

## Appendix R

### **Cleveland Cliffs Steel, LLC - Burns Harbor Responses to the FLMs Comments**

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**Boling, Jean**

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**From:** Maicher, Thomas W. <Thomas.Maicher@clevelandcliffs.com>  
**Sent:** Tuesday, August 17, 2021 1:38 PM  
**To:** Boling, Jean  
**Subject:** RE: Federal Land Managers Comments Associated with the Cleveland Cliffs Burns Harbor Facility  
**Attachments:** Four Factor Analysis Response\_2021-08-17.pdf

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Jean,

Please see the attached response per your request. In the Appendix, it does not include C.3 since COG Desulfurization Control Costs were not revised. Please let me know if you need anything else.

Tom



**THOMAS MAICHER**  
Manager Environmental  
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Please consider the environment before printing this e-mail

**From:** Boling, Jean <JBoling@idem.IN.gov>  
**Sent:** Thursday, July 29, 2021 2:26 PM  
**To:** Maicher, Thomas W. <Thomas.Maicher@clevelandcliffs.com>  
**Subject:** [EXTERNAL] Federal Land Managers Comments Associated with the Cleveland Cliffs Burns Harbor Facility

Good afternoon Thomas,

IDEM received the Federal Land Manager's (FLMs) comments on July 23, 2021, as expected, so we are now in the process of drafting Indiana's response to comments that will be incorporated into the draft RH SIP that will go out on public notice. As stated in the email I sent out on July 15, 2021, your timely response is needed to provide the additional information the FLMs have requested to address their comments related to the four-factor analysis conducted for the Cleveland Cliffs Burns Harbor Facility. The following bulleted items provide a summary of the detailed comments attached that are specific to this facility.

- We found several errors in the cost analyses provided for this facility and we request that these errors are corrected. Once corrected, we believe controls may be even more cost effective than estimated by IDEM. *Please provide updated cost analyses based on the errors identified or justification for why the recommended correction is not applicable.*
- Notwithstanding the analysis issues highlighted here, IDEM still identified a number of cost-effective control options for the Burns Harbor facility that are within the range of \$4,000-\$10,000/ton cost thresholds being used by other states in their regional haze implementation plans. We request that IDEM include these cost effective controls in their RH SIP.

Since the RH program is an iterative program that provides states with the flexibility to develop a cohesive strategy that demonstrates reasonable progress over time toward natural visibility by 2064, Indiana offered a weight of evidence demonstration consistent with this overarching principle to support the state's decision not to require additional control measures for the selected sources. The state continues to stand behind this decision, however, it is important to address the FLMs comments as thoroughly as possible to show that Indiana has seriously evaluated the selected sources in accordance with the RH Rule and section 169A(g)(1) of the CAA which lists four factors that must be taken into consideration in determining reasonable progress.

Please forward the information requests to me by close of business August 17, 2021 and if either one of you have any questions about the FLMs comments or would like to discuss any of them with us, we would be happy to make ourselves available. Thank you, in advance, for your cooperation and assistance.

*Jean Boling*

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**CERTIFIED MAIL**  
**RETURN RECEIPT REQUESTED**

August 17, 2021

Jean Boling, Senior Environmental Engineer  
Indiana Department of Environmental Management  
Office of Air Quality, Air Programs Branch  
100 North Senate Avenue, MC 61-53 IGCN 1003  
Indianapolis, IN 46204-2251

**Re: Response to Four-Factor Analysis Comments dated July 9 and 29, 2021**

Ms. Boling:

On September 30, 2020, the Cleveland-Cliffs Burns Harbor facility (Burns Harbor) submitted a Regional Haze Four-Factor Analysis (FFA) report in response to a request from the Indiana Department of Environmental Management (IDEM). Burns Harbor understands that the FFA report, along with FFA reports from other Indiana facilities, is being used by IDEM to inform decisions for the Regional Haze State Implementation Plan (SIP) regarding what emission reductions are necessary to make reasonable progress towards achieving natural visibility in Class I areas by 2064.

This letter is in response to your emails dated July 9 and 29, 2021, requesting input to respond to comments received from the Federal Land Managers (FLMs) regarding the facility's FFA report. The information below is being provided to addresses these comments.

**Comment 1 – Purchased Equipment Costs for Spray Dryer Absorber (SDA)**

The FLMs requested additional information regarding the control cost calculations for the installation of a SDA and for additional detail on how the control costs were adjusted for inflation.

The following steps were completed to calculate the purchased equipment costs for the SDA systems:

1. Calculate the mid-point for capital costs using Table 1a of the USEPA control technology fact sheet<sup>1</sup> referenced in the calculations, for spray dryers installed on combustion sources that are designed to burn less than 2,000 MMBtu/hr. The table references a capital cost range of \$30,000 - \$150,000 per MMBtu so the mid-point is \$90,000 per MMBtu in 2001 dollars.

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<sup>1</sup> USEPA, Air Pollution Control Technology Fact Sheet – Flue Gas Desulfurization.



3. Adjust the installed capital cost from 2001 dollars to 2019 dollars using the Chemical Engineering Plant Cost Index (CEPCI)<sup>2</sup>. Note that the 2020 index was not yet available, so the cost was only adjusted to 2019 dollars. The 2001 CEPCI index was 394.3 and the 2019 CEPCI index was 607.5, so for the Battery No. 1 Underfire Unit the adjusted cost was calculated to be \$64,478,506 ( $\$41,850,000 * 607.5 / 394.3$ ).
4. Calculate the purchased equipment cost by dividing the installed capital cost by 2.7572. This factor was derived using factors from the USEPA Control Cost Manual. For the Battery No. 1 Underfire Unit, the purchased equipment cost was calculated to be \$23,385,502 ( $\$64,478,506 / 2.7572$ ).

This calculation was performed so that the purchased equipment cost could be used with other cost factors from USEPA's Control Cost Manual to better delineate the capital cost categories. This was completed so the reviewer could see an itemized list of the capital expenditure as opposed to seeing a single, all-inclusive cost. However, because USEPA's control cost manual was used to back-calculate the purchased equipment cost and then the same manual was used to itemize the costs, the total capital cost calculated in the control cost evaluation (\$64,282,882) is similar to the total capital cost calculated using the USEPA fact sheet as shown in step 3 above (\$64,478,506).

#### **Comment 2 – Capital Cost Adjustment for Inflation**

The FLM's requested additional information on how the costs from coke oven gas desulfurization plant study were adjusted for inflation. The site-specific cost estimate from the Burns Harbor engineering study is based on 2008 dollars. The CEPCI cost index was initially considered for adjusting the cost to 2019 dollars, but the index did not accurately reflect Chicago-area trends in construction costs. For example, the CEPCI index noted a 4.5% increase in construction labor from 2008 to 2019 but the facility has realized a much higher increase in labor costs. In addition, CEPCI index for 2008 occurred after an increase of 9.5% from 2007 followed by a decrease of 9.3% to 2009, and it is likely that neither of these large swings were considered in the 2008 cost estimate. Therefore, the 2008 cost estimate was adjusted assuming an average inflation rate of 2% per year which is consistent with the average annual change in the CEPCI index from 2006 to 2019. However, we believe that this may be an underestimate of the actual inflation that will be realized if the project were required in the future.

#### **Comment 3 – General Comments Regarding Control Cost Calculations**

The FLMs provided four general comments regarding the control cost calculations. The comments are addressed individually below.

##### **a. Interest Rate**

The FLMs stated that the default prime bank rate should be used for the control cost calculations. Burns Harbor recognizes that the Control Cost Manual states that "*...if firm-specific nominal interest rates are not available, then the bank prime rate can be an appropriate estimate for interest rates....*"<sup>3</sup> The FFA control cost calculations assumed an interest rate of 5.5% which is lower than the Burns Harbor site-specific

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<sup>2</sup> <https://www.chemengonline.com/pci-home>

<sup>3</sup> USEPA, Control Cost Manual – Chapter 2 – Cost Estimation: Concepts and Methodology, 11/2017, page 15.

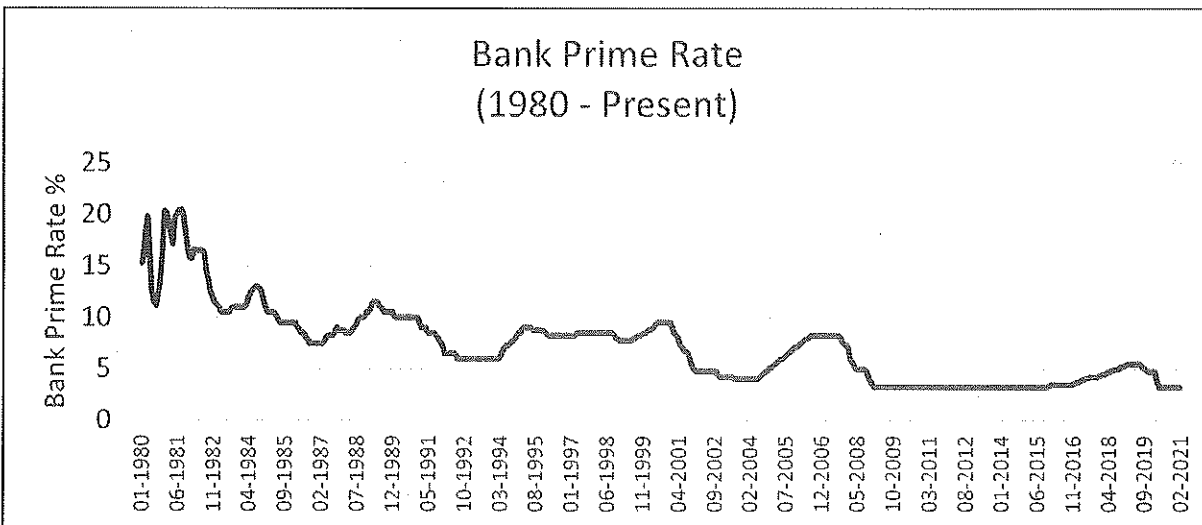




interest rate. However, the exact interest rate for the facility is confidential and, therefore, we are providing the following discussion regarding the use of an interest rate which is greater than today's historically low bank prime rate.

The statement in the previous paragraph from the Control Cost Manual regarding the use of the bank prime rate is specific to analyses for permit applications, and when a permit application is submitted, the construction is likely to commence soon after permit issuance. However, the FFA provided by Burns Harbor was specific to a Regional Haze SIP which, in general, are being developed to require controls by 2028, the end of the second implementation period.

As shown in the figure below, the prime interest rate can frequently change and the current rate of 3.25% is a historic low value. For example, the bank prime rate was at 5.5% as recently as July 2019 and was at 4.75% in February 2020 before dropping to the current 3.25% in April 2020. Although 3.25% may be available today, the historic volatility in the prime interest rate suggests that this value may not be available when financing an emission reduction project for which startup may not be required until 2028. Based on this volatility, uncertainty, and timeline for installing controls, Burns Harbor is justified in using an interest rate of 5.5% to represent a reasonable estimate for the future financing of a potential emission reduction project for startup by 2028. However, as previously stated, the site-specific interest rate is higher than 5.5% so this value underestimates the cost that would be realized by Burns Harbor if this project were required.



**b. Retrofit Factor**

The FLMs stated *"In the absence of documentation justifying the use of a higher retrofit factor, a value of 1 should be used."*

USEPA's Control Cost Manual states *"Unless the original designers had the foresight to include additional floor space and room between components for new equipment, the installation of retrofitted pollution control devices can impose an additional expense to "shoe-horn" the equipment into the right locations. For example, an SCR reactor can occupy thousands of square feet and... there is often little room for the reactor*



to fit in the existing space and additional ductwork, fans, and flue gas heaters may be needed to make the system work properly. To quantify the additional costs of installation not directly related to the capital cost of the controls themselves, engineers and cost analysts typically multiply the cost of the system by a retrofit factor."<sup>4</sup> A retrofit factor of 1 (e.g., 0% increase in total capital cost) is typically used for a site that will experience minimal retrofit issues while retrofit factors of 1.5 (e.g., 50% increase in total capital cost) and 1.6 (e.g., 60% increase in total capital cost) have been used for cost estimates for pollution control equipment installation at older facilities with limited space to accommodate the design and installation of new equipment.

The coke oven gas desulfurization cost analysis did not use a retrofit factor because the analysis was based on a site-specific study.

All other control cost calculations for Burns Harbor used a retrofit factor of 1 (e.g., 0% increase in total capital cost) as a conservative approach that was used due to the high cost-effectiveness (dollars per ton of potential pollutant removed) that resulted from the control cost calculations. In other words, because the cost-effectiveness was high, the retrofit factor was not further investigated or applied. However, a retrofit factor greater than one may be appropriate for these sources. For example, the sources that were evaluated are older emission units that were not designed to accommodate additional controls such as SDA and dry sorbent injection (DSI). A retrofit factor could be used to account for additional costs that were not otherwise considered in the cost effectiveness calculations. For example, site preparation at the facility will likely incur higher than anticipated costs for demolition and equipment removal. In addition, the detailed design would likely require redesign and relocation of pipe racks, duct work, and other equipment. Furthermore, additional or enhanced structural support may be necessary to accommodate the equipment. As such, a retrofit factor of 1.5, or even 1.6, could be appropriate for these sources. However, as previously stated, because the cost-effectiveness was high, the retrofit factor was not further investigated or applied.

### **c. Equipment Life**

The FLM stated that the control cost calculations should use an equipment life longer than 20 years for flue gas desulfurization (FGD) scrubbers and referenced an April 2021 update to the USEPA Control Cost Manual which stated:

*Equipment useful life: the analyses of costs for spray dry absorbers for the Burns Harbor units assumed a useful life of 20 years. According to the CCM Section 5 Chapter 1, "Acid gas scrubbers are relatively reliable systems that have been demonstrated to be exceedingly durable. In the past, the EPA has generally used equipment life estimates of 20 to 30 years for analyses involving acid gas scrubbers, although these estimates are recognized to be low for many installations. Many FGD systems installed in the 1970s and 1980s have operated for more than 30 years (e.g., Coyote Station; H.L. Spurlock Unit 2 in Maysville, KY; East Bend Unit 2 in Union, KY; and Laramie River Unit 3 in Wheatland, WY) and some*

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<sup>4</sup> USEPA, Control Cost Manual – Chapter 2 – Cost Estimation: Concepts and Methodology, 11/2017, page 27.



*scrubbers may have lifetimes that are much longer." Accordingly, a useful life greater than 20 years is appropriate for spray dry absorbers.<sup>5</sup>*

The facilities referenced by EPA in the Control Cost Manual are large coal-fired electric generating units (EGU) which comprise a vast majority of the FGD unit installations and operations in the United States. However, the sources in the Burns Harbor FFA report do not fire coal and are not large EGUs. Rather, this analysis evaluated FGD on coke battery underfire units and boilers which burn a variety of gaseous fuels. The sources will have different flue gas characteristics as well as design and operating challenges, which were likely not considered by USEPA when developing the updated information in the Control Cost Manual. As such, the general statement by USEPA that the equipment life for a FGD unit should be 30 years may not be appropriate for this application.

The conceptual design for the FGD systems in the Burns Harbor FFA report use fabric filters to remove the sorbent from the flue gas and USEPA has provided a different equipment life for this type of control equipment (emphasis added):

*The Manual methodology treats bags and bag replacement labor as an investment amortized over the useful life of the bags, while the rest of the control system is amortized over its useful life, typically 20 years.<sup>6</sup>*

*For fabric filters, the system lifetime varies from 5 to 40 years, with 20 years being typical.<sup>7</sup>*

Since the FGD systems that were considered use fabric filters, and because fabric filters are the major portion of the capital cost for these systems, a 20-year equipment life is appropriate for these control cost calculations.

#### **d. The use of an Indiana sales tax for purchased equipment**

The FLMS state that sales tax should not be included in the control cost calculations based on Indiana Code Title 6. Taxation § 6-2.5-5-30 which states that "Sales of tangible personal property are exempt from the state gross retail tax if... the property constitutes, is incorporated into, or is consumed in the operation of, a device, facility, or structure predominantly used and acquired for the purpose of complying with any state, local, or federal environmental quality statutes, regulations, or standards." Thus, the control cost calculations which calculated the sales tax have been updated with the Indiana sale tax line item removed. The updated calculations are attached. Please note that the Coke Oven Gas Desulfurization study did not consider sales tax and, therefore, this cost was not adjusted.

#### **Comment 4 – Cost Effectiveness Threshold**

The FLMS stated that IDEM should consider the application of a universal cost effectiveness threshold of \$4,000 - \$10,000 per ton used by other states. The use of a universal cost effectiveness threshold on a state-by-state basis allows for a comparison of facilities across multiple geographies and potentially assist

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<sup>5</sup> USEPA, Control Cost Manual – Section 5 – SO<sub>2</sub> and Acid Gas Controls, Chapter 1 – Wet and Dry Scrubbers for Acid Gas Control, 04/2021, page 1-8.

<sup>6</sup> USEPA, Control Cost Manual – Section 6 – Particulate Controls, Chapter 1 – Baghouses and Filters, 12/1998, page 1-49.

<sup>7</sup> USEPA, Control Cost Manual – Section 6 – Particulate Controls, Chapter 1 – Baghouses and Filters, 12/1998, page 1-48.



FLMs that are attempting to make arguments that a universal set of controls (similar to RACT or BACT) are necessary at this time for nearly all sources. However, the ultimate goal of the Regional Haze Rule is to achieve natural visibility, as defined within the rule, in all Class I areas by 2064. Each state is required to consider the specifics of overall impact on visibility in nearby Class I areas and use that to identify individual sources to evaluate further via Q/d<sup>8</sup>, trajectory analyses, regional photochemical analyses, etc. Therefore, a universal cost effectiveness threshold should not be used independent of these other considerations. The decision regarding which controls to consider as part of each state's reasonable progress plan would need to include a wholistic evaluation of all the factors including the visibility impact of sources in that state.

The Regional Haze Rule was written to work toward the 2064 natural visibility goal by requiring states to submit periodic revisions to the Regional Haze SIP to demonstrate how they will make reasonable progress towards this goal. It is important to note that the rule requires "reasonable progress" towards the goal and does not require a state to make the maximum amount of progress immediately nor allow a state to wait to make progress later.

The four closest Class I areas and the distance from our facility are:

- Mammoth Cave National Park – Kentucky (492 km)
- Seney National Wildlife Refuge – Michigan (511 km)
- Mingo National Wildlife Refuge – Missouri (568 km)
- Isle Royale National Park – Michigan (708 km)

As shown in Section 6.1 of our FFA report, each of these Class I areas have shown significant improvement in visibility and modeling shows they are projected to be below uniform rate of progress glidepaths in 2028. It seems logical that each state's decision about reasonable progress would be based on the visibility in nearby Class I areas and the potential impact of evaluated controls on impairment. For example, if a Class I area visibility issue has a very large impact from nitrates and limited impact from sulfates, and the visibility is already projected to be below the glidepath in 2028, then additional SO<sub>2</sub> control measures considered in this round of regional haze planning are likely unnecessary for reasonable progress. Each state's decision about what control measures to implement needs to consider the overall impact of those measures on downwind Class I area visibility along with the other planned measures that will impact each Class I area.

The Regional Haze Rule also requires that each state develop a "long term strategy" that considers emission reductions from all sources, including other air pollution control programs and planned source retirements and replacements.<sup>9</sup> As shown in Section 6.2 of our FFA report, there have already been substantial decreases in haze-causing pollutants, both nationally, regionally, and within Indiana. In addition, there are specific emission reductions that are planned prior to 2028 which will further improve

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<sup>8</sup> A Q/d analysis is sometimes used as a surrogate for source visibility impacts; this ratio is calculated by dividing the emissions (tons/year) by distance to an affected Class I area (kilometers).

<sup>9</sup> 40 CFR 51.305(2)(iv)





the visibility in the nearest Class I areas. Thus, Indiana's long-term strategy and associated reasonable progress goals must take these other emission reductions into consideration.

We recognize that the Regional Haze Rule requires the state to require selected sources to conduct an FFA and that the state must consider these analyses when setting their reasonable progress goal. However, IDEM should use the current trends of visibility improvement and the documented future emission reductions to demonstrate reasonable progress. Thus, IDEM should not impose a simple cost effectiveness threshold for the purpose of defining which control measures are necessary because overall visibility impairment to downwind Class I areas from Indiana sources (like Burns Harbor) are not necessary to meet the reasonable progress goals.

We believe that it is also important to repeat the conclusion in our FFA report that, independent of the four-factor analysis, any installation of additional emission control measures at Burns Harbor is not expected to have a perceptible impact on visibility in affected Class I areas and that no further visibility improvements are necessary to meet the 2028 uniform rate of progress.

Thank you for providing us the opportunity to provide this information to support IDEM's response to the comments from the FLMs. Please let us know if you need any additional information or would like to discuss this submittal in more detail.

Sincerely,



Thomas Maicher  
Manager, Environmental Department

Attachments:

- Updated control cost calculations



## **Appendix C.1**

### **Battery No. 1 Underfire**



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.1 – Table C.1-1: Cost Summary**  
**Battery No. 1 Underfire**  
**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	167.5	1507.4	\$60,778,920	\$9,062,592	\$6,012



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.1 – Table C.1-2: Summary of Utility, Chemical and Supply Costs  
Battery No. 1 Underfire

Operating Unit: Battery No. 1 Underfire Study Year: 2020  
Emission Unit Number  
Stack/Vent Number

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	68 \$/hr		60	2016	EPA SCR Control Cost Manual Spreadsheet	Assumed to be equivalent to operating labor
Maintenance Labor	68 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	68 \$/hr					
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.16 \$/kscf				2014-2018 EIA Average prices for the industrial sector in Indiana (latest available 8-20-2020)	
Compressed Air	0.48 \$/kscf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies					Taconite FIP Docket - Cost estimate for United Taconite	
Lime	163.68 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Irona	285.00 \$/ton			2020	Reagent cost for Irona from another Barr Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		160	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other	0%				Pollution control projects exempted from sales tax	
Sales Tax						
Interest Rate	5.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	63.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip cost (\$)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	465.0 MMbtU/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	385 Deg F				Performance test data	
Moisture Content	14.4%				Performance test data	
Actual Flow Rate	177,000 scfm				Performance test data	
Standardized Flow Rate	110,599 scfm @ 68° F		103,058 scfm @ 32° F		Calculated Value	
Dry Std Flow Rate	93,000 dscfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
Baseline Emissions						
	Lb/hr	Ton/Year	lb/hr	ton/year	lb/mmBtu	
Pollutant			ppmv	ppmv		
Nitrous Oxides (NO <sub>x</sub> )	611.0	3,552.0	1218	1218.1		Emission inventory data
Sulfur Dioxides (SO <sub>2</sub> )	382.4	1,874.9	412	411.9		Emission inventory data
SDA - SO <sub>2</sub> Control Efficiency	90%				EPA Test sheet for flue gas desulfurization (new installations) <a href="https://www3.epa.gov/tncat1/d1/r1/fdg.pdf">https://www3.epa.gov/tncat1/d1/r1/fdg.pdf</a>	





ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.1 – Table C.1-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Battery No. 1 Underfire  
Operating Unit: Battery No. 1 Underfire

Emission Unit Number	0		Stack/Vent Number	0
Design Capacity	465	MMBtu/hr	Standardized Flow Rate	103,058 scfm @ 32° F
Utilization Rate	100%		Temperature	385 Deg F
Annual Operating Hours	8,760	Hours	Moisture Content	14.4%
Annual Interest Rate	5.5%		Actual Flow Rate	177,000 acfm
Equipment Life	20	yrs	Standardized Flow Rate	110,599 scfm @ 68° F
			Dry Std Flow Rate	93,000 dscfm @ 68° F

CONTROL EQUIPMENT COSTS

Capital Costs							
Direct Capital Costs							
Purchased Equipment (A)							23,385,502
Purchased Equipment Total (B)	15%	of control device cost (A)					26,893,327
Installation - Standard Costs	74%	of purchased equip cost (B)					19,901,062
Installation - Site Specific Costs							NA
Installation Total							19,901,062
Total Direct Capital Cost, DC							46,794,390
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)					13,984,530
Total Capital Investment (TCI) = DC + IC							60,778,920
Adjusted TCI for Replacement Parts							60,594,532
TCI with Retrofit Factor							60,594,532
Operating Costs							
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.					1,309,176
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost					7,753,416
Total Annual Cost (Annualized Capital Cost + Operating Cost)							9,062,592

Emission Control Cost Calculation

Pollutant	Max Emis Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Emis T/yr	Reduction T/yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		1,674.9	90%			167.5	1,507.4	6,012
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

Notes & Assumptions

- Capital cost estimate based on mid-range of EPA spray dry fact sheet \$/(MMBtu/hr): <https://www3.epa.gov/tncalc1/dir1/fldg.pdf>
- Costs scaled up to design airflow using the 6/10 power law
- Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 5 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NOX and SO2 Emission Controls**  
**Appendix C.1 – Table C.1-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Battery No. 1 Underfire**

**CAPITAL COSTS**

**Direct Capital Costs**

<b>Purchased Equipment (A)<sup>(1)</sup></b>		<b>23,385,502</b>
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	2,338,550
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,169,275
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>26,893,327</b>

**Installation**

Foundations & supports	4% of purchased equip cost (B)	1,075,733
Handling & erection	50% of purchased equip cost (B)	13,446,664
Electrical	8% of purchased equip cost (B)	2,151,466
Piping	1% of purchased equip cost (B)	268,933
Insulation	7% of purchased equip cost (B)	1,882,533
Painting	4% of purchased equip cost (B)	1,075,733
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>19,901,062</b>

**Other Specific Costs (see summary)**

Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-

**Total Site Specific Costs**

Installation Total	NA	19,901,062
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**Total Direct Capital Cost, DC**

**Indirect Capital Costs**

Engineering, supervision	10% of purchased equip cost (B)	2,689,333
Construction & field expenses	20% of purchased equip cost (B)	5,378,665
Contractor fees	10% of purchased equip cost (B)	2,689,333
Start-up	1% of purchased equip cost (B)	268,933
Performance test	1% of purchased equip cost (B)	268,933
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	2,689,333
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>13,984,530</b>

**Total Capital Investment (TCI) = DC + IC**

**Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost**

<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>60,594,532</b>
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**OPERATING COSTS**

**Direct Annual Operating Costs, DC**

<b>Operating Labor</b>		
Operator	67.53 \$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 320.4 kW-hr, 8760 hr/yr, 100% utilization	204,800
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacf, 8760 hr/yr, 100% utilization	89,565
N/A		-
SW Disposal	63.34 \$/ton, 0.4 ton/hr, 8760 hr/yr, 100% utilization	212,215
Lime	183.68 \$/ton, 517.4 lb/hr, 8760 hr/yr, 100% utilization	416,284
Filter Bags	228.02 \$/bag, 704 bags, 8760 hr/yr, 100% utilization	68,344
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,309,176</b>

**Indirect Operating Costs**

Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,211,891
Property tax (1% total capital costs)	1% of total capital costs (TCI)	605,945
Insurance (1% total capital costs)	1% of total capital costs (TCI)	605,945
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	5,138,654
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery cost</b>	<b>7,753,416</b>

**Total Annual Cost (Annualized Capital Cost + Operating Cost)**

		<b>9,062,592</b>
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**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NOX and SO2 Emission Controls**  
**Appendix C.1 – Table C.1-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Battery No. 1 Underfire**

**Capital Recovery Factors**

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0637

**Replacement Parts & Equipment:**

**Filter Bags**

Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	704	
Total Rep Parts Cost	168,542 Cost adjusted for freight & sales tax	
Installation Labor	15,846 10 min per bag	EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4
Total Installed Cost	184,388	
Annualized Cost	68,344	

**Electrical Use**

	Flow scfm	D P in H <sub>2</sub> O	Efficiency	Hp	KW	
Blower, Baghouse	177,900	10.00			2,806,441	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					2,806,441	

**Reagents and Other Operating Costs**

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	517.43 lb/hr Lime
Solid Waste Disposal	3,350 ton/yr GSA unreacted sorbent and reaction byproducts	

**Operating Cost Calculations**

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Unit Cost \$	Unit of Measure	Use Rate	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>											
Op Labor		67.53 \$/hr					2.0 hr/8 hr shift		2,190	\$	147,892 \$/hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Supervisor		15% of Op.							NA	\$	22,184 of Op., 0.0, 8760 hr/yr, 100% utilization
<b>Maintenance</b>											
Maint Labor		67.53 \$/hr					1.0 hr/8 hr shift		1,095	\$	73,946 \$/hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Maint Mtls		100 % of Maintenance Labor							NA	\$	% of Maintenance Labor, 0.0, 8760 hr/yr, 100% utilization
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>											
Electricity		0.073 \$/kwh					320.4 kW-hr		2,806,441	\$	204,800 \$/kwh, 320.4 kW-hr, 8760 hr/yr, 100% utilization
Compressed Air		0.481 \$/kscf					2 scfm/kacfm		186,062	\$	89,565 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Water		5.129 \$/mgal					gpm				\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization
SW Disposal		63.34 \$/ton					0.38 ton/hr		3,350	\$	212,215 \$/ton, 0.4 ton/hr, 8760 hr/yr, 100% utilization
Lime		183.68 \$/ton					517.4 lb/hr		2,266	\$	416,284 \$/ton, 517.4 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags		228.02 \$/bag					704 bags		N/A	\$	68,344 \$/bag, 704 bags, 8760 hr/yr, 100% utilization



## **Appendix C.2**

### **Battery No. 2 Underfire**





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.2 – Table C.2-1: Cost Summary**  
**Battery No. 2 Underfire**  
**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	185.4	1668.4	\$54,897,089	\$8,363,033	\$5,013



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.2 – Table C.2-2: Summary of Utility, Chemical and Supply Costs  
Battery No. 2 Underfire

Operating Unit: Battery No. 2 Underfire Study Year: 2020  
Emission Unit Number  
Stack/Vent Number

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	68 \$/hr		60	2019	EPA SCR Control Cost Manual Spreadsheet	
Maintenance Labor	68 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	68 \$/hr					Assumed to be equivalent to operating labor
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the Industrial sector in Indiana	
Natural Gas	6.15 \$/scf				2014-2018 EIA Average prices for the Industrial sector in Indiana (latest available 8/20/2020)	
Compressed Air	0.49 \$/scf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies						
Lime	183.68 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Irona	285.00 \$/ton			2020	Reagent cost for irona from another Barr Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		160	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other						
Sales Tax	0%				Pollution control projects exempted from sales tax	
Interest Rate	6.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	63.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip cost (B)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	420.0 MMbtu/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	385 Deg F				Performance test data	
Moisture Content	14.4%				Performance test data	
Actual Flow Rate	160,000 scfm				Performance test data	
Standardized Flow Rate	92,978 scfm @ 68° F		93,160	scfm @ 32° F	Calculated Value	
Dry Std Flow Rate	94,000 dscfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
Baseline Emissions						
	Unit/yr	Ton/Year	lb/yr	lb/yr	lb/ton	
Nitrogen Oxides (NOx)	42.5	166.0	63	63.0		Emission inventory data
Sulfur Dioxide (SO <sub>2</sub> )	423.2	1,653.8	451	451.0		Emission inventory data
SOA - SO <sub>2</sub> Control Efficiency	90%				EPA fact sheet for lime gas desulfurization (new installations) <a href="https://www3.epa.gov/tncat1/fst1/fldg.pdf">https://www3.epa.gov/tncat1/fst1/fldg.pdf</a>	



Annualized Rate	1	Value	Standard Deviation	0
Annualized Rate	400	Value	Standard Deviation	93.30
Annualized Rate	600	Value	Standard Deviation	155
Annualized Rate	800	Value	Standard Deviation	166
Annualized Rate	900	Value	Standard Deviation	160.00
Annualized Rate	950	Value	Standard Deviation	160.00
Annualized Rate	975	Value	Standard Deviation	160.00
Annualized Rate	990	Value	Standard Deviation	160.00
Annualized Rate	995	Value	Standard Deviation	160.00
Annualized Rate	999	Value	Standard Deviation	160.00
Annualized Rate	1000	Value	Standard Deviation	160.00

CONTROL EQUIPMENT COSTS			
Control Costs			
Control Equipment Costs			
Control Equipment Costs (1)			21,122,231
Control Equipment Costs (2)	15	Control Equipment Costs (3)	24,250,744
Control Equipment Costs (4)			
Control Equipment Costs (5)	142	Control Equipment Costs (6)	13,127,192
Control Equipment Costs (7)			
Control Equipment Costs (8)			
Control Equipment Costs (9)			
Control Equipment Costs (10)			
Control Equipment Costs (11)	57	Control Equipment Costs (12)	13,539,161
Control Equipment Costs (13)			54,417,612
Control Equipment Costs (14)			54,379,410
Control Equipment Costs (15)			54,379,410
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Control Equipment Costs (100)			

[illegible]

1. Capital cost estimate based on mid-range of EPA spray dry heat treatment (NH<sub>3</sub> dry) <https://www.epa.gov/toxics/heat-treating.pdf>
2. Costs scaled up to design rate using the £10 power law
3. Costs scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
4. Calculations of EPA Air Pollution Control Cost Manual (En 2002, Section Chapter 1)



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NOx and SO2 Emission Controls  
Appendix C.2—Table C.2-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Battery No. 2 Underfire  
CAPITAL COSTS

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		21,122,340
Purchased Equipment Costs (a) – Absorber + packing + auxiliary equipment (b)		21,122,340
Insurance (c)	0% of purchased equipment (a)	-
State Sales Taxes	0.0% of control device cost (a)	0
Permit	0% of control device cost (a)	1,556,410
Purchased Equipment Total (B)	15%	24,220,747
Installation		
Foundations & supports	4% of purchased equipment (B)	971,630
Material & erection	50% of purchased equipment (B)	12,110,374
Contract	5% of purchased equipment (B)	1,211,037
Painting	1% of purchased equipment (B)	242,207
Erection	1% of purchased equipment (B)	242,207
Permitting	4% of purchased equipment (B)	971,630
Installation Subtotal Standard Expenses	74%	17,930,153
Cost Specific Costs (see comments)		
Site Preparation as required	N/A Site Specific	-
Erection as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-
Total Site Specific Costs		0
Installation Total		17,930,153
Total Direct Capital Cost, DC		42,150,900
<b>Indirect Capital Costs</b>		
Engineering & construction	10% of purchased equipment (B)	2,422,075
Construction & field expenses	20% of purchased equipment (B)	4,844,149
Contract fees	10% of purchased equipment (B)	2,422,075
Painting	1% of purchased equipment (B)	242,207
Performance test	1% of purchased equipment (B)	242,207
Miscellaneous	1% of purchased equipment (B)	-
Contingencies	10% of purchased equipment (B)	2,422,075
Total Indirect Capital Costs, IC	20%	12,610,533
Total Capital Investment (TCI) = DC + IC		54,761,433
Adjusted TCI for Replacement Parts (Capital, Filter Bags, etc.) for Capital Recovery Cost		54,761,433
Total Capital Investment (TCI) with Refractive Factor	0%	54,761,433
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
Operating Labor	67.53 \$/hr, 2.0 hr/shift, 8760 hr/yr, 100% utilization	147,232
Supervision	45% of Op. Cost, 3.0 hr/shift, 100% utilization	22,114
Maintenance	67.53 \$/hr, 1.0 hr/shift, 8760 hr/yr, 100% utilization	73,915
Materials & Supplies	100% of maintenance labor costs	73,915
Utilities, Supplies, Replacements & Waste Management	0.00 \$/hr, 2.0 hr/shift, 8760 hr/yr, 100% utilization	155,130
Electricity	0.43 \$/kwh, 2.0 hr/shift, 8760 hr/yr, 100% utilization	75,623
N/A		-
SDA Depreciation	63.34 \$/hr, 0.4 hr/shift, 8760 hr/yr, 100% utilization	224,875
Lube	133.43 \$/hr, 0.2 hr/shift, 8760 hr/yr, 100% utilization	48,416
Filter Bags	228.02 \$/hr, 0.2 hr/shift, 8760 hr/yr, 100% utilization	61,120
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
Total Annual Direct Operating Costs		1,341,442
<b>Indirect Operating Costs</b>		
Overhead	60% of direct labor and material costs	1,070,720
Administration (1% of total capital costs)	1% of total capital costs (TCI)	1,034,668
Property tax (1% of total capital costs)	1% of total capital costs (TCI)	647,304
Insurance (1% of total capital costs)	1% of total capital costs (TCI)	647,304
Capital Recovery	0.1337 for a 20-year equipment life and a 5% interest rate	4,681,155
Total Annual Indirect Operating Costs	Sum of indirect operating costs + capital recovery cost	7,081,151
Total Annual Cost (Annualized Capital Cost + Operating Costs)		8,422,593





Battery No. 2 Underfire

### Capital Recovery Factors

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0832

[illegible]

Equation	Equation	Equation	Equation	Equation
Equation	Equation	Equation	Equation	Equation
Equation	Equation	Equation	Equation	Equation
Equation	Equation	Equation	Equation	Equation

### Reagents and Other Operating Costs

Line Use Rate	1.30 ton/mo CaO/ton/mo SO <sub>2</sub>	572.63 total Line
Solid Waste Disposal	3.303 ton/yr GSA untreated sorbent and reaction byproducts	

### Operating Cost Calculations

[illegible]



## **Appendix C.4**

### **Power Station Boiler No. 7**



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.4 – Table C.4-1: Cost Summary**  
**Power Station Boiler No. 7**

**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	90.1	810.7	\$84,959,780	\$12,368,277	\$15,256
Dry Sorbent Injection (DSI)	70%	270.2	630.5	\$18,886,871	\$5,392,618	\$8,600



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.4 – Table C.4-2: Summary of Utility, Chemical and Supply Costs  
Power Station Boiler No. 7

Operating Unit: Power Station Boiler No. 7 Study Year: 2020  
Emission Unit Number  
Stack/Vent Number

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	68 \$/hr		60	2010	EPA SCR Control Cost Manual Spreadsheet	Assumed to be equivalent to operating labor
Maintenance Labor	68 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	68 \$/hr					
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.15 \$/scf				2014-2018 EIA Average prices for the industrial sector in Indiana (latest available 9/20/2020)	
Compressed Air	0.48 \$/scf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies						
Lime	183.68 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Trona	285.00 \$/ton			2020	Reagent cost for Trona from another Barr Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		180	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other						
Sales Tax	0%				Pollution control projects exempted from sales tax	
Interest Rate	5.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	63.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	18% of purchased equip cost (B)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	650.0 VM8TU/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	462 Deg F				Performance test data	
Moisture Content	10.5%				Performance test data	
Actual Flow Rate	439.516 scfm				Performance test data	
Standardized Flow Rate	231.699 scfm @ 68° F		234.537 scfm @ 92° F		Calculated Value	
Dry Std Flow Rate	221.045 scfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
Pollutant	Baseline Emissions Lb/hr	Top Year	Lb/hr	Long year	Lb/ton	
Stoichiometric (NO <sub>x</sub> )	33.3	146.0	91	21.0		Emission inventory data
Sulfur Dioxide (SO <sub>2</sub> )	205.7	900.8	93	93.2		Emission inventory data
SO <sub>2</sub> - SO <sub>2</sub> Control Efficiency	90%				EPA fact sheet for flue gas desulfurization (new installations) <a href="https://www3.epa.gov/tncat1/d1/r1/fig.pdf">https://www3.epa.gov/tncat1/d1/r1/fig.pdf</a>	
SO <sub>2</sub> - SO <sub>2</sub> Control Efficiency	70%				Control efficiency is based on Trona as injected reagent.	





ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.4 – Table C.4-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Power Station Boiler No. 7  
Operating Unit: Power Station Boiler No. 7

Emission Unit Number	0		Stack/Vent Number	0	
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	234,537	scfm @ 32° F
Utilization Rate	100%		Temperature	462	Deg F
Annual Operating Hours	8,760	Hours	Moisture Content	10.9%	
Annual Interest Rate	5.5%		Actual Flow Rate	439,519	acfm
Equipment Life	20	yrs	Standardized Flow Rate	251,699	scfm @ 68° F
			Dry Std Flow Rate	221,045	dscfm @ 68° F

CONTROL EQUIPMENT COSTS

Capital Costs							
Direct Capital Costs							
Purchased Equipment (A)							32,689,411
Purchased Equipment Total (B)	15%	of control device cost (A)					37,592,823
Installation - Standard Costs	74%	of purchased equip cost (B)					27,818,689
Installation - Site Specific Costs							NA
Installation Total							27,818,689
Total Direct Capital Cost, DC							65,411,512
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)					19,548,268
Total Capital Investment (TCI) = DC + IC							84,959,780
Adjusted TCI for Replacement Parts							84,501,915
TCI with Retrofit Factor							84,501,915
Operating Costs							
Total Annual Direct Operating Costs			Labor, supervision, materials, replacement parts, utilities, etc.				1,556,647
Total Annual Indirect Operating Costs			Sum indirect oper costs + capital recovery cost				10,811,630
Total Annual Cost (Annualized Capital Cost + Operating Cost)							12,368,277

Emission Control Cost Calculation

Pollutant	Max Emis Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Emis T/yr	Reduction T/yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		900.8	90%			90.1	810.7	15,256
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

Notes & Assumptions

- Capital cost estimate based on mid-range of EPA spray dry fact sheet \$/(MMBtu/hr): <https://www3.epa.gov/tncatc1/dir1/ffdg.pdf>
- Costs scaled up to design airflow using the 6/10 power law
- Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.4 – Table C.4-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 7**  
**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		32,689,411
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	3,268,941
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,634,471
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>37,592,823</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	1,503,713
Handling & erection	50% of purchased equip cost (B)	18,796,412
Electrical	6% of purchased equip cost (B)	3,007,426
Piping	1% of purchased equip cost (B)	375,928
Insulation	7% of purchased equip cost (B)	2,631,498
Painting	4% of purchased equip cost (B)	1,503,713
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>27,818,689</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-
<b>Total Site Specific Costs</b>		<b>NA</b>
<b>Installation Total</b>		<b>27,818,689</b>
<b>Total Direct Capital Cost, DC</b>		<b>65,411,512</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	3,759,282
Construction & field expenses	20% of purchased equip cost (B)	7,518,565
Contractor fees	10% of purchased equip cost (B)	3,759,282
Start-up	1% of purchased equip cost (B)	375,928
Performance test	1% of purchased equip cost (B)	375,928
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	3,759,282
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>19,548,268</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>84,959,780</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>84,501,915</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>84,501,915</b>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 795.5 kW-hr, 8760 hr/yr, 100% utilization	508,551
Compressed Air	0.48 \$/scf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	222,405
N/A		-
SW Disposal	63.34 \$/ton, 0.2 ton/hr, 8760 hr/yr, 100% utilization	114,131
Lime	183.68 \$/ton, 278.3 lb/hr, 8760 hr/yr, 100% utilization	223,882
Filter Bags	228.02 \$/bag, 1,748 bags, 8760 hr/yr, 100% utilization	169,710
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,556,647</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,690,038
Property tax (1% total capital costs)	1% of total capital costs (TCI)	845,019
Insurance (1% total capital costs)	1% of total capital costs (TCI)	845,019
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	7,240,773
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery cost</b>	<b>10,811,630</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>12,368,277</b>



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.4 – Table C.4-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Power Station Boiler No. 7

Capital Recovery Factors

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

Replacement Parts & Equipment: Filter Bags

Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	1748	
Total Rep Parts Cost	418,516	Cost adjusted for freight & sales tax
Installation Labor	39,349	10 min per bag
Total Installed Cost	457,865	
Annualized Cost	169,710	

EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4

Electrical Use

	Flow scfm	Q Pin H <sub>2</sub> O	Efficiency	Hp	kW	
Blower, Baghouse	439,519	10.00			6,968,837	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					6,968,837	

Reagents and Other Operating Costs

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	278.28 lb/hr Lime
Solid Waste Disposal	1,802 ton/yr GSA unreacted sorbent and reaction byproducts	

Operating Cost Calculations

Utilization Rate	100%	Annual Operating Hours	8,760				
Item	Unit	Unit of Use	Unit of Measure	Annual Use*	Annual Cost	Comments	
<b>Operating Labor</b>							
Op Labor	67.53 \$/Hr	2.0 hr/8 hr shift		2,190	\$ 147,892	\$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	
Supervisor	15% of Op.			NA	\$ 22,184	of Op., 0.0 , 8760 hr/yr, 100% utilization	
<b>Maintenance</b>							
Maint Labor	67.53 \$/Hr	1.0 hr/8 hr shift		1,095	\$ 73,946	\$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	
Maint Mtl	100 % of Maintenance Labor			NA	\$ 73,946	% of Maintenance Labor, 0.0 , 8760 hr/yr, 100% utilization	
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity	0.073 \$/kwh	795.5 kW-hr		6,968,837	\$ 508,551	\$/kwh, 795.5 kW-hr, 8760 hr/yr, 100% utilization	
Compressed Air	0.481 \$/kscf	2 scfm/kacfm		462,022	\$ 222,405	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	
Water	5.129 \$/mgal	gpm				\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization	
SW Disposal	63.34 \$/ton	0.21 ton/hr		1,802	\$ 114,131	\$/ton, 0.2 ton/hr, 8760 hr/yr, 100% utilization	
Lime	183.68 \$/ton	278.3 lb/hr		1,219	\$ 223,882	\$/ton, 278.3 lb/hr, 8760 hr/yr, 100% utilization	
Filter Bags	228.02 \$/bag	1,748 bags		N/A	\$ 169,710	\$/bag, 1,748 bags, 8760 hr/yr, 100% utilization	



**ArcelorMittal Burns Harbor**

**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**

**Appendix C.4 – Table C.4-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI) with Baghouse**

**Power Station Boiler No. 7**

**Operating Unit:**

**Power Station Boiler No. 7**

Emission Unit Number			Stack/Vent Number		
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	234,537	scfm @ 32° F
Utilization Rate	100%		Exhaust Temperature	462	Deg F
Annual Operating Hours	8,760	hr/yr	Exhaust Moisture Content	10.9%	
Annual Interest Rate	5.50%		Actual Flow Rate	439,519	acfm
Control Equipment Life	20	yrs	Standardized Flow Rate	251,699	scfm @ 68° F
Plant Elevation	610	ft	Dry Std Flow Rate	221,045	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>					
Direct Capital Costs					
Purchased Equipment (A)					7,443,146
Purchased Equipment Total (B)	15%	of control device cost (A)			8,559,618
Installation - Standard Costs	74%	of purchased equip cost (B)			6,334,117
Installation - Site Specific Costs					N/A
Installation Total					6,334,117
Total Direct Capital Cost, DC					14,893,735
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			4,451,001
Total Capital Investment (TCI) = DC + IC					18,886,871
Adjusted TCI for Replacement Parts					18,886,871
Total Capital Investment (TCI) with Retrofit Factor					18,886,871
<b>Operating Costs</b>					
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.			2,696,212
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost			2,696,406
Total Annual Cost (Annualized Capital Cost + Operating Cost)					5,392,618

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual Ton/Yr	Cont Eff %	Cont Emis Ton/Yr	Reduction Ton/Yr	Cont Cost \$/Ton Rem
PM10						
PM2.5						
Total Particulates						
Nitrous Oxides (NO <sub>x</sub> )						
Sulfur Dioxide (SO <sub>2</sub> )	205.66	900.78	70%	270.23	630.55	\$8,600
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )						
Fluorides						
Volatile Organic Compounds (VOC)						
Carbon Monoxide (CO)						
Lead (Pb)						

**Notes & Assumptions**

- 1 Baghouse capital cost estimate based on EPA-R05-OAR-2010-0954-0079, ancillary equipment from other Barr Engineering projects
- 2 Costs scaled up to design airflow using the 6/10 power law
- 3 Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- 4 Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1





# ArcelorMittal Burns Harbor

## Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls

### Appendix C.4 – Table C.4-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI) with Baghouse

#### Power Station Boiler No. 7

##### CAPITAL COSTS

###### Direct Capital Costs

###### Purchased Equipment (A) <sup>(1)</sup>

Purchased Equipment Costs (A) - Injection System + auxiliary equipment, EC		7,443,146
Instrumentation	10% included in vendor estimate	744,315
State Sales Taxes	0.0% of control device cost (A)	-
Freight	5% of control device cost (A)	372,157
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>8,559,618</b>

###### Installation

Foundations & supports	4% of purchased equip cost (B)	342,385
Handling & erection	50% of purchased equip cost (B)	4,279,809
Electrical	8% of purchased equip cost (B)	684,769
Piping	1% of purchased equip cost (B)	85,596
Insulation	7% of purchased equip cost (B)	599,173
Painting	4% included in vendor estimate	342,385
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>6,334,117</b>

###### Other Specific Costs (see summary)

Site Preparation, as required	N/A Site Specific	
Buildings, as required	N/A Site Specific	
Lost Production for Tie-In	N/A Site Specific	

###### Total Site Specific Costs

Installation Total	N/A	
<b>Total Direct Capital Cost, DC</b>		<b>14,893,735</b>

###### Indirect Capital Costs

Engineering, supervision	10% of purchased equip cost (B)	855,962
Construction & field expenses	20% of purchased equip cost (B)	1,711,924
Contractor fees	10% of purchased equip cost (B)	855,962
Start-up	1% of purchased equip cost (B)	85,596
Performance test	1% of purchased equip cost (B)	85,596
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	855,962
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>4,451,001</b>

##### Total Capital Investment (TCI) = DC + IC

19,344,736

##### Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost

18,886,871

##### Total Capital Investment (TCI) with Retrofit Factor 0%

18,886,871

##### OPERATING COSTS

###### Direct Annual Operating Costs, DC

###### Operating Labor

Operator	67.53 \$/Hr	147,892
Supervisor	0.15 of Op Labor	22,184

###### Maintenance

Maintenance Labor	67.53 \$/Hr	73,946
Maintenance Materials	100 % of Maintenance Labor	73,946

###### Utilities, Supplies, Replacements & Waste Management

Electricity	0.07 \$/kwh, 477.3 kW-hr, 8760 hr/yr, 100% utilization	305,131
N/A		-
Compressed Air	0.48 \$/scf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	222,405
N/A		-
Solid Waste Disposal	63.34 \$/ton, 0.5 ton/hr, 8760 hr/yr, 100% utilization	254,653
Trona	285.00 \$/ton, 1,142.6 lb/hr, 8760 hr/yr, 100% utilization	1,426,346
Filter Bags	228.02 \$/bag, 1,748 bags, 8760 hr/yr, 100% utilization	169,710
N/A		-
N/A		-
N/A		-
N/A		-

###### Total Annual Direct Operating Costs

2,696,212

###### Indirect Operating Costs

Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	377,737
Property tax (1% total capital costs)	1% of total capital costs (TCI)	188,869
Insurance (1% total capital costs)	1% of total capital costs (TCI)	188,869
Capital Recovery	0.0837 for a 20-year equipment life and a 5.5% interest rate	1,580,441
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery costs</b>	<b>2,696,406</b>

##### Total Annual Cost (Annualized Capital Cost + Operating Cost)

5,392,618



# ArcelorMittal Burns Harbor

## Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls

### Appendix C.4 – Table C.4-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI) with Baghouse Power Station Boiler No. 7

#### Capital Recovery Factors

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

#### Replacement Parts & Equipment: Filter Bags

Equipment Life	3 years
CRF	0.3707
Rep part cost per unit	228.02 \$/bag
Amount Required	1748 Bags
Total Rep Parts Cost	418,516 Cost adjusted for freight, sales tax, and bag disposal
Installation Labor	39,349 20 min per bag
Total Installed Cost	457,865
Annualized Cost	169,710

#### Electrical Use

	Flow acfm	Δ P in H <sub>2</sub> O	kWh/yr	
Blower	439,519	6.00	4,181,302	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total			4,181,302	

#### Reagent Use & Other Operating Costs

Trona use - 1.5 NSR	205.66 lb/hr SO <sub>2</sub>	1142.63 lb/hr Trona
Solid Waste Disposal	4,021 ton/yr DSI unreacted sorbent and reaction byproducts	

#### Operating Cost Calculations

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>								
Op Labor		67.53 \$/Hr		2.0 hr/8 hr shift		2,190 \$	147,892	\$/Hr, 2.0 hr/8 hr shift, 2,190 hr/yr
Supervisor		15% of Op Labor				NA \$	22,184	% of Operator Costs
<b>Maintenance</b>								
Maint Labor		67.53 \$/Hr		1.0 hr/8 hr shift		1,095 \$	73,946	\$/Hr, 1.0 hr/8 hr shift, 1,095 hr/yr
Maint Mtls		100% of Maintenance Labor				NA \$	73,946	100% of Maintenance Labor
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>								
Electricity		0.073 \$/kwh		477.3 kW-hr		4,181,302 \$	305,131	\$/kwh, 477.3 kW-hr, 8760 hr/yr, 100% utilization
Water				N/A gpm				
Compressed Air		0.481 \$/kscf		2.0 scfm/kacfm		462,022 \$	222,405	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Cooling Water				N/A gpm				
Solid Waste Disposal		63.34 \$/ton		0.5 ton/hr		4,021 \$	254,653	\$/ton, 0.5 ton/hr, 8760 hr/yr, 100% utilization
Trona		285.00 \$/ton		1,142.6 lb/hr		5,005 \$	1,426,346	\$/ton, 1,142.6 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags		228.02 \$/bag		1,748 bags		N/A \$	169,710	\$/bag, 1,748 bags, 8760 hr/yr, 100% utilization



## **Appendix C.5**

### **Power Station Boiler No. 8**



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.5 – Table C.5-1: Cost Summary**  
**Power Station Boiler No. 8**

**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	65.1	585.9	\$84,959,780	\$12,047,323	\$20,561
Dry Sorbent Injection (DSI)	70%	195.3	455.7	\$16,171,047	\$4,396,305	\$9,600





ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.5 – Table C.5-2: Summary of Utility, Chemical and Supply Costs  
Power Station Boiler No. 8

Operating Unit: Power Station Boiler No. 8 Study Year: 2020  
Emission Unit Number:  
Stack/Vent Number:

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	63 \$/hr		60	2016	EPA SCR Control Cost Manual Spreadsheet	
Maintenance Labor	65 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	65 \$/hr					Assumed to be equivalent to operating labor
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.15 \$/scf				2014-2018 EIA Average prices for the industrial sector in Indiana (latest available 8-20-2020)	
Compressed Air	0.48 \$/scf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies					Taconite FIP Docket - Cost estimate for United Taconite	
Lime	183.68 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Trona	285.00 \$/ton			2020	Resident cost for trona from another Barr Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		180	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other						
Sales Tax	0%				Pollution control projects exempted from sales tax	
Interest Rate	5.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	23.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip cost (B)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	500 DWT/MTU/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	415 Deg F				Performance test data	
Moisture Content	12.5%				Performance test data	
Actual Flow Rate	341,000 acfm				Performance test data	
Standardized Flow Rate	205,709 acfm @ 68° F		191,739 acfm @ 32° F		Calculated Value	
Dry Std Flow Rate	175,000 acfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
Pollutant	Baseline Emissions		lb/hr	ton/year	lb/mmBtu	
	Lb/hr	Ton/Year	ppmv	ppmv		
Nitrous Oxides (NO <sub>x</sub> )	43.0	276.0	50			Emission inventory data
Sulfur Dioxides (SO <sub>2</sub> )	148.6	651.0	85			Emission inventory data
SDA - SO <sub>2</sub> Control Efficiency	90%				EPA test sheet for flue gas desulfurization (new installations) <a href="https://www3.epa.gov/tscatc1/d1/r1/dg.pdf">https://www3.epa.gov/tscatc1/d1/r1/dg.pdf</a>	
DSI - SO <sub>2</sub> Control Efficiency	70%				Control efficiency is based on trona as injected reagent	



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.5 – Table C.5-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Power Station Boiler No. 8  
Operating Unit: Power Station Boiler No. 8

Emission Unit Number	0		Stack/Vent Number	0	
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	191,739	scfm @ 32° F
Utilization Rate	100%		Temperature	415	Deg F
Annual Operating Hours	8,760	Hours	Moisture Content	12.8%	
Annual Interest Rate	5.5%		Actual Flow Rate	341,000	acfm
Equipment Life	20	yrs	Standardized Flow Rate	205,769	scfm @ 68° F
			Dry Std Flow Rate	175,000	dscfm @ 68° F

CONTROL EQUIPMENT COSTS

Capital Costs								
Direct Capital Costs								
Purchased Equipment (A)								32,689,411
Purchased Equipment Total (B)	15%	of control device cost (A)						37,592,823
Installation - Standard Costs	74%	of purchased equip cost (B)						27,818,689
Installation - Site Specific Costs								NA
Installation Total								27,818,689
Total Direct Capital Cost, DC								65,411,512
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)						19,548,268
Total Capital Investment (TCI) = DC + IC								84,959,780
Adjusted TCI for Replacement Parts								84,604,547
TCI with Retrofit Factor								84,604,547
Operating Costs								
Total Annual Direct Operating Costs			Labor, supervision, materials, replacement parts, utilities, etc.					1,261,040
Total Annual Indirect Operating Costs			Sum indirect oper costs + capital recovery cost					10,786,283
Total Annual Cost (Annualized Capital Cost + Operating Cost)								12,047,323

Emission Control Cost Calculation

Pollutant	Max Ems Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Ems T/yr	Reduction T/yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		651.0	90%			65.1	585.9	20,561
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

Notes & Assumptions

- Capital cost estimate based on mid-range of EPA spray dry fact sheet \$(/MMBtu/hr): <https://www3.epa.gov/tncatc1/dir1/tfdg.pdf>
- Costs scaled up to design airflow using the 6/10 power law
- Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.5 – Table C.5-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 8**  
**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		32,689,411
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	3,268,941
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,634,471
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>37,592,823</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	1,503,713
Handling & erection	50% of purchased equip cost (B)	18,796,412
Electrical	8% of purchased equip cost (B)	3,007,426
Piping	1% of purchased equip cost (B)	375,928
Insulation	7% of purchased equip cost (B)	2,631,498
Painting	4% of purchased equip cost (B)	1,503,713
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>27,818,689</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-
<b>Total Site Specific Costs</b>		<b>NA</b>
<b>Installation Total</b>		<b>27,818,689</b>
<b>Total Direct Capital Cost, DC</b>		<b>65,411,512</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	3,759,282
Construction & field expenses	20% of purchased equip cost (B)	7,518,565
Contractor fees	10% of purchased equip cost (B)	3,759,282
Start-up	1% of purchased equip cost (B)	375,928
Performance test	1% of purchased equip cost (B)	375,928
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	3,759,282
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>19,548,268</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>84,959,780</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>84,604,547</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>84,604,547</b>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 617.2 kW-hr, 8760 hr/yr, 100% utilization	394,558
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	172,552
N/A		-
SW Disposal	63.34 \$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization	82,486
Lime	183.68 \$/ton, 201.1 lb/hr, 8760 hr/yr, 100% utilization	161,806
Filter Bags	228.02 \$/bag, 1,356 bags, 8760 hr/yr, 100% utilization	131,669
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,261,040</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,692,091
Property tax (1% total capital costs)	1% of total capital costs (TCI)	846,045
Insurance (1% total capital costs)	1% of total capital costs (TCI)	846,045
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	7,211,321
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery cost</b>	<b>10,786,283</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>12,047,323</b>



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.5 – Table C.5-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Power Station Boiler No. 8

Capital Recovery Factors

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

Replacement Parts & Equipment:		Filter Bags
Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	1356	
Total Rep Parts Cost	324,705	Cost adjusted for freight & sales tax
Installation Labor	30,529	10 min per bag
Total Installed Cost	355,234	
Annualized Cost	131,669	

EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4

Electrical Use

	Flow acfm	DP in H <sub>2</sub> O	Efficiency	Hp	kW	
Blower, Baghouse	341,000	10.00			5,406,760	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					5,406,760	

Reagents and Other Operating Costs

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	201.12 lb/hr Lime
Solid Waste Disposal	1,302 ton/yr GSA unreacted sorbent and reaction byproducts	

Operating Cost Calculations

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Unit of Use	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>									
Op Labor		67.53 \$/Hr		2.0 hr/8 hr shift			2,190	\$ 147,892	\$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Supervisor		15% of Op.					NA	\$ 22,184	of Op., 0.0, 8760 hr/yr, 100% utilization
<b>Maintenance</b>									
Maint Labor		67.53 \$/Hr		1.0 hr/8 hr shift			1,095	\$ 73,946	\$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Maint Mills		100 % of Maintenance Labor					NA	\$ 73,946	% of Maintenance Labor, 0.0, 8760 hr/yr, 100% utilization
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>									
Electricity		0.073 \$/kwh		617.2 kW-hr			5,406,760	\$ 394,558	\$/kwh, 617.2 kW-hr, 8760 hr/yr, 100% utilization
Compressed Air		0.481 \$/kscf		2 scfm/kacfm			358,459	\$ 172,552	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Water		5.129 \$/mgal		gpm					\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization
SW Disposal		63.34 \$/ton		0.15 ton/hr			1,302	\$ 82,486	\$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization
Lime		183.68 \$/ton		201.1 lb/hr			881	\$ 161,806	\$/ton, 201.1 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags		228.02 \$/bag		1,356 bags			N/A	\$ 131,669	\$/bag, 1,356 bags, 8760 hr/yr, 100% utilization





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.5 – Table C.5-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 8**

Operating Unit:		Power Station Boiler No. 8			
Emission Unit Number			Stack/Vent Number		
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	191,739	scfm @ 32° F
Utilization Rate	100%		Exhaust Temperature	415	Deg F
Annual Operating Hours	8,760	hr/yr	Exhaust Moisture Content	12.8%	
Annual Interest Rate	5.50%		Actual Flow Rate	341,000	acfm
Control Equipment Life	20	yrs	Standardized Flow Rate	205,769	scfm @ 68° F
Plant Elevation	610	ft	Dry Std Flow Rate	175,000	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>						
Direct Capital Costs						
Purchased Equipment (A)						6,358,707
Purchased Equipment Total (B)	15%	of control device cost (A)				7,312,513
Installation - Standard Costs						
	74%	of purchased equip cost (B)				5,411,260
Installation - Site Specific Costs						
Installation Total						5,411,260
Total Direct Capital Cost, DC						12,723,773
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)				3,802,507
Total Capital Investment (TCI) = DC + IC						16,171,047
Adjusted TCI for Replacement Parts						16,171,047
Total Capital Investment (TCI) with Retrofit Factor						16,171,047
<b>Operating Costs</b>						
Total Annual Direct Operating Costs			Labor, supervision, materials, replacement parts, utilities, etc.			2,073,831
Total Annual Indirect Operating Costs			Sum indirect oper costs + capital recovery cost			2,322,474
Total Annual Cost (Annualized Capital Cost + Operating Cost)						4,396,305

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual Ton/Yr	Cont Eff %	Cont Emis Ton/Yr	Reduction Ton/Yr	Cont Cost \$/Ton Rem
PM10						
PM2.5						
Total Particulates						
Nitrous Oxides (NO <sub>x</sub> )						
Sulfur Dioxide (SO <sub>2</sub> )	148.63	651.02	70%	195.31	455.71	\$9,600
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )						
Fluorides						
Volatile Organic Compounds (VOC)						
Carbon Monoxide (CO)						
Lead (Pb)						

**Notes & Assumptions**

- 1 Baghouse capital cost estimate based on EPA-R05-OAR-2010-0954-0079, ancillary equipment from other Barr Engineering projects
- 2 Costs scaled up to design airflow using the 6/10 power law
- 3 Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- 4 Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.5 – Table C.5-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 8**

**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
<b>Purchased Equipment (A) <sup>(1)</sup></b>		<b>6,358,707</b>
Purchased Equipment Costs (A) - Injection System + auxiliary equipment, EC		
Instrumentation	10% Included in vendor estimate	635,871
State Sales Taxes	0.0% of control device cost (A)	-
Freight	5% of control device cost (A)	317,935
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>7,312,513</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	292,501
Handling & erection	50% of purchased equip cost (B)	3,656,257
Electrical	8% of purchased equip cost (B)	585,001
Piping	1% of purchased equip cost (B)	73,125
Insulation	7% of purchased equip cost (B)	511,876
Painting	4% included in vendor estimate	292,501
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>5,411,260</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	
Buildings, as required	N/A Site Specific	
Lost Production for Tie-In	N/A Site Specific	
<b>Total Site Specific Costs</b>		<b>N/A</b>
<b>Installation Total</b>		<b>5,411,260</b>
<b>Total Direct Capital Cost, DC</b>		<b>12,723,773</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	731,251
Construction & field expenses	20% of purchased equip cost (B)	1,462,503
Contractor fees	10% of purchased equip cost (B)	731,251
Start-up	1% of purchased equip cost (B)	73,125
Performance test	1% of purchased equip cost (B)	73,125
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	731,251
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>3,802,507</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>16,526,280</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>16,171,047</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>16,171,047</b>

**OPERATING COSTS**

<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr	147,892
Supervisor	0.15 of Op Labor	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr	73,946
Maintenance Materials	100 % of Maintenance Labor	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 370.3 kW-hr, 8760 hr/yr, 100% utilization	236,735
N/A		-
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	172,552
N/A		-
Solid Waste Disposal	63.34 \$/ton, 0.3 ton/hr, 8760 hr/yr, 100% utilization	184,045
Trona	285.00 \$/ton, 825.8 lb/hr, 8760 hr/yr, 100% utilization	1,030,862
Filter Bags	228.02 \$/bag, 1,356 bags, 8760 hr/yr, 100% utilization	131,669
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>2,073,831</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	323,421
Property tax (1% total capital costs)	1% of total capital costs (TCI)	161,710
Insurance (1% total capital costs)	1% of total capital costs (TCI)	161,710
Capital Recovery	0.0837 for a 20-year equipment life and a 5.5% interest rate	1,353,182
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery costs</b>	<b>2,322,474</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>4,396,305</b>



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.5 – Table C.5-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 8**

**Capital Recovery Factors**

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

**Replacement Parts & Equipment: Filter Bags**

Equipment Life	3 years
CRF	0.3707
Rep part cost per unit	228.02 \$/bag
Amount Required	1356 Bags
Total Rep Parts Cost	324,705 Cost adjusted for freight, sales tax, and bag disposal
Installation Labor	30,529 20 min per bag
Total Installed Cost	355,234
Annualized Cost	131,669

**Electrical Use**

	Flow acfm	D P in H <sub>2</sub> O	kWh/yr	
Blower	341,000	6.00	3,244,058	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total			3,244,058	

**Reagent Use & Other Operating Costs**

Trona use - 1.5 NSR	148.63 lb/hr SO <sub>2</sub>	825.81 lb/hr Trona
Solid Waste Disposal	2,906 ton/yr DSI unreacted sorbent and reaction byproducts	

**Operating Cost Calculations**

Utilization Rate	100%	Annual Operating Hours	8,760				
Item	Unit Cost \$	Unit of Measure	Use Rate	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>							
Op Labor	67.53 \$/hr		2.0 hr/8 hr shift		2,190	\$ 147,892	\$/hr, 2.0 hr/8 hr shift, 2,190 hr/yr
Supervisor	15% of Op Labor				NA	\$ 22,184	% of Operator Costs
<b>Maintenance</b>							
Maint Labor	67.53 \$/hr		1.0 hr/8 hr shift		1,095	\$ 73,946	\$/hr, 1.0 hr/8 hr shift, 1,095 hr/yr
Maint Mtls	100% of Maintenance Labor				NA	\$ 73,946	100% of Maintenance Labor
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity	0.073 \$/kwh		370.3 kW-hr		3,244,056	\$ 236,735	\$/kwh, 370.3 kW-hr, 8760 hr/yr, 100% utilization
Water			N/A gpm				
Compressed Air	0.481 \$/kscf		2.0 scfm/kacfm		358,459	\$ 172,552	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Cooling Water			N/A gpm				
Solid Waste Disposal	63.34 \$/ton		0.3 ton/hr		2,906	\$ 184,045	\$/ton, 0.3 ton/hr, 8760 hr/yr, 100% utilization
Trona	285.00 \$/ton		825.8 lb/hr		3,617	\$ 1,030,882	\$/ton, 825.8 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags	228.02 \$/bag		1,356 bags		N/A	\$ 131,669	\$/bag, 1,356 bags, 8760 hr/yr, 100% utilization



## **Appendix C.6**

### **Power Station Boiler No. 9**





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.6 – Table C.6-1: Cost Summary**  
**Power Station Boiler No. 9**

**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	52.4	471.8	\$84,959,780	\$11,981,271	\$25,397
Dry Sorbent Injection (DSI)	70%	157.3	366.9	\$15,732,443	\$4,089,556	\$11,100



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.6 – Table C.6-2: Summary of Utility, Chemical and Supply Costs  
Power Station Boiler No. 9

Operating Unit: Power Station Boiler No. 9  
Emission Unit Number:  
Stack/Vent Number:  
Study Year: 2020

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	68 \$/hr		60	2010	EPA SCR Control Cost Manual Spreadsheet	Assumed to be equivalent to operating labor
Maintenance Labor	68 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	68 \$/hr					Assumed to be equivalent to operating labor
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.15 \$/scf				2014-2019 EIA Average prices for the industrial sector in Indiana (latest available 8/20/2020)	
Compressed Air	0.48 \$/scf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies						
Lime	183.66 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Irona	265.00 \$/ton			2020	Reagent cost for Irona from another Barr Engineering Co. Project	
Fabric Filter Bags	226.02 \$/bag		180	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other						
Sales Tax	0%				Pollution control projects exempted from sales tax	
Interest Rate	5.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	63.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip cost (B)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	650.0 MMBTU/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	451 Deg F				Performance test data	
Moisture Content	17.0%				Performance test data	
Actual Flow Rate	333,000 acfm				Performance test data	
Standardized Flow Rate	193,001 scfm @ 68° F		179,842	scfm @ 32° F	Calculated Value	
Dry Std Flow Rate	167,000 scfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level				Plant elevation	
Baseline Emissions						
	Lb/hr	Ton/Year	Lb/hr	ton/year	lb/mmmbtu	
Pollutant						
Filthous Oxides (NO <sub>x</sub> )	42.0	184.0	37	37.3		Emission inventory data
Sulfur Dioxides (SO <sub>2</sub> )	119.7	524.2	76	76.4		Emission inventory data
SDA - SO <sub>2</sub> Control Efficiency	60%				EPA fact sheet for flue gas desulfurization (new installations) <a href="https://www3.epa.gov/tncat1/drl/rlfkg.pdf">https://www3.epa.gov/tncat1/drl/rlfkg.pdf</a>	
DSI - SO <sub>2</sub> Control Efficiency	70%				Labor efficiency is listed on Irona as injected reagent.	



ArcelorMittal Burns Harbor

Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls

Appendix C.6 – Table C.6-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)

Power Station Boiler No. 9

Operating Unit:

Power Station Boiler No. 9

Emission Unit Number	0	Slack/Vent Number	0
Design Capacity	650 MMBtu/hr	Standardized Flow Rate	179,842 scfm @ 32° F
Utilization Rate	100%	Temperature	451 Deg F
Annual Operating Hours	8,760 Hours	Moisture Content	17.0%
Annual Interest Rate	5.5%	Actual Flow Rate	333,000 acfm
Equipment Life	20 yrs	Standardized Flow Rate	193,001 scfm @ 68° F
		Dry Std Flow Rate	157,000 dscfm @ 68° F

CONTROL EQUIPMENT COSTS

Capital Costs								
Direct Capital Costs								
Purchased Equipment (A)								32,689,411
Purchased Equipment Total (B)	15%	of control device cost (A)						37,692,823
Installation - Standard Costs	74%	of purchased equip cost (B)						27,818,689
Installation - Site Specific Costs								NA
Installation Total								27,818,689
Total Direct Capital Cost, DC								65,411,512
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)						19,548,268
Total Capital Investment (TCI) = DC + IC								84,959,780
Adjusted TCI for Replacement Parts								84,612,880
TCI with Retrofit Factor								84,612,880
Operating Costs								
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.						1,197,046
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost						10,784,225
Total Annual Cost (Annualized Capital Cost + Operating Cost)								11,981,271

Emission Control Cost Calculation

Pollutant	Max Emis Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Emis T/Yr	Reduction T/Yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		524.2	90%			52.4	471.8	25,397
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

Notes & Assumptions

- Capital cost estimate based on mid-range of EPA spray dry fact sheet \$/(MMBtu/hr): <https://www3.epa.gov/tncatc1/dir1/fldg.pdf>
- Costs scaled up to design airflow using the 6/10 power law
- Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**

**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**

**Appendix C.6 – Table C.6-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**

**Power Station Boiler No. 9**

**CAPITAL COSTS**

**Direct Capital Costs**

<b>Purchased Equipment (A) <sup>(1)</sup></b>		<b>32,689,411</b>
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	3,268,941
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,634,471
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>37,592,823</b>

**Installation**

Foundations & supports	4% of purchased equip cost (B)	1,503,713
Handling & erection	50% of purchased equip cost (B)	18,796,412
Electrical	8% of purchased equip cost (B)	3,007,426
Piping	1% of purchased equip cost (B)	375,928
Insulation	7% of purchased equip cost (B)	2,631,498
Painting	4% of purchased equip cost (B)	1,503,713
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>27,818,689</b>

**Other Specific Costs (see summary)**

Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-

<b>Total Site Specific Costs</b>	<b>NA</b>
<b>Installation Total</b>	<b>27,818,689</b>
<b>Total Direct Capital Cost, DC</b>	<b>65,411,512</b>

**Indirect Capital Costs**

Engineering, supervision	10% of purchased equip cost (B)	3,759,282
Construction & field expenses	20% of purchased equip cost (B)	7,518,565
Contractor fees	10% of purchased equip cost (B)	3,759,282
Start-up	1% of purchased equip cost (B)	375,928
Performance test	1% of purchased equip cost (B)	375,928
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	3,759,282
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>19,548,268</b>

<b>Total Capital Investment (TCI) = DC + IC</b>	<b>84,959,780</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>	<b>84,612,880</b>

<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>84,612,880</b>
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**OPERATING COSTS**

**Direct Annual Operating Costs, DC**

<b>Operating Labor</b>		
Operator	67.53 \$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 602.7 kW-hr, 8760 hr/yr, 100% utilization	385,302
Compressed Air	0.48 \$/scf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	168,504
N/A		-
SW Disposal	63.34 \$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization	66,414
Lime	183.68 \$/ton, 161.9 lb/hr, 8760 hr/yr, 100% utilization	130,279
Filter Bags	228.02 \$/bag, 1,324 bags, 8760 hr/yr, 100% utilization	128,580
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,197,046</b>

**Indirect Operating Costs**

Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,692,258
Property tax (1% total capital costs)	1% of total capital costs (TCI)	846,129
Insurance (1% total capital costs)	1% of total capital costs (TCI)	846,129
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	7,208,929
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery cost</b>	<b>10,784,225</b>

<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>	<b>11,981,271</b>
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ArcelorMittal Burns Harbor

Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls

Appendix C.6 – Table C.6-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)

Power Station Boiler No. 9

Capital Recovery Factors

<b>Primary Installation</b>	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

Replacement Parts & Equipment: Filter Bags

Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	1324	
Total Rep Parts Cost	317,087	Cost adjusted for freight & sales tax
Installation Labor	29,812 10 min per bag	
Total Installed Cost	346,900	
Annualized Cost	128,580	

EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4

Electrical Use

	Flow acfm	D P in H <sub>2</sub> O	Efficiency	Hp	kW	
Blower, Baghouse	333,000	10.00			5,279,915	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					5,279,915	

Reagents and Other Operating Costs

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	161.93 lb/hr Lime
Solid Waste Disposal	1,049 ton/yr GSA unreacted sorbent and reaction byproducts	

Operating Cost Calculations

Item	Utilization Rate	100% Unit Cost \$	Annual Operating Hours	8,760 Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>							
Op Labor		67.53 \$/Hr		2.0 hr/8 hr shift	2,190	\$ 147,892	\$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Supervisor		15% of Op.			NA	\$ 22,184	of Op., 0.0 , 8760 hr/yr, 100% utilization
<b>Maintenance</b>							
Maint Labor		67.53 \$/Hr		1.0 hr/8 hr shift	1,095	\$ 73,946	\$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Maint Mills		100 % of Maintenance Labor			NA	\$ 73,946	% of Maintenance Labor, 0.0 , 8760 hr/yr, 100% utilization
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity		0.073 \$/kwh		602.7 kW-hr	5,279,915	\$ 385,302	\$/kwh, 602.7 kW-hr, 8760 hr/yr, 100% utilization
Compressed Air		0.481 \$/kscf		2 scfm/kacfm	350,050	\$ 168,504	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Water		5.129 \$/mgal		gpm			\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization
SW Disposal		63.34 \$/ton		0.12 ton/hr	1,049	\$ 66,414	\$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization
Lime		183.68 \$/ton		161.9 lb/hr	709	\$ 130,279	\$/ton, 161.9 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags		228.02 \$/bag		1,324 bags	N/A	\$ 128,580	\$/bag, 1,324 bags, 8760 hr/yr, 100% utilization



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.6 – Table C.6-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 9**

Operating Unit:		Power Station Boiler No. 9			
Emission Unit Number			Stack/Vent Number		
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	179,842	scfm @ 32° F
Utilization Rate	100%		Exhaust Temperature	451	Deg F
Annual Operating Hours	8,760	hr/yr	Exhaust Moisture Content	17.0%	
Annual Interest Rate	5.50%		Actual Flow Rate	333,000	acfm
Control Equipment Life	20	yrs	Standardized Flow Rate	193,001	scfm @ 68° F
Plant Elevation	610	ft	Dry Std Flow Rate	157,000	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>					
Direct Capital Costs					
Purchased Equipment (A)					6,186,742
Purchased Equipment Total (B)	15%	of control device cost (A)			7,114,753
Installation - Standard Costs	74%	of purchased equip cost (B)			5,264,918
Installation - Site Specific Costs					N/A
Installation Total					5,264,918
Total Direct Capital Cost, DC					12,379,671
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			3,699,672
Total Capital Investment (TCI) = DC + IC					15,732,443
Adjusted TCI for Replacement Parts					15,732,443
Total Capital Investment (TCI) with Retrofit Factor					15,732,443
<b>Operating Costs</b>					
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.			1,824,418
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost			2,265,138
Total Annual Cost (Annualized Capital Cost + Operating Cost)					4,089,556

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual Ton/Yr	Cont Eff %	Cont Emis Ton/Yr	Reduction Ton/Yr	Cont Cost \$/Ton Rem
PM10						
PM2.5						
Total Particulates						
Nitrous Oxides (NO <sub>x</sub> )						
Sulfur Dioxide (SO <sub>2</sub> )	119.67	524.17	70%	157.25	366.92	\$11,100
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )						
Fluorides						
Volatile Organic Compounds (VOC)						
Carbon Monoxide (CO)						
Lead (Pb)						

**Notes & Assumptions**

- 1 Baghouse capital cost estimate based on EPA-R05-OAR-2010-0954-0079, ancillary equipment from other Barr Engineering projects
- 2 Costs scaled up to design airflow using the 6/10 power law
- 3 Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- 4 Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.6 – Table C.6-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 9**

**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		6,186,742
Purchased Equipment Costs (A) - Injection System + auxiliary equipment, EC		
Instrumentation	10% included in vendor estimate	618,674
State Sales Taxes	0.0% of control device cost (A)	-
Freight	5% of control device cost (A)	309,337
Purchased Equipment Total (B)	15%	<u>7,114,753</u>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	284,590
Handling & erection	50% of purchased equip cost (B)	3,557,377
Electrical	8% of purchased equip cost (B)	569,180
Piping	1% of purchased equip cost (B)	71,148
Insulation	7% of purchased equip cost (B)	498,033
Painting	4% included in vendor estimate	284,590
Installation Subtotal Standard Expenses	74%	<u>5,264,918</u>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	
Buildings, as required	N/A Site Specific	
Lost Production for Tie-In	N/A Site Specific	
Total Site Specific Costs		N/A
Installation Total		<u>5,264,918</u>
Total Direct Capital Cost, DC		<u>12,379,671</u>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	711,475
Construction & field expenses	20% of purchased equip cost (B)	1,422,951
Contractor fees	10% of purchased equip cost (B)	711,475
Start-up	1% of purchased equip cost (B)	71,148
Performance test	1% of purchased equip cost (B)	71,148
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	711,475
Total Indirect Capital Costs, IC	52% of purchased equip cost (B)	<u>3,699,672</u>
Total Capital Investment (TCI) = DC + IC		<u>16,079,343</u>
Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost		<u>15,732,443</u>
Total Capital Investment (TCI) with Retrofit Factor	0%	<u>15,732,443</u>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr	147,892
Supervisor	0.15 of Op Labor	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr	73,946
Maintenance Materials	100 % of Maintenance Labor	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 361.6 kW-hr, 8760 hr/yr, 100% utilization	231,181
N/A		-
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	168,504
N/A		-
Solid Waste Disposal	63.34 \$/ton, 0.3 ton/hr, 8760 hr/yr, 100% utilization	148,184
Trona	285.00 \$/ton, 664.9 lb/hr, 8760 hr/yr, 100% utilization	830,001
Filter Bags	228.02 \$/bag, 1,324 bags, 8760 hr/yr, 100% utilization	128,580
N/A		-
N/A		-
N/A		-
N/A		-
Total Annual Direct Operating Costs		<u>1,824,418</u>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	314,649
Property tax (1% total capital costs)	1% of total capital costs (TCI)	157,324
Insurance (1% total capital costs)	1% of total capital costs (TCI)	157,324
Capital Recovery	0.0837 for a 20-year equipment life and a 5.5% interest rate	1,316,480
Total Annual Indirect Operating Costs	Sum indirect oper costs + capital recovery costs	<u>2,265,138</u>
Total Annual Cost (Annualized Capital Cost + Operating Cost)		<u>4,089,556</u>



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.6 – Table C.6-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)  
Power Station Boiler No. 9

Capital Recovery Factors

<b>Primary Installation</b>	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

Replacement Parts & Equipment: Filter Bags

Equipment Life	3 years
CRF	0.3707
Rep part cost per unit	228.02 \$/bag
Amount Required	1324 Bags
Total Rep Parts Cost	317,087 Cost adjusted for freight, sales tax, and bag disposal
Installation Labor	29,812 20 min per bag
Total Installed Cost	346,900
Annualized Cost	128,580

Electrical Use

	Flow acfm	DP in H <sub>2</sub> O	kWh/yr	
Blower	333,000	6.00	3,167,949	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total			3,167,949	

Reagent Use & Other Operating Costs

Trona use - 1.5 NSR	119.87 lb/hr SO <sub>2</sub>	664.90 lb/hr Trona
Solid Waste Disposal	2,340 ton/yr DSI unreacted sorbent and reaction byproducts	

Operating Cost Calculations

Utilization Rate	100%	Annual Operating Hours	8,760				
Item	Unit Cost \$	Unit of Measure	Use Rate	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>							
Op Labor	67.53 \$/Hr		2.0 hr/8 hr shift		2,190 \$	147,892 \$/Hr, 2.0 hr/8 hr shift, 2,190 hr/yr	
Supervisor	15% of Op Labor				NA \$	22,184 % of Operator Costs	
<b>Maintenance</b>							
Maint Labor	67.53 \$/Hr		1.0 hr/8 hr shift		1,095 \$	73,946 \$/Hr, 1.0 hr/8 hr shift, 1,095 hr/yr	
Maint Mtls	100% of Maintenance Labor				NA \$	73,946 100% of Maintenance Labor	
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity	0.073 \$/kwh		361.6 kW-hr		3,167,949 \$	231,181 \$/kwh, 361.6 kW-hr, 8760 hr/yr, 100% utilization	
Water			N/A gpm				
Compressed Air	0.481 \$/kscf		2.0 scfm/kacfm		350,050 \$	168,504 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	
Cooling Water			N/A gpm				
Solid Waste Disposal	63.34 \$/ton		0.3 ton/hr		2,340 \$	148,184 \$/ton, 0.3 ton/hr, 8760 hr/yr, 100% utilization	
Trona	285.00 \$/ton		664.9 lb/hr		2,912 \$	830,001 \$/ton, 664.9 lb/hr, 8760 hr/yr, 100% utilization	
Filter Bags	228.02 \$/bag		1,324 bags		N/A \$	128,580 \$/bag, 1,324 bags, 8760 hr/yr, 100% utilization	





## **Appendix C.7**

### **Power Station Boiler No. 10**



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.7 – Table C.7-1: Cost Summary**  
**Power Station Boiler No. 10**

**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	33.4	300.2	\$84,959,780	\$11,946,645	\$39,796
Dry Sorbent Injection (DSI)	70%	100.1	233.5	\$15,712,806	\$3,762,960	\$16,100



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.7 – Table C.7-2: Summary of Utility, Chemical and Supply Costs  
Power Station Boiler No. 10

Operating Unit: Power Station Boiler No. 10  
Emission Unit Number:  
Stack/Vent Number:  
Study Year: 2020

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	63 \$/hr		60	2016	EPA SCR Control Cost Manual Spreadsheet	Assumed to be equivalent to operating labor
Maintenance Labor	69 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	69 \$/hr					
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.15 \$/scf				2014-2019 EIA Average prices for the industrial sector in Indiana (latest available 8/20/2020)	
Compressed Air	0.48 \$/scf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies					Taconite FIP Docket - Cost estimate for United Taconite	
Lime	163.69 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Trona	265.00 \$/ton			2020	Reagent cost for Trona from another Barr Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		100	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other	0%					
Sales Tax					Pollution control projects exempted from sales tax	
Interest Rate	5.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	63.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip cost (\$)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 hours				Emission inventory data	
Utilization Rate	100%				Assumed	
Design Capacity	650.0 MMbtu/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	432 Deg F				Performance test data	
Moisture Content	13.7%				Performance test data	
Actual Flow Rate	349,000 acfm				Performance test data	
Standardized Flow Rate	238,583 scfm @ 68° F		192,498 scfm @ 32° F		Calculated Value	
Dry Std Flow Rate	174,000 scfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
	Baseline Emissions		lb/hr	lb/year		
	Lb/hr	Ton/Year	ppmv	ppmv	lb/MMBtu	
Pollutant						
Nitrous Oxides (NO <sub>x</sub> )	38.8	170.0	51	31.1		Emission inventory data
Sulfur Dioxides (SO <sub>2</sub> )	76.2	333.6	44	43.8		Emission inventory data
SDA - SO <sub>2</sub> Control Efficiency	90%				EPA test sheet for flue gas desulfurization (new installations) <a href="https://www3.epa.gov/tncat1/d11/fhg.pdf">https://www3.epa.gov/tncat1/d11/fhg.pdf</a>	
DSI - SO <sub>2</sub> Control Efficiency	70%				Control efficiency is based on trona as wetted reagent.	



ArcelorMittal Burns Harbor

Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls

Appendix C.7 – Table C.7-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)

Power Station Boiler No. 10

Operating Unit:

Power Station Boiler No. 10

Emission Unit Number	0	Stack/Vent Number	0
Design Capacity	650 MMBtu/hr	Standardized Flow Rate	192,498 scfm @ 32° F
Utilization Rate	100%	Temperature	432 Deg F
Annual Operating Hours	8,760 Hours	Moisture Content	13.7%
Annual Interest Rate	5.5%	Actual Flow Rate	349,000 acfm
Equipment Life	20 yrs	Standardized Flow Rate	205,583 scfm @ 68° F
		Dry Std Flow Rate	174,000 dscfm @ 68° F

CONTROL EQUIPMENT COSTS

Capital Costs								
Direct Capital Costs								
Purchased Equipment (A)								32,689,411
Purchased Equipment Total (B)	15%	of control device cost (A)						37,592,823
Installation - Standard Costs	74%	of purchased equip cost (B)						27,818,689
Installation - Site Specific Costs								NA
Installation Total								27,818,689
Total Direct Capital Cost, DC								65,411,512
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)						19,548,268
Total Capital Investment (TCI) = DC + IC								84,959,780
Adjusted TCI for Replacement Parts								84,596,213
TCI with Retrofit Factor								84,596,213
Operating Costs								
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.						1,158,304
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost						10,788,341
Total Annual Cost (Annualized Capital Cost + Operating Cost)								11,946,645

Emission Control Cost Calculation

Pollutant	Max Emis Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Emis T/yr	Reduction T/yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		333.6	90%			33.4	300.2	39,796
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

Notes & Assumptions

- 1 Capital cost estimate based on mid-range of EPA spray dry fact sheet \$(/MMBtu/hr): <https://www3.epa.gov/ttn/catc1/dir1/fddg.pdf>
- 2 Costs scaled up to design airflow using the 6/10 power law
- 3 Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- 4 Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.7 – Table C.7-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 10**  
**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		32,689,411
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	3,268,941
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,634,471
Purchased Equipment Total (B)	15%	<u>37,592,823</u>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	1,503,713
Handling & erection	50% of purchased equip cost (B)	18,796,412
Electrical	8% of purchased equip cost (B)	3,007,426
Piping	1% of purchased equip cost (B)	375,928
Insulation	7% of purchased equip cost (B)	2,631,498
Painting	4% of purchased equip cost (B)	1,503,713
Installation Subtotal Standard Expenses	74%	<u>27,818,689</u>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-
<b>Total Site Specific Costs</b>		
Installation Total		<u>NA</u>
Total Direct Capital Cost, DC		<u>65,411,512</u>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	3,759,282
Construction & field expenses	20% of purchased equip cost (B)	7,518,565
Contractor fees	10% of purchased equip cost (B)	3,759,282
Start-up	1% of purchased equip cost (B)	375,928
Performance test	1% of purchased equip cost (B)	375,928
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	3,759,282
Total Indirect Capital Costs, IC	52% of purchased equip cost (B)	<u>19,548,268</u>
<b>Total Capital Investment (TCI) = DC + IC</b>		
Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost		<u>84,959,780</u>
		<u>84,956,213</u>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>		
	0%	<u>84,956,213</u>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 631.7 kW-hr, 8760 hr/yr, 100% utilization	403,815
Compressed Air	0.48 \$/scf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	176,601
N/A		-
SW Disposal	63.34 \$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization	42,262
Lime	183.68 \$/ton, 103.0 lb/hr, 8760 hr/yr, 100% utilization	82,901
Filter Bags	228.02 \$/bag, 1,388 bags, 8760 hr/yr, 100% utilization	134,758
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
Total Annual Direct Operating Costs		<u>1,158,304</u>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,691,924
Property tax (1% total capital costs)	1% of total capital costs (TCI)	845,962
Insurance (1% total capital costs)	1% of total capital costs (TCI)	845,962
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	7,213,712
Total Annual Indirect Operating Costs	Sum indirect oper costs + capital recovery cost	<u>10,788,341</u>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		
		<u>11,946,645</u>



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.7 – Table C.7-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Power Station Boiler No. 10

Capital Recovery Factors

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

Replacement Parts & Equipment:

Filter Bags

Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	1388	
Total Rep Parts Cost	332,323	Cost adjusted for freight & sales tax
Installation Labor	31,245	10 min per bag
Total Installed Cost	363,568	
Annualized Cost	134,758	

EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4

Electrical Use

	Flow acfm	DP in H <sub>2</sub> O	Efficiency	Hp	kW	
Blower, Baghouse	349,000	10.00			5,533,604	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					5,533,604	

Reagents and Other Operating Costs

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	103.04 lb/hr Lime
Solid Waste Disposal	667 ton/yr	GSA unreacted sorbent and reaction byproducts

Operating Cost Calculations

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Annual Use*	Annual Cost	Comments
		Unit Cost \$	Unit of Measure	Use Rate	Unit of Measure		
Operating Labor							
Op Labor		67.53 \$/Hr		2.0 hr/8 hr shift	2,190	\$ 147,892	\$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Supervisor		15% of Op.			NA	\$ 22,184	of Op., 0.0, 8760 hr/yr, 100% utilization
Maintenance							
Maint Labor		67.53 \$/Hr		1.0 hr/8 hr shift	1,095	\$ 73,946	\$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Maint Mtls		100 % of Maintenance Labor			NA	\$ 73,946	% of Maintenance Labor, 0.0, 8760 hr/yr, 100% utilization
Utilities, Supplies, Replacements & Waste Management							
Electricity		0.073 \$/kwh		631.7 kW-hr	5,533,604	\$ 403,815	\$/kwh, 631.7 kW-hr, 8760 hr/yr, 100% utilization
Compressed Air		0.481 \$/kscf		2 scfm/kacfm	366,869	\$ 176,601	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Water		5.129 \$/mgal		gpm			\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization
SW Disposal		63.34 \$/ton		0.08 ton/hr	667	\$ 42,262	\$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization
Lime		183.68 \$/ton		103.0 lb/hr	451	\$ 82,901	\$/ton, 103.0 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags		228.02 \$/bag		1,388 bags	N/A	\$ 134,758	\$/bag, 1,388 bags, 8760 hr/yr, 100% utilization



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.7 – Table C.7-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 10**

**Operating Unit:**

**Power Station Boiler No. 10**

Emission Unit Number			Stack/Vent Number		
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	192,498	scfm @ 32° F
Utilization Rate	100%		Exhaust Temperature	432	Deg F
Annual Operating Hours	8,760	hr/yr	Exhaust Moisture Content	13.7%	
Annual Interest Rate	5.50%		Actual Flow Rate	349,000	acfm
Control Equipment Life	20	yrs	Standardized Flow Rate	206,583	scfm @ 68° F
Plant Elevation	610	ft	Dry Std Flow Rate	174,000	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>					
Direct Capital Costs					
Purchased Equipment (A)					6,185,600
Purchased Equipment Total (B)	15%	of control device cost (A)			7,113,440
Installation - Standard Costs	74%	of purchased equip cost (B)			5,263,945
Installation - Site Specific Costs					N/A
Installation Total					5,263,945
Total Direct Capital Cost, DC					12,377,385
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			3,698,989
Total Capital Investment (TCI) = DC + IC					15,712,806
Adjusted TCI for Replacement Parts					15,712,806
Total Capital Investment (TCI) with Retrofit Factor					15,712,806
<b>Operating Costs</b>					
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.			1,494,072
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost			2,268,888
Total Annual Cost (Annualized Capital Cost + Operating Cost)					3,762,960

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual Ton/Yr	Cont Eff %	Cont Emis Ton/Yr	Reduction Ton/Yr	Cont Cost \$/Ton Rem
PM10						
PM2.5						
Total Particulates						
Nitrous Oxides (NO <sub>x</sub> )						
Sulfur Dioxide (SO <sub>2</sub> )	76.15	333.55	70%	100.07	233.49	\$16,100
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )						
Fluorides						
Volatile Organic Compounds (VOC)						
Carbon Monoxide (CO)						
Lead (Pb)						

**Notes & Assumptions**

- 1 Baghouse capital cost estimate based on EPA-R05-OAR-2010-0954-0079, ancillary equipment from other Barr Engineering projects
- 2 Costs scaled up to design airflow using the 6/10 power law
- 3 Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- 4 Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.7 – Table C.7-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 10**

**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
<b>Purchased Equipment (A) <sup>(1)</sup></b>		<b>6,185,600</b>
Purchased Equipment Costs (A) - Injection System + auxiliary equipment, EC		
Instrumentation	10% Included in vendor estimate	618,560
State Sales Taxes	0.0% of control device cost (A)	-
Freight	5% of control device cost (A)	309,280
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>7,113,440</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	284,538
Handling & erection	50% of purchased equip cost (B)	3,556,720
Electrical	8% of purchased equip cost (B)	569,075
Piping	1% of purchased equip cost (B)	71,134
Insulation	7% of purchased equip cost (B)	497,941
Painting	4% Included in vendor estimate	284,538
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>5,263,945</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	
Buildings, as required	N/A Site Specific	
Lost Production for Tie-In	N/A Site Specific	
<b>Total Site Specific Costs</b>		<b>N/A</b>
<b>Installation Total</b>		<b>5,263,945</b>
<b>Total Direct Capital Cost, DC</b>		<b>12,377,385</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	711,344
Construction & field expenses	20% of purchased equip cost (B)	1,422,688
Contractor fees	10% of purchased equip cost (B)	711,344
Start-up	1% of purchased equip cost (B)	71,134
Performance test	1% of purchased equip cost (B)	71,134
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	711,344
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>3,698,989</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>16,076,374</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>15,712,806</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>15,712,806</b>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr	147,892
Supervisor	0.15 of Op Labor	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr	73,946
Maintenance Materials	100 % of Maintenance Labor	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 379.0 kW-hr, 8760 hr/yr, 100% utilization	242,289
N/A		-
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	176,601
N/A		-
Solid Waste Disposal	63.34 \$/ton, 0.2 ton/hr, 8760 hr/yr, 100% utilization	94,296
Trona	285.00 \$/ton, 423.1 lb/hr, 8760 hr/yr, 100% utilization	528,162
Filter Bags	228.02 \$/bag, 1,388 bags, 8760 hr/yr, 100% utilization	134,758
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,494,072</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	314,256
Property tax (1% total capital costs)	1% of total capital costs (TCI)	157,128
Insurance (1% total capital costs)	1% of total capital costs (TCI)	157,128
Capital Recovery	0.0837 for a 20-year equipment life and a 5.5% interest rate	1,314,837
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery costs</b>	<b>2,268,888</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>3,762,960</b>





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.7 – Table C.7-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 10**

**Capital Recovery Factors**

<b>Primary Installation</b>	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

**Replacement Parts & Equipment: Filter Bags**

Equipment Life	3 years
CRF	0.3707
Rep part cost per unit	228.02 \$/bag
Amount Required	1388 Bags
Total Rep Parts Cost	332,323 Cost adjusted for freight, sales tax, and bag disposal
Installation Labor	31,245 20 min per bag
Total Installed Cost	363,568
Annualized Cost	134,758

**Electrical Use**

	Flow acfm	D P in H <sub>2</sub> O	kWh/yr	
Blower	349,000	6.00	3,320,163	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total			3,320,163	

**Reagent Use & Other Operating Costs**

Trona use - 1.5 NSR	76.15 lb/hr SO <sub>2</sub>	423.11 lb/hr Trona
Solid Waste Disposal	1,489 ton/yr DSI unreacted sorbent and reaction byproducts	

**Operating Cost Calculations**

Utilization Rate	100%	Annual Operating Hours	8,760				
Item	Unit Cost \$	Unit of Measure	Use Rate	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>							
Op Labor	67.53 \$/Hr		2.0 hr/8 hr shift		2,190	\$ 147,892	\$/Hr, 2.0 hr/8 hr shift, 2,190 hr/yr
Supervisor	15% of Op Labor				NA	\$ 22,184	% of Operator Costs
<b>Maintenance</b>							
Maint Labor	67.53 \$/Hr		1.0 hr/8 hr shift		1,095	\$ 73,946	\$/Hr, 1.0 hr/8 hr shift, 1,095 hr/yr
Maint Mtls	100% of Maintenance Labor				NA	\$ 73,946	100% of Maintenance Labor
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity	0.073 \$/kwh		379.0 kW-hr		3,320,163	\$ 242,289	\$/kwh, 379.0 kW-hr, 8760 hr/yr, 100% utilization
Water			N/A gpm				
Compressed Air	0.481 \$/kscf		2.0 scfm/kacfm		368,889	\$ 176,601	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Cooling Water			N/A gpm				
Solid Waste Disposal	63.34 \$/ton		0.2 ton/hr		1,489	\$ 94,296	\$/ton, 0.2 ton/hr, 8760 hr/yr, 100% utilization
Trona	285.00 \$/ton		423.1 lb/hr		1,853	\$ 528,162	\$/ton, 423.1 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags	228.02 \$/bag		1,388 bags		N/A	\$ 134,758	\$/bag, 1,388 bags, 8760 hr/yr, 100% utilization



## **Appendix C.8**

### **Power Station Boiler No. 11**



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.8 – Table C.8-1: Cost Summary**  
**Power Station Boiler No. 11**

**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	55.4	498.9	\$84,959,780	\$11,969,531	\$23,991
Dry Sorbent Injection (DSI)	70%	166.3	388.0	\$15,542,186	\$4,102,621	\$10,600



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.8 – Table C.8-2: Summary of Utility, Chemical and Supply Costs  
Power Station Boiler No. 11

Operating Unit: Power Station Boiler No. 11  
Emission Unit Number:  
Stack/Vent Number:  
Study Year: 2020

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	63 \$/hr		60	2016	EPA SCR Control Cost Manual Spreadsheet	Assumed to be equivalent to operating labor
Maintenance Labor	63 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	69 \$/hr					
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.15 \$/kscf				2014-2019 EIA Average prices for the industrial sector in Indiana (latest available 8/29/2020)	
Compressed Air	0.39 \$/kscf		0.39	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies						
Lime	163.68 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Trona	285.00 \$/ton			2020	Reagent cost for Trona from another Barr Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		180	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other						
Sales Tax	0%				Pollution control projects exempted from sales tax	
Interest Rate	5.50%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	63.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip. cost (\$)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	650 DPM/MTU/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	441 Deg F				Performance test data	
Moisture Content	13.5%				Performance test data	
Actual Flow Rate	323,000 scfm				Performance test data	
Standardized Flow Rate	189,283 scfm @ 68° F		176,377 scfm @ 32° F		Calculated Value	
Dry Std Flow Rate	181,600 scfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
Baseline Emissions						
	Lb/hr	Ton/Year	Lb/hr	Ton/Year	Lb/MMBtu	
Hydrogen Oxides (H <sub>2</sub> O)	43.2	189.0	37	37.4		Emission inventory data
Sulfur Dioxides (SO <sub>2</sub> )	126.9	554.4	70	78.7		Emission inventory data
SDA - SO <sub>2</sub> Control Efficiency	50%					EPA fact sheet for flue gas desulfurization (pre-installation) <a href="https://www.epa.gov/ttn/catc/d11/fhg.pdf">https://www.epa.gov/ttn/catc/d11/fhg.pdf</a>
DSI - SO <sub>2</sub> Control Efficiency	70%					Control efficiency is based on Trona as required reagent.





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.8 – Table C.8-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 11**  
Operating Unit:                      Power Station Boiler No. 11

Emission Unit Number	0		Stack/Vent Number	0
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	176,377 scfm @ 32° F
Utilization Rate	100%		Temperature	441 Deg F
Annual Operating Hours	8,760	Hours	Moisture Content	13.6%
Annual Interest Rate	5.5%		Actual Flow Rate	323,000 acfm
Equipment Life	20	Yrs	Standardized Flow Rate	189,283 scfm @ 68° F
			Dry Std Flow Rate	161,000 dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>					
Direct Capital Costs					
Purchased Equipment (A)					32,689,411
Purchased Equipment Total (B)	15%	of control device cost (A)			37,592,823
Installation - Standard Costs	74%	of purchased equip cost (B)			27,818,689
Installation - Site Specific Costs					NA
Installation Total					27,818,689
Total Direct Capital Cost, DC					65,411,512
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			19,548,268
Total Capital Investment (TCI) = DC + IC					84,959,780
Adjusted TCI for Replacement Parts					84,623,298
TCI with Retrofit Factor					84,623,298
<b>Operating Costs</b>					
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.			1,187,879
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost			10,781,652
Total Annual Cost (Annualized Capital Cost + Operating Cost)					11,969,531

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Emis T/yr	Reduction T/yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		554.4	90%			55.4	498.9	23,991
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

**Notes & Assumptions**

- Capital cost estimate based on mid-range of EPA spray dry fact sheet \$(/MMBtu/hr): <https://www3.epa.gov/tncatc1/dir1/fddg.pdf>
- Costs scaled up to design airflow using the 6/10 power law
- Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.8 – Table C.8-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 11**  
**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		32,689,411
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	3,268,941
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,634,471
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>37,592,823</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	1,503,713
Handling & erection	50% of purchased equip cost (B)	18,796,412
Electrical	8% of purchased equip cost (B)	3,007,426
Piping	1% of purchased equip cost (B)	375,928
Insulation	7% of purchased equip cost (B)	2,631,498
Painting	4% of purchased equip cost (B)	1,503,713
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>27,818,689</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-
<b>Total Site Specific Costs</b>		<b>NA</b>
<b>Installation Total</b>		<b>27,818,689</b>
<b>Total Direct Capital Cost, DC</b>		<b>65,411,512</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	3,759,282
Construction & field expenses	20% of purchased equip cost (B)	7,518,566
Contractor fees	10% of purchased equip cost (B)	3,759,282
Start-up	1% of purchased equip cost (B)	375,928
Performance test	1% of purchased equip cost (B)	375,928
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	3,759,282
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>19,548,268</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>84,959,780</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>84,623,298</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>84,623,298</b>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 584.6 kW-hr, 8760 hr/yr, 100% utilization	373,731
Compressed Air	0.48 \$/scf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	163,444
N/A		-
SW Disposal	63.34 \$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization	70,238
Lime	163.68 \$/ton, 171.3 lb/hr, 8760 hr/yr, 100% utilization	137,780
Filter Bags	228.02 \$/bag, 1,285 bags, 8760 hr/yr, 100% utilization	124,719
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,187,879</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,692,466
Property tax (1% total capital costs)	1% of total capital costs (TCI)	846,233
Insurance (1% total capital costs)	1% of total capital costs (TCI)	846,233
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	7,205,939
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery cost</b>	<b>10,781,652</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>11,969,531</b>



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.8 – Table C.8-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 11**

**Capital Recovery Factors**

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

**Replacement Parts & Equipment:**

**Filter Bags**

Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	1285	
Total Rep Parts Cost	307,565 Cost adjusted for freight & sales tax	
Installation Labor	28,917 10 min per bag	EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4
Total Installed Cost	336,482	
Annualized Cost	124,719	

**Electrical Use**

	Flow acfm	D P In H <sub>2</sub> O	Efficiency	Hp	KW	
Blower, Baghouse	323,000	10.00			5,121,359	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					5,121,359	

**Reagents and Other Operating Costs**

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	171.26 lb/hr Lime
Solid Waste Disposal	1,109 ton/yr GSA unreacted sorbent and reaction byproducts	

**Operating Cost Calculations**

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Unit of Use*	Annual Cost	Comments
Operating Labor							
Op Labor	67.53 \$/Hr		2.0 hr/8 hr shift	2,190	\$	147,892	\$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Supervisor	15% of Op.			NA	\$	22,184	of Op., 0.0 , 8760 hr/yr, 100% utilization
Maintenance							
Maint Labor	67.53 \$/Hr		1.0 hr/8 hr shift	1,095	\$	73,946	\$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Maint Mtls	100 % of Maintenance Labor			NA	\$	73,946	% of Maintenance Labor, 0.0 , 8760 hr/yr, 100% utilization
Utilities, Supplies, Replacements & Waste Management							
Electricity	0.073 \$/kwh		584.6 kW-hr	5,121,359	\$	373,731	\$/kwh, 584.6 kW-hr, 8760 hr/yr, 100% utilization
Compressed Air	0.481 \$/kscf		2 scfm/kacfm	339,538	\$	163,444	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Water	5.129 \$/mgal		gpm				\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization
SW Disposal	63.34 \$/ton		0.13 ton/hr	1,109	\$	70,238	\$/ton, 0.1 ton/hr, 8760 hr/yr, 100% utilization
Lime	183.68 \$/ton		171.3 lb/hr	750	\$	137,780	\$/ton, 171.3 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags	228.02 \$/bag		1,285 bags	N/A	\$	124,719	\$/bag, 1,285 bags, 8760 hr/yr, 100% utilization



**ArcelorMittal Burns Harbor**

**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**

**Appendix C.8 – Table C.8-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**

**Power Station Boiler No. 11**

Operating Unit:

Power Station Boiler No. 11

Emission Unit Number			Stack/Vent Number		
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	176,377	scfm @ 32° F
Utilization Rate	100%		Exhaust Temperature	441	Deg F
Annual Operating Hours	8,760	hr/yr	Exhaust Moisture Content	13.6%	
Annual Interest Rate	5.50%		Actual Flow Rate	323,000	acfm
Control Equipment Life	20	yrs	Standardized Flow Rate	189,283	scfm @ 68° F
Plant Elevation	610	ft	Dry Std Flow Rate	161,000	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>					
Direct Capital Costs					
Purchased Equipment (A)					6,109,530
Purchased Equipment Total (B)	15%	of control device cost (A)			7,025,960
Installation - Standard Costs	74%	of purchased equip cost (B)			5,199,210
Installation - Site Specific Costs					N/A
Installation Total					5,199,210
Total Direct Capital Cost, DC					12,225,170
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			3,653,499
<b>Total Capital Investment (TCI) = DC + IC</b>					<b>15,542,186</b>
Adjusted TCI for Replacement Parts					15,542,186
<b>Total Capital Investment (TCI) with Retrofit Factor</b>					<b>15,542,186</b>
<b>Operating Costs</b>					
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.			1,864,875
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost			2,237,746
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>					<b>4,102,621</b>

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual Ton/Yr	Cont Eff %	Cont Emis Ton/Yr	Reduction Ton/Yr	Cont Cost \$/Ton Rem
PM10						
PM2.5						
Total Particulates						
Nitrous Oxides (NO <sub>x</sub> )						
Sulfur Dioxide (SO <sub>2</sub> )	126.56	554.35	70%	168.31	388.05	\$10,600
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )						
Fluorides						
Volatile Organic Compounds (VOC)						
Carbon Monoxide (CO)						
Lead (Pb)						

**Notes & Assumptions**

- 1 Baghouse capital cost estimate based on EPA-R05-OAR-2010-0954-0079, ancillary equipment from other Barr Engineering projects
- 2 Costs scaled up to design airflow using the 6/10 power law
- 3 Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- 4 Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls**  
**Appendix C.8 – Table C.8-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 11**

**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		6,109,530
Purchased Equipment Costs (A) - Injection System + auxiliary equipment, EC		
Instrumentation	10% Included in vendor estimate	610,953
State Sales Taxes	0.0% of control device cost (A)	-
Freight	5% of control device cost (A)	305,477
Purchased Equipment Total (B)	15%	7,025,960
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	281,038
Handling & erection	50% of purchased equip cost (B)	3,512,980
Electrical	8% of purchased equip cost (B)	562,077
Piping	1% of purchased equip cost (B)	70,260
Insulation	7% of purchased equip cost (B)	491,817
Painting	4% Included in vendor estimate	281,038
Installation Subtotal Standard Expenses	74%	5,199,210
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	
Buildings, as required	N/A Site Specific	
Lost Production for Tie-In	N/A Site Specific	
Total Site Specific Costs		N/A
Installation Total		5,199,210
Total Direct Capital Cost, DC		12,225,170
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	702,596
Construction & field expenses	20% of purchased equip cost (B)	1,405,192
Contractor fees	10% of purchased equip cost (B)	702,596
Start-up	1% of purchased equip cost (B)	70,260
Performance test	1% of purchased equip cost (B)	70,260
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	702,596
Total Indirect Capital Costs, IC	52% of purchased equip cost (B)	3,653,499
Total Capital Investment (TCI) = DC + IC		15,878,669
Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost		15,542,186
Total Capital Investment (TCI) with Retrofit Factor	0%	15,542,186
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr	147,892
Supervisor	0.15 of Op Labor	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr	73,946
Maintenance Materials	100 % of Maintenance Labor	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 350.8 kW-hr, 8760 hr/yr, 100% utilization	224,239
N/A		-
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	163,444
N/A		-
Solid Waste Disposal	63.34 \$/ton, 0.3 ton/hr, 8760 hr/yr, 100% utilization	156,716
Trona	285.00 \$/ton, 703.2 lb/hr, 8760 hr/yr, 100% utilization	877,789
Filter Bags	228.02 \$/bag, 1,285 bags, 8760 hr/yr, 100% utilization	124,719
N/A		-
N/A		-
N/A		-
N/A		-
Total Annual Direct Operating Costs		1,864,875
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	310,844
Property tax (1% total capital costs)	1% of total capital costs (TCI)	155,422
Insurance (1% total capital costs)	1% of total capital costs (TCI)	155,422
Capital Recovery	0.0837 for a 20-year equipment life and a 5.5% interest rate	1,300,560
Total Annual Indirect Operating Costs	Sum indirect oper costs + capital recovery costs	2,237,746
Total Annual Cost (Annualized Capital Cost + Operating Cost)		4,102,621



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Controls  
Appendix C.8 – Table C.8-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)  
Power Station Boiler No. 11

Capital Recovery Factors

<b>Primary Installation</b>	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

**Replacement Parts & Equipment: Filter Bags**

Equipment Life	3 years
CRF	0.3707
Rep part cost per unit	228.02 \$/bag
Amount Required	1285 Bags
Total Rep Parts Cost	307,565 Cost adjusted for freight, sales tax, and bag disposal
Installation Labor	28,917 20 min per bag
Total Installed Cost	336,482
Annualized Cost	124,719

**Electrical Use**

	Flow acfm	D P in H <sub>2</sub> O	kWh/yr	
Blower	323,000	6.00	3,072,815	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total			3,072,815	

**Reagent Use & Other Operating Costs**

Trona use - 1.5 NSR	126.56 lb/hr SO <sub>2</sub>	703.19 lb/hr Trona
Solid Waste Disposal	2,474 ton/yr DSI unreacted sorbent and reaction byproducts	

**Operating Cost Calculations**

Utilization Rate	100%	Annual Operating Hours	8,760				
Item	Unit Cost \$	Unit of Measure	Use Rate	Unit of Measure	Annual Use*	Annual Cost	Comments
<b>Operating Labor</b>							
Op Labor	67.53 \$/Hr		2.0 hr/8 hr shift		2,190 \$	147,892 \$/Hr, 2.0 hr/8 hr shift, 2,190 hr/yr	
Supervisor	15% of Op Labor				NA \$	22,184 % of Operator Costs	
<b>Maintenance</b>							
Maint Labor	67.53 \$/Hr		1.0 hr/8 hr shift		1,095 \$	73,946 \$/Hr, 1.0 hr/8 hr shift, 1,095 hr/yr	
Maint Mts	100% of Maintenance Labor				NA \$	73,946 100% of Maintenance Labor	
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity	0.073 \$/kwh		350.8 kW-hr		3,072,815 \$	224,239 \$/kwh, 350.8 kW-hr, 8760 hr/yr, 100% utilization	
Water			N/A gpm				
Compressed Air	0.481 \$/kscf		2.0 scfm/kacfm		339,538 \$	163,444 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	
Cooling Water			N/A gpm				
Solid Waste Disposal	63.34 \$/ton		0.3 ton/hr		2,474 \$	156,716 \$/ton, 0.3 ton/hr, 8760 hr/yr, 100% utilization	
Trona	285.00 \$/ton		703.2 lb/hr		3,080 \$	877,789 \$/ton, 703.2 lb/hr, 8760 hr/yr, 100% utilization	
Filter Bags	228.02 \$/bag		1,285 bags		N/A \$	124,719 \$/bag, 1,285 bags, 8760 hr/yr, 100% utilization	



## **Appendix C.9**

### **Power Station Boiler No. 12**



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control**  
**Appendix C.9 – Table C.9-1: Cost Summary**  
**Power Station Boiler No. 12**

**SO<sub>2</sub> Control Cost Summary**

Control Technology	Control Eff %	Controlled Emissions T/yr	Emission Reduction T/yr	Installed Capital Cost \$	Total Annualized Cost \$/yr	Pollution Control Cost \$/ton
Spray Dry Absorber (SDA)	90%	70.3	632.5	\$84,959,780	\$12,200,529	\$19,289
Dry Sorbent Injection (DSI)	70%	210.8	492.0	\$17,641,403	\$4,789,193	\$9,700





ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control  
Appendix C.9 – Table C.9-2: Summary of Utility, Chemical and Supply Costs  
Power Station Boiler No. 12

Operating Unit: Power Station Boiler No. 12 Study Year: 2020  
Emission Unit Number  
Stack/Vent Number

Item	2020 Unit Cost	Units	Cost	Year	Data Source	Notes
Operating Labor	63 \$/hr		60	2016	EPA SCR Control Cost Manual Spreadsheet	
Maintenance Labor	69 \$/hr					Assumed to be equivalent to operating labor
Installation Labor	69 \$/hr					Assumed to be equivalent to operating labor
Electricity	0.07 \$/kwh				2016-2019 EIA Average prices for the industrial sector in Indiana	
Natural Gas	6.15 \$/scf				2014-2018 EIA Average prices for the industrial sector in Indiana (latest available 8/20/2023)	
Compressed Air	0.48 \$/scf		0.38	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Chemicals & Supplies						
Lime	163.68 \$/ton		145.00	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Irons	285.00 \$/ton			2020	Engineering Co. Project	
Fabric Filter Bags	228.02 \$/bag		160	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Other						
Sales Tax	0%				Pollution control projects exempted from sales tax	
Interest Rate	5.56%			2016	EPA SCR Control Cost Manual Spreadsheet	
Solid Waste Disposal	53.34 \$/ton		50	2012	Taconite FIP Docket - Cost estimate for United Taconite	
Contingencies	10% of purchased equip. cost (B)				EPA Cost Control Cost Manual Chapter 2	Suggested contingency range of 5% to 15% of total capital investment
Markup on capital investment (retrofit factor)	0%				EPA Cost Control Cost Manual Chapter 2	
Operating Information						
Annual Op. Hrs	8,760 Hours				Emission Inventory Data	
Utilization Rate	100%				Assumed	
Design Capacity	6500 MMBTU/hr				Boiler Design Capacity	
Equipment Life	20 yrs				Assumed	
Temperature	421 Deg F				Performance test data	
Moisture Content	11.3%				Performance test data	
Actual Flow Rate	359,000 scfm				Performance test data	
Standardized Flow Rate	239,128 scfm @ 68° F		222,624	scfm @ 32° F	Calculated Value	
Dry Std Flow Rate	202,000 scfm @ 68° F				Performance test data	
Plant Elevation	610 Feet above sea level					Plant elevation
Pollutant	Baseline Emissions		Lb/hr	ton/year		
	Lb/hr	ton/year	ppmv	ppmv	lb/mmBtu	
Mitrous Oxides (HCl)	48.6	204.6	32	32.2		Emission inventory data
Sulfur Dioxides (SO <sub>2</sub> )	160.5	702.8	60	79.6		Emission inventory data
SDA - SO <sub>2</sub> Control Efficiency	90%				EPA fact sheet for lime gas desulfurization (see calculations) <a href="https://www3.epa.gov/tncat1/d1/r1/Hdg.pdf">https://www3.epa.gov/tncat1/d1/r1/Hdg.pdf</a>	
DSI - SO <sub>2</sub> Control Efficiency	70%				Control efficiency is based on tons as injected reagent	



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control**  
**Appendix C.9 – Table C.9-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 12**  
Operating Unit: Power Station Boiler No. 12

Emission Unit Number	0		Stack/Vent Number	0	
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	222,824	scfm @ 32° F
Utilization Rate	100%		Temperature	421	Deg F
Annual Operating Hours	8,760	Hours	Moisture Content	11.3%	
Annual Interest Rate	5.5%		Actual Flow Rate	399,000	acfm
Equipment Life	20	yrs	Standardized Flow Rate	239,128	scfm @ 68° F
			Dry Std Flow Rate	202,000	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

Capital Costs					
Direct Capital Costs					
Purchased Equipment (A)					32,689,411
Purchased Equipment Total (B)	15%	of control device cost (A)			37,592,823
Installation - Standard Costs	74%	of purchased equip cost (B)			27,818,689
Installation - Site Specific Costs					NA
Installation Total					27,818,689
Total Direct Capital Cost, DC					65,411,512
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			19,548,268
Total Capital Investment (TCI) = DC + IC					84,959,780
Adjusted TCI for Replacement Parts					84,544,126
TCI with Retrofit Factor					84,544,126
Operating Costs					
Total Annual Direct Operating Costs		Labor, supervision, materials, replacement parts, utilities, etc.			1,399,324
Total Annual Indirect Operating Costs		Sum indirect oper costs + capital recovery cost			10,801,205
Total Annual Cost (Annualized Capital Cost + Operating Cost)					12,200,529

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual T/Yr	Cont Eff %	Exit Conc.	Conc. Units	Cont Emis T/yr	Reduction T/yr	Cont Cost \$/Ton Rem
PM10						0.0	-	NA
PM2.5						0.0	-	NA
Total Particulates						0.0	-	NA
Nitrous Oxides (NO <sub>x</sub> )						0.0	-	NA
Sulfur Dioxide (SO <sub>2</sub> )		702.8	90%			70.3	632.5	19,289
Sulfuric Acid Mist						0.00	-	NA
Fluorides						0.0	-	NA
Volatile Organic Compounds (VOC)						0.0	-	NA
Carbon Monoxide (CO)						0.0	-	NA
Lead (Pb)						0.00	-	NA

**Notes & Assumptions**

- Capital cost estimate based on mid-range of EPA spray dry fact sheet \$/(MMBtu/hr): <https://www3.epa.gov/tncalc1/dir1/ffdg.pdf>
- Costs scaled up to design airflow using the 6/10 power law
- Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
- Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control**  
**Appendix C.9 – Table C.9-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)**  
**Power Station Boiler No. 12**  
**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
Purchased Equipment (A) <sup>(1)</sup>		32,689,411
Purchased Equipment Costs (A) - Absorber + packing + auxiliary equipment, EC		
Instrumentation	10% of control device cost (A)	3,268,941
State Sales Taxes	0.0% of control device cost (A)	0
Freight	5% of control device cost (A)	1,634,471
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>37,592,823</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	1,503,713
Handling & erection	50% of purchased equip cost (B)	18,796,412
Electrical	8% of purchased equip cost (B)	3,007,426
Piping	1% of purchased equip cost (B)	375,928
Insulation	7% of purchased equip cost (B)	2,631,498
Painting	4% of purchased equip cost (B)	1,503,713
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>27,818,689</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	-
Buildings, as required	N/A Site Specific	-
Site Specific - Other	N/A Site Specific	-
<b>Total Site Specific Costs</b>		<b>NA</b>
<b>Installation Total</b>		<b>27,818,689</b>
<b>Total Direct Capital Cost, DC</b>		<b>65,411,512</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	3,759,282
Construction & field expenses	20% of purchased equip cost (B)	7,518,565
Contractor fees	10% of purchased equip cost (B)	3,759,282
Start-up	1% of purchased equip cost (B)	375,928
Performance test	1% of purchased equip cost (B)	375,928
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	3,759,282
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>19,548,268</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>84,959,780</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>84,544,126</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>84,544,126</b>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	147,892
Supervisor	15% of Op., 0.0 , 8760 hr/yr, 100% utilization	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization	73,946
Maintenance Materials	100% of maintenance labor costs	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 722.2 kW-hr, 8760 hr/yr, 100% utilization	461,668
Compressed Air	0.48 \$/scf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	201,902
N/A		-
SW Disposal	63.34 \$/ton, 0.2 ton/hr, 8760 hr/yr, 100% utilization	89,047
Lime	183.68 \$/ton, 217.1 lb/hr, 8760 hr/yr, 100% utilization	174,676
Filter Bags	228.02 \$/bag, 1,587 bags, 8760 hr/yr, 100% utilization	154,064
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>1,399,324</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	1,690,883
Property tax (1% total capital costs)	1% of total capital costs (TCI)	845,441
Insurance (1% total capital costs)	1% of total capital costs (TCI)	845,441
Capital Recovery	0.0837 for a 20- year equipment life and a 5.5% interest rate	7,228,660
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery cost</b>	<b>10,801,205</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>12,200,529</b>



ArcelorMittal Burns Harbor  
Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control  
Appendix C.9 – Table C.9-3: SO<sub>2</sub> Control Spray Dry Absorber (SDA)  
Power Station Boiler No. 12

Capital Recovery Factors

Primary Installation	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

Replacement Parts & Equipment:

Filter Bags

Equipment Life	3 years	
CRF	0.3707	
Rep part cost per unit	228.02 \$/bag	
Amount Required	1587	
Total Rep Parts Cost	379,934	Cost adjusted for freight & sales tax
Installation Labor	35,721	10 min per bag
Total Installed Cost	415,655	
Annualized Cost	154,064	

EPA Cont Cost Manual 6th ed Section 6 Chapter 1.5.1.4

Electrical Use

	Flow acfm	OP in H <sub>2</sub> O	Efficiency	Hp	KW	
Blower, Baghouse	399,000	10.00			6,326,384	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total					6,326,384	

Reagents and Other Operating Costs

Lime Use Rate	1.30 lb-mole CaO/lb-mole SO <sub>2</sub>	217.12 lb/hr Lime
Solid Waste Disposal	1,405 ton/yr	GSA unreacted sorbent and reaction byproducts

Operating Cost Calculations

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Unit of Use	Annual Use*	Annual Cost	Comments
		Unit of Cost \$	Measure	Rate	Unit of Measure			
Operating Labor								
Op Labor		67.53 \$/hr		2.0 hr/8 hr shift		2,190	\$ 147,892	\$/Hr, 2.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Supervisor		15% of Op.				NA	\$ 22,184	of Op., 0.0, 8760 hr/yr, 100% utilization
Maintenance								
Maint Labor		67.53 \$/hr		1.0 hr/8 hr shift		1,095	\$ 73,946	\$/Hr, 1.0 hr/8 hr shift, 8760 hr/yr, 100% utilization
Maint Mills		100 % of Maintenance Labor				NA	\$ 73,946	% of Maintenance Labor, 0.0, 8760 hr/yr, 100% utilization
Utilities, Supplies, Replacements & Waste Management								
Electricity		0.073 \$/kwh		722.2 kW-hr		6,326,384	\$ 461,658	\$/kwh, 722.2 kW-hr, 8760 hr/yr, 100% utilization
Compressed Air		0.481 \$/kscf		2 scfm/kacfm		419,429	\$ 201,902	\$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization
Water		5.129 \$/mgal		gpm				\$/mgal, 0 gpm, 8760 hr/yr, 100% utilization
SW Disposal		53.34 \$/ton		0.16 ton/hr		1,406	\$ 89,047	\$/ton, 0.2 ton/hr, 8760 hr/yr, 100% utilization
Lime		183.68 \$/ton		217.1 lb/hr		951	\$ 174,676	\$/ton, 217.1 lb/hr, 8760 hr/yr, 100% utilization
Filter Bags		228.02 \$/bag		1,587 bags		N/A	\$ 154,064	\$/bag, 1,587 bags, 8760 hr/yr, 100% utilization





**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control**  
**Appendix C.9 – Table C.9-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 12**

Operating Unit: Power Station Boiler No. 12

Emission Unit Number			Stack/Vent Number		
Design Capacity	650	MMBtu/hr	Standardized Flow Rate	222,824	scfm @ 32° F
Utilization Rate	100%		Exhaust Temperature	421	Deg F
Annual Operating Hours	8,760	hr/yr	Exhaust Moisture Content	11.3%	
Annual Interest Rate	5.50%		Actual Flow Rate	399,000	acfm
Control Equipment Life	20	yrs	Standardized Flow Rate	239,128	scfm @ 68° F
Plant Elevation	610	ft	Dry Std Flow Rate	202,000	dscfm @ 68° F

**CONTROL EQUIPMENT COSTS**

<b>Capital Costs</b>					
Direct Capital Costs					
Purchased Equipment (A)					6,947,695
Purchased Equipment Total (B)	15%	of control device cost (A)			7,989,849
Installation - Standard Costs	74%	of purchased equip cost (B)			5,912,488
Installation - Site Specific Costs					N/A
Installation Total					5,912,488
Total Direct Capital Cost, DC					13,902,337
Total Indirect Capital Costs, IC	52%	of purchased equip cost (B)			4,154,721
Total Capital Investment (TCI) = DC + IC					17,641,403
Adjusted TCI for Replacement Parts					17,641,403
Total Capital Investment (TCI) with Retrofit Factor					17,641,403
<b>Operating Costs</b>					
Total Annual Direct Operating Costs			Labor, supervision, materials, replacement parts, utilities, etc.		2,262,471
Total Annual Indirect Operating Costs			Sum indirect oper costs + capital recovery cost		2,526,722
Total Annual Cost (Annualized Capital Cost + Operating Cost)					4,789,193

**Emission Control Cost Calculation**

Pollutant	Max Emis Lb/Hr	Annual Ton/Yr	Cont Eff %	Cont Emis Ton/Yr	Reduction Ton/Yr	Cont Cost \$/Ton Rem
PM10						
PM2.5						
Total Particulates						
Nitrous Oxides (NO <sub>x</sub> )						
Sulfur Dioxide (SO <sub>2</sub> )	160.46	702.80	70%	210.84	491.96	\$9,700
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> )						
Fluorides						
Volatile Organic Compounds (VOC)						
Carbon Monoxide (CO)						
Lead (Pb)						

**Notes & Assumptions**

1. Baghouse capital cost estimate based on EPA-R05-OAR-2010-0954-0079, ancillary equipment from other Barr Engineering projects
2. Costs scaled up to design airflow using the 6/10 power law
3. Cost scaled up for inflation using the Chemical Engineering Plant Cost Index (CEPCI)
4. Calculations per EPA Air Pollution Control Cost Manual 6th Ed 2002, Section 6 Chapter 1



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control**  
**Appendix C.9 – Table C.9-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 12**

**CAPITAL COSTS**

<b>Direct Capital Costs</b>		
<b>Purchased Equipment (A) <sup>(1)</sup></b>		<b>6,947,695</b>
Purchased Equipment Costs (A) - Injection System + auxiliary equipment, EC		
Instrumentation	10% included in vendor estimate	694,769
State Sales Taxes	0.0% of control device cost (A)	-
Freight	5% of control device cost (A)	347,385
<b>Purchased Equipment Total (B)</b>	<b>15%</b>	<b>7,989,849</b>
<b>Installation</b>		
Foundations & supports	4% of purchased equip cost (B)	319,594
Handling & erection	50% of purchased equip cost (B)	3,994,924
Electrical	8% of purchased equip cost (B)	639,188
Piping	1% of purchased equip cost (B)	79,898
Insulation	7% of purchased equip cost (B)	559,289
Painting	4% included in vendor estimate	319,594
<b>Installation Subtotal Standard Expenses</b>	<b>74%</b>	<b>5,912,488</b>
<b>Other Specific Costs (see summary)</b>		
Site Preparation, as required	N/A Site Specific	
Buildings, as required	N/A Site Specific	
Lost Production for Tie-In	N/A Site Specific	
<b>Total Site Specific Costs</b>		<b>N/A</b>
<b>Installation Total</b>		<b>5,912,488</b>
<b>Total Direct Capital Cost, DC</b>		<b>13,902,337</b>
<b>Indirect Capital Costs</b>		
Engineering, supervision	10% of purchased equip cost (B)	798,985
Construction & field expenses	20% of purchased equip cost (B)	1,597,970
Contractor fees	10% of purchased equip cost (B)	798,985
Start-up	1% of purchased equip cost (B)	79,898
Performance test	1% of purchased equip cost (B)	79,898
Model Studies	N/A of purchased equip cost (B)	-
Contingencies	10% of purchased equip cost (B)	798,985
<b>Total Indirect Capital Costs, IC</b>	<b>52% of purchased equip cost (B)</b>	<b>4,154,721</b>
<b>Total Capital Investment (TCI) = DC + IC</b>		<b>18,057,058</b>
<b>Adjusted TCI for Replacement Parts (Catalyst, Filter Bags, etc) for Capital Recovery Cost</b>		<b>17,641,403</b>
<b>Total Capital Investment (TCI) with Retrofit Factor</b>	<b>0%</b>	<b>17,641,403</b>
<b>OPERATING COSTS</b>		
<b>Direct Annual Operating Costs, DC</b>		
<b>Operating Labor</b>		
Operator	67.53 \$/Hr	147,892
Supervisor	0.15 of Op Labor	22,184
<b>Maintenance</b>		
Maintenance Labor	67.53 \$/Hr	73,946
Maintenance Materials	100 % of Maintenance Labor	73,946
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>		
Electricity	0.07 \$/kwh, 433.3 kW-hr, 8760 hr/yr, 100% utilization	277,001
N/A		-
Compressed Air	0.48 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	201,902
N/A		-
Solid Waste Disposal	63.34 \$/ton, 0.4 ton/hr, 8760 hr/yr, 100% utilization	198,684
Trona	285.00 \$/ton, 891.5 lb/hr, 8760 hr/yr, 100% utilization	1,112,854
Filter Bags	228.02 \$/bag, 1,587 bags, 8760 hr/yr, 100% utilization	154,064
N/A		-
N/A		-
N/A		-
N/A		-
<b>Total Annual Direct Operating Costs</b>		<b>2,262,471</b>
<b>Indirect Operating Costs</b>		
Overhead	60% of total labor and material costs	190,780
Administration (2% total capital costs)	2% of total capital costs (TCI)	352,828
Property tax (1% total capital costs)	1% of total capital costs (TCI)	176,414
Insurance (1% total capital costs)	1% of total capital costs (TCI)	176,414
Capital Recovery	0.0837 for a 20-year equipment life and a 5.5% interest rate	1,476,221
<b>Total Annual Indirect Operating Costs</b>	<b>Sum indirect oper costs + capital recovery costs</b>	<b>2,526,722</b>
<b>Total Annual Cost (Annualized Capital Cost + Operating Cost)</b>		<b>4,789,193</b>



**ArcelorMittal Burns Harbor**  
**Regional Haze Four-Factor Analyses for NO<sub>x</sub> and SO<sub>2</sub> Emission Control**  
**Appendix C.9 – Table C.9-4: SO<sub>2</sub> Control Dry Sorbent Injection (DSI)**  
**Power Station Boiler No. 12**

**Capital Recovery Factors**

<b>Primary Installation</b>	
Interest Rate	5.50%
Equipment Life	20 years
CRF	0.0837

**Replacement Parts & Equipment: Filter Bags**

Equipment Life	3 years
CRF	0.3707
Rep part cost per unit	228.02 \$/bag
Amount Required	1587 Bags
Total Rep Parts Cost	379,934 Cost adjusted for freight, sales tax, and bag disposal
Installation Labor	35,721 20 min per bag
Total Installed Cost	415,655
Annualized Cost	154,064

**Electrical Use**

	Flow acfm	D P in H <sub>2</sub> O	kWh/yr	
Blower	399,000	6.00	3,795,831	Incremental electricity increase over with baghouse replacing scrubber including ducting
Total			3,795,831	

**Reagent Use & Other Operating Costs**

Trona use - 1.5 NSR	160.46 lb/hr SO <sub>2</sub>	891.50 lb/hr Trona
Solid Waste Disposal	3,137 ton/yr DSI unreacted sorbent and reaction byproducts	

**Operating Cost Calculations**

Item	Utilization Rate	100%	Annual Operating Hours	8,760	Annual Use <sup>a</sup>	Annual Cost	Comments
<b>Operating Labor</b>							
Op Labor	67.53 \$/Hr		2.0 hr/8 hr shift		2,190 \$	147,892 \$/Hr, 2.0 hr/8 hr shift, 2,190 hr/yr	
Supervisor	15% of Op Labor				NA \$	22,184 % of Operator Costs	
<b>Maintenance</b>							
Maint Labor	67.53 \$/Hr		1.0 hr/8 hr shift		1,095 \$	73,946 \$/Hr, 1.0 hr/8 hr shift, 1,095 hr/yr	
Maint Mills	100% of Maintenance Labor				NA \$	73,946 100% of Maintenance Labor	
<b>Utilities, Supplies, Replacements &amp; Waste Management</b>							
Electricity	0.073 \$/kwh		433.3 kW-hr		3,795,831 \$	277,001 \$/kwh, 433.3 kW-hr, 8760 hr/yr, 100% utilization	
Water			N/A gpm				
Compressed Air	0.481 \$/kscf		2.0 scfm/kacfm		419,429 \$	201,902 \$/kscf, 2.0 scfm/kacfm, 8760 hr/yr, 100% utilization	
Cooling Water			N/A gpm				
Solid Waste Disposal	63.34 \$/ton		0.4 ton/hr		3,137 \$	198,684 \$/ton, 0.4 ton/hr, 8760 hr/yr, 100% utilization	
Trona	285.00 \$/ton		891.5 lb/hr		3,905 \$	1,112,854 \$/ton, 891.5 lb/hr, 8760 hr/yr, 100% utilization	
Filter Bags	228.02 \$/bag		1,587 bags		N/A \$	154,064 \$/bag, 1,587 bags, 8760 hr/yr, 100% utilization	

