1})

	Ammonium Nitrate	Ammonium Sulfate	Elem. Carbon	Org. Carbon	Soil	Coarse	Sea Salt	Background (Rayleigh)
Baseline (20% worst days – Current conditions)	18.15	21.32	3.2	13.58	0.45	2.8	0.49	12
Natural- (20% worst days- EPA estimated)	1.5	2.65	0.4	14.11	0.5	3.48	0.62	12

#1 Calculation of Baseline Visibility

= 10 ln (sum of the baseline "pollutant" b_{ext} values/10) = 10 ln (71.99/10)

= 19.74 deciview

[178] Removal of non-controllable impacts, derivation of species-specific glide path, and other technical work was done by Scott Copeland of the CIRA/VIEWS Staff.

#2 Calculation of 2064 Natural Visibility

= 10 ln (sum of the natural “pollutant” b_{ext} values/10) = 10 ln (35.26/10)
= 12.60 deciview or (19.74- 12.60) /60 years = 0.119 dv/year

#3 Calculation of 2064 Visibility Attainable If 25% of Nitrate and Sulfate is Assumed Controllable and All Other Components Held Constant at Baseline Levels (Adjusted Glide Path for NO_3 and SO_4))

= 10 ln (((baseline b_{ext} for EC+OC+Soil+Coarse+SS+Rayleigh) + natural background sulfate + nitrate) + 0.75 (reduction needed in nitrate + sulfate))/10)
= 10 ln (((3.2+13.58+0.45+2.8+.49+12) + (1.5 + 0.75(18.15-1.5)+ (2.65+ 0.75(21.32-2.65)))/10)
= 18.43 deciview or (19.74-18.43) /60 years = 0.0218 dv/yr

#4 Calculation of Reduction in Annual Light Extinction Needed to Stay on Adjusted Visibility Glideslope

Since we know the needed deciview reduction each year (0.0218), we can calculate the corresponding reduction in light extinction needed for each year.
b_{ext} (Mm^{-1}) = 10 exp (Haze Index /10)
Haze Index is expressed in units of deciviews

	‘02	‘03	‘04	‘05	‘06	‘07	‘08	‘09	‘10	‘11	‘12	‘13	‘14	‘15	‘16	‘17	‘18
Haze Index (dv)	19.74	19.72	19.70	19.67	19.65	19.63	19.61	19.59	19.56	19.54	19.52	19.50	19.48	19.46	19.43	19.41	19.39
B ext (Mm^{-1})	72.0	71.8	71.7	71.5	71.4	71.2	71.1	70.9	70.7	70.6	70.4	70.3	70.1	70.0	69.8	69.7	69.5

#5 Calculation of Percent Reduction in Combined Ammonium Nitrate and Sulfate by 2012 and 2018 to Stay on Adjusted Glide Path for NO_3 and SO_4

2012
To calculate the % reduction in light extinction needed by 2012, we took the difference in light extinction between 2012 and 2002 divided by the “Minnesota” contribution to manmade ammonium nitrate and sulfate

= (72.0-70.4)/ ((18.15-1.5)*0.25 + (21.32- 2.65)*0.25)

= 0.1812 or 18 % reduction in light extinction from ammonium nitrate and sulfate

2018
To calculate the % reduction in light extinction needed by 2018, we took the difference in light extinction between 2018 and 2002 divided by the “Minnesota” contribution to manmade ammonium nitrate and sulfate

= (72.0-69.5)/ ((18.15-1.5)*0.25 + (21.32- 2.65)*0.25)
= 0.283 or 28 % reduction in light extinction from ammonium nitrate and sulfate by 2018 from 2002; this was rounded to 30%

We used the percent reduction in combined ammonium nitrate and sulfate light extinction as a surrogate for the percent reduction needed in NO_X and SO_2 emissions.

Appendix 10.5: Factor Analysis of Control Strategies (EC/R Report)

The EC/R Report, *Reasonable Progress for Class I areas in the Northern Midwest – Factor Analysis,* can be found at

http://www.ladco.org/reports/rpo/consultation/products/reasonable_progress_for_class_i_areas_in_the_northern_midwest-factor_analysis_draft_final_technical_memo_july_18_2007.pdf

Appendix 10.6: CENRAP Cost Curve Analysis of Control Strategies

Alpine Geophysics performed a cost curve analysis of various control strategies, originally included in the *CENRAP Regional Haze Control Strategy Analysis Plan*, and updated in 2007.[179] The cost curves were created using AirControlNET, with the purpose of assisting CENRAP members in evaluating potential control strategies. AirControlNET is a database tool for analyzing emissions control strategies and doing basic cost analysis; the underlying data comes from EPA reports and the Air Pollution Control Cost Manual. EPA notes that AirControlNET is best used for looking at control strategies from a national or regional level.[180]

In June and July 2007, CENRAP used the information contained in the cost curves to determine the visibility improvement that could result from implementing a certain subset of the control strategies in the cost curve analysis.[181]

The CENRAP POG determined that Control Sensitivity Run should include all emission reductions available at a cost less than $5000/ton and on facilities with emissions (in tons) that when divided by the facility's distance from any Class I area (in kilometers), was greater than or equal to five (often called the Q/5D criteria.) The results showed that applying these controls would result in BWCAW achieving 93% of the visibility improvement needed to meet the URP, while VNP would achieve 69% of the URP, and Isle Royale 87%.

The following tables show which point sources are controlled in the CENRAP states that the MPCA has identified as contributing to visibility impairment in BWCAW and VNP (Iowa, Minnesota, Missouri) under the stated assumptions, along with the relevant control strategy and cost per ton figures. The tables include only those sources that are within Q/5D of VNP or BWCAW.

Due to the limitations of the AirControlNET model noted above, the MPCA believes that these cost estimates are not appropriate for making a final determination of whether controls on a certain source are cost-effective. Therefore, Minnesota is using these tables merely to point to sources or source categories that should be further evaluated in order to determine if controls truly are cost-effective. The listing in this table of a control strategy on a specific source should not be considered a definitive statement of the cost-effectiveness of the listed control or a specific decision or request to place the listed controls on the stated source.

[179] Stella, 2007.
[180] EPA, Technology Transfer Network. *AirControlNET*. (webpage)
[181] CENRAP, *Results from Control Sensitivity Run, Base18Gc1*

Table 10.6.1: NO_X Controls, Q/5D for BWCAW or VNP

State	County	Plant Name	Point ID	Source Type for Control	Control Measure	Tons Reduced	Annualized Cost ($2005)	Cost Per Ton Reduced
Iowa	Woodbury	MIDAMERICAN ENERGY CO. - GEORGE NEAL NOR	148766	Utility Boiler - Coal/Wall	SCR	3739	$5,252,502	$1,405
Iowa	Woodbury	MIDAMERICAN ENERGY CO. - GEORGE NEAL SOU	147140	Utility Boiler - Coal/Wall - Other Coal	LNBO	1191	$2,900,440	$2,435
Iowa	Wapello	IPL - OTTUMWA GENERATING STATION	143977	Utility Boiler - Coal/Tangential	SCR	4708	$13,000,038	$2,761
Iowa	Pottawattamie	MIDAMERICAN ENERGY CO. - COUNCIL BLUFFS	143798	Utility Boiler - Coal/Wall - Other Coal	LNBO	671	$2,960,866	$4,413
Minnesota	Cook	MINNESOTA POWER - TACONITE HARBOR ENERGY	EU001	Utility Boiler - Coal/Tangential	SCR	411	$1,536,959	$3,737
Minnesota	Cook	MINNESOTA POWER - TACONITE HARBOR ENERGY	EU002	Utility Boiler - Coal/Tangential	SCR	411	$1,574,337	$3,828
Minnesota	Cook	MINNESOTA POWER - TACONITE HARBOR ENERGY	EU003	Utility Boiler - Coal/Tangential	SCR	411	$1,592,948	$3,873
Minnesota	Itasca	MINNESOTA POWER INC - BOSWELL ENERGY CTR	EU004	Utility Boiler - Coal/Tangential - POD10	LNC3	806	$1,413,275	$1,753
Minnesota	Itasca	MINNESOTA POWER INC - BOSWELL ENERGY CTR	EU003	Utility Boiler - Coal/Tangential - POD10	LNC3	600	$884,162	$1,474
Minnesota	Koochiching	Boise Cascade Corp - International Falls	EU320	Sulfate Pulping - Recovery Furnaces	SCR	361	$939,170	$2,603
Minnesota	St. Louis	MINNESOTA POWER INC - LASKIN ENERGY CTR	EU001	Utility Boiler - Coal/Tangential	SCR	1064	$1,346,571	$1,265
Minnesota	St. Louis	MINNESOTA POWER INC - LASKIN ENERGY CTR	EU002	Utility Boiler - Coal/Tangential	SCR	1063	$1,346,571	$1,267
Minnesota	St. Louis	EVTAC Mining - Fairlane Plant	EU042	ICI Boilers - Coke	SCR	1365	$3,142,325	$2,302
Minnesota	Sherburne	NSP - SHERBURNE GENERATING PLANT	EU002	Utility Boiler - Coal/Tangential - POD10	LNC3	998	$1,873,316	$1,877
Minnesota	Sherburne	NSP - SHERBURNE GENERATING PLANT	EU001	Utility Boiler - Coal/Tangential - POD10	LNC3	701	$1,880,449	$2,682
Missouri	Pike	HOLCIM (US) INC-CLARKSVILLE	16745	Cement Manufacturing - Wet	Mid-Kiln Firing	1808	$149,510	$83
Missouri	Randolph	ASSOCIATED ELECTRIC COOPERATIVE INC-THOM	17575	Utility Boiler - Coal/Wall - Other Coal	LNBO	682	$3,114,256	$4,563

Table 10.6.2: SO2 Controls, Q/5D for BWCAW or VNP

State	County	Plant Name	Point ID	Source Type for Control	Control Measure	Tons Reduced	Annualized Cost ($2005)	Cost Per Ton Reduced
Iowa	Muscatine	CENTRAL IOWA POWER COOP. - FAIR STATION	100125	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	4504	$5,854,468	$1,300
Iowa	Woodbury	MIDAMERICAN ENERGY CO. - GEORGE NEAL NOR	148766	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	11440	$20,886,351	$1,826
Iowa	Woodbury	MIDAMERICAN ENERGY CO. - GEORGE NEAL NOR	148765	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	7020	$13,365,237	$1,904
Iowa	Woodbury	MIDAMERICAN ENERGY CO. - GEORGE NEAL SOU	147140	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	14255	$35,558,570	$2,494
Iowa	Wapello	IPL - OTTUMWA GENERATING STATION	143977	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	15894	$40,687,209	$2,560
Iowa	Louisa	MIDAMERICAN ENERGY CO. - LOUISA STATION	147281	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	12964	$36,698,267	$2,831
Iowa	Pottawattamie	MIDAMERICAN ENERGY CO. - COUNCIL BLUFFS	143798	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	12141	$36,299,373	$2,990
Iowa	Des Moines	IPL - BURLINGTON GENERATING STATION	145381	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	5384	$17,059,783	$3,169
Iowa	Allamakee	IPL - LANSING GENERATING STATION	145136	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	5926	$19,213,055	$3,242
Iowa	Clinton	IPL - M.L. KAPP GENERATING STATION	144559	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	5036	$17,331,069	$3,441
Iowa	Linn	IPL - PRAIRIE CREEK GENERATING STATION	144096	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	3753	$13,730,673	$3,658
Minnesota	Itasca	MINNESOTA POWER INC - BOSWELL ENERGY CTR	EU001	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	2329	$9,472,980	$4,068
Minnesota	Itasca	MINNESOTA POWER INC - BOSWELL ENERGY CTR	EU002	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	2315	$9,472,980	$4,092
Minnesota	Itasca	MINNESOTA POWER INC - BOSWELL ENERGY CTR	EU004	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	7403	$30,486,914	$4,118
Missouri	Clay	INDEPENDENCE POWER AND LIGHT-MISSOURI CI	5430	Utility Boilers - Very High Sulfur Content	FGD Wet Scrubber	8058	$6,232,581	$774
Missouri	Franklin	AMERENUE-LABADIE PLANT	6964	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	14741	$34,190,931	$2,319
Missouri	Franklin	AMERENUE-LABADIE PLANT	7408	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	14988	$34,874,750	$2,327

State	County	Plant Name	Point ID	Source Type for Control	Control Measure	Tons Reduced	Annualized Cost ($2005)	Cost Per Ton Reduced
Missouri	Franklin	AMERENUE-LABADIE PLANT	7262	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	14912	$34,874,750	$2,339
Missouri	Jefferson	AMERENUE-RUSH ISLAND PLANT	11565	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	13979	$32,994,250	$2,360
Missouri	Franklin	AMERENUE-LABADIE PLANT	7087	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	14285	$34,019,977	$2,382
Missouri	Henry	KANSAS CITY POWER & LIGHT CO-MONTROSE GE	7847	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	6362	$15,425,097	$2,425
Missouri	Henry	KANSAS CITY POWER & LIGHT CO-MONTROSE GE	7849	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	6191	$15,134,675	$2,445
Missouri	Jefferson	AMERENUE-RUSH ISLAND PLANT	11563	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	13276	$32,994,250	$2,485
Missouri	Henry	KANSAS CITY POWER & LIGHT CO-MONTROSE GE	7848	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	5928	$14,840,835	$2,504
Missouri	St. Louis	AMERENUE-MERAMEC PLANT	21421	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	8494	$21,733,761	$2,559
Missouri	St. Louis	ANHEUSER-BUSCH INC-ST. LOUIS	20274	Bituminous/Subbituminous Coal (Industrial Boilers)	SDA	1996	$5,303,934	$2,658
Missouri	Platte	KANSAS CITY POWER & LIGHT CO-IATAN GENER	16912	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	14332	$38,179,875	$2,664
Missouri	Jackson	AQUILA INC-SIBLEY GENERATING STATION	9953	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	9166	$24,430,935	$2,665
Missouri	St. Louis	AMERENUE-MERAMEC PLANT	21423	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	7081	$19,721,240	$2,785
Missouri	Randolph	ASSOCIATED ELECTRIC COOPERATIVE INC-THOM	17575	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	9469	$38,179,875	$4,032
Missouri	New Madrid	ASSOCIATED ELECTRIC COOPERATIVE INC-NEW	14944	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	8132	$33,051,234	$4,064
Missouri	New Madrid	ASSOCIATED ELECTRIC COOPERATIVE INC-NEW	14942	Utility Boilers - Medium Sulfur Content	FGD Wet Scrubber	8026	$33,051,234	$4,118
Missouri	Jefferson	DOE RUN COMPANY-HERCULANEUM SMELTER	11722	Primary Metals Industry	Sulfuric Acid Plant	10653	$46,396,391	$4,355

Appendix 10.7: Fire Emissions and Impact of Fire on Visibility

Minnesota's various ecosystems, including prairie and oak savanna, woodlands, and conifer forests, are dependent on and adapted to fire disturbance. For this reason, prescribed burning has become a common management tool for maintaining these ecosystems. Reasons for burning include: hazardous fuel reduction, site preparation, seed production, wildlife habitat improvement and maintenance, range/pasture improvement and maintenance, disease and insect control (forest health), ecosystem management, restoration and maintenance of biological diversity, restoration of fire as a natural process, research, and training. Another purpose of prescribed burning is to reduce the frequency, size, and intensity of wildfires and consequently reduce total emissions from biomass burning.

MRPO worked with a contractor to develop an inventory of fire emissions from agricultural, prescribed, and wildfire burning in 2001 – 2003 for the Midwest states: Illinois, Indiana, Michigan, Ohio, Wisconsin, Minnesota, Missouri and Iowa.[182] The inventory report shows that Minnesota has the greatest emissions of the eight states due to burning.[183] Estimated $PM_{2.5}$ emissions (for 2003) for Minnesota were 11,454 tons; about 69% of the regional total 16,656 tons. Of the estimated $PM_{2.5}$ emissions from fire in Minnesota, about 68% were attributed to prescribed burning; for OC, 4,182 tons of the total 6,184 tons of OC were attributable to prescribed burning. In addition to PM, total amounts of VOCs (29,445 tons) and NO_X (4,181 tons) were calculated. The report also shows that in Minnesota, total acres burned by both wildfire and prescribed fire increased in each successive year, and total acres burned in the state were usually more than twice the next highest state.[184]

Impact of Smoke on 20% Worst Days

In part because of this high level of burning, it is important to look at the impacts of smoke on visibility, particularly on the 20% worst visibility days. Table 10.5 shows those days among the worst 20% days with the highest light extinction due to organic and elemental carbon.

There are several tools available to determine whether fires are affecting the air monitoring data. First, databases providing the time, location, and size of wild and prescribed fires can be examined for a connection to the high values measured at the monitor site. The linkage is provided by surface-based meteorological conditions at the air monitor. Minnesota uses this method to assess the effect of fire emissions on air quality as part of evaluating the Smoke Management Plan (SMP). To look at regional air movement and long-range transport, NOAA HYSPLIT back trajectories can be used, placing an endpoint at the monitor location. Satellite images that depict fires in distant areas are also available for certain dates.

MRPO examined five of the 20% worst days with high OC and EC contributions (June 1, 28 and July 19, 2002; August 25, 2003; and July 17, 2004) to assess whether OC from fire may cause or contribute to these elevated values.[185] Using HYSPLIT back trajectories (500 m elevation) and Natural Resources Canada/Canada Forest Service satellite maps of fires, it appears that monitoring data for four of the five days was highly influenced by wildfires in Manitoba and Saskatchewan.

Figures 10.7.1 and 10.7.2 show the back trajectories and fire maps for two of the days examined by MRPO; the remaining days show similar back trajectories that begin in Canada.

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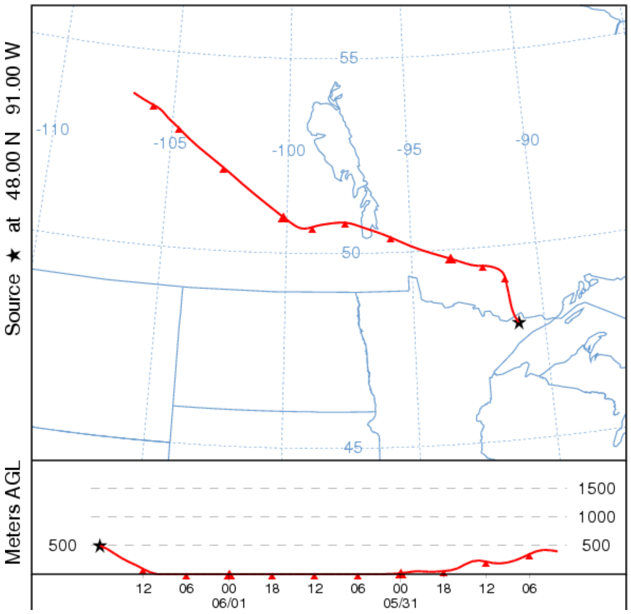
[182] Boyer, et al, 2004.
[183] Boyer, et al, 2004. Table 8-2, p 67.
[184] Boyer, et al, 2004. Table 8-3, p 70.
[185] MRPO, 2007b.

Figure 10.7.1: HYSPLIT and Fire Maps for 6/1/2002



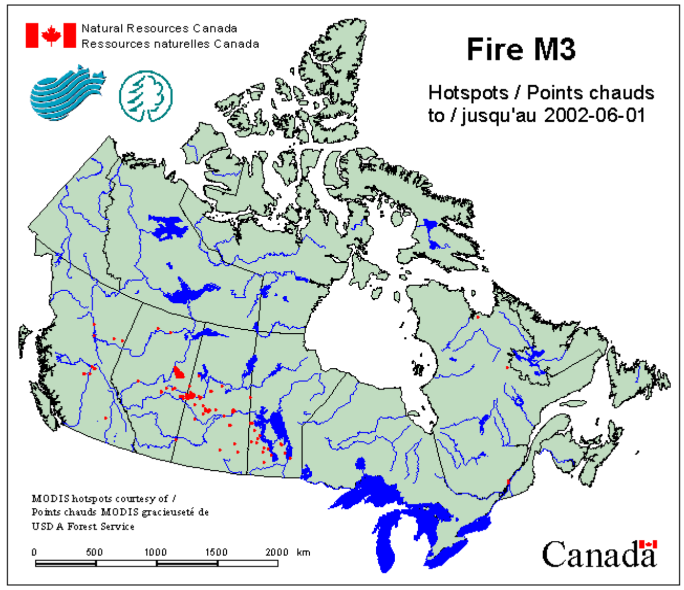
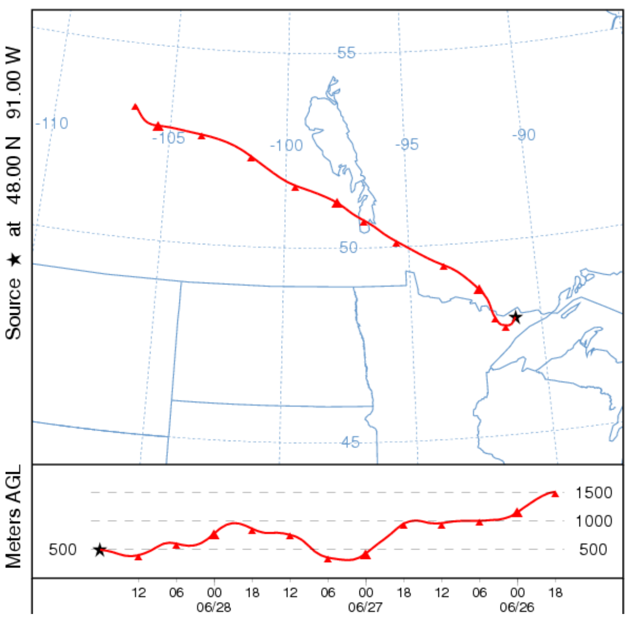
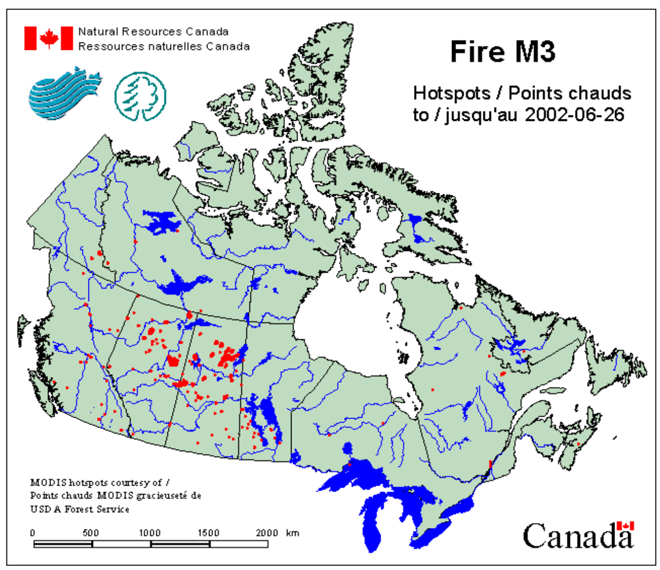


Figure 10.7.2: HYSPLIT and Fire Map for 6/28/02





The MPCA then used NOAA HYSPLIT trajectories (100, 500, and 1000m) of 72 hour duration to analyze the additional days not included in the MRPO review, and to re-analyze one day MRPO also investigated. The MPCA compared the HYSPLIT trajectories to various fire information databases and satellite images of fire in order to determine the impact of fire on the air parcels traveling to the IMPROVE monitors.

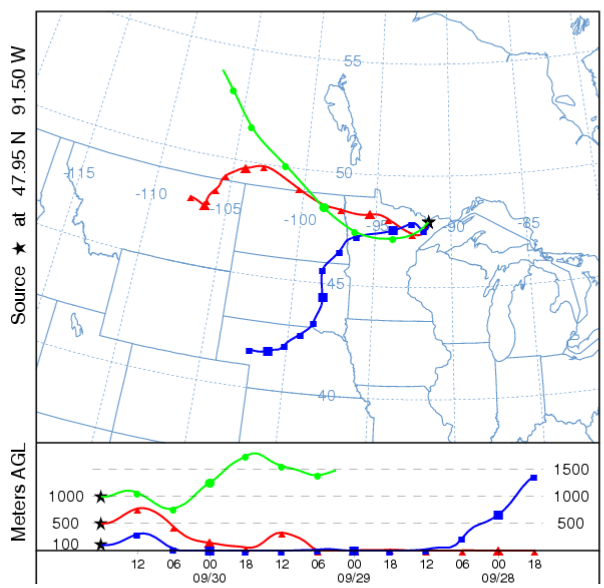
The fire information databases and images used by the MPCA included the Canadian Wildland Fire Information System (CWFIS) and the Minnesota Interagency Fire Center (MIFC) databases. However, the CWFIS platform does not include satellite hotspot images in the U.S. before 2004. The MIFC wildfire database records begin in 1985, but electronic records of prescribed burn information only began in 2003.

Sept 30, 2000

This date recorded the highest OC and EC in concentration and in light extinction for the year; it is also the highest EC concentration of the 20% worst days during the baseline period at both BWCAW and VNP. The elevated OC and EC levels are a characteristic fire signature.

The three-level 72-hour back trajectories for Sept 30, 2000 go in different directions at the western border of Minnesota. The 1000m plot begins in Northern Saskatchewan. The 500m plot follows along the US-Canada border to eastern Montana and the 100m plot begins in west central Nebraska. The CWFIS website does not provide maps of Canadian fires for these dates.

Figure 10.7.3: HYSPLIT Back Trajectories for 9/30/2000

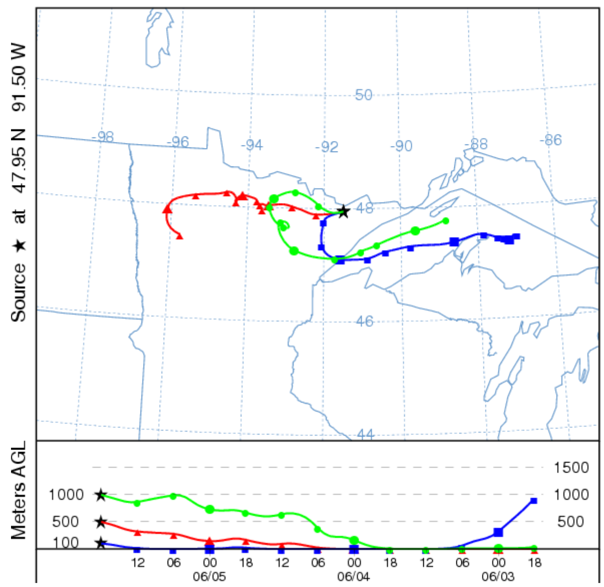


There were 1943 wildfires reported in Minnesota in 2000. According to Minnesota Interagency Fire Center (MIFC) data, there were a number of small wildfires in the state on these days, but most of them were off the trajectories, including the largest fire of the period (75.5 acres). Given the transit time and tracks of the trajectories, it is possible that wildfires in Canada contributed to the fire components at the monitor. It is also possible that agricultural or rangeland burning in the Dakotas or Nebraska, or some prescribed burns in Minnesota, added to the carbon measured at the monitor, but this cannot be determined without additional research, due to a lack of data availability.

June 5, 2003
The mid and high-level back trajectories for this date approach the monitor from the west. Both the low and high levels reverse direction and originate over Lake Superior. There are only a few "hotspots" in Ontario north and east of the lake. Of the 28 recorded wildfires in Minnesota on these three days, the largest (58 acres) is well south of the plots.

There is a 220 acre prescribed fire in St Louis County on June 4, followed by a second prescribed burn of 40 acres close by on June 5. The location of these fires is about 55 miles west of the IMPROVE monitor. They are beneath the 500m trajectory, which moves near ground level on June 4 about nine hours travel time from the monitor. The 1000m air parcel moves just north of the mid-level plot at about the same speed. Transit time is adequate for secondary particle formation. Because the IMPROVE sampler collects a 24 hour air sample, the larger fire may have affected the monitor early on June 5 followed by added carbon compounds from the smaller fire.

Figure 10.7.4: HYSPLIT Back Trajectories for 6/5/2003



Of the nine 20% worst days during the baseline period examined, this day is one likely to have been significantly affected by fires in Minnesota.[186]

August 7, 2003
For the date of August 7, 2003, satellite images show extensive fires on the southwest side of Hudson Bay on August 5 and 6 that may have contributed to elevated OC. All three HYSPLIT trajectories originate in that vicinity. It is reasonable to conclude that Canadian wildfires contributed to the high OC and EC recorded on this date at both of Minnesota's Class I areas.

[186] The trajectories for Sept 30, 2000 and June 5, 2003 are predominantly in the U.S. In addition, they cannot be analyzed by satellite mapping at this time using CWFIS, the National Interagency Fire Center (NIFC) websites or the Fire Information for Resource Management System (FIRMS) website of the University of Maryland/NASA.

Figure 10.7.5: HYSPLIT Back Trajectories for 8/7/2003

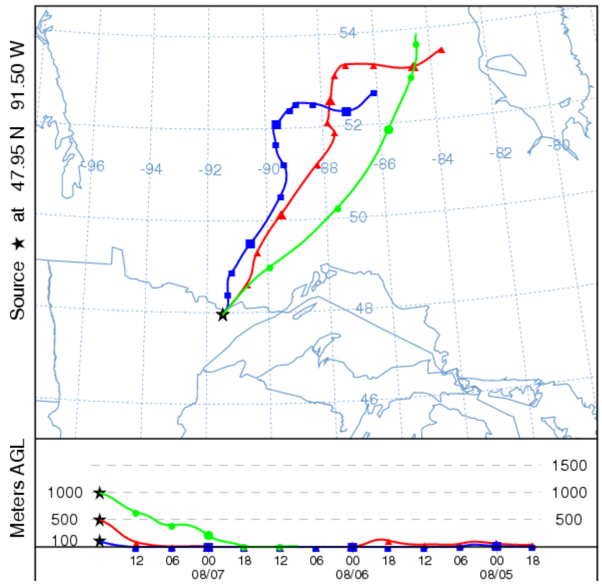
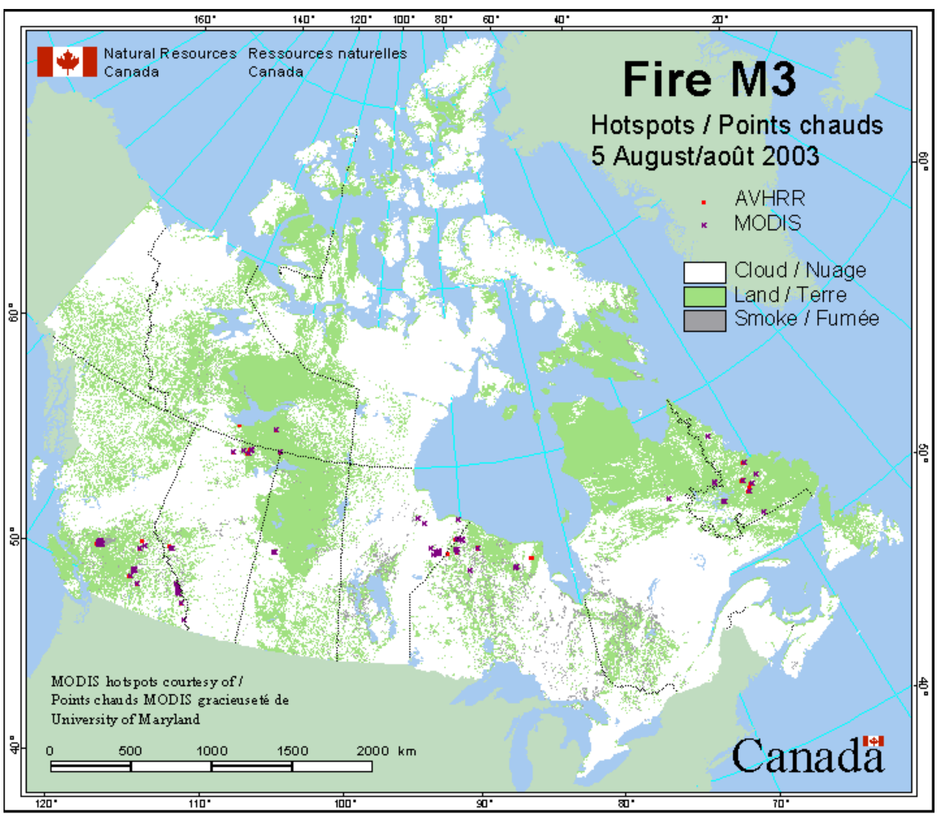


Figure 10.7.6: Canadian Fire Hotspots for 8/5/2003



<u>August 25, 2003</u>

The August 25, 2003 worst day, previously analyzed by MRPO, was reanalyzed by the MPCA with NOAA HYSPLIT trajectories (100, 500, and 1000m) of 72 hour duration and Canada Forest Service satellite imagery of Canadian fire. The trajectory for 1000m begins above the Pacific and passes over extensive fires in the south of British Columbia at about 3000m before arriving at the IMPROVE monitor. The two other trajectories circulate over northern Minnesota and southern Manitoba. There are no fires in Manitoba at this time.

Figure 10.7.7: HYSPLIT Back Trajectories for 8/25/2003

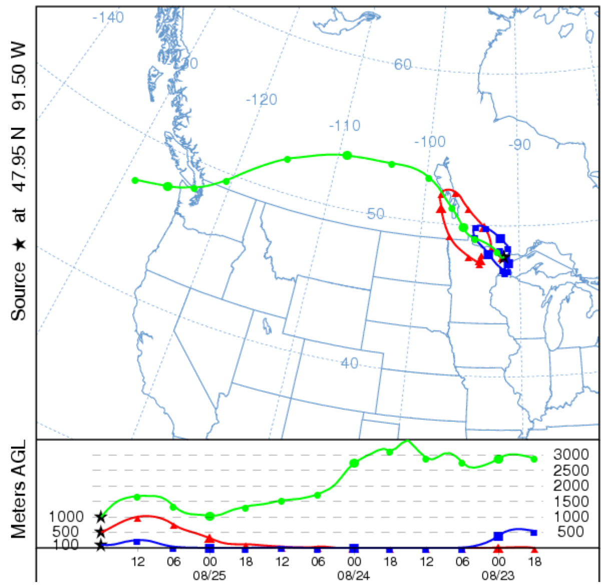
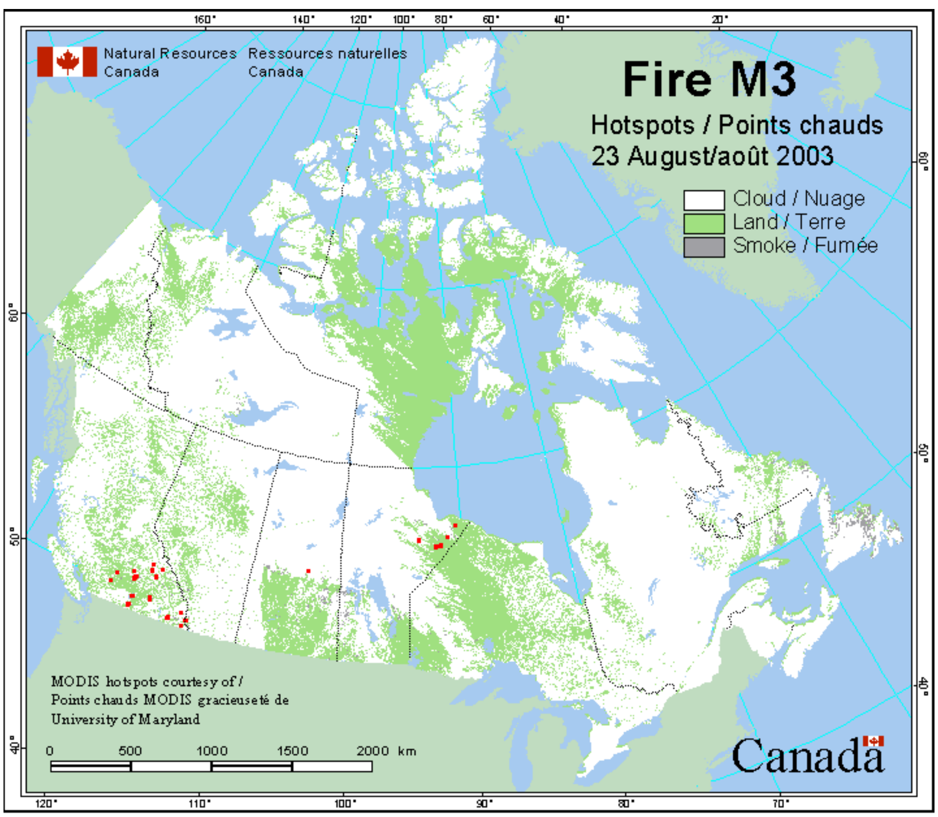


Figure 10.7.8: Canadian Fire Hotspots for 8/23/2003



July 26, 2004

This is the one date of this analysis for which the CWFIS website provides hotspot images of fires in the U.S. Again, back trajectories from the BOWA monitor were plotted. There were no fires in extreme south Ontario that could have transported to the sampler (1000m). The only fire in Minnesota, North Dakota, or South Dakota during these three days was in or near Fargo, ND on July 25 and 26. The location is right between the 500m and 1000m trajectories. This may have been a structural or industrial fire, but the source of this infrared image is unknown.

A fire does appear on the satellite image for July 27 in VNP. This fire was ignited by lightning on July 5 on the Kabetogama Peninsula. After many days, the fire became large enough and/or hot enough to be recorded by satellite infrared image. A report by MIFC describes an active fire on July 24 and 25 and a "smoke column...up to about 2500 feet." This fire would have been right beneath the 1000m trajectory plot on July 26. Though farther south, the lower level plots may have also carried emissions from this fire to the IMPROVE BOWA monitor, about 70 miles away. The amounts of OC and EC at the VOYA monitor are greater than at BOWA for this date.

Figure 10.7.9: HYSPLIT Back Trajectories for 7/26/2004

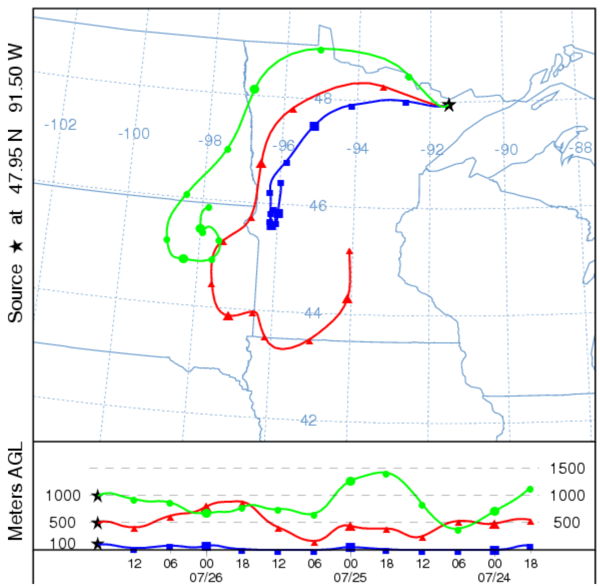


Figure 10.7.10: CWFIS Fire Hot Spots for 7/25/2004

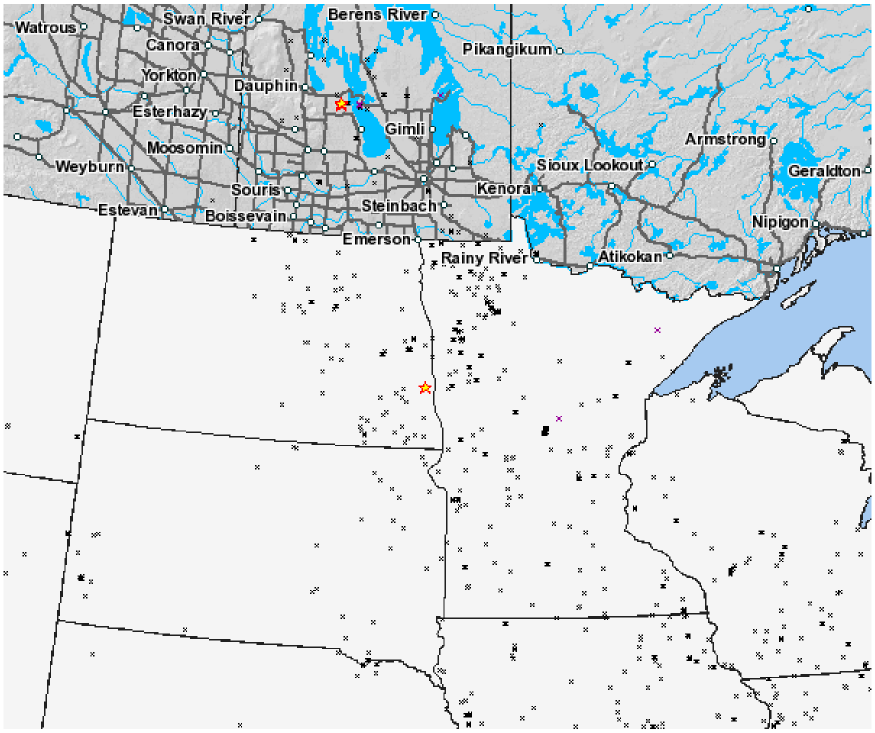
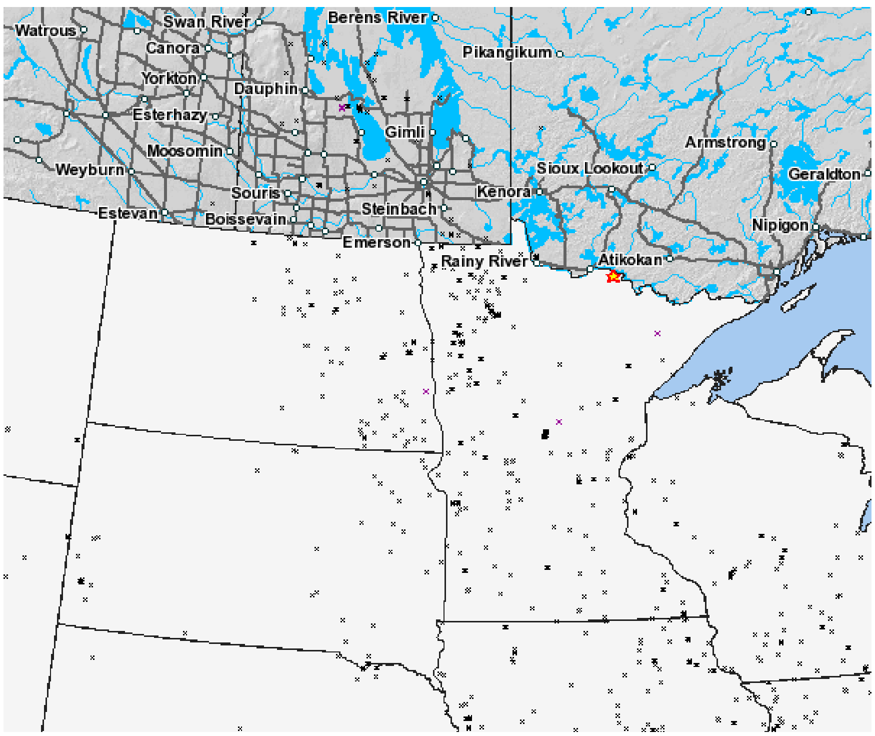


Figure 10.7.11: CWFIS Fire Hot Spots for 7/27/2004



Summary

Of the 20% worst visibility days during the baseline period, most of the nine days with the highest light extinction due to OC and EC appear to be influenced by fires in Canada. The values of OC for July 19, 2002 are the highest of all the nine days at both VNP and BWCAW. At VNP, the measured OC is about 90% greater than the next highest value. At BWCAW, it is about 75% greater than the second value. For EC, the amounts measured on this date are second only to those of Sept 30, 2000 at both Class I areas. These carbons are attributed to wildfires in Canada.[187] Clearly biomass burning can be a player in summertime organic and elemental carbon effects at the IMPROVE monitors.

Although Canadian fire is most important in the number of worst OC and EC days, there were two days when transboundary emissions are not important. For June 5, 2003 and July 26, 2004, it is reasonable to conclude that fire in Minnesota contributed to elevated concentrations of OC and EC. On these days, prescribed burns and wildfire upwind of the monitor appear to affect the IMPROVE data. As described previously, prescribed fire and wildland fire use are addressed by Minnesota's SMP.

It is important to note that summertime fires can add to natural biogenic secondary organic aerosols (SOA) due to emissions from trees in forested landscapes. It is difficult to apportion the contribution of fire emissions and of biogenics during this season whenever air moves over forested areas to the monitor.

MRPO determined that subtracting the five days of high OC concentration from the 20% worst days, in general, had a relatively small effect on visibility impairment for the baseline average – a range 0.3 dv at Minnesota's Class I areas to less than 0.2 dv at Michigan's Class I areas.[188]

Lastly, as reported in the studies cited and as recorded in the MIFC database, Minnesota has a lot of fire during three seasons of the year.[189] There is more fire in Minnesota than in any other state in the region and there is therefore more potential for contribution to the OC and EC components of visibility impairment.

In addition, Minnesota's Class I areas are impacted due to their position on the Canadian border. Although better visibility days are generally associated with transport from Canada, BWCAW and VNP are also vulnerable to the effects of extensive wildfires in Canada, which can contribute significantly to some of the 20% worst days at Minnesota's Class I areas.

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[187] MRPO, 2007b.
[188] MRPO, 2007b.
[189] Boyer, et al., 2004.

Appendix 10.8: EPA's Certification of Smoke Management Plan

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

OCT 22 2004

REPLY TO THE ATTENTION OF:
AR-18J

NOV 2004
RECEIVED

James L. Warner
Director, Majors and Remediation Division
Minnesota Pollution Control Agency
520 Lafayette Road North
Saint Paul, Minnesota 55155-4194

Dear Mr. Warner:

Thank you for your September 8, 2004, letter submitting the Smoke Management Plan for Minnesota. Your letter certifies that the Minnesota Smoke Management Plan meets the basic requirements as presented in the Environmental Protection Agency's (EPA's) "Interim Air Quality Policy on Wildland and Prescribed Fires."

Smoke management plans serve to protect air quality, address visibility impacts in Class I areas, and help avoid public safety hazards. Smoke management plans are designed to minimize emissions and air quality impacts from fires, thus helping to prevent violations of the National Ambient Air Quality Standards (NAAQS).

Since Minnesota has a certified smoke management plan, EPA will give special consideration to high particulate matter (PM) concentrations attributed to fires in certain cases. In the case that fire emission cause or contribute to: violations of the $PM_{2.5}$ or PM_{10} NAAQS, visibility impairment in Class I areas, or failure to achieve reasonable progress toward visibility goals, EPA will give Minnesota special consideration. EPA may have Minnesota review and improve its Smoke Management Plan should problems arise. If you have any questions, do not hesitate to contact Matt Rau, of my staff, at 312-886-6524.

Sincerely yours,

Stephen Rothblatt, Director
Air and Radiation Division

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